USDA United States Department of Agriculture

Forest Service

Tongass National Forest

R10 - MB-367a

June 1998

Sea Level Timber Sale

Draft Environmental Impact Statement

Volume I

Acronymns And Symbols

ADF&G	Alaska Department of Fish and Game
AHMU	Aquatic Habitat Management Unit
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
ASQ	Allowable Sale Quantity
BBF	One Billion Board Feet
BMP	Best Management Practice
CEQ	Council on Environmental Quality
CFL	Commercial Forest Land
CFR	Code of Federal Regulations
CZMA	Coastal Zone Management Act of 1976
DBH	Diameter at Breast Height
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EVC	Existing/Expected Visual Condition
FEIS	Final Environmental Impact Statement
FSH	Forest Service Handbook
FSM	Forest Service Manual
GIS	Geographic Information System
IDT	Interdisciplinary Team
KPC	Ketchikan Pulp Company
KV	Knutsen-Vandenberg Act
LTF	Log Transfer Facility
LUD	Land Use Designation
LWD	Large Woody Debris (same as LOD)
MBF	One Thousand Board Feet
MELP	Multi-Entry Layout Process
MIS	Management Indicator Species
MM	Maximum Modification
MMBF	One Million Board Feet
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
P	Primitive
PR	Partial Retention
R	Retention
RM	Roaded Modified
RN	Roaded Natural
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
SHPO	State Historic Preservation Officer
SPM	Semi-Primitive Motorized
SPNM	Semi-Primitive Nonmotorized
TLMP	Tongass Land Management Plan
TRUCS	Tongass Resource Use Cooperative Survey
TTRA	Tongass Timber Reform Act
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
VCU	Value Comparison Unit
VQO	Visual Quality Objective
WAA	Wildlife Analysis Area

Acknowledgments
Front cover: By Cindy Ross Barber, 1992. The design illustrates the range of interconnected issues addressed in the EIS.

United States Department of Agriculture | Forest Service | Ketchikan Area Tongass National Forest | 648 Mission Street Ketchikan, AK 99901

File Code: 1950

Date: May 5, 1998

Dear Reader:

Enclosed is the Draft Environmental Impact Statement (EIS) for the Sea Level Project Area.

If you received a complete set of documents, the following items should be found in the package:

1. Summary
2. Draft Environmental Impact Statement (Volume I)
3. Draft EIS Appendices A - H (Volume II)
4. Large scale color Project Area Map of Existing Condition
5. Large scale color Project Area Map of Wetlands

Note that 11" x 17" maps of each alternative are included in Chapter 2 of the DEIS (Volume I).

If you elected to receive the summary only, you will find 11" x 17" alternative maps bound into the back of the document as well as a large-scale Project Area Map (Existing Condition Map) included with the summary.

You are encouraged to review and comment on the Draft EIS. Written comments must be received by August 7, 1998. Comments should be addressed to:

Forest Supervisor
Tongass NF - Ketchikan Area
Attn: Sea Level Draft EIS
Federal Building
Ketchikan, AK 99901

Subsistence hearings will be held in Saxman and Metlakatla. Each subsistence hearing will be preceded by an open house to answer questions you may have.

I encourage you to take the time to review and comment on the Draft EIS, and to participate in the subsistence and public hearings. Your input will be used to prepare the Final EIS and the Record of Decision. Your interest in the management of the Tongass National Forest is appreciated.

Sincerely,

Gene Eide

BRADLEY E. POWELL
Acting Forest Supervisor

cc: Jimmy DeHerrera, District Ranger, Ketchikan Ranger District
Dave Arrasmith, Planning Staff Officer

Draft Environmental Impact Statement

Sea Level

United States Department of Agriculture
Forest Service—Alaska Region

Lead Agency	U.S.D.A. Forest Service Tongass National Forest Ketchikan Administrative Area
Responsible Official	Forest Supervisor Ketchikan Administrative Area Tongass National Forest Federal Building Ketchikan, Alaska 99901
For Further Information Contact:	Pete Griffin, IDT Leader Ketchikan Ranger District Tongass National Forest 3031 Tongass Avenue Ketchikan, Alaska 99901 (907) 225-2148

Abstract

The USDA Forest Service proposes to harvest up to approximately 60 million board feet of timber in the Sea Level Project Area, Ketchikan Ranger District, Ketchikan Administrative Area, Tongass National Forest. The actions analyzed in this Draft Environmental Impact Statement (EIS) are designed to implement direction contained in the Tongass Land Management Plan (TLMP). The Draft EIS describes 6 alternatives which provide different combinations of resource outputs and spatial locations of harvest units. The alternatives include: 1) No Action, proposing no new harvest from the project area at this time; 2) configure harvest units to provide the maximum amount of timber within the TLMP Standards and Guidelines; 3) configure harvest units to emphasize timber sale economics, fisheries, wildlife, and subsistence values; 4) minimize harvest in important subsistence areas, wildlife travel corridors, and in the Sea Level Creek watershed; 5) avoid harvest in the Elf Point and Marble Creek areas and in wildlife travel corridors; and, 6) limit logging to the Shelter Cove area to minimize effects of roading on subsistence, fisheries, and wildlife habitat.

Table of Contents

Volume I

Volume I

Volume II

Appendices

Volume I

List of Tables

Volume I

List of Figures

Volume I

Chapters 1 to 4

Chapter 1

Purpose and Need

Chapter 1

Purpose and Need

Key Terms

Allowable Sale Quantity (ASQ)—the maximum quantity of timber that may be sold each decade from a National Forest.
Land Use Designation (LUD)—method of classifying land uses, presented in the Forest Plan (Tongass Land Management Plan 1997).
MMBF—million board feet.
Management Prescriptions—management practices and intensity selected and scheduled for application on a specific area to attain multiple-use goals and objectives.
Old-growth Forest—an ecosystem distinguished by old trees and related structural attributes. They differ from younger forests in a variety of characteristics including tree size, accumulation of large dead woody material, number of canopy layers, tree species composition, and ecosystem function.
Scoping—a process used to determine the significance of a proposed action, what analysis is required, what data is needed, and what public participation is appropriate.
Tongass Land Management Plan (TLMP)—the 10-year land allocation plan for the Tongass National Forest, also known as the Forest Plan. The TLMP Revision was completed in 1997.
Value Comparison Unit (VCU)—area which generally encompasses a drainage basin where resource inventories and interpretations are made.

Introduction

In compliance with the National Environmental Policy Act (NEPA) and other relevant laws and regulations, the Forest Service has prepared this Environmental Impact Statement (EIS) on the effects of timber harvest in the Sea Level Project Area (Figure 1-2) on Revillagigedo Island of the Ketchikan Administrative Area, Tongass National Forest. The proposed action would make available approximately 60 million board feet (MMBF) of timber, in multiple timber sales in the Ketchikan Area timber sale program. This EIS discloses the direct, indirect, and cumulative environmental impacts and any irreversible or irretrievable commitment of resources that would result from each proposed alternative.

Decision to be Made

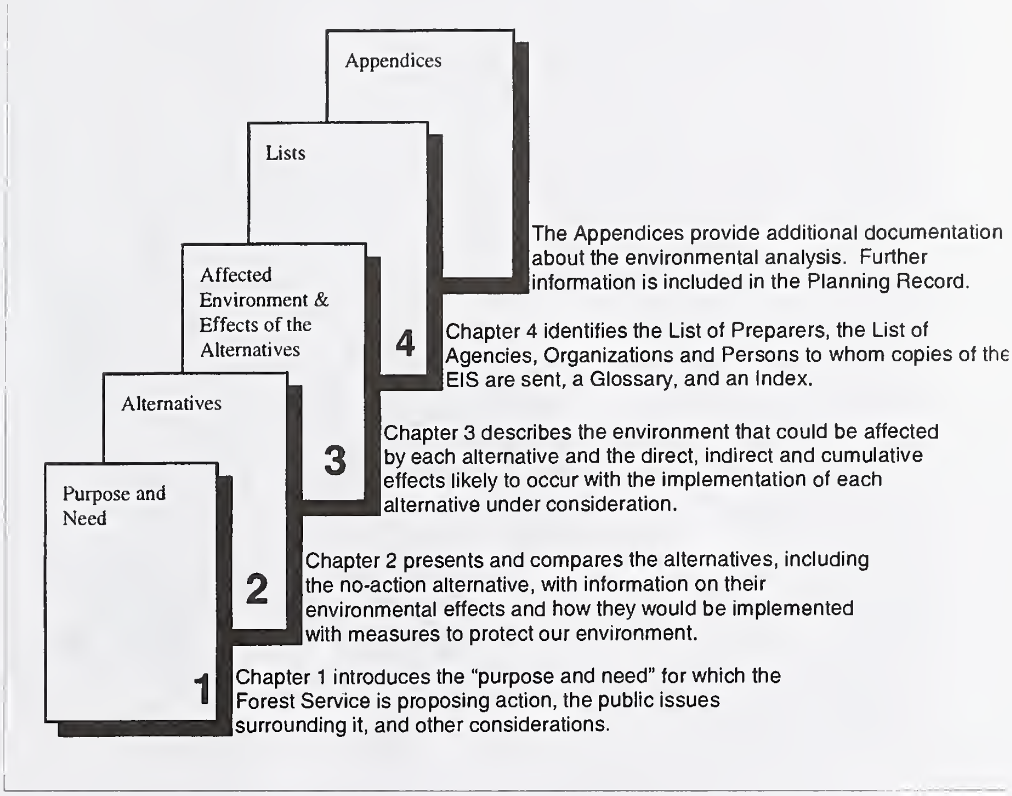
Based on the environmental analysis, the Ketchikan Area Forest Supervisor must decide whether or not, and if so how, to make timber available from the Sea Level Project Area in accordance with the implementation of the Tongass Land Management Plan (TLMP 1997). The decisions will include:

- the volume of timber to make available in this area, in one or more timber sales;
- the locations of timber harvest units;
- the locations of arterial and collector roads; and
- necessary standards and guidelines, mitigation measures, and enhancement opportunities for sound resource management.

Document Organization

Chapter 1, in addition to explaining the purpose and need for the proposed action, discusses how the Sea Level Project relates to the Forest Plan and to other related actions, the key issues driving the EIS analysis, and the authorities guiding the EIS process. Chapter 2 describes and compares the proposed action and no-action alternatives. Chapter 3 describes the potentially affected environment and the anticipated effects of the alternatives on the natural and human environment in the Project Area and those areas directly affected by the proposed action. Chapter 4 contains the list of authors, distribution list, glossary, index, and cited literature. Finally, a series of appendices provides helpful references to understanding the Draft EIS. Additional documentation may be found in the project Planning Record located at the Ketchikan Ranger District in Ketchikan.

Figure 1-1
How This Document is Organized



Project Area

The Sea Level Project Area contains 91,747 acres of National Forest System lands and is located approximately 18 air miles east of Ketchikan, Alaska (Figure 1-2). It encompasses an area of south central Revillagigedo (Revilla) Island that extends from Swan Lake south along both sides of Carroll Inlet and includes the lands adjacent to Thorne Arm. There are no communities within or adjacent to the Project Area. Access to the Project Area is by small plane or boat generally originating from Ketchikan.

The project Area includes portions of Value Comparison Units (VCUs) 746, 753, 754.2, 755.2, 756, 757, and 759 (Figure 1-3). VCU boundaries generally follow major watershed divides with a few minor exceptions.

Figure 1-2
Project Area Vicinity Map

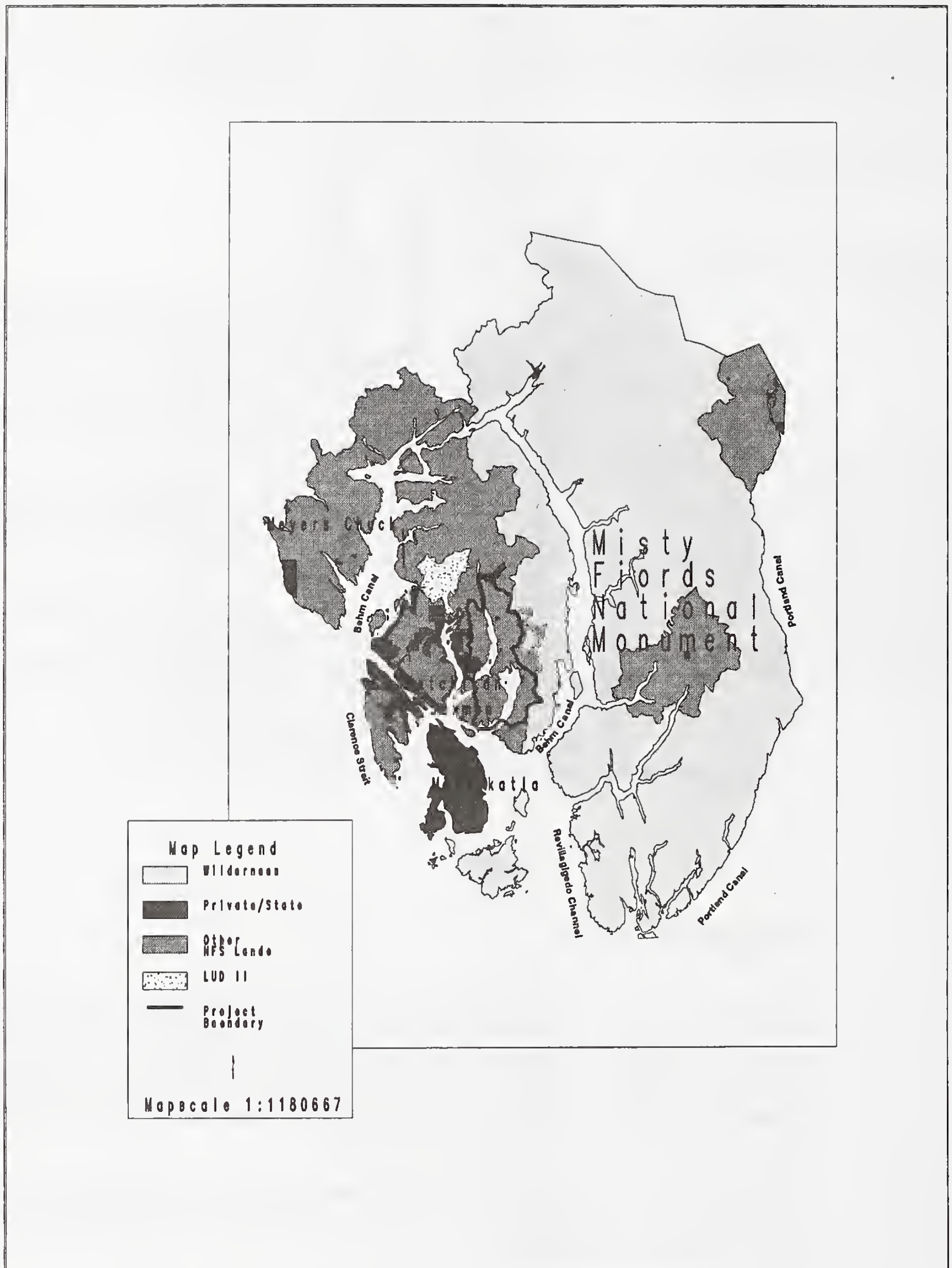
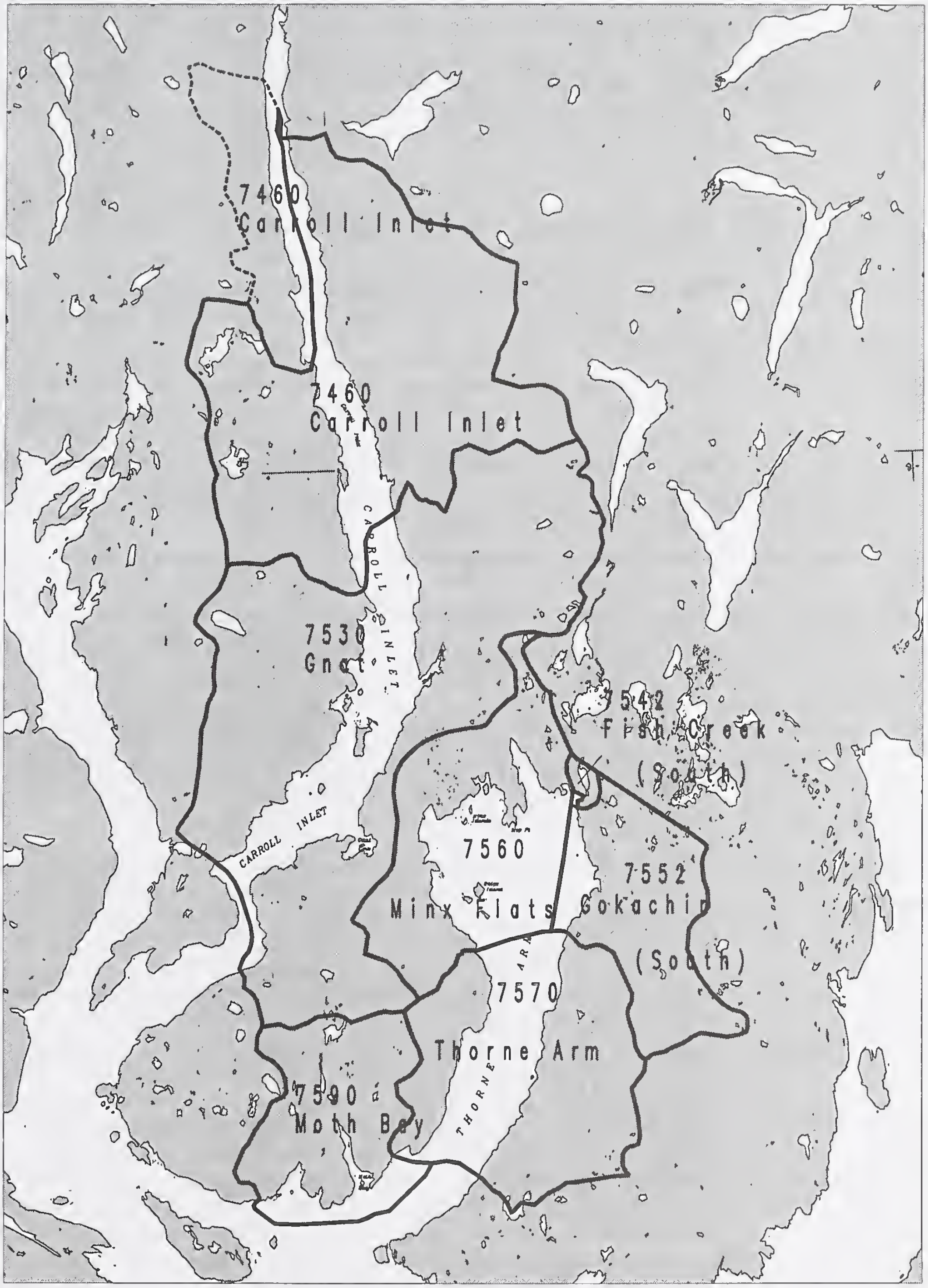


Figure 1-3
VCU Boundaries



Proposed Action

The proposed action would harvest approximately 60 MMBF of timber from an estimated 2,500 acres through a series of timber sales beginning in 1999. As many as 65 miles of new road would be built to facilitate timber removal. Two existing log transfer facilities (LTFs) and one re-constructed facility would be utilized to implement the action alternatives.

The proposed action is consistent with the TLMP (1997). Project implementation will help move the existing forest condition toward the desired future condition.

Purpose and Need

The Sea Level Timber Sale Project is proposed at this time to move the Project Area toward the desired condition and respond to the goals and objectives identified for the Project Area by the TLMP (1997).

The Forest Plan identified Forest-wide multiple-use goals and objectives (TLMP, pp.2-2 to 2-5). Forest-wide goals are achieved through the allocation of lands to the LUDs, through implementation of the standards and guidelines specified for the LUDs, and through other activities conducted on the Forest. Objectives are achieved by implementing the management prescriptions for each of the LUDs. Some of the goals and objectives listed for the Timber Production, Modified Landscape, and Scenic Viewshed LUDs include, among others:

- improve timber growth and productivity on suitable timber lands made available for timber harvest, and manage these lands for long-term sustained yield of timber,
- contribute to a timber supply to meet market demand, and
- provide opportunities for local employment in the wood products industry, which in turn contribute to the local and regional economies of Southeast Alaska.

The Sea Level Project is designed to meet these goals and objectives. It will also move the Project Area towards the desired future condition identified by the Plan by managing suitable timber lands for the production of sawtimber and other wood products and allowing a variety of successional stages within the Project Area that provide a range of wildlife habitat conditions (TLMP, pp. 3-127, 3-135 to 3-136, and 3-144).

Timber Growth and Productivity

Losses of the timber resource caused by age decay and disease are considerable in old-growth forests. It is not uncommon for well over 30 percent of the timber volume in old-growth stands to be defective and thus unusable for wood products. Tree vigor tends to decrease with maturity, causing an increase in susceptibility to pathogens and insects. Disease and decay processes are a natural part of forest ecosystems, and play a key role in providing wildlife habitat in old-growth forests. However, the Forest Plan allocated approximately 53 percent of the land within the Sea Level Project Area to the Timber Production LUD. The desired condition for this LUD, as identified by the Forest Plan, states that suitable timber lands are to be managed for the production of sawtimber and other wood products. Tree stands are healthy and in a balanced mix of age classes from young stands to trees of harvestable age (TLMP, p. 3-144). An additional 20 percent of the land within the Sea Level Project Area is allocated to the Modified Landscape and Scenic Viewshed LUDs respectively. The desired condition for these lands is, in part, that they will produce a yield of timber which contributes to the Forest-wide sustained yield (TLMP, pp. 3-136 and 3-127). Harvesting aging stands, including those in declining health, on lands that allow timber harvest and replacing them with faster growing, healthy stands will reduce the volume loss associated with decay and disease and increase the growth and yield of the managed forest land.

The remaining 27 percent of the Project Area is allocated to non-development LUDs, mostly Semi-remote Recreation (12 percent) and Old-growth Habitat (12 percent). The desired condition for the Semi-remote Recreation LUD is to provide for recreation and tourism in natural appearing settings with ecological processes and natural conditions being only minimally affected by past or current human activities. The desired condition for the Old-growth Habitat LUD states that all forested areas will have attained old-growth forest characteristics, providing a diversity of old-growth habitat types and associated species and subspecies and ecological processes. Timber volume from either LUD (such as salvage) does not contribute to the Forest-wide allowable sale quantity.

Currently, western hemlock makes up 65 percent of the old-growth forests in the project area. Western Hemlock is susceptible to dwarf mistletoe, a disease that does not infect Alaska yellow or western redcedar and rarely infects Sitka spruce. Western hemlock also appears to have more insect enemies than Sitka spruce. In addition, western hemlock has the lowest economic value of the four major commercial species in the Project Area. Harvesting existing stands dominated by western hemlock can encourage the growth of Sitka spruce and the cedars, creating a more diverse species mix and minimizing losses due to insects and diseases that are species specific.

Market Demand

Section 101 of the Tongass Timber Reform Act of 1990 (TTRA) provides direction to ''seek to provide a supply of timber from the Tongass National Forest which (1) meets the annual market demand for timber from such forest and (2) meets the market demand from such forest for each planning cycle,'' to the extent consistent with the multiple use and sustained yield of all renewable forest resources and other direction. Market demand for Tongass National Forest timber is derived from factors which include: Southeast Alaska's timber industry mill capacity; local, national, and international timber markets; and projected local, national, and world-wide timber supplies.

The Alaska Region uses the projections of the Pacific Northwest Research (PNW) Station to help determine demand for Tongass National Forest timber. The latest PNW Station market demand estimates for timber through the year 2010 are based on three scenarios, of demand—low, medium, and high. In the low demand scenario, high stumpage, harvest, and manufacturing costs limit Alaska's share of markets. Under the high demand scenario, increased harvest and manufacturing efficiency, with resulting lower costs, make Alaskan mills more competitive. Projected annual sawlog demand for the next decade is 113 million board feet (mmbf) for the low scenario, 133 mmbf for the medium, and 156 mmbf for the high scenario (Brooks and Haynes, 1997).

The Forest Service intent is to provide the opportunity for the timber industry as a whole to acquire a supply of purchased, but unharvested timber equal to about 3 years of timber consumption, considering the average rate of harvest for the past few years and any indicators of change in that rate from planning cycle projections or other sources. This supply is a means of providing for stability in relation to fluctuating market demand. It is estimated that a 3-year supply of timber, based on medium demand projections, is 399 mmbf.

As of September 30, 1997 there is 504 mmbf of unharvested timber volume under contract to the timber industry (Automated Timber Sales Accounting System Report 900, September 30, 1997). Of this volume, however, 300 mmbf is allocated to the Ketchikan Pulp Company under the terms of the long-term contract settlement agreement, with 204 mmbf under independent industry contract. In order to meet the intent of having a 3-year supply, approximately 195 mmbf of timber needs to be cleared through the NEPA process and offered to industry. It takes approximately 3 years for timber to be cleared through the NEPA process. At this time, there is approximately 624 MMBF proposed under other ongoing

NEPA analyses on the Tongass for the 1998 to 2002 period. Timber volume from the Sea Level Project Area will contribute to the 3-year supply.

Timber volume from the Sea Level Project will be provided as a component of the 10-year timber program identified by the Forest Plan, which attempts to provide timber to industry in an even flow over the planning cycle. The Forest Plan states that the Ketchikan Area is expected to contribute up to a maximum of 121 mmbf per year for the next 10 years (TLMP 1997, Appendix L-8).

Appendix A of this EIS provides a detailed rationale for why the Sea Level Project Area was selected for analysis at this time. In summary, Appendix A states that the Sea Level Project Area was selected at this time because:

- the TLMP allocated over 53 percent of the Project Area as a Timber Production LUD, with sufficient timber volume available to help meet market demand;
- timber management activities will contribute to meeting the goals, objectives, and desired condition for this LUD;
- most of the other Timber Production LUD's on the Forest have or are planning to have timber management activities scheduled in them;
- timber harvest infrastructure (roads, log transfer sites, and rock quarries) are in place or in need of maintenance to reduce potential resource damage; and
- to provide local employment opportunities in the wood products industry, consistent with providing for the multiple use and sustained yield of all renewable forest resources.

The Sea Level Project is a component of the Ketchikan Area's timber management plan to contribute toward the volume identified by the Forest Plan sale schedule and will help meet Forest Plan goals and objectives. At this time, the Ketchikan Area has approximately 160 MMBF in additional volume undergoing NEPA analysis which could also contribute toward the sale schedule volume.

Local Employment Opportunities

Timber is one of several valuable resources on the Tongass and many people depend on it for their livelihood. Timber from the Tongass is harvested for sawn wood products such as lumber and cants and wood chip exports, and is the basis for a major industry in Southeast Alaska that provided about 1,749 direct jobs in Fiscal Year 1996 (Alaska Department of Labor, May 1997).

The Tongass timber sale program is part of a long-term cooperative between the Federal government, the State of Alaska, and local governments to provide greater economic diversity and stability in Southeast Alaska and more year-round employment. The Sea Level Project would contribute to this, providing the opportunity for approximately 8.24 jobs and $350,000 in associated income per MMBF harvested (Forest Service IMPLAN model - base year 1992). The Proposed Action for the Sea Level Project Area would provide the opportunity for approximately 494 jobs and $21.0 million in associated income.

Relationship of this Project to the Tongass Land Management Plan

The National Forest Management Act of 1976 (NFMA) directs each National Forest to prepare a plan to guide the management of its lands. The Tongass Land Management Plan (TLMP) was completed in 1979 and amended in 1986 and 1991. The current revised TLMP was approved in 1997 (USDA Forest Service 1997), and now guides the management of the Tongass National Forest.

1997 TLMP Transition

The Record of Decision (ROD) for the 1997 TLMP (USDA Forest Service 1997b) includes direction for the transition to the revised Forest Plan. Timber Sale Projects which were initiated under the direction of the 1979 TLMP, and which would be completed within the next few years, may be affected to varying degrees by the revised TLMP. The ROD describes four categories of timber sale projects and their relationship to the 1997 TLMP (see 1997 TLMP ROD pg 41). The Sea Level Timber Sale Project is identified under Category 3: "Timber sale projects now being planned, but for which a NEPA decision document will not be signed before the effective date of this Plan."

The ROD directs that Category 3 projects (including the Sea Level Project need to be consistent with applicable management direction in the 1997 TLMP, except for new standards and guidelines for wildlife which address landscape connectivity, endemic terrestrial mammals, northern goshawk, and marten management. The new measures are to be incorporated in a manner that is least disruptive to the design and implementation of these projects and the extent of that incorporation will be determined through a review by an interagency implementation team. Discussions of direct, indirect, and cumulative effects for these wildlife resources have been included in Chapter 3 of this EIS.

The Sea Level Project EIS is "tiered" to the revised TLMP EIS (USDA Forest Service 1997a), and also to the Alaska Regional Guide EIS (USDA Forest Service 1983). General discussions from these documents and the administrative planning record are incorporated by reference rather then repeated in this EIS (see the References Cited section in Chapter 4).

Management Direction

The 1997 TLMP provides the primary direction for Forest management by means of the integrated components described in the following list.

- **Forest Multiple-Use Goals** are concise statements that guide the overall management of the Forest. These describe a desired future condition, expressed in broad, general terms, with no specific date by which the goals are to be achieved.
- **Forest Management Objectives** are objectives for specific resources and the levels of goods and services (resource outputs) that are anticipated during the first decade of Forest Plan implementation.
- **Management Prescriptions** are a description of land uses and activities which may occur on specific areas of land, such as LUDs. The management prescriptions in the 1997 TLMP include 19 LUDs (see Table 1-1), with a range of management objectives, and standards and guidelines to ensure attainment of those objectives.
- **Forest-wide Standards and Guidelines** are the standards and guidelines that apply to all, or most, areas of the Forest. Each management prescription includes a list of standards and guidelines that apply to that LUD.

Table 1-1
Land Use Designations as Defined in TLMP (1997)

Non-Development LUDs		Development LUDs	
Wilderness and National Monument	**Mostly Natural**	**Moderate Development**	**Intensive Development**
Wilderness National Monument	LUD II Old-growth Habitat Research Natural Area Remote Recreation Semi-Remote Recreation Municipal Watershed Special Interest Area Wild River Scenic River Recreational River Experimental Forests	Scenic Viewsheds Modified Landscapes	Timber Production Minerals Transportation and Utility Corridors

Source: Tongass Land Management Plan Revision Record of Decision (USDA Forest Service 1997b).

Management Prescriptions for the Sea Level Project Area

The 1979 TLMP divided the Forest into land areas called value comparison units, or VCUs. VCUs are roughly equivalent to large watersheds. Their boundaries usually follow easily recognizable watershed divides. As stated earlier, the 1997 TLMP Revision established 19 LUDs (see Table 1-1). A LUD is a defined area of land to which specific land use prescriptions are applied. The area within a given VCU may be allocated to more than one LUD.

The Project area encompasses all or portions of seven VCUs. The 1997 TLMP allocates National Forest System land within the Sea Level Project Area VCUs to six LUDs. Each of these six LUDs include management objectives and specific standards and guidelines designed to ensure attainment of those objectives. Standards and guidelines take precedence over annual targets or projected outputs; no project will be funded for which the standards and guidelines cannot be implemented. The TLMP LUDs in the Project Area are described below.

Timber Production—These lands are managed for the production of sawtimber and other wood products on an even-flow, long-term sustained yield basis. An extensive road system will be developed for accessing the timber and for recreation uses, hunting, fishing, and other public and administrative uses. Management activities will usually dominate most seen areas. A variety of wildlife habitats, predominantly in the early and middle successional stages, are present. They comprise 53 percent of the non-encumbered National Forest System lands in the Project Area.

Modified Landscape—This LUD provides for a variety of uses. Timber harvest and roads are allowed and the yield contributes to the Forest-wide sustained yield. Management activities are subordinate to the characteristic landscape as seen in the foreground from popular travel routes and use areas. In the middle to background distance, management activities may dominate the characteristic landscape. A variety of successional stages provide a range of wildlife habitat conditions. The Modified Landscape LUD occupies 18 percent of the Project Area.

Scenic Viewshed—In areas managed under the Scenic Viewshed LUD, forest visitors and others using identified popular travel routes and use areas will view a natural-appearing landscape. Management activities in the foreground will not be evident to the casual visitor. Activities in the middle-ground and background will be subordinate to the characteristic landscape. Timber yields will contribute to the Forest-wide sustained yield. A variety of successional stages providing wildlife habitat occur, although late-successional stages predominate. The Scenic Viewshed LUD comprises 2 percent of the Project Area.

Semi-remote Recreation—Areas in the Semi-remote Recreation LUD are characterized by generally unmodified natural environments. Ecological processes and natural conditions are only minimally affected by past or current human uses or activities. Timber harvest and road construction are generally not permitted. This LUD occupies 12 percent of the Project Area.

Old-growth Habitat—On lands within this LUD, old-growth forests are to be maintained and early seral conifer stands are to be managed to achieve old-growth forest characteristics. The objective is to achieve a diversity of old-growth habitat types and associated species and subspecies and ecological processes. Timber harvest is not permitted except to achieve the LUD objective and roads and other facilities are to be avoided. These lands occupy 12 percent of the Project Area.

Wild River—The Wild River LUD is used to maintain the natural, free-flowing, and undisturbed condition of the river, or river segments. Ecological processes and changes predominate. The outstandingly remarkable values for which the river was designated are retained. Recreation users are to have the opportunity for experiences in the primitive and semi-primitive range, including solitude and remoteness in a natural setting. Forested lands are classified as unsuitable for timber production. This LUD comprises less than 1 percent of the Project Area.

Nonnational Forest System Lands—State, private and other lands not managed by the Tongass National Forest. This is not a LUD, but an exclusion zone where National Forest management practices do not apply. Approximately 3 percent of the Project Area is comprised of non-National Forest System lands.

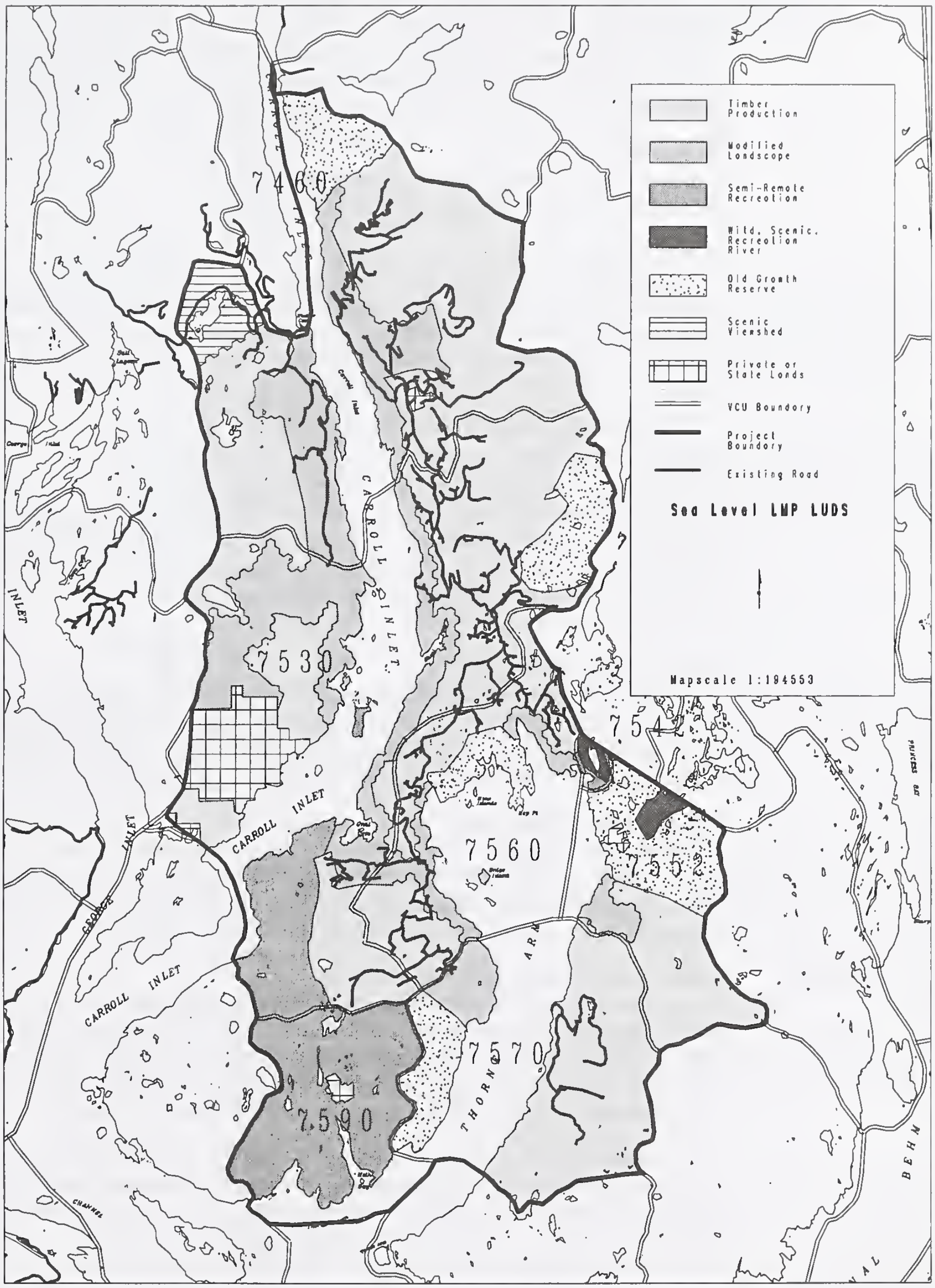
Table 1-2 displays the management prescriptions within the Project Area by VCU, and the corresponding acres associated with each Land Use Designation. Figure 1-4 displays the location of the 1997 TLMP LUDs within the Project Area.

Table 1-2
Land Use Designations as Defined in TLMP (1997)

TLMP VCU Number	TM	ML	SV	SR	OG	WR	Non NFS Lands	VCU Acres
746	16,203	6,459	1,736	0	2,064	0	103	26,567
753	16,506	7,177	0	3,644	2,270	0	2,899	32,496
745.2	0	0	0	130	0	254	0	384
755.2	3,730	613	0	0	3,422	372	118	8,255
756	5,449	1,533	0	0	1,222	0	0	8,204
757	8,053	1,154	0	0	1,923	0	0	11,130
759	0	0	0	7575	0	0	152	7,727
Total Acres Excluding Saltwater	**49,941**	**16,936**	**1,736**	**11,349**	**10,901**	**626**	**3,272**	**94,763**

TM—Timber Production
ML—Modified Landscape
SV—Scenic Viewshed
SR—Semi Remote Recreation
OG—Old-growth Habitat
WR—Wild River
Non NFS Lands—Non National Forest System Lands
Note: Discrepancies may be found between tables due to rounding.

Figure 1-4
Sea Level Project Area Land Use Designation as Allocated in TLMP (1997)



Public Involvement

Scoping

The NEPA process (40 CFR 1501.7) was used to determine the scope of the issues to be addressed and identify major concerns related to the proposed action. The scoping process was used to invite public participation and collect initial comments. The public was provided opportunities to comment on the project at the following points during the process.

Notice of Intent (NOI)

A Notice of Intent was published in the Federal Register on May 9, 1997, when it was decided that an EIS was to be completed for the project.

Public Mailing

On May 1, 1997, a letter providing information and asking for input was mailed to 623 individuals and groups that had previously shown interest in National Forest timber projects in Southeast Alaska. The mailing included eight Federal agencies, 18 State agencies and divisions, 67 Native and municipal government offices, 213 businesses and other organizations and groups, as well as individual citizens. By the close of scoping, 49 responses to this initial mailing were received.

Local News Media

Announcements about the project were printed in the Ketchikan Daily News, Island News, Wrangell Sentinel, Sitka Sentinel, Petersburg Pilot, and Juneau Empire. A scoping document describing the project was placed in the May 10, 1997 weekend edition of the Ketchikan Daily News. A news release was issued to all Southeast Alaska news outlets (radio/TV/newspaper) on April 28, 1997, that described the Sea Level project, and how the public could be involved.

Open House Meetings

Two open house public meetings were held during the scoping period to solicit public input. On May 21, 1997 at the Saxman Tribal House in Saxman, Alaska and on May 22, 1997 at the Cape Fox Lodge in Ketchikan, Alaska. Each meeting lasted from 7:00 to 9:00 PM, and was advertised in the Ketchikan Daily News and on local radio stations in advance of the meeting.

Briefings/Consultation

Additional briefings were held to provide information and clarification on issues and alternatives from April 1997 through February 1998 with individuals and organizations. Consultation with tribal, local, state and federal government agencies also occurred during this time.

Open IDT Meeting

Preliminary Issues and Alternatives

A news release was issued on October 23, 1997, which resulted in an article regarding the Sea Level EIS and upcoming open IDT meeting in the Ketchikan Daily News on October 29, 1997. A letter, similar to the news release, was mailed on the same date to anyone who had submitted scoping comments. The Meetings and Brevities section of the Ketchikan Daily News announced the open IDT meeting on October 30 and 31, 1997.

The purpose of the open IDT meeting was to provide the public a chance to comment on the significant issues and the range of alternatives the IDT had identified for the Draft EIS as a result of public scoping. The results of the meeting were documented in an article by the Ketchikan Daily News on November 1 and 2, 1997.

Draft EIS

Availability of Draft EIS for Public Comment

Release of the Draft EIS will initiate a minimum 45-day comment period during which time written or verbal comments will be welcomed from interested parties. The period for public comments on this Draft EIS and the deadline for receipt of comments are identified in the cover letter accompanying this document and will be published in the local news media. Written comments on this EIS should be mailed to:

Forest Supervisor
ATTN. Sea Level EIS
Tongass National Forest
Federal Building
Ketchikan, AK 99901

Subsistence Hearings

Subsistence hearings on the Draft EIS will be held in the communities of Saxman and Ketchikan, Alaska. Open houses to describe the analysis process and to answer public questions will be held in conjunction with the subsistence hearings. Public comment on the Draft EIS will also be accepted at that time. Dates, times, and locations are included in the cover letter accompanying this document and will be publicized in the local media.

Final EIS

Analysis and Incorporation of Public Comments

Public comments and subsistence comments will be analyzed and incorporated into the Final EIS. A Final EIS is projected to be released in September 1998, along with a ROD that will summarize the alternatives considered and state which one is to be implemented. The ROD will also summarize mitigation of adverse environmental impacts.

Issues

Issues Associated with the Proposed Action

The significant public issues, management concerns, and resource opportunities identified through the public and internal scoping process were used to formulate issue statements. Issues were raised by individuals, organizations, other Federal, State, and local agencies, as well as affected Alaska Native governments. Similar issues and concerns were grouped when appropriate.

Issues 1 through 7 were determined to be significant and within the scope of the project. All these issues will be addressed in all alternatives. Issues A-F were considered but eliminated from detailed study because their resolution either falls outside the scope of the Sea Level project or they were resolved through application of appropriate mitigation measures across all alternatives.

Issue 1: Timber Economics and Supply

The issue encompasses public concern over the amount of timber available and proposed for harvest, methods of timber harvest, and balancing timber production with other Forest uses. It includes the issue of how the Project Area contributes to the long-term timber supply. It also includes concern for ensuring cost-effective timber harvest.

Issue 2: Fish Habitat, Water Quality, and Soils

This issue addresses public concern for maintaining water quality in streams which provide suitable habitat for anadromous and resident fish. Fish and shellfish within the Sea Level Project Area are important to sport, commercial, and subsistence users throughout Southeast Alaska. This issue also includes concerns about timber harvesting on steep slopes, mass movement of soil, stream temperature sensitivity, as well as karst and cave protection.

Issue 3: Recreation and Scenic Quality

Forest management activities could affect existing recreational pursuits for users of the Sea Level Project Area. More specifically, increased human access, timber harvest, and other developments could affect recreation values and opportunities including: hunting, fishing, scenic quality, and recreation use areas. Comments emphasized the importance of protecting the scenic quality along inlets and bays, particularly from the Fish Creek Cabin. The quality and types of recreation activities available to forest users could be enhanced by planning, facilitating, or developing a road system that, when eventually liked to Ketchikan, would allow increased access to existing and potential recreation sites.

Issue 4: Wildlife

This issue includes concerns over several wildlife species and the habitats critical to the maintenance of those wildlife populations. Alaskan wildlife is valuable for aesthetic, economic, recreational, ecological, and subsistence purposes. Of primary concern are the effects of timber harvest and associated road construction upon wildlife species dependent on old-growth habitat. Related to the overall concern is the question of how timber harvest would further fragment existing large blocks of old-growth habitat . The need for a project specific old-growth habitat strategy (incorporating old-growth connectivity and open road densities) that ties into the Forest Plan habitat strategy was also identified.

Issue 5: Subsistence

Primary concern is the potential effect of timber harvest and road construction on the abundance and distribution of subsistence resources. For many, subsistence consists of hunting, fishing, trapping, and gathering to supplement their food sources, income, and other needs. Other aspects to be evaluated are, competition from non-rural subsistence users and access to the resources.

Issue 6: Social and Economic Effects

This issue reflects concerns about effects on community employment and income, population, community stability, and life-styles. The economies of most communities in Southeast Alaska depend almost exclusively on the Tongass National Forest to provide natural resources for uses such as fishing, tourism, recreation, timber harvesting, mining, and subsistence.

Issue 7: Marine Environment

The marine waters and their associated mud flats and estuaries found in protected coves and bays within the Project Area provide habitat for species such as Dungeness crab and juvenile salmon. Since coves and bays are the points of concentrated activity associated with marine transport of logs, logging camps, and sort yards, some marine species are subject to effects from log transfer and storage facilities. The use of three existing LTF sites is proposed.

Issues Outside the Scope of This Analysis

The following public issues were considered but eliminated from detailed study because their resolution is beyond the scope of this document.

Issue A: Regional Timber Supply and Demand

Analysis of timber supply and demand is a regional issue which exceeds the scope of this analysis. This issue was addressed as part of the TLMP Revision (TLMP, 1997a) process. A site-specific environmental analysis documents the effects of the proposed activities; it does not constitute the selling or conveyance of property rights. The volume of timber cleared in a NEPA document may be sold in whole, in part, or not at all, depending upon rapidly changing market conditions or other factors important in the overall management of the National Forests. Predicting the effects of the proposed activities upon the regional timber supply and demand is beyond the capability and scope of this document, other than concluding that timber sales that implement the project will contribute volume to the timber supply and will help meet demand. How the project contributes to the long-term timber supply is addressed as part of Issue 1: Timber Economics and Supply.

Issue B: Manage Sea Level for Sustained Yield
The National Forest Management Act (NMFA) directs that a sustainable level of harvest be identified for each National Forest. There is no direction or intent to establish a sustainable level of harvest for individual project areas or other small geographic subdivisions of the Forest. All alternative's considered meet Forest Plan standards and guidelines which ensure protection for multiple resource values over the entire Forest.

Issue C: Bradfield Road Transportation Link
Some members of the public expressed a concern that the Bradfield Road Transportation Link be evaluated in whole or in part in this EIS.

The Bradfield road connection (excluding Revillagigedo Island) is neither a connected action nor a reasonably foreseeable action ripe for decision.

Issue D: Below Cost Timber Sales
Below cost timber sales are a national issue and not within the scope of this project. The financial impacts of the alternatives are displayed in Chapter 3 of this EIS.

Issue E: Ketchikan-Shelter Cove Transportation Link
This issue reflects the resource concerns as well as the opportunity to coordinate the construction of logging roads and potential future connections to the road system on other parts of Revillagigedo Island, specifically Ketchikan to Shelter Cove. Several alternative routes could connect the Ketchikan road system to the Shelter Cove road system. All these routes are outside the Sea Level Project Area, and no connection is anticipated under any alternative. A road connection would not be constructed and available for use for another 10 years. A preliminary analysis indicates that it would be cheaper to raft the logs back to Ketchikan or elsewhere, and therefore a timber sale would not facilitate a road connection in any case. While the two actions appear to be linked because of geography, the timing is not similar. Nor are the two actions inextricably linked; the timber sale may proceed without a road connection and a road connection may be constructed without a timber sale. The reasonably foreseeable cumulative effects of a road connection will, however, be addressed in this EIS.

Issue F: Heritage Resources
The Project Area lies largely within the area traditionally claimed by two Southern Tlingit groups, the Tantakwan (also referred to as the Tongass or Ketchikan Tribe) and the Sanyakwan (also referred to as the Saxman or Cape Fox Tribe). Because of the importance of this area in preserving the Tlingit culture and traditional values, the Forest Service has, and will continue to work closely with both the Tongass and Cape Fox Tribes to identify sites of cultural importance. Once identified, the Forest Service will protect these sites by avoiding them when planning and implementing management activities.

The National Historic Preservation Act (NHPA) directs Federal agencies to take into account the effect of proposed actions on historic properties. Historic properties are those properties included in or eligible for inclusion in the National Register of Historic Places. Federal regulations also require a "Section 106 review" for proposed actions. In response to this issue, we have completed the NHPA Section 106 review for all timber harvest related activities proposed by the action alternatives. This includes units, roads, and LTF's. As a result of this review, we have avoided all known heritage resource sites in the Project Area or otherwise specified stipulations to protect them.

Federal and State Permits, Licenses, and Certifications

To proceed with the timber harvest as addressed in this EIS, various permits must be obtained from Federal and State agencies. Administrative actions on these permits would be initiated after the EIS is filed with the Environmental Protection Agency (EPA). The agencies and their responsibilities are listed below.

U.S. Army Corps of Engineers

- Approval of discharge of dredged or fill material into waters of the United States (Section 404 of the Clean Water Act of 1977, as amended).
- Approval of construction of structures or work in navigable waters of the United States (Section 10 of the Rivers and Harbors Act of 1899).

U.S. Environmental Protection Agency

- Storm water discharge permit.
- National Pollutant Discharge Elimination System review (Section 402 of the Clean Water Act).

State of Alaska, Department of Natural Resources

- Authorization for occupancy and use of tidelands and submerged lands.

State of Alaska, Department of Environmental Conservation

- Certification of compliance with Alaska Water Quality Standards (Section 401 Certification).
- Solid Waste Disposal Permit (Section 402 of the Clean Water Act).

U.S. Coast Guard

- Coast Guard Bridge Permit (in accordance with the General Bridge Act of 1946) required for all structures constructed within the tidal influence zone.

Legislation and Executive Orders Related to this EIS

Shown below is a brief list of laws pertaining to preparation of EISs on Federal lands. Some of these laws are specific to Alaska, while others pertain to all Federal lands.

- Alaska Native Claims Settlement Act (ANCSA) of 1971
- Alaska Native Interest Lands Conservation Act (ANILCA) of 1980
- American Indian Religious Freedom Act of 1978
- Archeological Resource Protection Act of 1980
- Cave Resource Protection Act of 1988
- Clean Air Act of 1970 (as amended)
- Clean Water Act of 1977 (as amended)
- Endangered Species Act (ESA) of 1973 (as amended)
- Executive Order 11593 (cultural)
- Executive Order 11988 (floodplains)
- Executive Order 11990 (wetlands)
- Executive Order 12898 (environmental justice)
- Executive Order 12962 (aquatic systems and recreational fisheries)
- Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (as amended)
- Marine Mammal Protection Act of 1972
- National Environmental Policy Act (NEPA) of 1969 (as amended)
- National Forest Management Act (NFMA) of 1976 (as amended)
- National Historic Preservation Act of 1966 (as amended)
- Native American Graves Protection and Repatriation Act of 1990 (Public Law 101-601)
- Tongass Timber Reform Act (TTRA) of 1990
- Wild and Scenic Rivers Act of 1968 (amended 1986)

In addition, the Coastal Zone Management Act (CZMA) of 1976, as amended, pertains to the preparation of an EIS. Federal lands are not included in the definition of the coastal zone as prescribed in the CZMA. The act, however, requires that activities of Federal agencies affecting the Coastal Zone be consistent to the maximum extent practicable with the enforceable policies of the approved State Coastal Management Program. This determination is made by the U.S. Forest Service.

The Alaska Coastal Management Plan incorporated the Alaska Forest Resources and Practices Act of 1979 as applied standards and guidelines for timber harvesting and processing. Standards and Guidelines described in the Forest Plan, as well as other existing policy and direction in the Forest Service Manual and Handbooks, equal or exceed protection measures prescribed by State standards.

Availability of the Planning Record

An important consideration in preparation of this EIS has been reduction of paperwork as specified in 40 CFR 1500.4. In general, the objective is to furnish enough site-specific information to demonstrate a reasoned consideration of the environmental impacts of the alternatives and how these impacts can be mitigated.

The Planning Record is available upon issuance of the EIS at the Ketchikan Ranger District, Ketchikan, Alaska. Other reference documents, such as the 1997 TLMP, are available at public libraries around the region as well as all Forest Service offices.

Chapter 2

Alternatives

Chapter 2

Alternatives

Key Terms

Alternative—one of several options proposed for analysis and decision.
Best Management Practices (BMPs)—practices used for the protection of water quality.
Desired Future Condition—a desired condition of the land to be achieved sometime in the future but has no specific date by which it is to be accomplished.
Diameter at Breast Height (DBH)—diameter of a standing tree at four feet, six inches above the root collar on the uphill side.
Large Old-growth Blocks—contiguous blocks of wildlife habitat to be managed and conserved for breeding pairs, connectivity, and distribution of species of concern.
High value marten habitat—defined by TLMP as stands of high volume productive old growth below 1500 feet elevation.
Implementation monitoring—collecting information to evaluate whether mitigation measures were carried as planned.
Logging System Transportation Analysis (LSTA)—design and mapping of potential timber harvest units, including logging methods and roads.
Mitigation—measures designed to counteract or reduce environmental effects.
MMBF—million board feet.
Partial cut—harvest of timber other than by clearcut; examples include shelterwood, seed tree, and group selection.
Roadless area—an area of undeveloped public land with no improved roads, generally over 5,000 acres, as identified in the TLMP.
Subsistence—customary and traditional uses by rural Alaskans of wild renewable resources for personal or family consumption.
Windfirm—individual trees or groups of trees that are able to resist being blown over by the wind.

Introduction

Chapter 2 summarizes the development of alternative actions for making timber available to the local forest products industry, while implementing the Tongass Land Management Plan (TLMP1997) in the Sea Level Project Area. It also discusses the alternatives considered but eliminated from detailed study. Finally this chapter explains and compares the six alternative actions selected for detailed study. Chapter 2 presents the alternatives in comparative form, sharply defining the issues to provide a clear basis for choice among options by the decision maker and the public.

Much of the information in Chapter 2 is summarized from Chapter 3, Environment and Effects. Chapter 3 contains the detailed scientific basis for establishing a baseline and measuring the environmental consequences for each of the alternatives. For the best understanding of the six alternatives, readers should consult Chapter 3.

Alternative Development

Each alternative in this EIS presents a different approach to the issues. Five action alternatives were developed to meet the purpose and need of the project, while minimizing or avoiding environmental impacts. Each action alternative represents a site-specific proposal developed through intensive interdisciplinary unit and road design using topographic maps, GIS mapping capabilities, and aerial photos coupled with resource inventories and site inspections.

The alternative development process has been guided by several concepts and principals of sound resource management. Each alternative follows the standards, guidelines, and direction contained in the Forest Plan, the Alaska Regional Guide, and applicable Forest Service manuals and handbooks.

Ecosystem Management

Ecosystem management is a concept incorporated into forest management in recent years. The philosophy is to emphasize ecological, physical, and social sciences to guide resource management to sustain the health, productivity, and intangible values of the land. These concepts were considered in the selection and design of individual harvest units and roads included in the alternatives.

Ecosystem management looks at forest management on two levels: (1) the landscape level, which may be a geological province or a large watershed, and (2) the stand level, which deals with individual harvest units. The forest plan incorporates ecosystem management at the landscape level through land use allocation and the development of standards and guidelines. This disperses incompatible uses and spreads impacts out over time and space. Some issues—such as maintaining large unfragmented blocks of old-growth over time —have been resolved through land use allocation in the forest planning process. A site-specific project level plan implements that direction and responds to public comments through the development of alternatives which determine which stands are treated and how they are managed.

Some tools employed at the stand level may include:

- a deferred entry,
- reducing harsh edges through unit placement, looking for opportunities to retain small patches of uncut timber in harvest units,
- maintaining wildlife travel corridors,
- leaving snags in harvest units (where safety regulations allow), and
- trying nonstandard harvest practices where resource issues and physical limitations permit.

The Sea Level Interdisciplinary Team (IDT) used a combination of issues and resource knowledge to subdivide the Sea Level Project Area into a variety of important landscape zones. Definition of these landscape zones considered TLMP allocation of old growth habitat, distribution of previous timber harvest, travel and dispersal corridors between zones that can be used by wildlife, the existing and potential road network for accessing timber, and subsistence uses. The landscape level considerations included the characteristics of the Sea

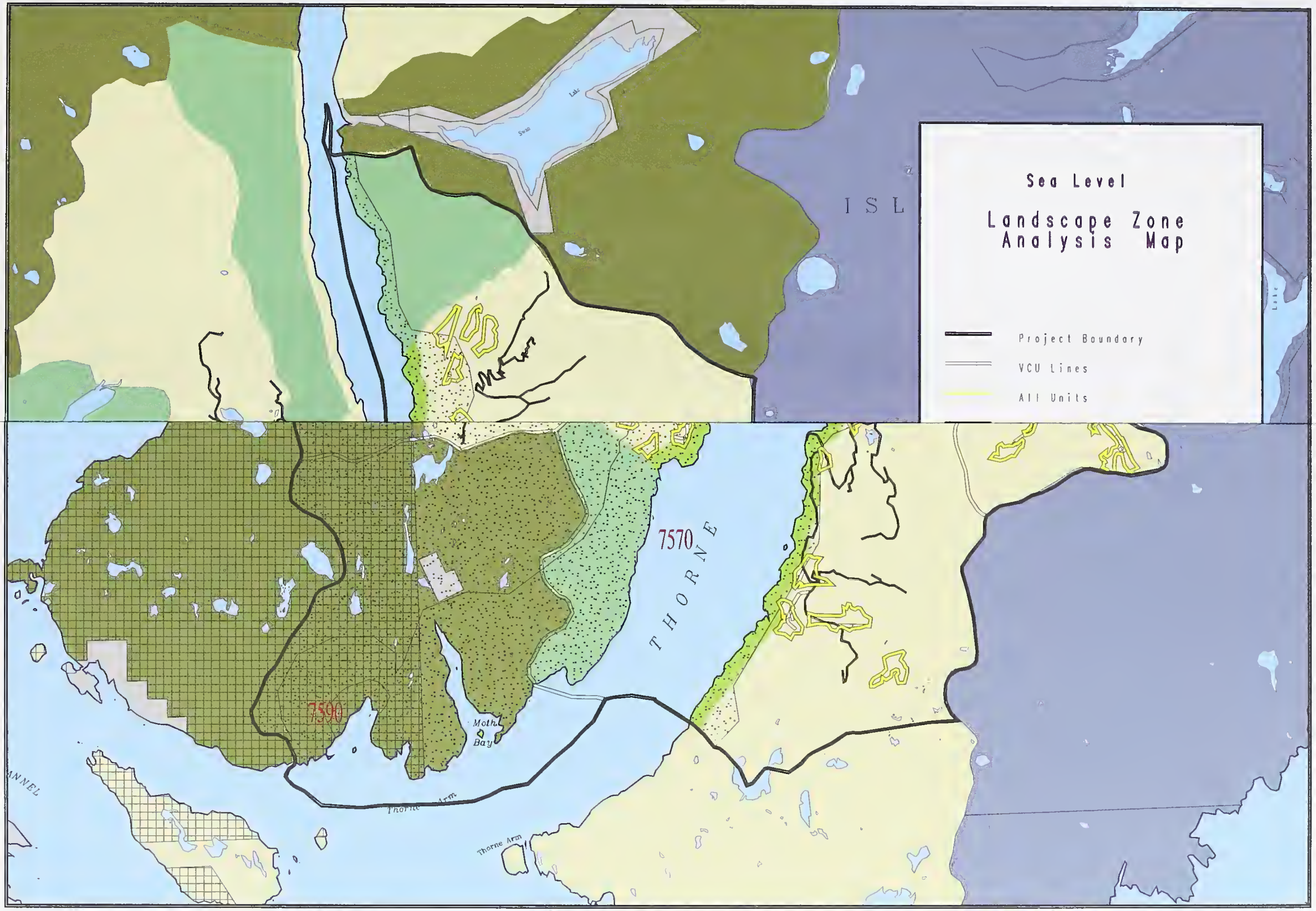
Level Project Area itself as well as its relationship to adjacent areas such as the Misty Fiords National Monument, Swan Lake hydroelectric facility, and Shelter Cove. Consideration was given to social factors (including subsistence use, visual concerns, timber harvest economics, and Tribal governments), and land use designations in the development of landscape zones. Table 2-1 displays the Landscape Management Zones for the Sea Level Project Area.

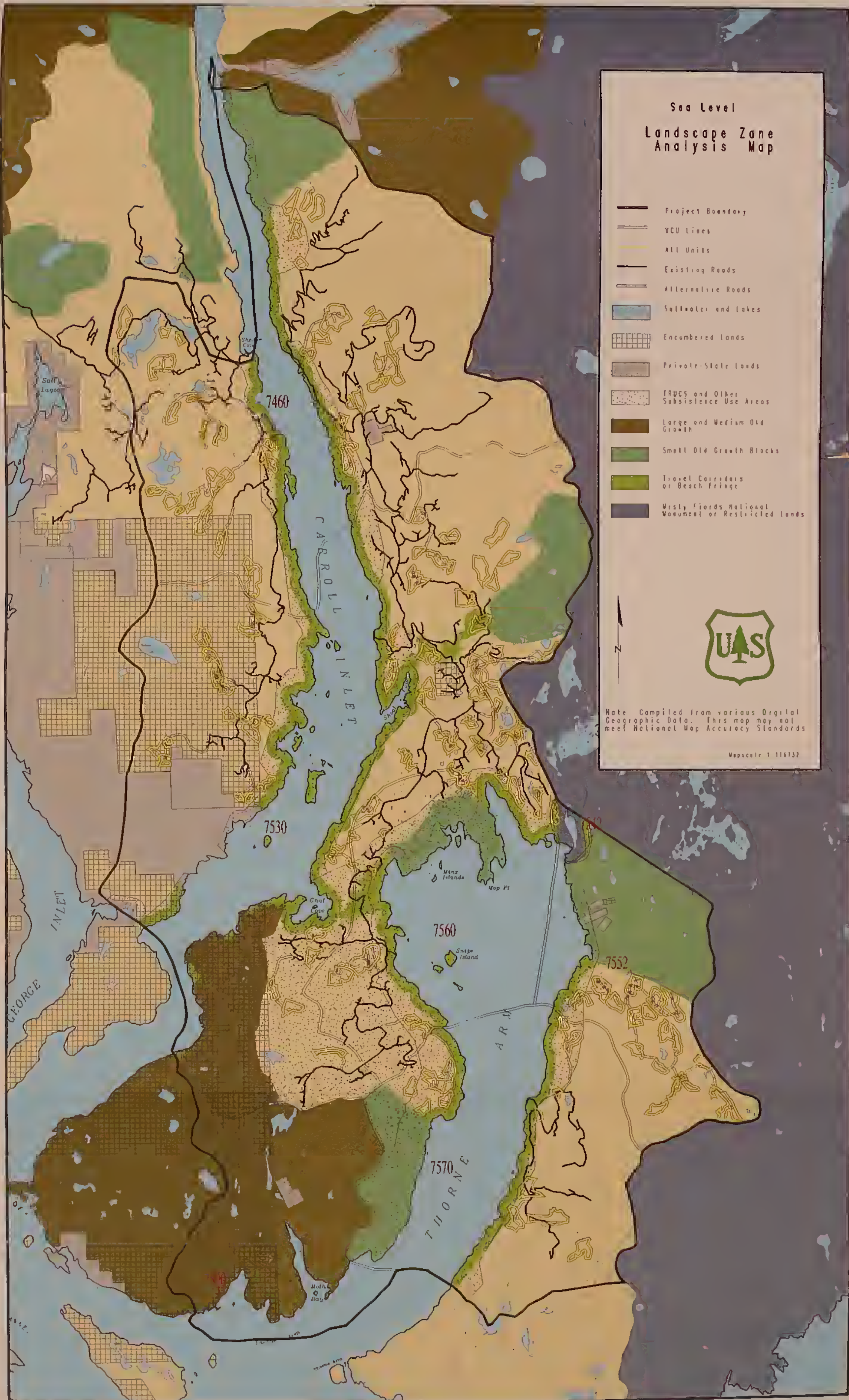
Table 2-1
Sea Level Landscape Management Zones

Landscape Management Zones	Description
1. Large and Medium sized old-growth habitat reserves	Large and medium Old-growth Habitat reserves delineated in the 1997 TLMP provide old-growth habitat that help maintain viable wildlife populations.
Carroll Point Block	This medium sized old-growth habitat block is located between Carroll Inlet and Thorne Arm. It is managed as a Semi-remote Recreation Land Use Designation (LUD) in the TLMP, which would not allow commercial timber harvest. This block is approximately 10,948 acres.
Swan Lake Block	This medium sized old-growth habitat reserve block is managed as a Semi-remote Recreation LUD in the TLMP, which allows no commercial timber harvest. This 13,474-acre block is located south of the Swan Lake Hydropower facility.
2. Small Old-growth Habitat Reserves	Five small blocks of unfragmented old-growth habitat located inside the project boundary collectively total 11,193 acres.
3. Late-successional Travel Corridors	Travel corridors provide connectivity between large and medium old-growth habitat reserves and nondevelopment LUDs as required in the 1997 Forest Plan. These corridors generally follow riparian zones, beach fringe, or other areas of gentle topographic relief commonly utilized for migration between areas.
4. Misty Fiords National Monument	Misty Fiords was designated as a National Monument to preserve a unique ecosystem and the remarkable geologic and biological features it contains. Protection and study of the geology, plant and animal succession, historical resources, and fish and wildlife resources are specifically directed. This Misty Fiords National Monument includes over two million acres of wilderness and old growth habitat.
5. Subsistence Use Areas and Traditional Use Zones	This is an area of important subsistence use as identified by the 1988 Tongass Resource Use Cooperative Survey (TRUCS) survey. This Landscape Management Zone identifies locations within the Project Area which are used for hunting and fishing activities by households in Southeast Alaska communities combined with more recent information gained from consultation with Tribal governments.

Chapter 3 and the Appendices contain additional maps that present some of the features described above in greater detail. The landscape management zones described in the previous table (Table 2-1) are displayed by location on the color fold-out map on the next page (Figure 2-1).

Figure 2-1
Color Map of Landscape Zones (next page)


Sea Level
Landscape Zone
Analysis Map
Project Boundary
VCU Lines
All Units
ISL
THORNE
7570
7590
Moth Bay
Thorne Arm
Thorne Arm
NNEL



Sea Level
Landscape Zone Analysis Map
Project Boundary
VCU Lines
All Units
Existing Roads
Alternative Roads
Saltwater and Lakes
Encumbered Lands
Private-State Lands
TRUCS and Other Subsistence Use Areas
Large and Medium Old Growth
Small Old Growth Blocks
Travel Corridors or Beach Fringe
Misty Fiords National Monument or Restricted Lands
N
Note Compiled from various Digital Geographic Data. This map may not meet National Map Accuracy Standards
Mapscale 1 116732
CARROLL INLET
GEORGE INLET
THORNE ARM
7460
7530
7560
7552
7570
Salt Lagoon
Coal Cove
Snipe Island
Moth Bay

Process Used to Formulate Alternatives

An interdisciplinary approach was used to develop alternatives to the proposed action. The scoping process for the Sea Level Project Area began in April 1997 and concluded in October 1997. Alternative development began after completing the scoping process and addressed issues and concerns identified in scoping.

This document is the Draft EIS for this project. The intent of publishing a draft EIS is to seek public comment on the alternatives so the agency can better respond to concerns in developing the Final EIS, and in making a final decision on the proposed action. All alternatives have been developed to varying degrees to address public comments and concerns. The following guidelines were used to formulate alternatives:

Address the Issues Identified During the Scoping and Public Comment Periods

This ensures that the interests of the various citizens, groups, and organizations that could be affected by this project are reflected in the alternatives.

Integrated Resource Analysis Focused on the Proposed Action

Forest Plan implementation begins by comparing the existing condition with desired future condition and the management emphasis for the area. This is followed by a determination of what, if any, changes are necessary and what management practices can be used to achieve that desired future condition. The purpose of an integrated resource analysis is to determine what management practices best respond to the management emphasis and to ensure their consistency with Forest Plan direction.

Adherence to Forest Plan objectives and standards is an essential component of Forest Plan implementation. The list of possible management practices which would work toward the desired future condition for timber must be consistent with the need to meet Forest Plan standards and objectives for other resources.

Evaluate a Reasonable Range of Alternatives

Unresolved conflicts, identified by the Forest Service and the public, are the issues related to the proposed action. In responding to unresolved conflicts, not every conceivable alternative must be considered, but selection and discussion of alternatives must permit a reasoned choice and foster informed decision making and informed public participation. Taken together, these concepts help determine the range of alternatives.

The issues, ways of addressing the issues, and possible levels of resource use on Revilla Island vary widely. The ID Team concentrated on providing a range of alternatives by varying the location and mixes of resources committed under each alternative and by varying the number and kinds of activities to be conducted.

Upper limits on timber outputs and associated road mileages considered in this EIS are guided by TLMP standards and guidelines as well as requirements regarding timber harvest in the National Forest Management Act and its implementing regulations.

Lower limits on timber outputs and associated road mileages are directly related to the issues and concerns, as well as the purpose and need for action described in Chapter 1.

Consistency with TLMP and the Record of Decision

The Sea Level project is consistent with the standards and guidelines in the TLMP . The documented analysis and relevant discussion from TLMP is incorporated by reference rather than repeated.

Alternatives Eliminated from Detailed Study

A number of alternatives were examined, but not considered for detailed study in this Final EIS. This section presents those alternatives and the rationale for excluding them from further consideration.

Alternative A

Single Resource or Issue

Alternatives that focused solely upon one resource or issue were eliminated from consideration as implementable alternatives. While alternatives constructed around a single resource may not be implementable, the issue itself may still be significant. Each alternative is evaluated against all the significant issues.

Alternative B

Shelter Cove Road Connection

The proposed Shelter Cove road connection is a separate project independent of the Sea Level project. The road link project is a reasonably foreseeable, but unconnected action, with the Federal Highways Administration being the lead agency. The preliminary preferred road connection alternative routes have been identified, and are located almost entirely outside the Sea Level Project Area. The two proposed actions appear to be connected because of the potential road locations and opportunity to haul harvested timber back to Ketchikan. The dissimilar time lines do not make the road connection available for the Sea Level Project. Preliminary analysis also indicates that log haul back to Ketchikan by a connecting route would be uneconomical.

Alternative C

No New Road Construction

Several commenters asked the Forest Service to minimize or avoid the construction of new roads within the Project Area by harvesting only timber that is accessible from existing roads. An alternative of this nature would not meet the intended purpose and need of the Project.

Alternatives Considered for Detailed Study

Six alternatives for making timber available to the timber industry from the Sea Level Project Area were considered in detail. Each alternative is consistent with the TLMP (1997). This section provides a discussion of: (1) the emphasis or intent of each alternative; (2) various resource outputs associated with implementation; and (3) environmental consequences. Alternatives are summarized in Table 2-2.

Alternative 1 (No Action)

Emphasis

The emphasis of this alternative is to propose no new timber harvest from the Sea Level Project Area at this time. It does not preclude timber harvest from other areas at this time, or from the Sea Level Project Area at some time in the future. This alternative serves as a benchmark by which effects of the action alternatives can be measured. The Existing Condition map shows the distribution of vegetation associated with no timber harvest.

Outputs

There are no timber harvest outputs associated with this alternative. Visual quality, wildlife habitat, and semi-primitive recreation would remain in their current condition.

Alternative 2

Emphasis

This alternative accelerates progress toward the desired future condition for timber production while meeting Forest Plan standards and guidelines. Timber volume made available is maximized. This alternative is designed to harvest as much of the project area as possible in a manner that meets standards and guidelines.

Outputs

This alternative would schedule the harvest of 2,843 acres, in 106 units for approximately 71 MMBF. Of this, 444 acres would be planned for individual tree mark (ITM) partial cut and the remainder planned for patch cut/clearcut, and group select harvest. To implement this harvest, 59 miles of new road would be constructed, and 23 miles of existing road would be reconstructed. Road clearing will yield an additional 6 MMBF of right-of-way (ROW) volume. It schedules 232 acres for helicopter yarding. Preliminary analysis indicates a net mid-market stumpage value of $71.78 per MBF.

The use of three existing LTFs will be required to implement this alternative. Floating or land based logging camps and log sort yards are anticipated with the Shelter Cove, Shoal Cove and Elf Point LTFs. The Alternative 2 map provides the spatial relationship among roads, units and other geographic features of the Sea Level Project Area.

Alternative 3

Emphasis

The objective of this alternative is to emphasize timber economics by harvesting stands with the greatest potential for economic return. The location of harvest units, selection of silvicultural prescriptions, logging systems, and transportation network is aimed at maximizing the appraised timber value. This approach emphasizes a positive net economic return for the project by seeking to minimize logging and road construction costs. This entry proposes only limited helicopter timber harvest. This alternative attempts to minimize impacts to old-growth habitat, wildlife travel corridors, riparian habitat, and wetlands.

Outputs

Alternative 3 schedules the harvest of 61 individual harvest units, totaling 39 MMBF from 1,620 acres. Of this harvest, 198 acres are planned for ITM partial cut, the remainder for patch cut/clearcut, and group select harvest. This would require the construction of 39 miles of new road plus 18 miles of reconstruction. Road clearing will yield an additional 3 MMBF of ROW volume. It schedules 43 acres for helicopter yarding. Preliminary analysis indicates a net mid-market stumpage value of $32.22 per MBF.

The use of three existing LTF will be required to implement this alternative. Floating or land based logging camps are anticipated with the Shelter Cove, Shoal Cove and Elf Point LTFs. The Alternative 3 map provides the spatial relationship among roads, units, and other geographic features of the Sea Level Project Area.

Alternative 4

Emphasis

The emphasis of this alternative is to meet the purpose and need while minimizing timber harvest in the Minx Flat area. Harvest avoids Minx Flats to maintain more connecting habitat between the Carroll Point Medium Old-growth Reserve and Misty Fiords National Monument, and to address marten concerns in VCU 7560. Alternative 4 also avoids harvest in the Sea Level Creek watershed. Unit selection and road locations minimize the harvest of high value subsistence, riparian, and wildlife travel corridors.

Outputs

Alternative 4 would harvest 45 units, totaling 27 MMBF from 1,226 acres. Of this harvest, 49 acres are planned for ITM partial cut and the remainder for patch clearcut harvest. This requires the construction of 26 miles of new roads and 20 miles of reconstruction. Road clearing will yield an additional 2 MMBF of ROW volume. It schedules 43 acres for helicopter yarding. Preliminary analysis indicates a net mid-market stumpage value of $34.26 per MBF.

The use of three existing LTFs will be required to implement this alternative. Floating or land based logging camps are anticipated with the Shelter Cove, Shoal Cove and Elf Point LTFs. The Alternative 4 map provides the spatial relationship among roads, units, and other geographic features of the Sea Level Project Area.

Alternative 5

Emphasis

The emphasis of this alternative is to meet the purpose and need while avoiding timber harvest in the Minx Flats, Elf Point, and Marble Creek areas. This alternative minimizes harvest in the Minx Flats area to address wildlife habitat connectivity concerns in that area. This alternative is similar to Alternative 4 except that it avoids timber harvest in the Elf Point area to protect wolf and deer habitat.

Outputs

Alternative 5 schedules the harvest of 31 units totaling 20 MMBF from 847 acres. Of this harvest, 56 acres are planned for ITM partial cut; the remainder are planned for patch cut/clearcut, and group select harvest. This alternative requires the construction of 22 miles of new specified roads plus 19 miles of reconstruction. Road construction clearing will yield an additional 2 MMBF of ROW volume. It schedules 35 acres for helicopter yarding. Preliminary analysis indicates a net mid-market stumpage value of $2.33 per MBF.

The use of two existing LTFs will be required to implement this alternative. Floating or land based logging camps are anticipated with the Shelter Cove and Shoal Cove LTFs. The Alternative 5 map provides the spatial relationship among roads, units, and other geographic features of the Sea Level Project Area.

Alternative 6

Emphasis

The objective of this alternative is to respond to public comments suggesting that only Shelter Cove units should be considered for harvest. The remainder of the Project Area would be deferred to emphasize other resource values. Avoiding new road construction addresses the subsistence, fisheries, and wildlife issues of roaded access differently than standard road closures.

Outputs

Alternative 6 schedules the harvest of 13 units totaling 8.1 MMBF from 390 acres. All units are planned for clearcut harvest. This alternative requires the construction of 11 miles of new roads plus 7 miles of reconstruction. Road construction clearing will yield approximately 1 MMBF of ROW volume. This yields an average of 91 MBF per mile of new road construction. It schedules no helicopter yarding. Preliminary analysis indicates a negative net mid-market stumpage value of -$8.90 per MBF.

The use of one existing LTF will be required to implement this alternative. Floating or land based logging camps are anticipated with the Shelter Cove. The Alternative 6 map provides the spatial relationship among roads, units, and other geographic features of the Sea Level Project Area.

Forest Service Preferred Alternative

Comparing the benefits and adverse effects of each alternative against the issues, the Forest Service has identified Alternative 3 as the preferred alternative in this DEIS. A final selection of an alternative will be made by the Ketchikan Area Forest Supervisor in the Record of Decision (ROD) for the Final EIS.

Comparison of Alternatives

The comparison of alternatives draws together the conclusions from the analysis presented throughout the document and provides a summary of the results. Table 2-2 provides a summary of activities, outputs, and environmental consequences by which the alternatives may be compared. The following sections provide a comparison of alternatives by: (1) summary comparison of outputs and environmental consequences; (2) proposed activity; and (3) significant issues.

Table 2-2 provides a summary of activities, outputs, and environmental consequences by which the alternatives may be compared.

Table 2-2
Summary Comparison of Alternatives

Activity/Resource	Units	Alternatives 1	2	3	4	5	6
Timber							
Units	Number	0	106	61	45	31	13
Estimated harvest unit volume	MMBF	0	71	39	27	20	8
Estimated right-of-way (ROW) volume	MMBF	0	6	3	2	2	1
Individual tree mark	Acres	0	444	198	56	68	0
Patch cut/clearcut/group select	Acres	0	2,399	1422	1170	779	390
Total harvest	Acres	0	2,843	1,620	1,226	847	390
Shovel harvest	Acres	0	180	128	44	44	8
Cable harvest	Acres	0	2,431	1,449	1,139	1,907	382
Helicopter harvest	Acres	0	232	43	43	35	0
Estimated Net-stumpage (mid-market rates)	$ / MBF	0	71.78	32.22	34.26	2.33	-8.90
Total receipts to State of Alaska	$Millions	0	5.12	2.88	1.92	1.54	.01
Average annual jobs over 4 years	No. of jobs/year	0	157	91	58	49	16
Roads and Transportation							
New Road construction	Miles	0	58.8	39.1	26.0	22.4	10.7
Road Reconstruction	Miles	0	23.1	18.3	19.5	18.8	7.2
Roads crossing Class I or II streams	Number	0	20	5	4	3	5
Biodiversity							
Unfragmented old-growth patches remaining							
1,000 Acres and larger	Acres	5,695	4,287	4,901	5,464	5,553	5,695
500-1,000 Acres	Acres	4,397	714	3,641	3,673	3,353	4,397
100-500 Acres	Acres	4,732	5,676	4,172	4,137	4,738	4,554
Corridors connecting old growth blocks	Acres harvested	0	98	98	0	0	0
Old growth acres remaining in Project Area	Acres	17,534	14,128	15,699	16,220	16,577	17,251
Percent of 1954 old-growth remaining	Percent	54	43	48	50	51	53
Wildlife - Project Area							
1997 MIS - deer	Habitat capability	2411	2311	2350	2366	2380	2400
1997 MIS - bear	Habitat capability	172	172	172	172	172	172
1997 MIS - marten	Habitat capability	160	154	156	157	158	159
1997 MIS - gray wolf	Habitat capability	7.0	6.7	6.9	6.9	6.9	7.0
Subsistence - WAAs 405 and 406							
Deer Habitat Capability (percent of 1954)	Percent	87	85	86	86	86	87
Percent of 1954 Needed to Support Current Harvest	Percent	22	22	22	22	22	22
Soils							
Very high mass movement	Acres harvested	0	0	0	0	0	0
High mass movement	Acres harvested	0	1,367	649	513	283	229
Wetlands harvested	Acres	0	914	556	444	309	260
Wetlands roaded	Miles	0	34	22	17	12	6
Roadless Areas							
Roadless areas	Acres (M)	34,413	24,925	30,217	27,440	29,954	34,413

Source: IDT 1997.

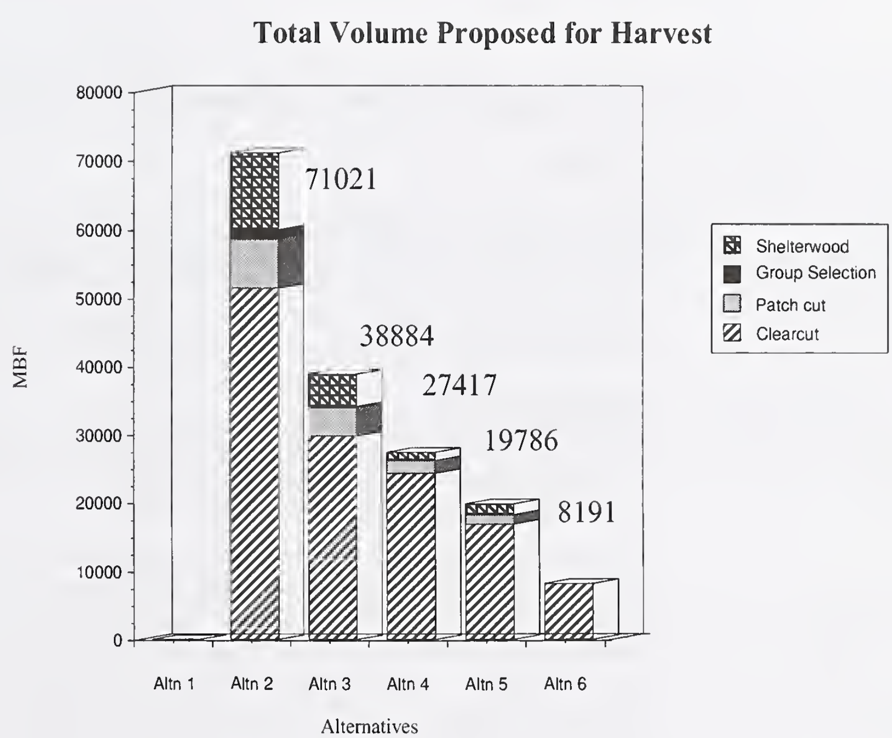
Comparison of Alternatives by Proposed Activity

The action alternatives propose the harvest of from 390 to 2,843 acres. Alternative 2 proposes the most acres for selection harvest (427), while Alternative 6 proposes no selection harvest. Table 2-2 shows the number of acres within units including deferrals under each alternative by silvicultural system.

Alternative 2 proposes the highest level of harvest with approximately 2,843 acres of timber harvest. Of the action alternatives, Alternative 6 proposes the lowest level of harvest with 390 acres. Table 2-2 shows the number of acres proposed for harvest by each alternative by silvicultural system.

Only one action alternative (Alt. 2) yields volume equal to or greater than the proposed action of 60 MMBF. Alternative 6 provides the least volume at 8 MMBF and Alternative 2 the most, with 71 MMBF. Figure 2-2 shows the volume of timber proposed for harvest by each alternative by silvicultural system.

Figure 2-2
Total Volume Proposed for Harvest



Road development is divided into two categories, construction and reconstruction. Table 2-2 shows the number of miles of road construction and reconstruction proposed to access the harvest units for each alternative. Alternative 2 proposes the most road construction (58.8 miles) and reconstruction (23.1 miles) while Alternative 6 proposes the least amount of road construction (10.7 miles) and reconstruction (7.2 miles).

There are three existing LTFs to implement the various alternatives. The IDT has projected which units or groups of harvest units would most economically be hauled to a given LTF. Table 2-3 shows the volume of harvest projected to be hauled to each LTF.

Table 2-3
Proposed Harvest, by Log Transfer Facility, in MMBF

	No Action	Alt. 2	Alt. 3	Alt. 4	Alt.5	Alt. 6
Shoal Cove	0	30.5	14.7	6.9	11.7	0.0
Shelter Cove	0	21.9	13.6	13.1	9.1	8.2
Elf Point	0	18.6	10.5	7.4	0.0	0.0
Total	**0**	**71.0**	**38.8**	**27.4**	**19.8**	**8.2**

Source: Oien, 1998.

Comparison of Alternatives by Significant Issue

Issue 1 Timber Harvest Economics and Supply

Chapter 1 presents the significant issues that are the focus of this EIS and the key indicators for evaluating the impacts of timber harvest on each issue. This section compares the alternatives in terms of these issues. The baseline for comparing alternatives is Alternative 1, the no-action alternative. Chapter 3 contains the detailed evaluation of the potential effects of timber harvest and road construction activities under each alternative on forest resources.

Logging Systems

The issue encompasses public concern with the amount of timber available and proposed for harvest, methods of timber harvest, and balancing timber production with other Forest uses. It includes the issue of how the Project Area contributes to the timber supply. It also includes concern for ensuring cost-effective timber harvest.

Estimated timber economics focuses on the residual value (stumpage) of the timber after all associated logging and transportation costs are subtracted. Generally, the most expensive logging method is helicopter, followed by slackline, highlead, live skyline (shotgun), running skyline and shovel yarding. Average yarding distance, uphill versus downhill yarding, volume per acre, species composition and value, in combination with other factors, will influence the relative cost of each yarding method. Helicopter yarding is necessary in areas where it is impractical to build road or where aerial logging is necessary to meet specific standards and guidelines. Alternative 2 proposes the most helicopter acreage (232), while Alternative 6 proposes none. Table 2-2 displays the acres of harvest proposed for each logging system proposed in each alternative.

Mid-market Value

The analysis of timber values in the Timber section of Chapter 3 looks at the mid-market estimates for each alternative. Alternative 6 shows a negative net-stumpage at mid-market. Alternatives 2 through 5 are positive at mid-market.

Table 2-2 compares the economics of timber harvest in dollars per thousand board feet ($/MBF) for each alternative under mid-market conditions (generally representing the average market condition and product mix). The stumpage value expresses the net dollar value of the timber volume after subtracting the production, manufacturing and profit/risk costs from the log values.

Timber Supply

The Sea Level Project Area is composed of moderately difficult topography from a logging standpoint. Alternative 2 would harvest 2,843 acres yielding 77 MMBF (including ROW volume) and Alternative 6 would harvest 390 acres yielding 9 MMBF (including ROW volume). Alternative 3, 4, and 5 would harvest 1,620 acres, 1,226 acres, and 847 acres respectively (see Table 2-2).

Public concern has been focused on the effects of timber supply on community stability and rates of harvest scheduled in the Forest Plan. The TLMP Revision has addressed this issue by incorporating updated information into the Forest Plan which includes not only the effects on timber supply, but land use allocations and revised standards and guidelines. The Ten Year Sale Action Plan in Appendix A of this document reflects the updated Forest Plan and its application to the Sea Level Project Area. The Sea Level project is consistent with TLMP standards and guidelines.

Issue 2 Fish Habitat and Water Quality

Best Management Practices

We anticipate no measurable effects on water quality or fisheries production by any of the timber harvest or associated activities proposed by any of the action alternatives. All alternatives meet the requirements and intent of the Clean Water Act. Implementation of site specific stream buffers that range from 100 to 500 feet wide effectively mitigate direct stream channel impacts from proposed timber harvest and road construction. Adherence to Best Management Practices (BMPs) outlined in the Soil and Water Conservation Handbook (FSH 2509.22) during the design of units and roads minimize the potential direct effects to fish as well. Site-specific BMPs are noted on the individual unit and road cards in the appendix.

Stream Crossings

Another measure of potential risk to fish habitat from timber harvest is the associated new road construction and road reconstruction which crosses streamcourses (see Chapter 3-Fisheries). During placement of culverts or bridges, sediment is introduced into streams which will have short-term effects on water quality. Improper application of BMPs could result in long-term habitat degradation. Alternative 5 proposes the fewest stream crossings, while Alternative 2 proposes the most.

Mass Movement Index (MMI)

Following timber harvest, there is an increased risk of landslides until second growth and the brush layer become firmly established. One way of analyzing this risk is to determine the amount of timber harvest on slopes which have high mass movement index (MMI) soils. This rating does not imply that such a mass-wasting event will occur; rather, it ranks the alternatives on the basis of the potential for a mass-wasting event to occur, which may or may not result in an increase in stream sediment. Increased stream sedimentation can result in loss or impairment of fish spawning and rearing habitat. Summary Table 2-2 displays the proposed harvest on high MMI and very high MMI soils by alternative. Virtually all very high MMI soils have been removed from the timber base. Only those sites that appear to be small inclusions that have been retained in the unit pool. These sites have been examined by a professional soil scientist during unit reconnaissance.

Sediment Transfer and Deposition

A number of watersheds were evaluated for sediment delivery and depositional potential using a watershed-level analysis (Geier and Loggy, 1995). The watersheds were divided into sub-basins and reaches. Sediment transport and deposition indices were developed based upon watershed morphology, discharge, and potential sediment sources. For a detailed description of this process see Appendix D (Watershed Report). This sediment transfer index indicates where in a watershed sediment production and deposition is a potential problem for maintenance of aquatic habitat. The quantity of sediment transported and deposited depends upon a number of factors, including nature of sediment source, stream discharge, and channel morphology. These are factors that resource managers consider when planning activities on areas linked to important aquatic habitat.

Results of sediment transport and deposition risk assessment for roads and units in the Sea Level action alternatives indicate that Alternatives 4, 5, and 6 have a lower overall risk of sediment delivery to streams than the other action alternatives. Alternative 6 harvests the fewest acres, and avoids most sensitive areas. Alternative 3 reduces overall risk by minimizing harvest unit location and road construction near some stream courses. Alternative 2 poses the highest risk of sediment delivery from road-related sediment.

Issue 3 Recreation and Scenic Quality

Scenic Quality

Management activities could affect existing recreational pursuits of users of the Sea Level project area. Increased access, timber harvest, and other developments could affect recreation values and opportunities including: hunting, fishing, scenic quality, and existing recreation use areas. Comments mentioned the importance of protecting the scenic quality along inlets and bays, particularly around the Fish Creek Cabin. The quality and types of recreation activities available to forest users could be enhanced by developing a road system that, when linked to Ketchikan, would allow increased access to existing and potential recreation sites. Other aspects of this issue were related to the visual impacts to flight-seeing.

There are six key viewsheds within the Project Area. The proposed visual quality objectives (VQOs) for this project establish the minimum visual quality management standards for these key viewsheds: Saddle Lakes, Middle Carroll Inlet, Lower Carroll Inlet, Upper Thorne Arm, Lower Thorne Arm, and Fish Creek. Alternative 1 represents the existing visual condition. In all viewsheds for all alternatives, the proposed harvest units achieve the adopted visual quality objectives.

Roadless Areas

The TLMP EIS (1997) identified two roadless areas which lie within or partially within the Project Area. The impact of timber harvesting on roadless areas is much larger than the acres harvested because the sights and sounds associated with the harvest activity affect the surrounding area. Roadless areas generally need to be 5,000 acres to be considered roadless. Table 2-2 displays the acres of roadless area that will remain after implementation of each alternative. Neither Alternative 1 nor Alternative 2 affect the roadless areas. Alternative 2 would reduce the roadless area acreages the most (by approximately 10,000 acres) and Alternative 3 would reduce roadless area acreages the least of the remaining alternatives (by approximately 4,000 acres).

Issue 4 Wildlife Habitat

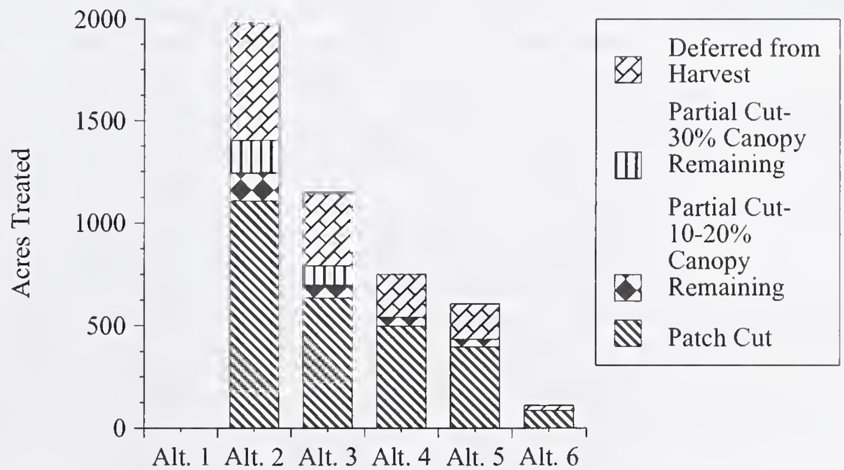
This issue includes concerns over several wildlife species and the habitats critical to maintenance of those wildlife populations, as Alaskan fish and wildlife are valuable for aesthetic, economic, recreational, and subsistence purposes. Of primary concern are the effects of timber harvest and associated road construction upon wildlife species dependent on old growth habitat. Related to the overall concern is the question of whether timber harvest operations would further fragment existing large blocks of old-growth habitat and result in declines in biological diversity. The need for a project specific old-growth habitat strategy (incorporating the issues of connectivity and open road densities) that ties into a larger scale (Forest Plan) habitat strategy was also identified.

The major effect on wildlife habitats in all action alternatives is the reduction of old-growth forest habitat. Impacts to other habitats were reduced by the interdisciplinary design of units prior to alternative formulation. All alternatives result in impacts consistent with the implementation of the TLMP (1997) and the Forest-wide Standards and Guidelines.

Table 2-2 displays wildlife habitat capabilities, as estimated by habitat capability models, for the key Management Indicator Species (MIS) found in the Sea Level Project Area.

The TLMP (1997) defined high value marten habitat as stands below 1500 feet elevation in high volume productive old growth strata. There are approximately 19,821 acres of high value marten habitat in the Project Area. Figure 2-10 shows a comparison of the amount of TLMP high value marten habitat harvested under each alternative.

Figure 2-3
Acres of TLMP High Value Marten Habitat Treated in the Sea Level Project Area, by Alternative



Source: Burns 1997. Data derived from GIS database.

In all alternatives, over half of the TLMP high value habitat treated is treated using patch cuts. About twice as many acres are patch cut as are deferred from harvest. Acres with partial cut treatments fall into two categories. Those in VCUs with less than 33 percent of the productive old growth harvested retain 10 to 20 percent of the original stand structure per TLMP marten standards and guidelines. Those VCUs with over 33 percent of the productive old growth harvested retain 30 percent canopy closure to meet TLMP marten standards and guidelines.

Forest fragmentation represents a change in the overall forest landscape from large, contiguous blocks of old-growth forest to smaller blocks separated by timber harvest units. Increased amounts of forest fragmentation indicate reduced habitat potential for species which are thought to be dependent on interior old-growth forest habitat. One way to analyze forest fragmentation is to measure the reduction of large, contiguous blocks of old-growth forest as a result of timber harvest. The Project Area contains a significant amount of old-growth habitat in blocks over 1,000 acres in size. Table 2-2 displays the number of acres of old-growth habitat in large blocks that will remain after implementation of an alternative.

Large and medium sized blocks of old growth (Misty Fiords National Monument, Carroll Point, and Swan Lake) are adjacent to the Project Area. Several small reserves of unfragmented old-growth habitat located inside the project boundary (see Figure 2-1). None of the alternatives propose harvest in small, medium or large old growth reserves as established in TLMP 1997.

Late successional corridors (see Figure 2-1) that provide connectivity between core areas of unfragmented old-growth habitat were identified. Alternatives 2 and 3 would impact the corridors to the largest degree (98 acres). Alternatives 4, 5 and 6 do not harvest any of the connecting corridors.

All alternatives are consistent with the viable population strategy in the 1997 Forest Plan.

Issue 5 Subsistence Use

Primary concern is the potential effect, as well as the cumulative effects, of timber harvest and road construction upon the abundance and distribution of subsistence resources. For many, subsistence consists of hunting, fishing, trapping, and gathering to supplement their food sources, income, and other needs. Aspects to be evaluated are competition from non-rural subsistence users and access to the resources.

Chapter 3 evaluates the potential site-specific effects on subsistence that could result from implementing any of the proposed timber harvest and associated road construction alternatives.

The Tongass Resource Use Cooperative Survey (TRUCS) identified areas which are most heavily used by subsistence households. Based on the TRUCS, the Project Area contains no high or moderate use subsistence areas. High and moderate use is interpreted to mean greater than 50 households ever used the area for subsistence deer hunting.

Deer hunting is one aspect of subsistence use affected by timber harvest. The Wildlife and Subsistence sections of Chapter 3 discuss the computer models used to estimate the effects of timber harvest on deer habitat capability, both long range and short range. Based on this analysis, Alternative 1 will cause no reduction of deer habitat capability. Among the action alternatives, Alternative 6 would cause the least reduction to deer habitat capabilities, while Alternative 2 would reduce deer habitat capabilities the most within the Project Area.

The Project Area is located within portions of two Wildlife Analysis Areas (WAA), 405 and 406. The harvest is 110 deer per year based on ADF&G hunter surveys for both complete WAAs. Approximately 22 percent of the original (1954) habitat capability is needed to support this level of deer harvest. Currently (1997) the two full WAAs provide 87 percent of the original habitat capability for deer. The habitat capability through the year 2007 is projected to be approximately 85 percent of the original (1954) habitat capability.

Table 2-2 displays the percent of 1954 deer habitat capability for each alternative compared to the percent needed to support current deer harvest levels in WAAs 405 and 406. The full WAA habitat capability has not been reduced for the effects of fragmentation.

Competition for subsistence resources in the Project Area is an issue. Subsistence users are concerned with competition from residents of Ketchikan. Since Ketchikan residents are considered non-rural, this competition can be regulated if it starts to restrict rural residents' ability to obtain subsistence resources. In the Wildlife Section, the cumulative analysis discussed a potential road connection between Shelter Cove and Ketchikan. If such a connection is made, it could increase the amount of rural and non-rural use of the area. This may lead to an increase in the amount of competition to the point that there could be a significant restriction in subsistence use of deer and marten in the Project Area.

At that point the Federal Subsistence Board could exercise its authority to regulate non-rural harvest of deer and prioritize the harvest of deer among rural residents to protect the resource. The current deer population level does not require restrictions on non-rural users.

There is no evidence to indicate that availability of salmon, finfish, shellfish, or other food resources to subsistence users would be affected by sport or non-rural harvest. Any increase in competition from non-rural Alaskan residents and nonresidents would not be substantial because of the availability of resources in the immediate vicinity and in the surrounding areas.

The analysis indicates that the actions proposed in Alternatives 2 through 6 will not represent a significant possibility of a significant restriction on subsistence use of deer, black bear, marten or otter in the Project Area. Direct effects may cause a significant possibility of a significant restriction for wolves. This is based on a comparison between harvest levels and habitat capability in WAAs 405 and 406.

Increasing human population coupled with future reductions of habitat capability for deer, black bear, marten, and wolf, and in light of the fact that Saxman residents' use of the area is under-reported for the Project Area, there may be a significant possibility of a significant restriction of subsistence use of deer, black bear, marten, and wolf at some point in the future (next 100 years) for all alternatives including the No Action Alternative.

Issue 6 Social and Economic Effects

This issue reflects concerns about effects on community employment, income, community stability, and life-styles. The economics of most communities in Southeast Alaska depend almost exclusively on the Tongass National Forest to provide natural resources for uses such as fishing, tourism, recreation, timber harvesting, mining, and subsistence. Many Southeast Alaskans want to maintain the natural environment which makes their life-style unique. At the same time, they want to maintain their economic livelihood.

The State of Alaska receives 25 percent of the sum of all net receipts from timber sold on National Forest System Lands plus any purchaser road credits. This money is earmarked for public schools and roads. Table 2-4 shows the estimated returns to the State of Alaska and the Ketchikan Gateway Borough from the harvest of timber (from this project only) by alternative. Actual returns will be based upon layout sale volumes, appraised rates, bid premiums and may differ from this estimate, which is based on mid-market rates.

Table 2-4
Estimated Returns to State of Alaska from Sale of Timber*

Alternative	Estimated total volume (MMBF)	Estimated Total receipts ($)	Estimated State of Alaska returns ($)	Estimated Ketchikan (KGB) returns** ($)
1	0	0	0	0
2	77	5,527,000	1,381,000	6,079
3	42	1,353,000	338,000	1,488
4	29	993,000	248,000	1,092
5	22	51,260	12,815	56
6***	9	34,830	8,707	38

Source: Marks, 1998.
* Based on mid-market rates timber receipts.
** Based on historical average percent distribution.
*** Alt. 6 receipts are base rate values

Table 2-5 displays the employment (jobs) and personal income (salaries) associated with each alternative averaged over a 4-year period. The jobs and salaries listed include those both directly and indirectly dependent upon the timber industry.

Table 2-5
Timber Industry Average Annual Employment and Income by Alternative

	Alternative					
	1	2	3	4	5	6
Volume Harvested (MMBF)	0	77	42	29	22	9
4-Year Average	0	19	11	7	6	2
Employment (Jobs/year)	0	157	91	58	49	16
Personal Income (Million$/year)	0	6.65	3.85	2.45	2.10	0.70

Source: Marks, 1998.

In these alternatives, the total volume (including ROW volume) harvested ranges from 9 MMBF in Alternative 6 to 77 MMBF in Alternative 2. Alternatives 3, 4 and 5 provide 42 MMBF, 29 MMBF, and 22 MMBF respectively. These volumes could be sold to timber purchasers.

Under Alternative 1, the no-action alternative, none of the employment described above would result from timber harvest in the Sea Level Project Area. This would have a negative effect on timber harvest employment if timber purchasers are not be able to substitute volume from other sources. The effects of Alternative 1 are not predictable and could range from elimination of shifts to partial or full shutdown of local mills for unspecified periods of time.

The projected long-term effects of different harvest levels on the Tongass National Forest are contained in the TLMP Final EIS (1997). This analysis includes falldown factors such as additional streams, blind leads, unsuitable soils, and a variety of other factors.

None of the alternatives is expected to have a significant direct impact on the commercial fishing, recreation, and tourism industry or related employment.

Issue 7 Marine Environment

The marine waters and their associated mud flats and estuaries found in protected coves and bays within the Project Area provide habitat for species such as Dungeness crab and juvenile salmon. The Project Area includes Thorne Arm and Carroll Inlet which are important commercial, subsistence, and sport fishing areas. Since coves and bays are the points of concentrated activity associated with marine transport of logs, logging camps, and sort yards, some marine species are subject to effects from log transfer and storage facilities. Three existing will be used in the alternatives.

Direct effects to the marine environment are assumed to occur only from development and use of LTFs, and are limited to the intertidal area affected by rock fill and either the intertidal or subtidal areas potentially affected by accumulations of bark debris.

There are three existing LTF sites scheduled for use on this project. The maximum number of LTFs that would be utilized under any alternative is 3 (all existing sites). All sites are existing, permitted, LTF sites. Table 2-6 displays the LTFs involved in the various alternatives. See also the detailed alternative maps included with the Sea Level EIS.

Table 2-6
Log Transfer Facilities Required, by Alternative and System

		Alternative						
Site Name	**Site Number**	**1**	**2**	**3**	**4**	**5**	**6**	**LTF System**
Elf Point	1	N	I	I	I	N	N	Barge
Shelter Cove	2	N	I	I	I	I	I	A Frame
Shoal Cove	3	N	I	I	I	I	N	A Frame

Source: Oien, 1996.
I = Planned for intermittent use.
N = Not planned for use.

Table 2-7 displays the number of LTFs used or developed, the total acreage of the structural embankment, and the estimated acres to be affected by bark deposition. The combination of the marine habitat covered by the structural embankment and the area potentially covered by bark deposition represents the total loss of marine benthic habitat for each alternative.

Table 2-7
Marine Benthic Habitat Acres Affected by Alternative

	Alternative					
	1	2	3	4	5	6
Existing LTF Sites	3	3	3	3	3	3
Structural Embankment	0.46	0.46	0.46	0.46	0.46	0.46
Bark Deposition	2.00	2.00	2.00	2.00	2.00	2.00
Total Acres of Marine Benthic Habitat Affected	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**	**2.46**

Source: Oien, 1998.

The No-action Alternative would have no measurable additional effect on the marine environment, while Alternatives 2, 3, 4, 5, and 6 affect the marine system (2.46 acres) in a similar fashion. The loss of habitat is much less than one percent of the available marine habitat in the Project Area. Since all species identified along the subtidal (underwater) survey transects are common throughout Southeast Alaska, it is concluded that there would not be a significant impact to the marine environment from continuing to use LTFs at the existing sites.

Mitigation

TLMP Mitigation

The Forest Service uses many protective measures in the planning and implementation of projects. The application of these measures begins during the planning and design phases of a project. The standards, guidelines, and direction contained in the TLMP (1997), Alaska Regional Guide, and applicable Forest Service manuals and handbooks have been applied in the development of alternatives and design of harvest units and roads.

Listed below is a summary of some of the mitigation measures common to all alternatives. Specific mitigation measures, as applied to each individual unit, can be seen in the "As Planned" Unit Design and Road Cards. These unit and road cards are an important tool for implementing the project, as they list applicable standards and guidelines and provide a mechanism for tracking project implementation. Unit Design and Road Cards have been developed for each individual unit that occurs in an alternative and appear in DEIS Appendix H.

Water Quality and Fish Production

TTRA, Best Management Practices

Mitigation to protect water quality, fish habitat, and wetlands includes application of the Best Management Practices (BMPs) stated in the Soil and Water Conservation Handbook (USDA FSH 2509.22). This handbook provides standard operating procedures for all stream classes. The TTRA mandates a minimum 100-foot buffer on all Class I streams and on Class II streams that flow directly into Class I streams. This legal requirement has been incorporated into riparian standards and guidelines for stream process groups found in the Forest Plan. The width of these buffers may be greater than 100 feet for reasons such as topography, riparian soils, a windfirm boundary, timber stand boundaries, logging system requirements, and varying stream channel locations. In addition, certain Class III streams flow directly into or have been identified as influencing Class I streams. These Class III streams have been buffered to the slope break of the channel or to a windfirm boundary to protect water quality. Split yarding or full suspension was built into the logging and transportation design process, as was partial and full suspension over wetland soils or soils with a higher mass movement potential. Direct in stream impacts are minimized through road construction timing and fish passage requirements on Class I and II streams. Refer to Appendix D (Watershed Report) for the rationale and to Appendix H (Unit Design and Road Cards) for the unit-specific stream buffering, suspension, passage, and timing requirements being applied. Application of BMPs and riparian standards and guidelines will protect water quality, fish habitat, and wetlands as well as riparian habitat important to other species such as deer, bear, and furbearers.

Wildlife

Mitigation measures to protect wildlife habitat are a part of the design of the alternatives, including the location of the harvest units and roads. Harvest units and roads are intentionally located away from important wildlife habitats (to the extent practicable) to reduce the effects on wildlife. Beach and estuary habitats are completely avoided by harvest units, while road incursions are minimized to the extent practicable. Where possible, disturbance of important travel corridors is minimized to allow the movement of wildlife.

Goshawks

The TLMP (1997) contains the following guidelines for preserving habitat around all confirmed and probable nests. These guidelines have been incorporated into the Sea Level Project.

> *Nesting Habitat*—Maintain an area of not less than 100 acres of productive old-growth forest (if it exists) generally centered over the nest tree or probable nest site. Include prey handling areas, perches, roosts, inactive nest stands, hiding cover and foraging opportunities for young goshawks. Vegetative structure should include a multi-layered, closed (over 60%) forest canopy, a relatively open understory, with large trees (usually 20+ inches DBH) and low ground vegetation. These conditions generally equate to the high timber volume strata used in the 1997 Forest Plan.
>
> *Management:* No commercial timber harvest is permitted. Existing roads may be maintained. New road construction is permitted if no other reasonable roading alternatives outside the mapped nesting habitat exist. Permit no continuous disturbance likely to result in nest abandonment within the surrounding 600 feet from March 15 to August 15. Activity restrictions are removed for active nests that become inactive or are unsuccessful.

All new nests discovered during field reconnaissance or unit layout will be protected from timber harvest and blowdown by implementing the above measures.

Marbled Murrelets

Due to the limited information available on nesting habitat requirements of marbled murrelets, any nests located during field reconnaissance or unit layout will be assessed on a case-by-case basis.

A 600-foot, generally circular, radius of undisturbed forest habitat surrounding identified murrelet nests will be maintained. Disturbance activities within this buffer will be minimized during the nesting season (May 1 to August 15). The Buffer zone will be maintained and the site monitored for nesting activity for not less than two nesting seasons after nest discovery. The buffer protection may be removed if the site remains inactive for two or more consecutive nesting seasons.

Trumpeter Swans

Timber harvest units that are within a half mile of Gnat Cove estuary and Low Lake will allow harvest and road construction activities from April 1 to October 31. During the remainder of the year, harvest and road construction may occur if swans are not present. This affects the units 48 and 173.

Bald Eagle Nests

Road construction activities that are within a half mile of bald eagle nests will usually have blasting restricted to the period of September 1 to February 28. If the nest is unoccupied, normal blasting procedures are also permitted from June 1 to August 31, if there is no direct danger to eagles, nests, eagle nest trees, or other eagle habitat elements. Blasting within one-half mile of an active eagle nest is only allowed if: (1) the blasting can be accomplished in accordance with the requirements of the Bald Eagle Protection Act; (2) written coordination with the U.S. Fish and Wildlife Service has occurred; and (3) the results of the interagency coordination are documented. Alternatives 1 and 6 have no harvest units within one-half mile of known bald eagle nests. Alternative 5 has 3 units within ½ mile of a known eagle nest; alternative 4, 6 units within one-half mile; alternative 3, 10 units within ½ mile; and alternative 2, 18 units within a half mile of known eagle nests.

The interagency agreement also establishes a 330-foot buffer zone around each nest where disturbance activities are prohibited. None of the alternatives propose harvest within the 330-foot buffer zone.

Whale Habitats

The following Forest Plan standards and guidelines apply to all Forest Service permitted or approved activities:

- Provide for the protection and maintenance of whale habitats.
- Ensure that Forest Service permitted or approved activities are conducted in a manner consistent with the Marine Mammal Protection Act, the Endangered Species Act, and National Marine Fisheries Service regulations for approaching whales, dolphins, and porpoise. "Taking" of whales is prohibited; "taking" includes harassing or pursuing or attempting any such activity.

Marine Mammals

Forest-wide Standards and Guidelines to provide for protection and maintenance of harbor seal, Steller sea lion, and sea otter habitats are as follow:

1. Ensure that Forest Service permitted or approved activities are conducted in a manner consistent with the Marine Mammal Protection Act and the Endangered Species Act. Taking'' of marine mammals is prohibited; taking includes harassment, pursuit, or attempting any such activity.
2. Locate facilities and concentrated human activities requiring Forest Service approval as far from known marine mammal haulouts, rookeries and known concentration areas as practicable. The following distances are provided as general guidelines for maintaining habitats and reducing human disturbance:
   - Facilities, camps, LTFs, campgrounds and other developments should be located one mile from known haulouts and farther if the development is large.
   - Individuals associated with Forest Service permitted or approved activities will not intentionally approach within 100 yards, or otherwise intentionally disturb or displace any hauled-out marine mammal.
   - Dispose of waste oil and fuels off-site as regulated by the Alaska Department of Environmental Conservation.

Several harbor seal haulout areas identified near the Project Area have been listed below.

- Minx Islands and associated rocks in Thorne Arm,
- Snipe Islands and associated rocks in Thorne Arm,
- Rocks off Mop and Pop Points in Thorne Arm, and
- Rocks and islands in Carroll Inlet from Shoal Cove to Hume Island

Waterfowl
Significant waterfowl areas include Gnat Cove estuary, and the estuaries at the head of Thorne Arm. These habitats will be maintained through the protection of the 1000-foot estuary buffer. Activities are located as far from these areas as feasible. Disturbance to waterfowl will be minimized by the mitigation for protecting trumpeter swans.

Mountain Goat
Aircraft flights, including helicopter yarding of timber, will seek to avoid mountain goat kidding areas from May 15 through June 15. Flights should maintain a 1,500-foot vertical or horizontal distance from traditional summer and kidding areas and animals.

Restrict blasting within 1 mile of known mountain goat kidding areas from May 15 through June 15.

Subsistence
Because most subsistence use involves harvesting fish and game, mitigation measures that protect fish and game resources also protect subsistence activities. By placing units and roads away from beach and estuary fringe habitats, and away from salmon bearing streams, mitigation measures were built into each of the alternatives considered in the EIS. Road management objectives (closures) were also heavily influenced by the desire of subsistence hunters to limit access.

Recreation
Effects of timber harvest on views from anchorages and known recreational day use areas will be reduced by leaving buffers of timber along the beaches and inland lakes. The proposed visual quality objectives for this plan emphasize the protection of the visual resource as viewed from saltwater, particularly in Carroll Inlet and Thorne Arm. Protecting these viewsheds will reduce the direct effects on visual quality. Stream riparian buffers will protect fisheries habitat in the Project Area.

Cultural Resources
Potential effects on cultural resources can be minimized by excluding project activities from most high probability areas (exceptions are LTFs, camps, a small number of units, and access roads to these facilities). The high probability areas were all surveyed in 1994 and 1995, except for exact road locations which cannot be precisely determined until after unit and road layout occurs. Types of mitigation measures include avoidance, protective enclosures, monitoring of harvest activities, restrictions on size or road location, and recovery and documentation of materials.

Sensitive Plants
Choris Bog Orchid (Platanthera chorisana) is a designated sensitive species. Six populations of this species were discovered in muskeg openings during botanical surveys of the Project Area conducted in 1995. Populations are located within the vicinity of harvest Units 2 and 80 in the Shoal Cove area, 126 and 134 in the Sea Level Creek drainage and along Road # 8341160 of the Shelter Cove road system. The primary risk of perturbation to these populations would be through road construction activities. Road locations have been adjusted to avoid direct impacts to known locations of Choris Bog Orchid.

Monitoring

Monitoring is divided into three broad categories: Forest Plan monitoring, routine implementation monitoring, and project-specific effectiveness monitoring. These are discussed in the following sections.

Forest Plan Monitoring

Three levels of monitoring are incorporated into the TLMP monitoring and evaluation plan (Forest Plan, Chapter 6).

1. Implementation Monitoring is used to determine if standards and guidelines, and management prescriptions are implemented as detailed in the Forest Plan and project specifications,
2. Effectiveness Monitoring is used to determine if standards and guidelines, and management prescriptions, as designed and implemented, are effective in meeting Forest Plan goals and objectives, and
3. Validation Monitoring is used to determine whether the data, assumptions, and coefficients used in the development of the Plan are correct.

Most monitoring elements involve the mitigation measures described previously. The feedback provided by monitoring can be used to develop improved methods or additional treatments to ensure that the mitigation will be effective in the future.

Mitigation/ Monitoring Feedback Loop

An annual monitoring report is prepared by the Tongass at the end of each year. This report addresses all monitoring questions contained in the Forest Plan; references monitoring being conducted on the Forest; assesses progress toward achieving the goals and objectives described in the Forest Plan; and certifies that the Forest Plan is sufficient to guide management of the Forest over the next year or proposes needed changes and an approach for dealing with those changes.

Some Forest Plan monitoring is conducted over the entire Forest on a sample basis. Samples may or may not be taken within the Sea Level Project Area. Other monitoring, particularly implementation monitoring, is conducted on all projects. A total of 36 implementation, effectiveness, and validation monitoring items are identified in the forest monitoring plan.

Implementation Monitoring

Implementation monitoring assesses whether the project was implemented as designed and whether or not it complies with the Forest Plan. Planning for routine implementation monitoring began with the preliminary design of harvest units and roads. Specialists used on-the-ground inventories, computer inventories, and aerial photographs to prepare unit cards for each harvest unit. Cards were also prepared for each segment of road. Resource specialists wrote their concerns on the cards and described how the concerns should be addressed in the design of each unit and road segment. The unit and road cards are the basis for determining whether recommendations were implemented during the Sea Level Project.

Implementation monitoring is part of the administration of a timber sale contract. The sale administrators and road inspectors ensure that the prescriptions contained on the unit and road cards are incorporated into contract documents and then monitor performance relative to contract requirements. Input by resource staff specialists; fisheries biologists, soil scientists, hydrologists and engineers, is regularly requested during implementation to provide technical advice when questions arise.

The Ketchikan Area conducts reviews of BMP (and other standard and guideline) implementation and effectiveness. The results are summarized in the Tongass National Forest

Annual Monitoring and Evaluation Report. This report provides the public with information about how management direction of the Forest is being carried out.

Effectiveness Monitoring

Project-Specific Effectiveness Monitoring

In addition to Forest Plan implementation monitoring, project-specific effectiveness monitoring activities are identified. Effectiveness monitoring seeks answers about the effectiveness of design features or mitigation measures in protecting natural resources.

Sensitive Species

Choris Bog Orchid

Objective—To provide protection of specific habitats for this species which is located in the Sea Level Project Area.

Desired Result—Minimal site disturbance to populations of Choris Bog Orchid. Populations are located within the vicinity of harvest Units 2 and 80 in the Shoal Cove area, 126 and 134 in the Sea Level Creek drainage and along Road # 8341160 of the Shelter Cove road system.

Measurement—Protect known locations during sale implementation.

Threshold—Visual inspection of site indicates signs of disturbance or reduced vigor.

Corrective Action—Consult with Area TES coordinator.

Responsible Staff—Ketchikan Ranger District Staff timber/silviculture staff.

Record of Results—Daily diaries used for contract administration. Prepare a brief report of results each year.

Annual Cost—On-going business for timber/silviculture

Trumpeter Swan

Objective—Protect wintering Trumpeter Swans.

Desired Results—Preferred swan wintering areas in Gnat Cove and Low Lake will be protected from disturbance.

Measurement—Visual observation of wintering swans at least once when any timber harvest or road construction occurs within one-half mile of Gnat Cove estuary or Low Lake between November 1 and April 1.

Threshold—Evidence that swans are avoiding available habitat because of forest management activities.

Corrective Action—Consult Ketchikan District Ranger and SO wildlife staff if a conflict arises.

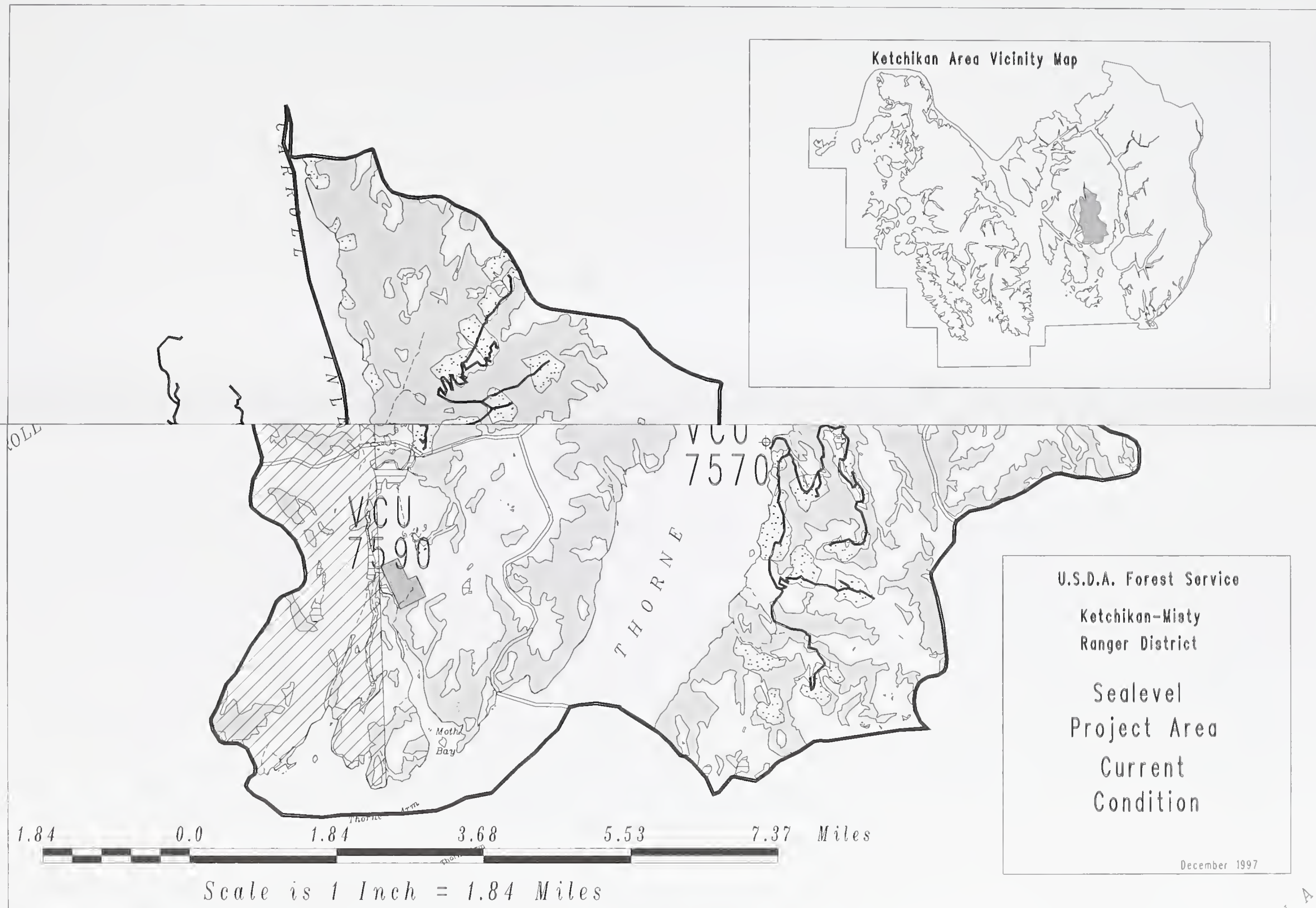
Responsible Staff—Ketchikan Ranger District sale administration employees and wildlife staff.

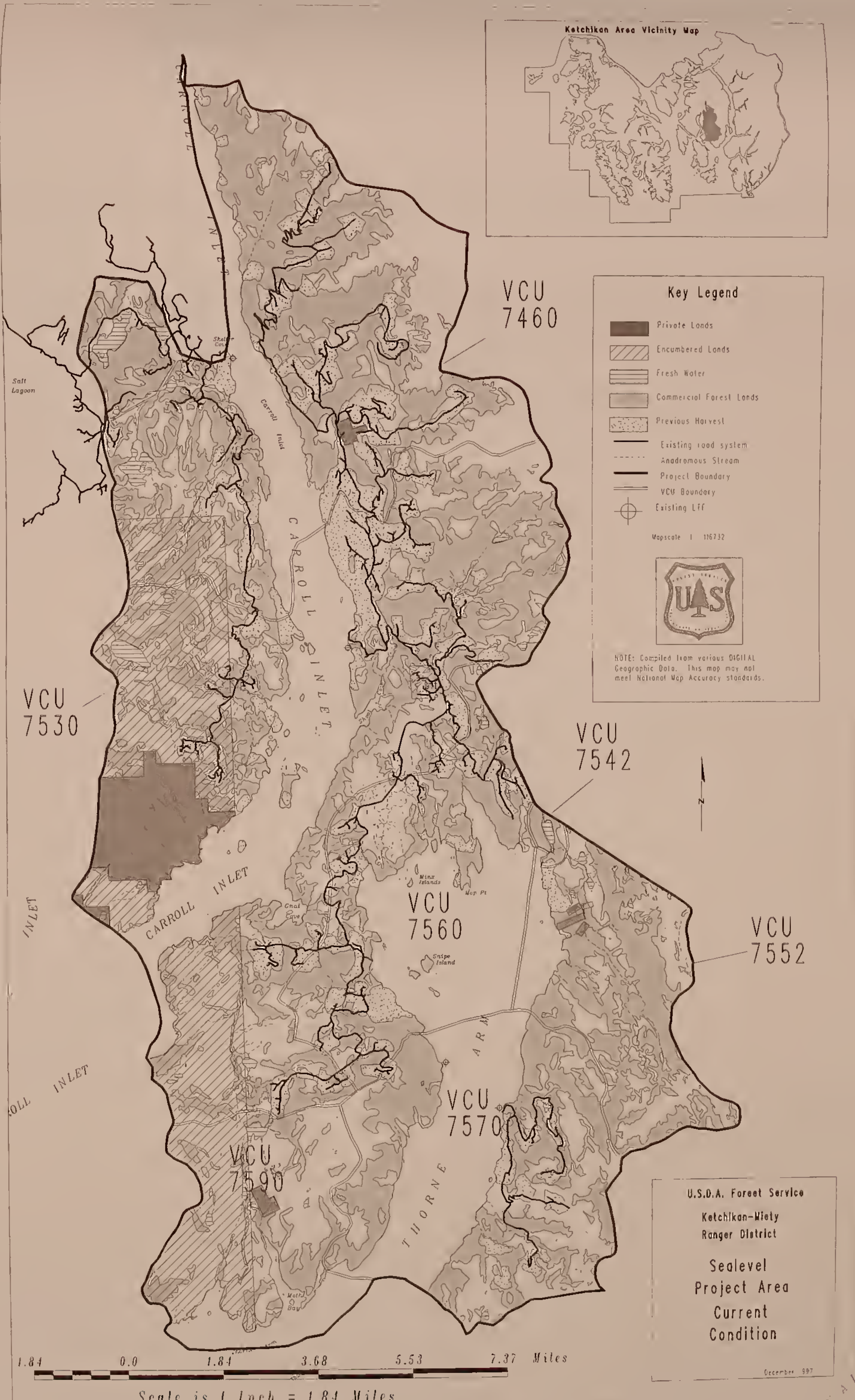
Record of Results—Sale administrator may record swan observations in daily diary forms. Wildlife specialists will prepare a short memo.

Annual Cost—Ongoing business for sale administrator and wildlife specialist.

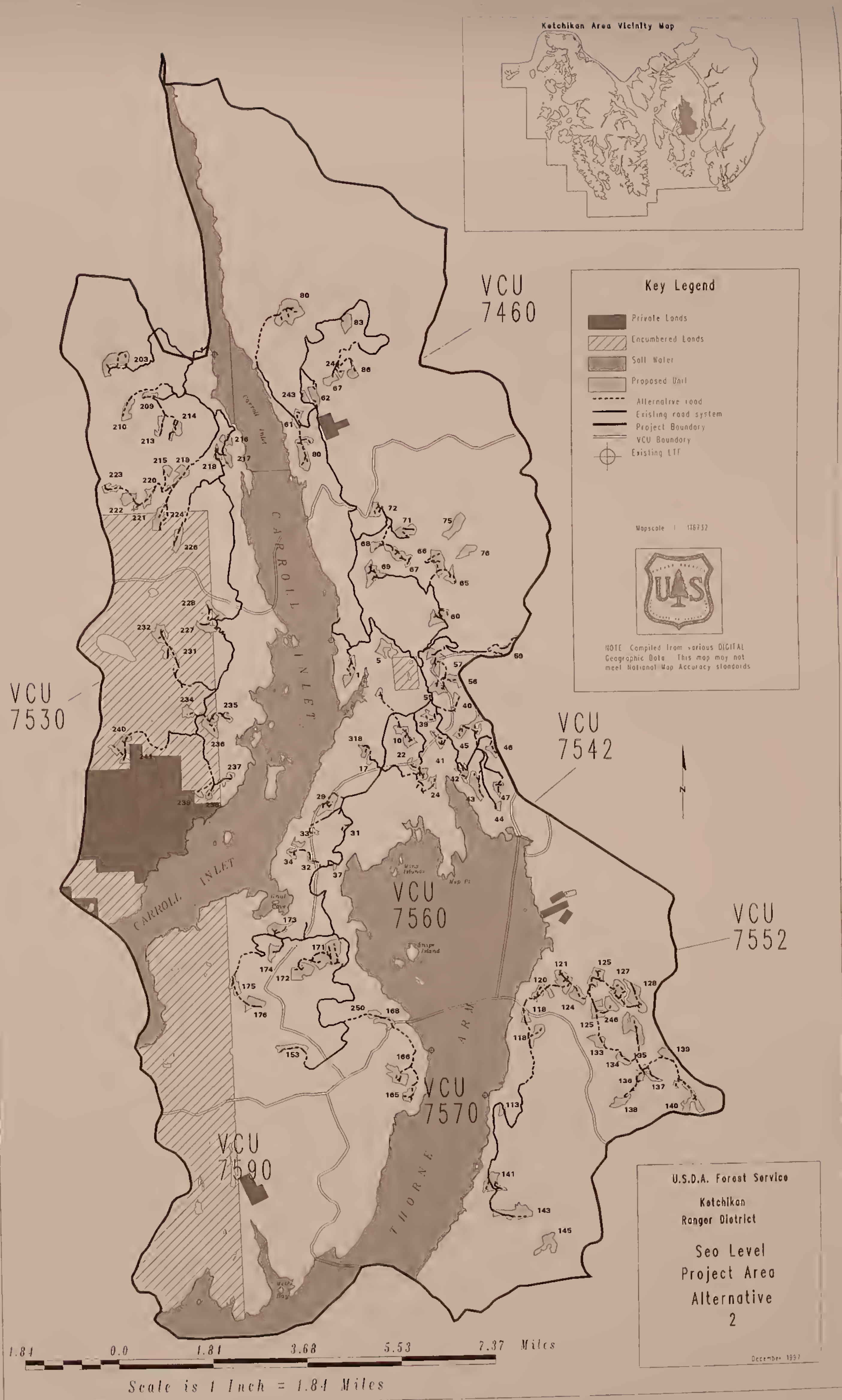
Validation Monitoring

Validation monitoring is conducted to show if the assumptions or models used in planning are correct. It is usually carried out at the Regional level in conjunction with research. Validation monitoring may or may not occur within the Sea Level Project Area since this type of monitoring is built into a Forest-wide Action Plan.

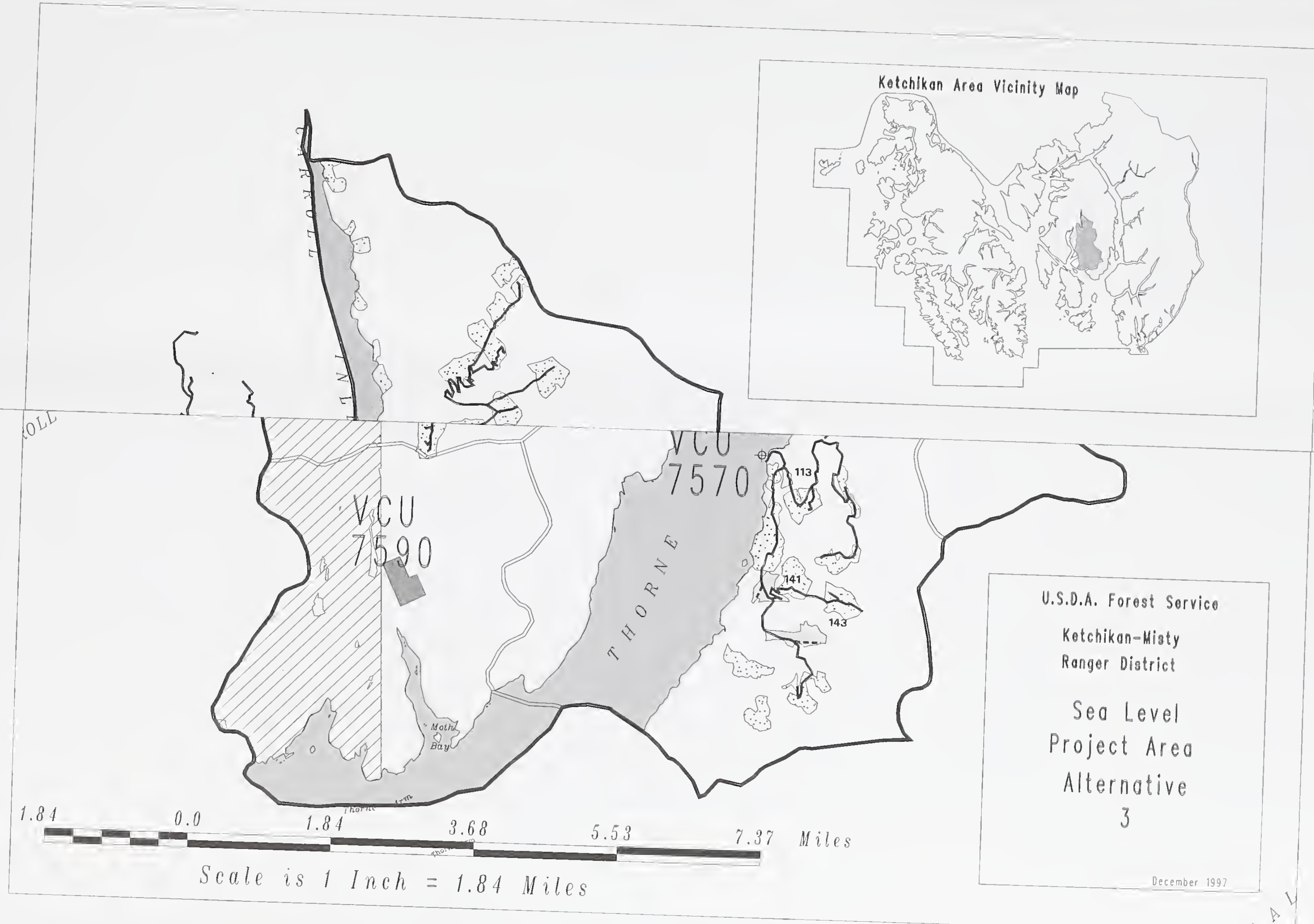

Ketchikan Area Vicinity Map
CARROLL INLET
THORNE
VCU 7570
VCU 7590
Moth Bay
1.84
0.0
1.84
3.68
5.53
7.37
Miles
Scale is 1 Inch = 1.84 Miles
U.S.D.A. Forest Service
Ketchikan-Misty
Ranger District
Sealevel
Project Area
Current
Condition
December 1997


Ketchikan Area Vicinity Map
Key Legend
Private Lands
Encumbered Lands
Fresh Water
Commercial Forest Lands
Previous Harvest
Existing road system
Anadromous Stream
Project Boundary
VCU Boundary
Existing LTF
NOTE: Compiled from various DIGITAL Geographic Data. This map may not meet National Map Accuracy standards.
VCU 7460
VCU 7530
VCU 7542
VCU 7552
VCU 7560
VCU 7570
VCU 7590
CARROLL INLET
Carroll Inlet
Salt Lagoon
Minx Islands
Snipe Island
THORNE ARM
U.S.D.A. Forest Service
Ketchikan-Misty Ranger District
Sealevel Project Area Current Condition
1.84 0.0 1.84 3.68 5.53 7.37 Miles
Scale is 1 Inch = 1.84 Miles

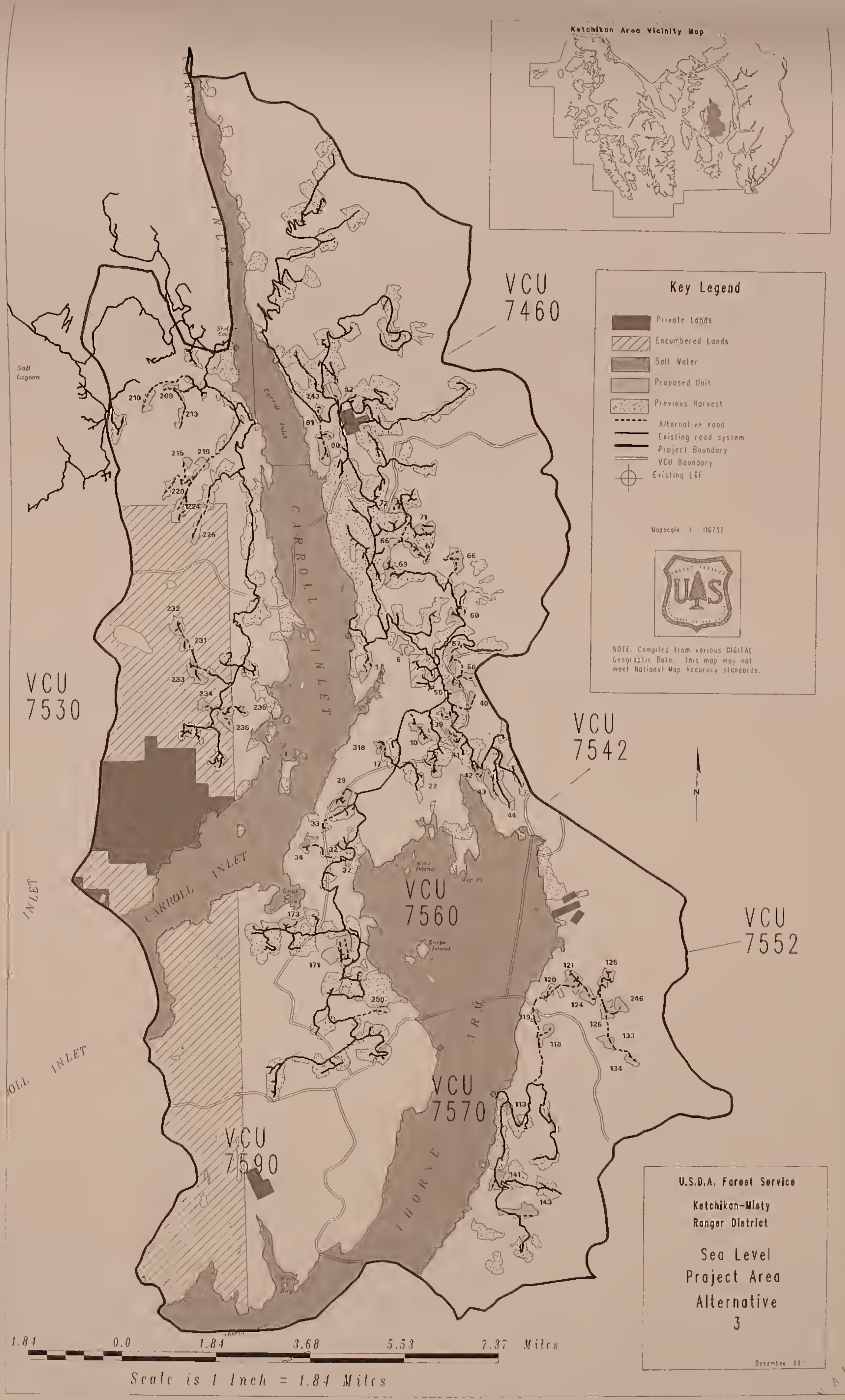

Ketchikan Area Vicinity Map
VCU
7570
VCU
7590
THORNE
Moth
Bay
165
113
136
137
138
140
141
143
145
U.S.D.A. Forest Service
Ketchikan
Ranger District
Sea Level
Project Area
Alternative
2
December 1997
1.84
0.0
1.84
3.68
5.53
7.37
Miles
Scale is 1 Inch = 1.84 Miles



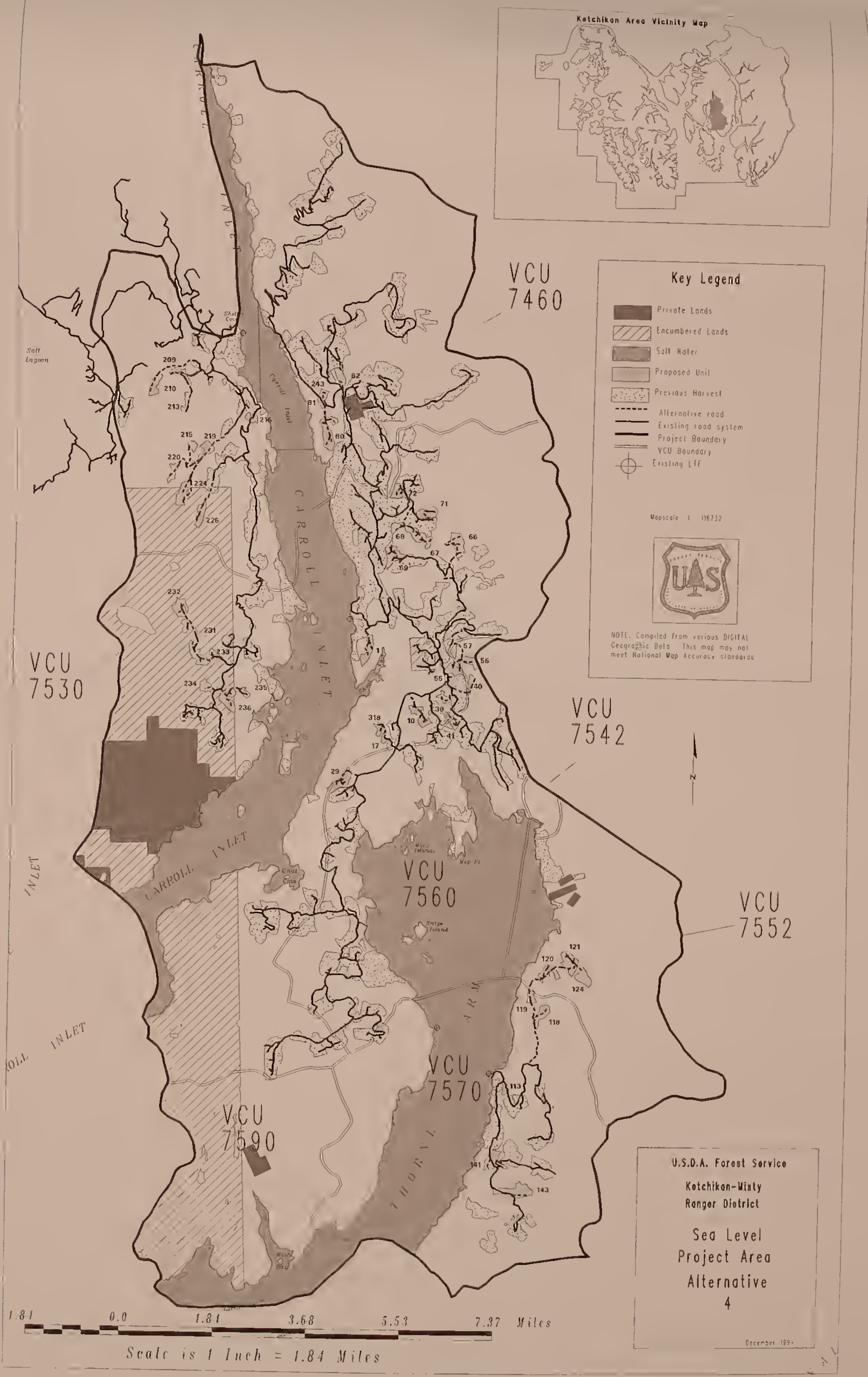
Ketchikan Area Vicinity Map
Key Legend
Private Lands
Encumbered Lands
Salt Water
Proposed Unit
Alternative road
Existing road system
Project Boundary
VCU Boundary
Existing LTF
NOTE Compiled from various DIGITAL Geographic Data This map may not meet National Map Accuracy standards
VCU 7460
VCU 7530
VCU 7542
VCU 7552
VCU 7560
VCU 7570
VCU 7590
CARROLL INLET
THORNE ARM
U.S.D.A. Forest Service
Ketchikan Ranger District
Sea Level Project Area Alternative 2
December 1997
1.84 0.0 1.84 3.68 5.53 7.37 Miles
Scale is 1 Inch = 1.84 Miles



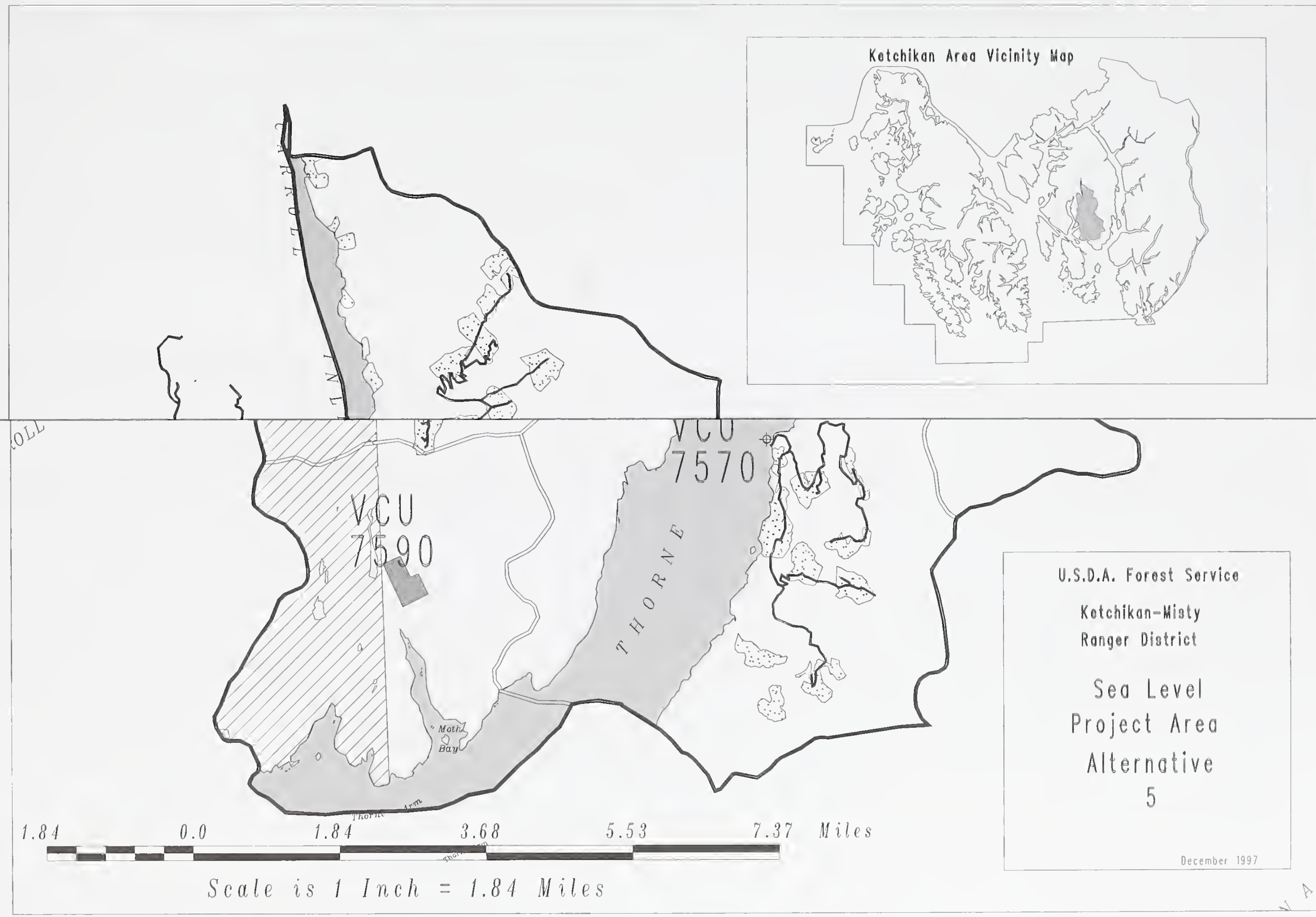
Ketchikan Area Vicinity Map
VCU
7570
VCU
7590
THORNE
Moth Bay
113
141
143
1.84
0.0
1.84
3.68
5.53
7.37 Miles
Scale is 1 Inch = 1.84 Miles
U.S.D.A. Forest Service
Ketchikan-Misty
Ranger District
Sea Level
Project Area
Alternative
3
December 1997

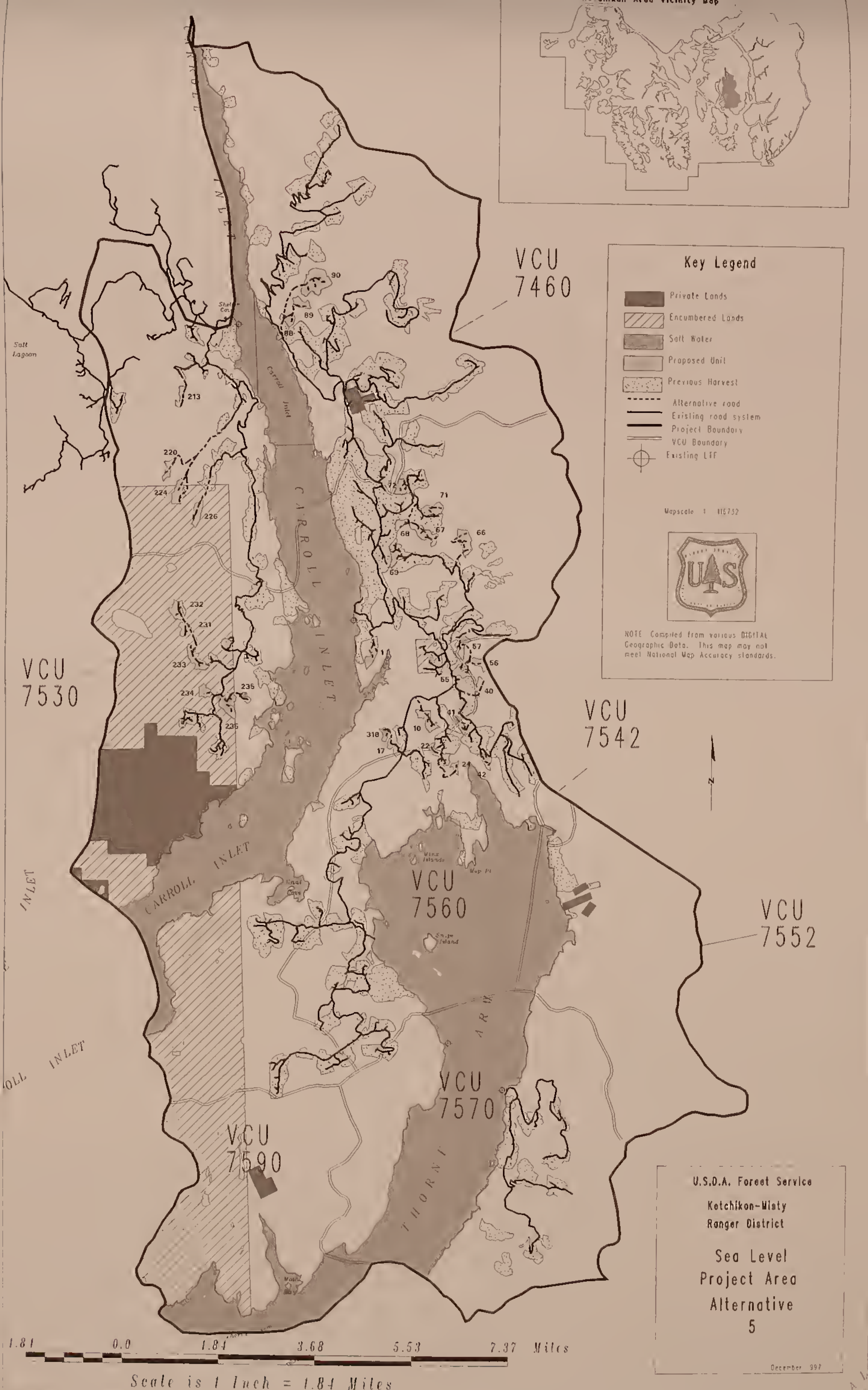

Ketchikan Area Vicinity Map
Key Legend
Private Lands
Encumbered Lands
Salt Water
Proposed Unit
Previous Harvest
Alternative road
Existing road system
Project Boundary
VCU Boundary
Existing LTF
Mapscale 1: 116732
NOTE. Compiled from various DIGITAL Geographic Data. This map may not meet National Map Accuracy standards.
VCU 7460
VCU 7530
VCU 7542
VCU 7552
VCU 7560
VCU 7570
VCU 7590
CARROLL INLET
Salt Lagoon
U.S.D.A. Forest Service
Ketchikan-Misty Ranger District
Sea Level Project Area Alternative 3
1.84 0.0 1.84 3.68 5.53 7.37 Miles
Scale is 1 Inch = 1.84 Miles


Ketchikan Area Vicinity Map
VCU 7570
VCU 7590
THORNE
Thorne Arm
Moth Bay
CARROLL INLET
113
141
143
1.84
0.0
1.84
3.68
5.53
7.37 Miles
Scale is 1 Inch = 1.84 Miles
U.S.D.A. Forest Service
Ketchikan-Misty
Ranger District
Sea Level
Project Area
Alternative
4
December 1997

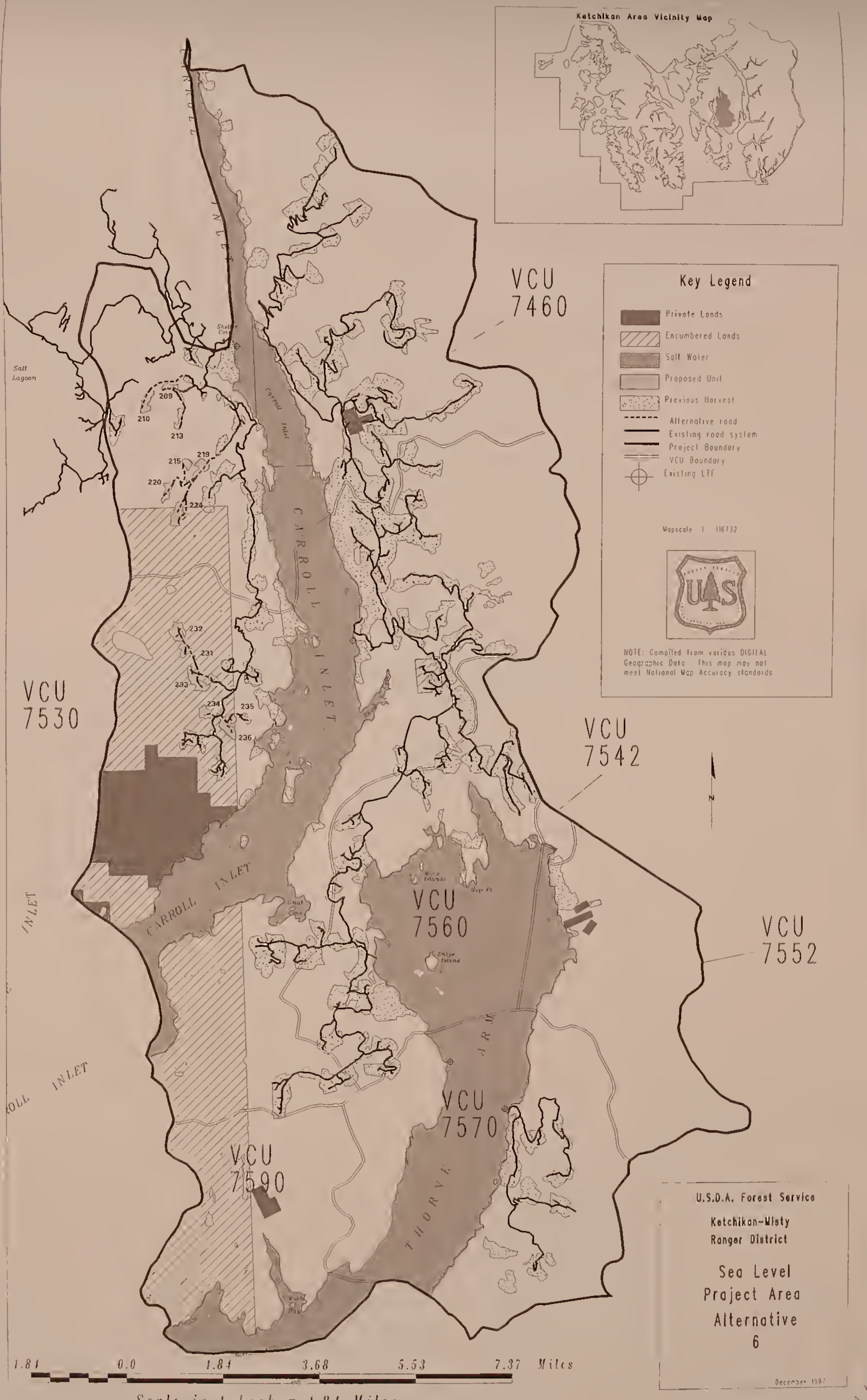


Ketchikan Area Vicinity Map
Key Legend
Private Lands
Encumbered Lands
Salt Water
Proposed Unit
Previous Harvest
Alternative road
Existing road system
Project Boundary
VCU Boundary
Existing LTF
NOTE. Compiled from various DIGITAL Geographic Data. This map may not meet National Map Accuracy standards.
VCU 7460
VCU 7530
VCU 7542
VCU 7552
VCU 7560
VCU 7570
VCU 7590
CARROLL INLET
THORNE ARM
U.S.D.A. Forest Service
Ketchikan-Misty Ranger District
Sea Level Project Area Alternative 4
1.81 0.0 1.81 3.68 5.53 7.37 Miles
Scale is 1 Inch = 1.84 Miles


Ketchikan Area Vicinity Map
VCU 7570
VCU 7590
THORNE
Moth Bay
1.84
0.0
1.84
3.68
5.53
7.37
Miles
Scale is 1 Inch = 1.84 Miles
U.S.D.A. Forest Service
Ketchikan-Misty
Ranger District
Sea Level
Project Area
Alternative
5
December 1997


Key Legend
Private Lands
Encumbered Lands
Salt Water
Proposed Unit
Previous Harvest
Alternative road
Existing road system
Project Boundary
VCU Boundary
Existing LTF
NOTE: Compiled from various DIGITAL Geographic Data. This map may not meet National Map Accuracy standards.
VCU 7460
VCU 7530
VCU 7542
VCU 7552
VCU 7560
VCU 7570
VCU 7590
CARROLL INLET
THORNE ARM
U.S.D.A. Forest Service
Ketchikan-Misty Ranger District
Sea Level Project Area Alternative 5
1.84 0.0 1.84 3.68 5.53 7.37 Miles
Scale is 1 Inch = 1.84 Miles


Ketchikan Area Vicinity Map
CARROLL INLET
THORNE
VCU 7570
VCU 7590
Moth Bay
Thorne Arm
1.84 0.0 1.84 3.68 5.53 7.37 Miles
Scale is 1 Inch = 1.84 Miles
U.S.D.A. Forest Service
Ketchikan-Misty
Ranger District
Sea Level
Project Area
Alternative
6
December 1997


Ketchikan Area Vicinity Map
Key Legend
Private Lands
Encumbered Lands
Salt Water
Proposed Unit
Previous Harvest
Alternative road
Existing road system
Project Boundary
VCU Boundary
Existing LTF
Mapscale 1 : 116732
NOTE: Compiled from various DIGITAL Geographic Data. This map may not meet National Map Accuracy standards.
VCU 7460
VCU 7530
VCU 7542
VCU 7552
VCU 7560
VCU 7570
VCU 7590
CARROLL INLET
THORNE ARM
Salt Lagoon
209
210
213
215
219
220
224
232
231
233
234
235
236
U.S.D.A. Forest Service
Ketchikan-Misty Ranger District
Sea Level Project Area Alternative 6
December 1997
1.84 0.0 1.84 3.68 5.53 7.37 Miles
Scale is 1 Inch = 1.84 Miles

Chapter 3

Environment and Effects

Chapter 3

Affected Environment and Effects of the Alternatives

Introduction

This chapter presents information about those aspects of the environment that may be affected by the activities in the proposed alternatives. The "Affected Environment" portion of each resource section describes the current condition of the resource, trends related to its status, and relevant characteristics that may be subjected to impacts from the alternatives. The "Effects of the Alternatives" portion of each section presents the direct, indirect, and cumulative effects (or impacts) of activities under the alternatives. Chapter 3 combines into a single chapter information that in many Environmental Impact Statements (EISs) appears in separate chapters (generally called Chapter 3 "Affected Environment" and Chapter 4 "Environmental Consequences"). This chapter provides the basis for the comparison of the alternatives in Chapter 2.

Available Information

There is less than complete knowledge about many of the relationships and conditions of wildlife, fish, forests, jobs, and communities. The ecology, inventory, and management of a large forest area is a complex and developing science. The biology of wildlife species prompts questions about population dynamics and habitat relationships. The interaction of resource supply, the economy, and communities is the subject matter of an inexact science.

The interdisciplinary team (IDT) examined the data and relationships used to estimate the effects of the alternatives. The data and level of analysis used were commensurate with the importance of the possible impacts. Relevant discussion in the Tongass Land Management Plan (TLMP) is incorporated by reference.

When encountering information gaps, the IDT concluded that obtaining the missing information may have added precision to estimates or better defined relationships. However, the basic data and central relationships are sufficiently well established in the respective sciences and additional information would be unlikely to reverse or nullify understood relationships. While additional information would be welcomed and may add precision, it is not essential to a reasoned choice among the alternatives as they are constituted.

3 Environment and Effects

Analyzing Effects

Effects are quantified where possible, although qualitative discussions are also included. The means by which any identified potential adverse effects will be reduced or mitigated are described in detail in Chapter Two.

Environmental consequences are the effects of implementing an alternative on the physical, biological, social, and economic environment. Direct environmental effects are defined as those occurring at the same time and place as the initial cause or action. Indirect effects are those that occur later in time or are spatially removed from the activity but would be significant in the foreseeable future. Cumulative effects result from the incremental effects of actions when added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

The reasonably foreseeable time frame over which both direct and indirect effects are estimated is through the end of a 10-year planning period in the year 2007. Alternative 2 is used to display the reasonably foreseeable future actions, as this is the maximum harvest alternative, within Forest Plan standards and guidelines, and volume not harvested in other action alternatives could be harvested as part of another project by the year 2007.

The cumulative effects are also projected for various resources up to the year 2054 and 2140. The year 2054 is the year by which most areas within land use designations (LUDs) permitting timber harvest will be converted from old-growth to second-growth timber management. The year 2140 is when the Forest Plan estimates the management emphasis or desired future condition will be reached. The cumulative effects analysis in this document tiers to the TLMP. It also considers the 10-year timber sale action plan referenced in Appendix A which is used to project the volume range to be harvested in each operating period. As a result, the cumulative effects do not depend entirely on the alternatives presented in this EIS. Rather, they include what may be expected under the direction detailed in TLMP. The decisions made in the Forest Plan provide long-range direction for management of the Tongass National Forest for the duration of the Forest Plan. Cumulative effects analyzed in this EIS include both the effects of this project and those projected by the TLMP (1997), Preferred Alternative, which are incorporated by reference.

The following assumptions were made to assess the reasonably foreseeable effects to the year 2007. These assumptions reflect current management and technology of national forests and provide a uniform approach to estimating effects of timber harvest and road construction.

- Laws, standards, guidelines, and Best Management Practices (BMPs) for water quality would be followed. These requirements are expected to be at least as much protection in the future as they do today.
- Timber sale planning would use an interdisciplinary process.
- All acres of suitable land, as identified in the Preferred Alternative of the TLMP (1997), would be equally subject to impacts.
- The no-action alternative would represent only a delay in implementing the TLMP and, based on volume projections in the ten year timber sale action plan, foreseeable cumulative effects would begin to occur before 2007.
- Future effects on resources from timber harvest and road construction would be similar to impacts projected for current alternatives.

Potential adverse environmental effects which cannot be avoided are discussed. Unavoidable adverse effects may result from managing the land for one resource at the expense of the use or condition of other resources. Many adverse effects can be reduced or mitigated by limiting the extent or duration of effects. Mitigation measures to be implemented, including standards and guidelines, are specified for project activities under the alternatives. These are discussed briefly throughout the chapter, and in detail in Chapter Two.

- *Short-term effects* are those that occur annually or within the first 10 years of project implementation.
- *Long-term productivity* refers to the capability of the land and resources to continue producing goods and services for 50 years and beyond.
- *Irreversible commitments* are decisions affecting non-renewable resources such as soils, minerals, plant and animal species, and cultural resources. Such commitments of resources are considered irreversible because the resource has deteriorated to the point that renewal can occur only over a long period of time or at a great expense, or the resource has been destroyed or removed. For example, a rock pit which is used to provide rock to build roads throughout the Project Area would be considered an irreversible commitment of the resource.
- *Irretrievable commitments* represent opportunities foregone for the period during which resource use or production cannot be realized. These decisions are reversible, but the production opportunities foregone are irretrievable. An example of such commitments is the allocation of LUDs that do not allow timber harvest in areas containing suitable and accessible timber lands, a decision that is made at the Forest Plan level. For the time over which such allocations are made, the opportunity to produce timber from those areas is foregone, thus irretrievable.

Land Divisions

The land area of the Tongass National Forest has been divided in several different ways to describe the different resources and allow analysis of how they may be affected by Forest Plan and project level decisions. These divisions vary by resource since the relationship of each resource to geographic conditions and zones also varies. Three of these are used for more than one resource and are described briefly here.

Ecological Provinces

The Tongass National Forest identifies 21 large land areas that are distinguished by differences in ecological processes (TLMP EIS, Chapter 3, Biodiversity). They are defined by a combination of climatic and geographic features. The Sea Level Project Area lies within the Revilla Island/Cleveland Peninsula ecological province (Number 15) and is discussed in the Biological Diversity and Wildlife sections of this chapter.

Value Comparison Units (VCUs)

These are distinct geographic areas, each encompassing a drainage basin containing one or more large stream systems. The boundaries usually follow major watershed divides. The Tongass contains 867 VCUs; three are found in the Sea Level Project Area. They are used to describe the locations of specific resources in the Project Area. VCUs 737, 744, and 746 are within the Sea Level Project Area.

Wildlife Analysis Areas (WAAs)

These are Forest Service land divisions that correspond to Minor Harvest Areas used by the Alaska Department of Fish and Game. Approximately 190 apply to the Tongass National Forest, two of which apply to the Sea Level Project Area. They are used in the Subsistence and Wildlife sections. Portions of WAAs 406 and 510 are included within the Sea Level project Area.

Description of the Ecosystem

Project Area

The Sea Level Project Area lies entirely within the Revillagigedo (Revilla) Island/Cleveland Peninsula ecological province. This province includes Revillagigedo, Annette, Duke, and Gravina Islands and the Cleveland Peninsula south and west of Eagle Lake. This province is a combination of climatic and geographic features. The Revilla Island/Cleveland Peninsula Ecological Province includes 1,174,000 acres. This province contains 526,226 acres of productive old growth. Approximately six percent of the available old growth has been harvested since 1954.

The Cleveland Peninsula portion of the province is a part of the mainland of Southeast Alaska's panhandle region. The remainder of the ecological province is made up of Revillagigedo Island.

The Project Area is mountainous, often rising abruptly from sea level to several thousand feet. Elevations of forested areas extend up to approximately 2,200 feet in the Project Area.

Abiotic Components

The configuration of the coastline, the warm Japanese ocean current, and the high coastal mountains produce abundant rainfall. Storms and moderate to heavy precipitation occur year round, but most commonly from September through November. The abundant moisture feeds numerous streams, rivers, and lakes.

The Sea Level Project Area has a maritime climate, resulting from the moderating influence of the Pacific Ocean. In the summer, this provides a cooling influence, while in winter, temperatures are warmer than would be expected for these latitudes. Normal temperatures range from the mid-40s to the mid-60s in the summer, and from the high teens to the low 40s in the winter. During the warmer months, temperatures are highest inland and lowest along the coasts, while in the colder months, the reverse is true.

The Sea Level Project Area has complete cloud cover about 85 percent of the year. October is generally the wettest month. High precipitation persists through the middle of November when intermittent snowfall occurs. Snowfall varies according to elevation and distance inland from the coast. Snow accumulation below 500 feet elevation is short-lived, generally melting within a few days due to warmer temperatures and rain.

The climate has a significant influence on the ecology of Revilla Island. Moderate temperatures and ample precipitation produce good growing conditions for commercial forest species. These factors also slow rates of decomposition, resulting in the characteristic buildup of organic material on the forest floor. Storms produce winds in excess of 80 knots and heavy precipitation occurs from September through December. Wind generated by these storms is a significant factor in the development of forest stands. Blowdown ranging from a few trees to several hundred acres may occur. Blowdown accompanied by heavy precipitation and saturation of the soil, may trigger landslides in forested areas. Windthrow is further discussed in the Silviculture section of Chapter 3.

Biotic Components

The coastal forest of the Revilla Island/Cleveland Peninsula Ecological Province is part of the cool, temperate rainforest that extends along the Pacific coast from southern British Columbia to Prince William Sound. Most of the forest is composed of old-growth conifers, primarily western hemlock and Sitka spruce, with mountain hemlock, western redcedar and Alaska yellowcedar as other major components. Red alder is common along streams, beach fringes, and on sites recently disturbed by logging and landslides. Subalpine fir occurs occasionally at tree line.

Blueberries, huckleberry, Sitka alder, devil's club, and salal are common shrubs in the forest. Plant growth on the forest floor includes deerheart, dwarf dogwood, single delight, and skunk cabbage. Mosses grow in great profusion on the ground, on fallen logs, on the lower branches of trees, and in forest openings.

Grass-sedge meadows usually are located along lakes and major streams. Interspersed throughout the forest are muskegs dominated by sphagnum mosses and sedges.

The alpine zone usually lies above 2,500 feet. It occupies the area above the coastal forest and is separated from the forest by a subalpine or transition zone. Alpine plants have adapted to snowpack and wind abrasion by evolving low-profile growth forms. Low, mat-forming vegetation covers most alpine areas, with cushion-like plants occupying crevices on rock outcrops and talus slopes.

The forests, shorelines, streams, and rivers of Southeast Alaska provide habitat for over 350 species of birds and mammals, including both nongame animals and animals such as black bear, Sitka black-tailed deer, moose, wolf, mountain goat, beaver, otter and marten. Many of these are found in the project area. The coastline provides an ideal habitat for a large population of bald eagles, and wetlands provide nesting habitat for waterfowl.

A highly productive marine environment includes an abundance of marine mammals, halibut, herring, and shellfish. Both resident and anadromous fish are found within and adjacent to the project area, including five species of Pacific salmon, Dolly Varden char, cutthroat trout, and steelhead trout.

Site-specific information on biological resources in the Project Area follows in various sections of this chapter.

Air Quality

Key Terms

Ambient air—that air, external to building, encompassing or surrounding a specific region.
Ambient air quality standard—the prescribed level of pollutants in the outside air that cannot be exceeded legally during a specified time in a specified geographical area.
Class I Airshed—one of three classes of areas provided for in the Clean Air Act for the Prevention of Significant Deterioration program. Class I Airsheds are the "cleanest" and receive special visibility protection.
Class II Airshed—the second of three classes of areas provided for in the Clean Air Act. Class II Airsheds have no specific attainment criteria.
Prevention of Significant Deterioration (PSD)—a program established by the Clean Air Act to protect ambient air quality and air-quality-related values.

Affected Environment

Although there is little scientific information on the baseline air quality of the Sea Level Project Area, the air quality of the region is generally good. Exchange of air typically comes from relatively pollution-free air off the Gulf of Alaska. Local sources of airborne particulates include motor vehicle emissions, motor vessels and cruise ships, dust, residential and commercial heating sources in the Ketchikan Gateway Borough population center, marine traffic on Tongass Narrows, the Ketchikan Pulp Company sawmill at Ward Cove, and a limited amount of prescribed burning.

Vehicles and home heating, particularly wood-fired heating, contribute to regional particulate matter concentrations. Alaska has experienced localized problems with wood smoke and has issued regulations that limit open burning and other air pollution-generating activities in wood smoke control areas between November 1 and March 31. The wood smoke control areas do not include the Sea Level Project Area. Open burning may be restricted in the Project Area when an air quality advisory is issued by the Alaska Department of Environmental Conservation (ADEC) (AAC 50.030). The ADEC has the primary responsibility for attainment and maintenance of Ambient Air Quality Standards under the provisions of the Clean Air Act (see TLMP 1997 for related air quality discussion). The Forest Service cooperates with the Alaska agency to protect air quality in National Forests. The entire Project Area is a Class II Airshed for purposes of Prevention of Significant Deterioration (PSD) and does not have specific attainment criteria under the Clean Air Act. There are no Class I Airsheds designated in Southeast Alaska, which is a more restrictive requirement.

Effects of the Alternatives

Direct, Indirect and Cumulative Effects

There is presently little information on the possible effects of ambient air quality on forest resources in Southeast Alaska. Forest health monitoring recently initiated under a national resource program includes air resource related parameters. Methods of conducting inventories are being developed to address this information need. Monitoring of baseline resource conditions on the forest is being conducted at this time.

National Ambient Air Quality Standards (NAAQS) for indicators of matter less than 10 microns (PM10) in size are established by the Federal Environmental Protection Agency (EPA) as the concentration limits needed to protect all of the public against adverse effects on public health and welfare. PM10 indicators are utilized because the human respiratory system cannot efficiently filter out particulate matter this size or smaller. Wildfires and prescribed fires can be a source of fugitive particulate matter less than 10 microns in size.

Prevention of Significant Deterioration (PSD) of ambient air quality is a program established by the Clean Air Act to:

- Protect public health and welfare from any actual or potential adverse effects from air pollutants not withstanding attainment and maintenance of all national ambient air quality standards.
- Ensure economic growth will occur in a manner consistent with the preservation of existing clean air resources.
- Preserve air quality and air quality related values in areas of special national or regional natural, recreational, scenic, or historic values.
- Ensure that any decision to permit increased air pollution is made only after there has been adequate opportunity for informed public participation in the decision making process and after careful evaluation of all consequences.

The NAAQS for particulate matter less than 10 microns in size would not be violated by the proposed action. PSD increments in the Southeast Alaska Intrastate Air Quality Control Region, for sulphur dioxide, oxides of nitrogen, and total suspended particulate, have not at this point in time been triggered, making an analysis unnecessary.

All of the management alternatives are expected to have limited, short-term impact on the ambient air quality. Alternative 1, the no-action alternative, would result in the least emission of particulate and gaseous air pollutants in the near term. The potential for uncontrolled forest fires would be slightly higher for the action alternatives because of the logging slash created. The occurrence of forest fires, even when logging slash is present, is extremely rare in Southeast Alaska due to the amount of precipitation received throughout the year.

Effects on Air Quality Outside the Project Area

The action alternatives may result in a continued supply of raw wood products to the Ketchikan Pulp Company (KPC) sawmill at Ketchikan. This would indirectly affect air quality at the KPC's mill at Ward Cove, Alaska. Processing of timber harvested from the Sea Level Area would result in emissions into the air and may affect air quality.

KPC operates a sawmill in Ward Cove near Ketchikan, Alaska. As part of a request by the Alaska Department of Environmental Conservation (ADEC) and as part of KPC's most recent air quality permit to operate, KPC submitted a dispersion modeling assessment to address the ambient impacts of various mill emissions. By the consent decree, KPC also agreed to conduct ambient air quality monitoring for PM10 at a minimum of two locations near the mill if required as a result of the ambient impact assessment. The ambient impact assessment is also an important component for siting the ambient monitors, if necessary, for an air quality network.

For further information on the effect of KPC's operations on air quality at Ward Cove and EPA's permitting process, contact the EPA Region 10 Office in Seattle, Washington, or the Alaska Department of Environmental Conservation offices in Ketchikan or Juneau, Alaska.

Aquatic Resources

Key Terms

Adfluvial—species or populations of fish that do not go to sea, but live in lakes and enter streams to spawn.
Alluvial Fan Channel—a fan-shaped deposit of sand, gravel, and fine material made by a stream where it runs out onto a level plain or meets a slower stream.
Bedload—sand, silt and gravel, or soil and rock debris rolled along the bottom of a stream by moving water.
Best Management Practices (BMPs)—land management methods, measures, or practices intended to minimize or reduce water pollution.
Estuary—relatively flat, intertidal, and upland areas where saltwater meets freshwater, as at the heads of bays and the mouths of streams.
Large Woody Debris (LWD)—stable woody material in a stream channel.
Potential Impact Index (PII)—risk index based on proposed management activities within a watershed.
Riparian Management Area (RMA)—the area including water, land, and plants adjacent to perennial streams, lakes and other bodies of water that is managed for the inherent qualities of the riparian ecosystem.
Sediment Risk Index (SRI)—a hydrological risk index based on sediment storage and transport potential.
Storage Potential Index (SPI)—index that predicts the sediment storage potential, it is a combination of the storage and depositional streams within a watershed.
Stream Order—the designation (first, second, third, etc.) of the relative position of stream segments in a drainage basin network. The smallest tributaries are first-order streams; the junction of two first-order streams produces a second-order stream, etc.
Third Order Watershed—A watershed that contains a third-order stream segment.
Transport Potential Index (TPI)—index based on stream channel ability to transport sediment.
V-notch—a deeply incised, narrow valley drainage with a characteristic "V" shaped cross section.
Watershed Analysis—a systematic process for characterizing and evaluating ecological processes within a watershed.

Affected Environment

Introduction

Fish and aquatic resources in the Sea Level Project Area help support subsistence, commercial, and sport fisheries. The fishery resources are important to the economy and life-styles of area residents and its visitors (see the Subsistence and Recreation sections).

Project Area streams support four species of salmon (pink, chum, coho, and chinook), as well as cutthroat trout, rainbow/steelhead trout, and Dolly Varden char. These species are the most important to the commercial, recreational, and subsistence fisheries of the region. Additionally, these fish are a food resource to bears, river otters, eagles, and other wildlife. Habitat requirements for Dolly Varden, coho salmon, and pink salmon are discussed later in this section (see Management Indicator Species). Nongame fish species, including sculpin, stickleback, and smelt, occur in Project Area waters (Taylor 1979).

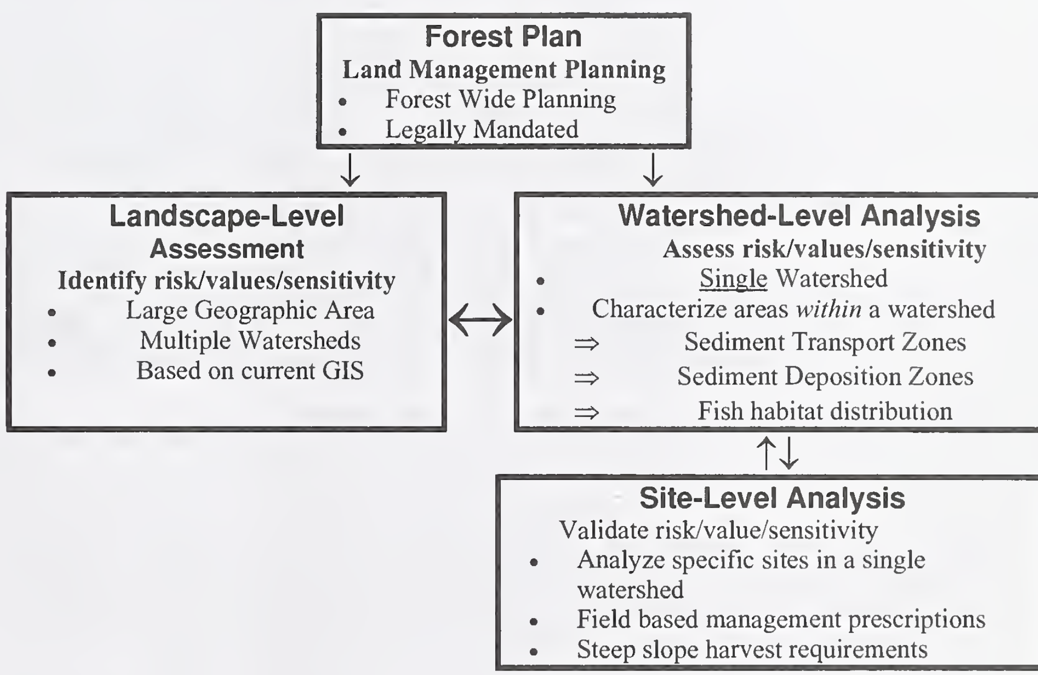
Watershed Analysis

Watershed analysis is a procedure for assessing important riparian and aquatic habitat values and geomorphic processes within a watershed, (TLMP 1997, Appendix J). It describes key aquatic and riparian resources, along with habitat conditions and trends.

Relationship to the Planning Process

The Tongass watershed analysis is a process designed to be compatible with current regional planning processes. Land management planning in the Alaska Region occurs at two levels: forest-wide and project-level. Within this context, watershed analysis may occur at four scales: forest-level, landscape-level, watershed-level, and site-level, as shown in Figure Aquatic−1.

Figure Aquatic-1
Spatial Scales for Watershed Analysis in the Alaska Region



Source: USDA Forest Service 1997c.

The Watershed Analysis Handbook for the Alaska Region (USDA Forest Service 1997c) provides the framework for this watershed analysis. The handbook outlines eight core topics to address in watershed analysis:

- Species and Habitat
- Hydrology
- Stream channel

- Water Quality
- Human Uses
- Natural Disturbance
- Mass Slope/Erosion (potential for landslides/landslides)
- Vegetation

Watershed analysis requires the use of both computer models and field work. Analytical tools and field analysis are used to determine levels of sensitivity for key areas within each watershed. They are also used to identify areas that are important for maintaining the integrity and function of riparian areas and stream channels.

Scale and Intensity

The Project Area contains 92 watersheds. The landform and topography range from tidal flats to subalpine and tundra crested mountains. The watersheds range in size from less than 64 acres to 20 square miles (mi^2) with an average watershed size of 2 square miles.

There are 53 watersheds greater than 0.5 mi^2. Fifty-four watersheds contain proposed management activity. Ten watersheds greater than 0.5 mi^2 have no proposed management activity; eleven watersheds less than 0.5 mi^2 have proposed management activity. Analysis for all watersheds with proposed management activity includes the minimum products outlined by Appendix J of the Forest Plan. Watershed analysis on the 11 watersheds less than 0.5 mi^2 primarily applies only the third level of analysis which is the site level analysis (including a computer model that analyzes units within a watershed).

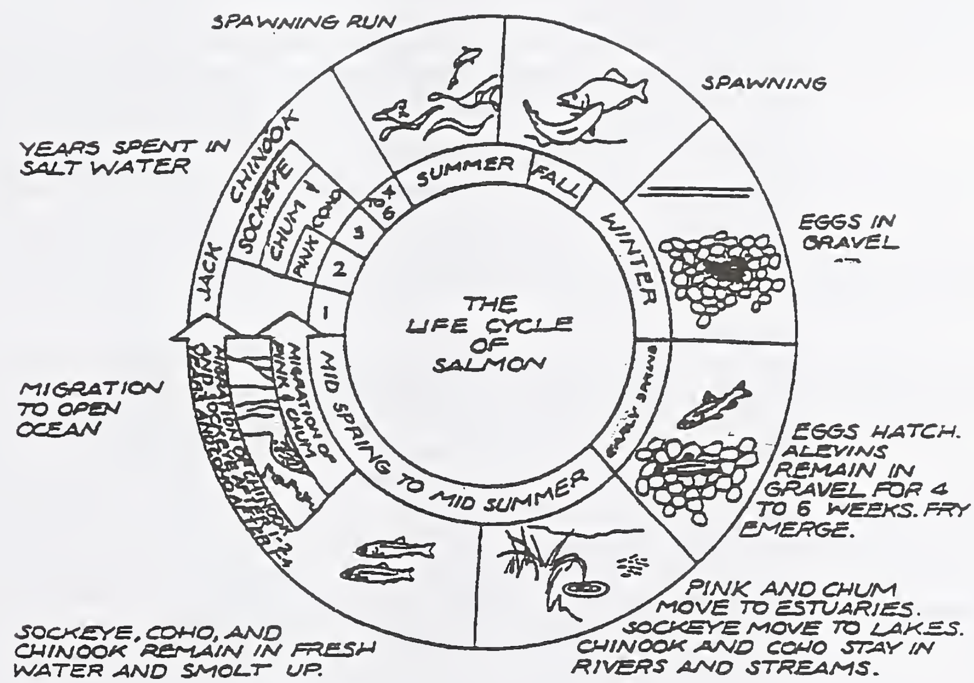
Quantitative information from Basin Wide Stream Surveys (BWS) provided information to help addresses the biological factors of the fisheries resources such as fish distributions, channel condition, and riparian vegetation. The BWS also includes information such as natural or management related disturbances within the Riparian Management Areas. The Road Condition assessment identified existing stream crossings, effectiveness of fish passage, and drainage problems that could result in increased sediment to fish habitat.

Management Indicator Species

National Forest Management Act regulations direct the use of Management Indicator Species (MIS) in forest planning to help display the effects of forest management. MIS are species whose population changes are believed to best indicate the effects of land management activities (USDA Forest Service 1997a). Through the MIS concept, the total number of species occurring within a Project Area is reduced to a manageable set of species that collectively represent the complex of habitats, species, and associated management concerns. The MIS are used to assess the maintenance of population viability, changes in biological diversity, and effects on species in public demand.

For the Forest Plan revision (TLMP Revision 1997), coho and pink salmon have been selected as MIS for anadromous fish species and represent two different phases of salmon life history: spawning/egg incubation and freshwater rearing. Dolly Varden char was selected to represent resident species for the Sea Level Project Area. Anadromous fish spend at least part of their life in freshwater and part in saltwater. Salmon lay their eggs in the stream gravels, and the juveniles hatched from the eggs emerge from the gravels. Depending on the species of the salmon, the amount of time the juveniles spend in fresh water is variable before maturing in the ocean. Resident trout and char spend all of their life in fresh water, spawning in streambed gravels and growing to maturity in the streams and lakes of the area. Figure Aquatic Resources–2 displays life cycles for different salmon species.

Figure Aquatic-2
Salmon Life Cycles



Source: Unknown

Although the Alaska Department of Fish and Game (ADF&G) does not list sockeye or king salmon in the Project Area king salmon were observed in Gunsight Creek. Both cutthroat trout and Dolly Varden char may be present in their anadromous forms or as resident or as resident populations in lakes and reaches of streams not generally used by anadromous species. There have been no recorded introductions of resident or anadromous fish in the Project Area. There are no significant water uses within the project area, and there are no Threatened and Endangered species within the Project Area.

Fish Habitat

Large Woody Debris

The maintenance of woody riparian vegetation is important as a source of nutrient input. As debris accumulates in streams, it creates pools, traps nutrient-laden organic matter, and supports aquatic insects and other food items for fish. Gradual entry of Large Woody Debris (LWD) into the aquatic system is desirable to maintain stream habitat diversity and stability. Large amounts entering abruptly can be detrimental to the aquatic ecosystem by becoming a physical barrier and causing bank erosion and fish migration problems. In most cases, however, gradual and consistent input of LWD is important to maintain stream productivity (Harris 1989).

Past management practices have reduced the total amount of large in-channel woody material in some anadromous streams in the Project Area, see the *Resource Report*. Prior to the enactment of TTRA, timber often was harvested to the edge of the streams, and stream cleaning operations were commonly conducted to prevent perceived fish passage problems. Cleaned streams have consistently shown lower over winter survival rates than unharvested or harvested-but-buffered streams (Heifetz et al. 1986, Bryant 1983, 1985, Bjornn et al. 1991). There is no documentation that this took place in the Project Area.

Blowdown of Trees

Blowdown of trees is a natural phenomenon in Southeast Alaska. There is evidence to show that blowdown is predictable. Natural factors and shape of harvest units determine the probability of blowdown occurring in adjacent stands (Harris 1989; Moore 1977). These will be refined during field layout of the units to reduce blowdown hazard. TLMP provides direction to protect Riparian Management Areas (RMAs). A limited amount of blowdown can contribute to the large woody debris needed to maintain in-stream habitat. Many streams within the Project Area have blowdown of trees in narrow buffers. Often, trees left to serve as buffer, would blow down into the creek leaving no buffer to serve as thermo-regulators or to stabilize the stream banks. These blown down trees now function as Large Woody Debris.

Intertidal Zone

The lower reaches of larger streams in the Project Area, including reaches within the intertidal zone (ITZ) contain the bulk of existing spawning habitat for pink and chum salmon. These species typically do not rear in freshwater; fry emigrate to saltwater shortly after emergence. Pink and chum salmon are often impeded in their upstream migration by barriers or breaks in stream gradients that pose little or no problem for other salmonids. In contrast, coho salmon and steelhead may ascend such barriers with ease and are often distributed much higher in the watersheds. Coho salmon may occupy small streams with relatively high (> 12 percent) gradients. In Southeast Alaska, juvenile coho generally rear in fresh water for 2 years before outmigrating as smolts. Typically, drainages in the Project Area with numerous braided side channels and high amounts of instream LWD contain the greatest amount of rearing habitat for juvenile coho salmon. In the Project Area major estuaries are located at Shoal Cove and Sea Level Creek. Additional small estuaries are found at the outlet of smaller stream systems throughout the Project Area.

Habitat Capability

The productivity of marine waters in the Gulf of Alaska, and the survival of salmon and steelhead trout, are both highly variable and cyclic. Since the mid-1970's, favorable ocean currents have resulted in high productivity and, consequently, high marine survival of salmon (AFHA 1995). Harvests of salmon have been at record or near record levels in Southeast Alaska for the past few years. These increases are thought to be primarily associated more with favorable oceanic conditions rather than any change in freshwater habitats.

Riparian Management Areas (RMAs)

The RMA for the Project Area is the combined mapping of several functional resource components. Stream class forms the core of the RMA. The stream RMA component was designed to express riparian forest processes important to salmonid habitat for all class I and Class II streams. The remaining components and the resource elements that were used to create the RMA are the riparian vegetation, sensitive soils, sideslope and stream channel stability, and landforms. The RMAs for class I and II streams are delineated on the unit cards found in Appendix H.

RMAs comprise the aquatic and riparian ecosystem, and the adjacent floodplain, wetlands, and upland areas with potential to deliver sediment to channels. They sustain hydrologic, geomorphic, and ecological processes that affect streams, stream processes, and aquatic habitats (Federal Agency Guide for Watershed Analysis, 1994). Specific standards and guidelines, by stream process group, are associated with Riparian Management Areas.

Riparian Habitat Management Objectives (RHMOs)

Fish habitat objectives (AFHA 95) have been developed to concisely measure and describe desired physical and biological conditions for fish habitat. These measurable objectives for stream, riparian, and watershed define those conditions that need to be maintained and monitored to protect fish habitat quality. The objectives for the Tongass should be viewed as benchmarks that are used to objectively assess or measure fish habitat condition and not management goals that are always attainable. The habitat conditions are a first approximation of scientifically based indicators of healthy, fully functioning aquatic systems on the Tongass National Forest. The three Riparian Habitat Management Objectives are:

- Pool Area–expressed as a percentage of total habitat area;
- Large Woody Debris–expressed as frequency of LWD pieces per unit area (1,000m^2) of stream, by channel type and process group; and
- Width-to-Depth Ratio–Expressed as the ratio of bankfull width (BFW) of a stream to the depth of water (active channel width) by channel type and process group.

Project Area Fisheries Habitat Assessments

The Sea Level project implements the standards and guidelines applicable to project-level planning presented in the Forest Plan (TLMP 1997). Project analysis also includes the following:

- Classification of streams by stream class: Class I, II, III, IV, and nonstream categories.
- Fish habitats and communities were inventoried and characterized on 38 streams using the Region 10 Basin Wide Survey (BWS) Protocol (1995 and 1996). The ground verified data was incorporated into the Geographic Information System (GIS) and used for project-level planning. The BWS survey data summary and discussion is located in the Watershed Report, Appendix D.
- During field reconnaissance, areas with steep slopes, high hazard soils, and Class III streams were identified and evaluate for risk of adverse impacts on headwater channels. BMPs listed on the individual unit and road cards are prescribed to reduce the risk of on-site erosion and delivery of sediment to a stream channel.
- Watershed-level analyses are provided for the principle Sea Level Project Area watersheds. Additional site-specific analysis is used to address the potential delivery of sediment from Class III to Class I and II streams. The intent of this site-specific analysis is to determine where protection of headwater areas is required to reduce the risk of downstream impacts to fish habitat.
- Site-specific stream buffers are provided for floodplain and confined alluvial channels. Harvest units adjacent to Class I and Class II stream channels were investigated by project fisheries biologists to determine the extent and type of buffer necessary to assure protection of any small, off-channel streams associated with floodplains and to provide a long term source of woody debris. After further analysis, some stream buffers have been enlarged to encompass adjacent riparian soils and fens.

Hydrology

The yearly runoff cycle follows seasonal variations in temperature, rainfall, and snowmelt. Fish Creek, located in Thorne Arm, generally portrays the annual water discharge cycle representative of streams in the Project Area (personal communication, T.W. Geier, Hydrologist, Ketchikan Administrative Area, Tongass national Forest, December 1996). Fish Creek has two low-flow and two high-flow periods. In March, average monthly discharge drops to about 258 cubic feet per second (cfs) because of cold temperatures and minimal snowmelt. In late May to early June, average discharge increases to about 507 cfs as spring precipitation changes to rain, and snowmelt occurs. During the summer, precipitation decreases and evapotranspiration increases; consequently, stream discharge drops to an average monthly value of 326 cfs in August. In autumn, average river discharge rises with the increased rainfall and reaches a peak of almost 700 cfs in October.

Precipitation

Abundant precipitation is characteristic of the temperate maritime climate of Southeast Alaska. Estimated mean annual precipitation ranges from less than 120 inches at Sea Level Creek located at the head of Thorne Arm, to over 200 inches on mountain summits at elevations of over 4,000 feet. Much of the precipitation at higher elevations is received as snow. As a result of abundant snowpack, which may persist at higher elevations into late summer, snowmelt runoff is an important contribution to stream flows particularly during low-flow periods in mid-to-late summer. No known areas of perennial snow and ice are located within the area.

All streams in the Project Area produce a large volume of runoff per unit of land in the watershed. Runoff varies greatly, depending upon the time of year. Spring snowmelt contributes to increased runoff between April and June. In some streams, spring runoff can often approach fall runoff levels, which generally is the period of highest stream flows. Low flow periods occur between January and March and again in mid-July to August.

Groundwater

Little is known about the characteristics of groundwater hydrology in the mountain valleys of Southeast Alaska. Extensive areas of poorly drained peatlands in the Sea Level Creek valley serve as areas which intercept, store, and discharge runoff. Unconsolidated glacial drift, outwash, colluvium and residual material, and to an unknown degree local bedrock, serve as mediums for groundwater flow, as evidenced by the numerous springs and small perennial streams which are characteristic of the valley side-slopes. Wetlands within the area serve as a major medium of transport for groundwater along the landscapes hydraulic gradient. Uplands, bogs, and other extensive wetlands intercept precipitation. Much of the water infiltrated, is retained in the high groundwater storage capacity of these wetlands. It is gradually released to fens further down the gradient. These fens, in turn, continue the process by transfer of groundwater to riparian, lacustrine and estuarine areas at the lower end of the hydraulic gradient.

Inventory

Channel Type

Perennial streams on the Forest are inventoried by channel type. The Alaska Region Channel Type Classification System is an inventory and planning tool that stratifies stream and lake sections within a watershed into different stream process groups. The process groups are based on physical characteristics of streams and predict the streams' physical response to different ecological and land use processes. Table Aquatic-1 describes process groups location in a watershed and their function in sediment routing.

Table Aquatic-1
Process Group Locations and Sediment Regimens

	CRITERIA	
PROCESS GROUP NAME	**Landform**	**Sediment Regimens**
Palustrine (PA)	Lowland/Wetlands	Storage

Flood Plain (FP)	Flood plain	Balanced or Deposition
Alluvial Fan (AF)	Alluvial fan/con	Deposition
Large Contained (LC)	Canyon or entrenched in lowlands	Balanced
Moderate Gradient Mixed Control (MM)	Footslope/narrow valleys	Balanced
Moderate Gradient Contained (MC)	Entrenched in hills or lowlands	Erosive
High Gradient Contained (HC)	Mountain slope	Erosive

Source: Alaska Region Publication R10-TP-26, April 1992.

Channel types provide a system to estimate the amount and quality of fish habitat within the Project Area. The amount and quality of rearing habitat predicted by the various channel types has been established through field studies within the Tongass National Forest (Murphy et al, 1987). Individual channel types have fairly consistent physical and biological characteristics (Marion, et al, 1987). Channel types help define the parts of a drainage basin and, as such, are tools intended to complement a holistic watershed management approach.

The Sea Level Project Area contains a variety of channel types, mostly in the Palustrine, Floodplains, Moderate Gradient Mixed Control, Large Contained, Moderate Gradient Contained, and High Gradient Contained Process Groups. Short stretches of the Estuarine and Alluvial Fan Process Groups are also included. Process groups describe the interrelationship between watershed runoff, landform relief, geology, and glacial or tidal influences on fluvial erosion or depositional processes. Process groups are used for assigning riparian standards and guidelines.

Stream Class

Streams have also been categorized by stream class, a classification primarily associated with fish use. Stream classes describe values, such as whether anadromous or resident fish inhabit a particular stream. Definitions for each stream class are as follows:

- **Class I**: Streams with anadromous or adfluvial fish habitat; or high quality resident fish waters listed in Appendix 68.1, Region 10 Aquatic Habitat Management Handbook (FSH 2609.24), June 1986; or habitat above fish migration barriers known to provide reasonable enhancement opportunities for anadromous fish.
- **Class II**: Streams with resident fish populations and generally steep (6-15 percent) gradient (can also include streams from 0-6 percent gradient) where no anadromous fish occur, and otherwise not meeting class I criteria. These streams have limited fisheries values and generally occur upstream of migration barriers or have other habitat features that preclude anadromous fish use.
- **Class III**: Perennial and intermittent streams with no fish populations, but which have sufficient flow or transport sufficient sediment and debris to have an immediate influence on downstream water quality or fish habitat capability. These streams generally have bankfull widths greater than five feet and are highly incised into the surrounding hillslope.
- **Class IV:** Other intermittent, ephemeral, and small perennial channels with insufficient flow or sediment transport capabilities to have an immediate influence on downstream water quality or fish habitat capability. These streams generally are shallowly incised into the surrounding hillslope. The class IV stream updates in the

USFS Geographical Information System (GIS) data base assigns the same RMA widths as class III.

- **Nonstreams**: Rills and other watercourses, generally intermittent and less than 1 foot in bankfull width, with little or no incisement into the surrounding hillslope, and with little or no evidence of scour.

Table Aquatic-2 displays estimated miles of each stream class within the Project Area.

Table Aquatic-2
Miles of Stream Class in the Project Area

Stream Class	Miles
I	152.7
II	142.5
III	206.9
IV	8.0

Source: GIS database 1997.

Water Quality

The Project Area contains a variety of freshwater resources which can be characterized with respect to their hydrology, water quality, and consumptive water uses. The Alaska Department of Environmental Conservation (ADEC) is the responsible State agency for designing and enforcing water quality standards under the Clean Water Act. ADEC and the Forest Service have entered into an agreement to implement the water quality protection tasks described in the Alaska Non-point Source Pollution Control Strategy, approved by the EPA in August 1990 (ADEC 1990).

Water quality affects use by humans, fish, and all other organisms. The most important characteristics for water management on the Project Area are temperature, sediment, and chemical properties. These water quality characteristics are discussed below and correspond to the key water quality parameters identified in the State of Alaska water quality criteria for maintaining natural productivity of aquatic organisms.

Stream Temperature and Dissolved Oxygen

The principle source of heat for small streams is solar energy striking the stream surface. Streams in the Project Area are not highly sensitive to temperature changes. Frequent cloud cover, low air temperatures, steep channel gradients, abundant precipitation, and snow melt runoff through most of the summer keep stream temperatures below the range considered harmful to aquatic organisms.

Dissolved oxygen content in most streams, and lakes in Southeast Alaska is usually at or near saturation due to self-aeration in the turbulent, high-gradient streams. In quiet waters in lakes and wetlands, dissolved oxygen content may drop below saturation.

Summer high and winter low water temperatures influence fish survival and condition. Water temperature affects the metabolic rate of aquatic organisms and can affect the migration timing of adult and juvenile fish. Harvest of streamside vegetation, as well as the total amount of harvest in a watershed, can affect water temperature. The Thorne River and salmon-producing tributaries of the Staney Creek watershed stream temperatures were reported to increase much more rapidly in logged than in unlogged study areas due to removal of streamside vegetation. Rates of increase in water temperature between similar study areas indicated 0.28 Celsius/100 feet (0.50 degrees Fahrenheit) through logged areas and 0.02 Celsius/100 feet (0.04 degrees Fahrenheit) through unlogged forest (Taylor and Gibbons 1973).

Timber harvest to the streambank is suspected of raising stream temperatures to a level which may contribute to adult fish kills, although no direct link has been established (Beak 1989, Konopacky 1991). Many of the streambanks within the Project Area have previously been harvested. Amount of harvest within the Riparian Management Areas (RMA) is discussed later in this section. No fish kills due to temperature have been documented in the Project Area. Applications of Forest Standards and Guides and Best Management Practices (BMP) will minimize effects of timber harvest and road construction on stream systems.

Streams potentially sensitive to temperature changes have one or more of the following characteristics: south-facing slopes, lack of immediate downstream forested stream buffers, historical timber harvest activities in RMAs, shallowness, low flows, adjacency to ponds or muskegs, and fish production (USDA Forest Service 1986a). In 1995 Ketchikan Ranger District implemented a stream temperature monitoring effort in the North Revilla project area. Monitoring sites were established at Klam Creek and Traitors Creek.

On Klam Creek temperatures on the unharvested portion of the fish stream exceeded state water quality standards for the months of June through August. The data suggests that stream temperatures will exceed State Waters Quality Standards on streams where there has been no management as well as streams that have had management influence (see Sea Level Fisheries Resource Report 1997).

Water Chemistry

Muskeg streams in the Project Area typically are slightly acidic (pH 6.5). Although water in Southeast Alaska is never completely free of organic and inorganic matter, chemical water quality is high. Concentration of total dissolved solids are typically less than 150 ppm (USDA Forest Service 1993b).

Uses of Water

Consumptive

Key consumptive water uses within the Project Area include domestic, recreational, and commercial water supply, and the propagation of fish resources. Existing uses include:

- U.S. Coast Guard Loran facility at Shoal Cove uses surface water for domestic water supply;
- U.S. Forest Service Administrative site at Shoal Cove uses surface water; US Forest Service Recreation Cabin--Fish Creek uses surface water sources; and
- Although there are currently no logging operations that require camps in the Project Area, logging operators use surface water for domestic water supply.

There are no congressionally designated municipal watersheds within the Project Area.

Beneficial

The waters of the area are an important source of habitat for resident and anadromous fish and other aquatic life. Additional beneficial uses of the waters of the study area include stream channel maintenance, dispersed recreation use (see Sea Level Recreation Resource Report), terrestrial wildlife habitat (see Sea Level Wildlife Resource Report), and subsistence harvest.

Stream Sediment

Natural and Management Disturbances

Sediment consists of water-transported materials such as gravel, sand, and silt. Gravel and sand move along the stream bottom as bedload. Silt is generally transported within the water column as suspended material and causes water to appear murky or turbid. Under natural conditions both suspended and bedload sediments move during storm runoff events. The rate of sediment transport depends on discharge velocity and availability of materials. Stream sediment can reduce stream habitat quality, restrict sunlight penetration, and clog pores between gravels, preventing the flow of oxygen-rich water to fish eggs.

Aquatic productivity can be influenced by the concentration of sediment in the water column and the amount of fine sediment introduced into spawning gravel. Sediment reduces water circulation necessary for fish egg and fry survival and growth. Sediment also retards emergence of the young fish after hatching. During winter, young salmonids use spaces between gravel and rubble to escape the effects of low water temperatures, increased water velocities, and ice. When these spaces fill with sediment, the young fish must emerge from the gravel and use energy to maintain themselves in the current, reducing their ability to survive.

Suspended sediment may also irritate the mouth and gills of young fish, and if persistent, can erode the gills of larger fish. Such damage may increase fish stress, leading to increased susceptibility to disease. As rearing pools fill with sediment, rearing space is reduced, lowering habitat capability, and increasing stress and vulnerability to predators. Sediment indirectly affects fish by reducing populations of aquatic insects which are important fish food, increasing competition for food items, weakening unsuccessful feeders, and reducing the number of fish that can be produced from a stream section. Salmonids are generally sight feeders, and turbid water reduces feeding efficiency.

Landslides are a natural source of sediment. Swanston (1989) indicated that about 3 percent of all major landslides directly affect fish-bearing streams. Steep terrain and heavy rainfall are factors which contribute to natural sediment production. There is no formalized landslide inventory for the Project Area on GIS. The District soils and water files contain information about landslides that have occurred on the Project Area.

Major sources of management induced sediment in the area result from: (1) road construction activities, (2) road use and maintenance, and (3) logging activities. Research indicates that there are no statistically significant changes in suspended sediment average values before and after logging (Meehan et al. 1969; Beschta 1980, Lloyd et al. 1987). Research by Paustian (1987) indicates that natural suspended sediment concentrations in watersheds in Southeast Alaska are typically low. In the Project Area, road condition surveys were conducted to identify fish passage concerns and potential road induced sediment sources. Active natural streambank erosion is obvious on Painted Creek. Volcanic ash in the stream banks and bed of Painted Creek are a significant natural source of sediment.

Instream construction activities in Class I streams are restricted to periods when eggs or alevin are not in the gravels, generally during summer months. To avoid disturbance during spawning, instream construction activities are not allowed when adult salmon are in the streams. The windows for instream construction can vary slightly from stream to stream. Site specific fisheries and field information (including ADF&G recommendations) are used to determine the operating windows and will be applied to the Project Area. In the Ketchikan Area, the windows for instream operations are generally established to be June 1 to August 7 for pink and chum salmon, June 15 to September 1 for coho salmon, and July 18 through August 7 for steelhead trout. Site-specific information on timing restrictions may be found in Appendix H, Road Cards.

Sediment Risk Assessments

Sediment Risk Assessment (SRA) model was run on 92 watersheds in the Project Area. The rating system characterizes and ranks watersheds based on geological and hydrological (geo-hydromorphic) risk factors to address four of the core topics identified in the Watershed Analysis Handbook: Mass Slope/Erosion (potential for landslides/landslides), Hydrology, Stream channel and Vegetation management. The Landscape level SRA focuses on the nature and extent of sediment sources within each watershed.

The computer SRA model is based on information from GIS. The model develops sediment transport and deposition indices, based upon watershed morphology, discharge, and potential sediment sources (see attributes and definitions in Appendix D). The Watershed Report of Appendix D, Volume II, provides a comprehensive investigation of the watersheds where management activity is proposed. In March 1997, Geier and Sainz ran the Landscape Level SRA model using the nit pool for the Sea Level Project Area. To further test the model, in November 1997, they ran the model against all of Revillagigedo Island's 405 watersheds. Eighteen of the Project Area Watersheds ranked within the top 10 percent of the Island SRA for existing condition, the Sediment Risk Index (SRI). Painted Creek ranked the highest, setting the SRI scale at 100 for Revilla Island watersheds.

The SRA model was again run using the units identified in the unit pool. The SRA compared 92 watersheds within the Project Area. Watersheds less than one-half square mile were not ranked in the SRA. Of the 92 Project Area watersheds, 59 watersheds contain proposed management activity (harvest or roads), and 53 watersheds larger than ½ square mile. The watersheds less than one-half square mile are more effectively analyzed on site specific basis. Watershed Characterizations found in Appendix D address the core topics outlined in this chapter for all watersheds where management activity is proposed regardless of size. The characterizations include information about the topography, hydrology, channels, fish habitat, existing roads, and vegetative management within the last 30 years.

There are two important assumptions implicit in the Sediment Risk Index (SRI) (USDA Forest Service 1998). First, the SRI assumes that watersheds with the higher combinations of storage potential and transport potential have higher levels of management concern because material transported from steep, unstable areas can remain in low-gradient valley-bottom streams, resulting in pool filling and other undesirable channel adjustments. The second is that all transport streams within the watershed drain into the depositional streams. The SRI does not analyze sediment routing through the stream network and may give spurious results in certain circumstances. For example, the SRI may overestimate sediment risk in a watershed with a wetland complex on a plateau that drains down a slope into salt water. In this case, many of the transport streams exist downstream of depositional areas and are incapable of transporting material to them.

An exception to these assumptions occurs in watersheds located in the Minx Flat area. Watersheds E72A, E75A, E77A, and FA1A all rated relatively high on the SRI score (Table Aquatic-6). However, these watersheds exhibit relatively flat ground with high densities of depositional channels that would route sediment through transport channels downstream to salt water.

The SRA model identified watersheds that might be particularly sensitive to increased management activity based on existing condition. The sensitive watersheds identified by the model are not all major watersheds. Other major watersheds exist within the Project Area and are briefly discussed later and in the Watershed Report (Appendix D). The watersheds identified as sensitive by the model may not be truly "sensitive" to increased management as long as management includes protection of critical riparian and fish habitat. There are watersheds identified as sensitive that do not have critical riparian or fish habitat. Watersheds with little to no critical riparian or fish habitat are generally small and have steep, greater than 6 percent gradient, stream channels.

Major Watersheds

The watersheds listed in Table Aquatic-3 contain significant populations of resident or anadromous fish and are greater than 5 square miles in size. These watersheds have the greatest potential for contributing to the recreation or commercial fisheries.

Table Aquatic-3
Major Watersheds

Watershed Name	Watershed Number	Size of Watershed mi^2
Buckhorn Creek	E50A	5.3
Calamity Creek	I14A	6.6
Coho Cove Creek	E33A	5.8
Easy Creek	D96A	6.0
Fish Creek	D97A	33.3[1]
Licking Creek	D91A	6.4
Marble Creek	D87A	5.8
Saddle Lakes	D79A	9.2
Sea Level Creek	E79A	20.1[2]
Spit Creek	E42A	8.0

1 Value reflects mi^2 of actual watershed size, watershed within project boundary 0.5 mi^2
2 Value reflects mi^2 of actual watershed size, watershed within project boundary 9.5 mi^2 .

Sea Level Creek and Painted Creek watersheds are the only two anadromous fish producing watersheds that contain more than three true sub-watersheds within the Project Area. The Watershed Report of Appendix D contains the characterizations of these watersheds. The Saddle Lakes watershed contains 484 acres of lake habitat that may eventually be road accessible from Ketchikan. Fish Creek, Spit Creek, and Sea Level Creeks provide excellent steelhead and salmon fishing opportunities. Sea Level Creek and Painted Creek are analyzed for geomorphic risk at the watershed level. That analysis compares sub-watersheds within a large watershed.

Environmental Consequences

Introduction

This section addresses the direct, indirect, and cumulative impacts to the aquatic resources of the Sea Level Project Area. The issues raised during scoping drove the effects analysis of this document. The tools used in the effects analysis are described in the previous section of the Aquatic Resource section. They are the Sediment Risk Assessment models, Basin Wide (Stream) Surveys, and Road Condition Assessments.

Summary

Anticipated impacts to water and fish are related primarily to the existing and proposed road network, which will be managed to meet many different needs not limited to recreation or logging. None of the action alternatives are likely to have an effect on stream flows or water chemistry. Potential effects on water quality, temperature, and fish habitat are related to clear-cut near streams. This occurs at stream crossings and also in a few areas where roads need to parallel the stream within approximately 100 feet. The road condition survey identified the effects of the alternatives for the Riparian Management Areas (RMA) by stream class (see Chapter 3 - Roads and Facilities). Information in the roads section includes, number of existing crossings and their condition, the number of proposed stream crossings, and the amount of RMA in acres and miles that will be directly affected.

Timing windows for in-stream construction are in place and can be modified on a site specific basis to reduce the direct and indirect effects to fish habitat. The implementation of riparian buffers on fish streams and RMAs will meet fish habitat protection needs.

Buffers are assigned to streams based upon both stream class and channel types. By considering both stream class and channel type, additional buffers or other protection measures can be specified in order to maintain or enhance fish habitat and water quality. This was done for each inventoried stream based on stream class and channel type. The IDT then overlaid these buffers with the potential units. Aerial photos were examined to determine if buffers had to be wider to account for windfirmness, logical units, and small slivers between buffers. During layout, if additional streams are found, the same standards and guidelines are used to establish buffers for each stream based on its stream class and channel type.

RMAs identify the areas of greatest concern for maintaining riparian and wetland functions and hillslope stability. RMAs are tailored to the characteristics of each individual watershed to account for variability in geology, soils, vegetation, and hydrology.

Direct and Indirect Effects

Riparian Management Areas

Timber harvest has potential positive and negative effects on fish habitat capability. Timber harvest may affect the sources of LWD, stream stability, water flow, and quality. Timber harvest under some circumstances, may have a positive effect on fish by increasing the amount of primary productivity in a stream system. However, these potential positive effects, which are generally only seasonal in nature, may be diluted by increased flows and are not quantified in this assessment.

With increased developmental activities there is an added risk of stream habitat impacts (such as accelerated numbers of landslides over background levels, blowdown of leave strips, and the subtle impacts that may result from stream reactions to rain-on-snow events), and cumulative effects of many small but individually insignificant actions affecting the riparian zone. Harvest on MMI 3 (high mass movement index) soils, miles of road construction and reconstruction, and the number of stream crossings, are indicators of potential increased risk that may temporarily affect the sources of LWD, stream stability, and water quality. Application of BMPs and Forest Plan standards and guidelines will minimize potential effects.

Timber Harvest Considerations

Based upon watershed analysis to the site level, (BMP 12.6, Riparian Area Designation and Protection, and 12.6a Buffer Design and Layout), timber within Class III RMAs may become available for timber harvest and be converted from nonsuitable to suitable forested lands. Table Aquatic-4 shows the Standard and Guide RMAs set forth by the Forest Plan.

Table Aquatic-4
Riparian Management Areas Widths by Channel Process Groups

	RIPARIAN MANAGEMENT AREAS							
PROCESS GROUP	**Alluvial Fan**	**Flood Plain**	**High Gradient Contained**	**Large Contained**	**Moderate Contained**	**Mixed Moderate**	**Palustrine**	**Lakes and Ponds**
Stream Class I and IIa (TTRA fish streams)	140[1]	130[4]	100[2]	100	100	120	100	100[5]
Stream Class IIb (non TTRA fish streams)	140[1]	130[4]	100[3]	100[3]	100[2]	120	85[4]	Variable
Stream Class III[6]	140[1]	130	Slope Break	Slope Break	Slope Break	120	85[4]	Variable

1 No commercial timber harvest within the Riparian management Area, which is the greater of the active portion of the alluvial fan or 140 feet from the current channel(s). Manage across the remainder of the fan with the objective of leaving large trees within the stand for future recruitment to stream channels.
2 No comercial timber harvest within 100 feet or to the top of the V-notch (side-slope break), whichever is greater.
3 No programmed commercial timber harvest within 100 feet or to the top of the channel sideslope break.
4 No programmed commercial timber harvest in the Riparian Management Area (greatest of flood plain, riparian vegetation or soils or riparian associated wetland fens). Manage an appropriate distance beyond the no-harvest zone to provide for a reasonable assurance of windfirmness of the Riparian Management Area.
5 No programmed commercial timber harvest within 100 horizontal feet of the lake margin or within the Riparian Management Area (greatest of, riparian vegetation or soils or riparian associated wetland fens or the height of one site potential tree).
6 Includes Class III and some class IV streams identified in harvest units; uses Class II RMA widths for both.

The RMAs for class I and II streams are delineated on the unit cards found in *Appendix H.* Edges of harvest units, including riparian buffer strips, are prone to damage from winds. The direction that a buffer strip is oriented does not always determine whether the buffer will be prone to wind damage. Harvest units and road corridors near or within the stream riparian zones will be designed to minimize blowdown of trees. Table Aquatic-5 displays the acres of RMA for each alternative.

The acreage displayed in the Class III column reflects an estimate of the amount of acreage that could be adjusted upon further site refinement of RMA delineations. An accurate assessment of class III RMA acreage requires site analysis and application of BMP 12.6 and 12.6a. There is a broad range of natural variability in V-notch widths and widths between sideslope breaks on class III streams. This variability makes estimating acreage of RMA difficult. Based on initial site visits, it is likely that 50 percent more streams will be found on the ground than are shown on existing inventories.

Table Aquatic-5
Acres of RMA in Stream Class I, II, and III RMA by Alternative

Alternative	Prescription	Class I	Class II	Class III
2	Defer	180.2	170.3	125.2
	ITM	0.0	0.0	12.4
	Patch & Clear-Cut	0.0	0.0	80.5
3	Defer	5.7	15.7	82.4
	ITM	0.0	0.0	3.4
	Patch & Clear-Cut	0.0	0.0	51.9
4	Defer	0.3	10.1	60.1
	ITM	0.0	0.0	2.5
	Patch & Clear-Cut	0.0	0.0	41.8
5	Defer	0.2	1.8	53.1
	ITM	0.0	0.0	3.1
	Patch & Clear-Cut	0.0	0.0	31.6
6	Defer	0.1	0.0	6.6
	ITM	0.0	0.0	0.0
	Patch & Clear-Cut	0.0	0.0	7.6

Source: Sainz GIS database. 1996.

Operations in RMA

In compliance with BMP 12.6a there may be occasion where individual trees are cut within the RMA to access timber on the other side of a buffer or for cable tail holds on the other side or within a buffer. Any trees fallen within the RMA will be fallen in accordance with BMP 13.16 Stream Channel Protection. This would occur only after completion of a stream course protection plan by a District Fisheries Biologist.

Hydrology

Water yield responses to timber harvest activities have received little study in Southeast Alaska's watersheds. There were no observed changes in stream flow measured in the Maybeso watershed (Prince of Wales Island) following clear-cutting of 25 percent of the drainage basin (Meehan et al. 1969). An analysis of Staney Creek drainage basin, also on

Prince of Wales Island, following harvest of 35 percent of the watershed did show significant increases in summer low flows (Bartos 1989).

Several variables (elevation, aspect, basin geomorphology, soils, vegetation, geology, snow storage, and precipitation patterns, cutting unit size, distribution of units within the watershed, and scheduling of harvest entries) could influence stream runoff. BMPs applied in the Project Area (see Unit and Road Cards—Appendix H, for site specific application) would reduce the potential for changes in streamflow regimes. See Mitigation Measures, Chapter 2, for a discussion of the stream buffering that will be done under all action alternatives.

Water Quality

Application of BMPs and Forest Plan Standards and Guidelines will minimize sediment delivery by controlling surface erosion from roads and harvest units. This will be accomplished by avoiding or minimizing landslide and surface erosion potential, and by proper design and installation of road drainages and stream crossings. There is, however, a risk of catastrophic events, large landslides that may occur naturally and cannot be predicted. The effects of land management activities on fish and other beneficial water uses are complex and not easily quantified. Direct, indirect, and cumulative effects result from potential changes in erosion, sedimentation, stream temperature, recruitment of large woody debris, and the stream nutrient cycle.

The Forest Service applies Best Management Practices (BMPs) that are consistent with State Forest Practices and other applicable State water quality regulations. The effectiveness of BMPs is determined by the degree to which water quality meets Alaska State Water Quality standards. The State has set numerical standards which include dissolved oxygen, turbidity, temperature, and sediment (ADEC, 1995). Although numerical standards are included in the Alaska State water quality regulations, measurements are difficult to routinely apply to the regulation of non-point sediment sources on road construction and timber sale sites. The Environmental Protection Agency (EPA) has determined that the reasonable implementation, application, and monitoring of BMPs achieves compliance with the input of the intent of the Clean Water Act.

Water quality studies conducted in Southeast Alaska indicate that except for short-term localized deviations from numerical standards, BMPs are effective in maintaining sediment concentrations within State standards (Paustian 1987). The results of these investigations suggest that no measurable effects on chemical water quality or aquatic productivity would occur as the result of timber harvesting in the Sea Level Project Area. Soil and water chemistry monitoring on a small sub-watershed that was clear-cut and burned in the Pavlof drainage near Tenakee, Alaska, measured no loss in total nitrogen and only slight leaching of potassium, magnesium, and phosphorous into surface water (Stednick et al. 1982). Timber harvesting has not been shown to result in detrimental concentrations of dissolved solutes being flushed into surface water bodies (Chamberlin 1982). High concentrations of dissolved nutrients that could impair drinking water or aquatic nutrient cycling are of principle concern. Research on coastal forest watersheds have measured only slight releases of key dissolved nutrients resulting from clear-cutting and slash burning treatments (Fredriksen 1971). Effects upon water quality in the Sea Level Project Area systems will be within State standards in all alternatives.

Sediment may consist of bedload material or suspended sediment (turbidity). The State of Alaska will grant a short-term variance from anti-degradation requirements or water quality criteria for a one-time, temporary activity, such as the installation of a road crossing, that is a non-point source of sediment, and for a temporary activity associated with the placement of fill material affecting a specific water body. Specific activities of this nature are identified in the Unit and Road Cards—Appendix H.

Water Temperature and Dissolved Oxygen

Individual units were analyzed for their potential effects on temperature-sensitive tributaries. Buffers will mitigate most temperature-sensitivity concerns. Characteristics that contribute to temperature sensitivity include one or more of the following: south-facing slopes, lack of immediate downstream forested stream buffers, historical and continued harvest activities, shallowness, flow, adjacency to ponds or muskegs, and fish production . Stream temperature monitoring effort on Klam Creek and Traitors Creek indicated that temperatures did not exceed water quality standards set by the State of Alaska (see Sea Level Fisheries Resource Report 1997).

The temperature, gradient, and flow characteristics of the streams in the area generally assure dissolved oxygen contents at or near saturation at most times. The effects of timber harvest and road construction on dissolved oxygen are expected to be negligible for all alternatives.

Consumptive Water Use

The effect of the proposed action on the consumptive uses of the water resources of the area will be insignificant in all alternatives. No net loss to fish habitat will occur in any of the alternatives. Application of BMPs will maintain water quality for all consumptive uses stated previously.

Stream Sediment

Estimates of sediment delivery to Southeast Alaska streams from timber harvest indicate that sediment increases are minimal and not distinguishable from natural fluctuations in sediment yield. In the Indian River on Chichagof Island, prior to harvest, two years of monitoring was conducted by the Forest Service. In 1978 and 1979, total sediment yield was 0.07 tons/acre and 0.16 tons/acre, respectively. Post harvest monitoring showed sediment yields in 1980 and 1981 of 0.11 and 0.14 tons/acre, respectively (Paustian 1987). Suspended sediment values in Indian River during the study period ranged from 0.19 mg./l to 175 mg./l.

Some increases in sediment delivery to streams above naturally occurring rates can be expected to result from timber harvest and road construction (Rice et al. 1979; Madej 1982; Reid and Dunn 1984; Furniss et al. 1991; Chamberlin et al. 1991). Sediment may be generated in each action alternative from short-term and long-term land disturbing activities. Sediment production and delivery to streams is roughly proportional to the amount of road constructed, slope gradient, soil type, the amount of use, the number of stream crossings, the proximity of the road to the stream, area of timber harvested, yarding system used, and the amount of naturally produced sediment. Construction of new roads expose soil, which may be eroded and cause sediment delivery to streams. Yarding and road construction on high or very high mass movement index soils may cause landslides that generate sediment. See the Soils, Riparian, and Roads and Facilities sections of this chapter for detailed effects of yarding and road construction and reconstruction on Mass Movement Index (MMI) sites. Best Management Practices and Standard and Guides set forth by the Forest Plan Revision will be used to mitigate the effects of potential sediment production.

The proposed alternatives have the potential to affect water quality and fish production in the Project Area watersheds. The potential for direct effects on beneficial uses will depend mainly upon the topography and location of proposed roads and harvest units in relation to stream channels and high landslide potential areas.

The sediment transfer index discussed in Landscape section of affected environment indicates where sediment production and deposition in a watershed is a potential problem for maintenance of aquatic habitat. The quantity of sediment transported and deposited depends upon a number of factors, including nature of sediment source, stream discharge, and channel morphology.

Watershed Cumulative Effects

Sediment Risk Assessments

Fifty-nine watersheds within the Project Area contain either existing roads or timber harvest. Twenty six watersheds have over 20 percent of the acres harvested or roaded within the last 30 years. Table Aquatics-6, on next page, shows a limited set of Project Area watersheds greater than or equal to 0.5 mi^2 . The scale and intensity of analysis for the smaller watersheds is less. The watersheds are listed according to the "percent harvest roads total" column. Twenty-eight watersheds show over 20 percent of the watershed as harvested or roaded. Some watersheds show up to approximately 50 percent harvested or roaded. Watersheds E47A and E45A (private lands rather than National Forest System lands) show over 65 percent of the watersheds as harvested or roaded.

The SRA models did not assign indices to 39 of the watersheds of less than one-half square mile nor to 49 watersheds that make up approximately 15 mi^2 of first order watersheds that flowed directly to salt water. The 49 watersheds are characterized by area that contain one or more streams that flow directly to salt water and are generally on steep ground. The average watershed size for the Project Area is approximately two square miles. Of 26 watersheds that show very high management percentage only six are greater than two mi^2 . Ten watersheds are greater than 5 mi^2, see table Aquatic-3 for the 10 watersheds and their size.

Relative Risk

BMPs will limit most effects of sedimentation and increased flows from roads and harvest units (see *Unit and Road Cards—Appendix H* for site specific applications). Effects are expected to be greater in those drainages with the highest percentages of harvest. Recommendations are that RMA Standards and Guideline buffers should be adjusted only where there will be no increase in risk to fish habitat or other RMA functions within Project Area watersheds. The risk of sedimentation from unplanned events and cumulative effects is related to the amount of timber harvest, rate of harvest, and location of roads within a watershed. Although the amount of risk can be quantified, the frequency of such events in the past has been low, and the risk of future unexpected detrimental effects should be minimal because of the implementation of standards, guidelines, and other protective measures. These areas are identified on unit cards and may be updated between the Draft and Final EIS after more field work is completed.

Painted Creek watershed (E76A) rated the highest risk watershed for sediment delivery and deposition. Within Painted Creek watershed, 84 acres scheduled for harvest as part of the Brand X timber sale. Harvest for the Brand X sale may occur concurrently with the Sea Level entry. The streams in the Brand X units were surveyed by Forest Service biologists as part of the interdisciplinary team process. Analyses, since March 1997, identified sensitive areas to avoid within the Painted Creek watershed. Analyses conclude that the areas of the Painted Creek watershed proposed for harvest can be harvested with no loss to existing fish habitat, see Appendix D, Watershed Report–Painted Creek.

Table Aquatic-6 displays characteristics of the 53 watersheds in the project area with an area of 0.5 mi^2 or greater.

Table Aquatic-6
Watershed

ADF&G Number and Creek Name	Minor Code	Area (mi2)	Depositional Stream Index	Transi-tional Stream Index	Drainage Efficiency Index	Transport Potential Index	Storage Potential Index	Percent High MMI	Percent Harvest Roads Existing	Percent Harvest Roads Proposed	Percent Harvest Roads Total	Sediment Risk Index	Poten-tial Impact Index
101-45-10590	E47A	1.9	13	40	57	62	16	2	69	0	69	58	0
101-45-10530	E45A	1.4	10	52	47	52	13	9	63	0	63	48	0
No number or name	115A	1.3	7	19	55	87	8	61	47	13	60	49	37
No number or name	FA1A	1.3	26	17	100	53	27	1	38	15	53	69	61
101-43-10230	E72A	1.1	48	33	77	49	50	11	34	13	47	91	68
No number or name	113A	0.9	9	27	66	71	10	43	28	17	45	50	50
101-43-10150	E69A	0.7	5	26	37	66	7	89	31	13	44	39	31
No number or name	DX5A	0.6	0	31	34	64	2	81	44	0	44	21	0
101-43-10160	E70A	1.6	2	33	31	42	5	52	39	2	42	26	3
No number or name	FA4A	0.8	0	38	24	32	3	56	34	8	42	17	8
101-43-10290	E77A	2.4	23	53	93	63	27	18	28	13	41	75	57
101-43-10180	E71A	1.7	0	48	38	25	3	19	26	14	40	17	14
101-45-10900	E75A	1.1	48	0	95	31	48	8	16	24	40	71	100
101-45-10870	D96A	5.9	10	34	59	80	12	54	37	2	38	56	5
101-45-10710	E53A	0.8	8	0	25	32	8	71	15	21	36	30	37
101-45-10590	FA3A	0.5	0	52	41	52	4	58	29	7	36	25	10
101-45-10860 Marble Creek	D87A	5.9	11	49	44	57	14	54	32	3	35	52	9
101-45-10880 Painted Creek	E76A	11.1	29	17	77	100	30	65	22	13	35	100	75
101-45-10690	E52A	0.6	0	87	44	73	6	90	21	10	31	38	22
101-43-10095	EX8A	0.5	0	0	41	64	0	100	3	27	29	0	0
No number or name	DW1A	0.9	8	57	26	6	12	0	16	10	25	16	9
No number or name	EZ2A	0.8	74	95	89	19	80	4	11	13	25	71	56
101-45-10600	E48A	1.7	13	62	59	66	17	58	15	7	23	61	26
No number or name	E84A	0.8	0	29	55	82	2	81	19	3	22	23	4
101-45-10730 Gunsight Creek	D86A	3.2	17	47	75	42	20	27	11	11	22	53	34
101-45-10830 Licking Creek	D91A	6.4	4	36	51	63	7	65	17	4	22	38	10
101-41-10080	E67A	0.9	0	0	28	8	0	20	0	20	20	1	1
No number or name	DQ7A	0.5	0	0	35	24	0	39	7	13	20	0	0
No number or name	E81A	0.5	0	0	52	45	0	56	0	19	19	0	0
101-45-10850 Calamity Creek	I14A	6.6	4	59	48	45	8	50	13	6	19	34	12

Table Aquatic-6 (cont.)
Watershed

ADF&G Number and Creek Name	Minor Code	Area (mi2)	Depositional Stream Index	Transitional Stream Index	Drainage Efficiency Index	Transport Potential Index	Storage Potential Index	Percent High MMI	Percent Harvest Roads Existing	Percent Harvest Roads Proposed	Percent Harvest Roads Total	Sediment Risk Index	Potential Impact Index
No number or name	D92A	0.5	0	0	70	13	0	8	4	14	18	1	1
101-43-10470	E80A	0.8	17	100	52	15	24	18	0	18	18	34	37
101-43-10630	D85A	1.3	19	13	64	55	20	49	8	9	17	60	30
101-43-10750 Saddle Lakes	D79A	9.2	9	19	58	32	10	28	10	7	17	32	14
No number or name	E49A	3.0	19	64	50	37	23	40	10	6	16	54	18
101-43-10230	E73A	1.7	100	6	87	18	100	5	10	4	15	78	19
101-43-10630	E85A	4.6	10	21	27	22	12	47	9	5	14	29	9
101-45-10940	E42A	8.0	17	33	59	57	20	55	9	4	14	61	15
101-45-10670	E50A	5.3	3	23	52	53	4	63	5	8	13	28	13
No number or name	E82A	1.1	0	34	40	48	2	78	0	12	12	19	13
No number or name	DV9A	0.8	45	0	44	8	45	12	1	10	12	35	21
101-45-10610	DV8A	0.6	14	91	55	70	20	77	7	0	8	68	1
101-43-10410 Sea Level Creek	E79A	20.1	11	21	32	8	13	16	0	6	6	18	6
101-43-10560	E83A	2.5	2	9	38	39	3	64	4	1	5	19	1
101-43-10080	E68A	1.2	0	23	47	36	2	51	0	4	4	14	3
No number or name	E33A	5.9	11	16	47	26	12	34	2	0	2	32	0
101-45-10815	D93A	0.8	0	0	39	12	0	20	1	0	1	1	0
101-41-10120	E34A	1.6	8	7	56	44	8	52	0	0	0	35	0
101-41-10100	E35A	1.0	0	0	45	36	0	53	0	0	0	1	0
No number or name	E36A	0.6	0	0	38	24	0	41	0	0	0	1	0
No number or name	E64A	0.7	3	42	79	49	6	40	0	0	0	31	0
101-41-10600	E65A	1.0	0	0	50	43	0	55	0	0	0	1	0
No number or name	E87A	1.6	4	0	41	0	4	0	0	0	0	2	0

Source: Mike Brown, D. Parker Smith 1997.

Major Watersheds

The Watershed Report, Appendix D, contains detailed watershed characterizations of all the watersheds with proposed management activity. What follows are descriptions of the ten watersheds with a drainage area of 5.0 mi^2 or greater.

Buckhorn Creek (E50A)

Buckhorn Creek covers approximately 5 miles. Most of the channel types in this watershed transport sediment (88 percent) with very little depositional channel type, about 4 percent.

Buckhorn Creek ranks 23rd out of 53 watersheds with a PII score of 13. The detailed watershed characterization for this watershed shows that a 100- to 300-foot implementation buffer along the mainstem of this watershed would adequately protect the fisheries resources in this watershed. One hundred-foot minimum buffer widths were placed on this system's first entry which occurred approximately 3 years ago. If units identified in the unit pool for this watershed were harvested, 13 percent of the watershed would be roaded or harvested. There may be occasion in this watershed where reduction of RMA standard and guideline buffers along class three streams would not adversely affect the quality of fish habitat.

Calamity Creek (I14A)

Calamity Creek watershed covers approximately seven mi^2. The watershed extends inland from salt water to Misty Fiords National Monument boundary. The watershed ranked 24th with a PII score of 12 which is relatively low. If units identified in the unit pool for this watershed were harvested, cumulative disturbance would remain less than 20 percent. One-hundred foot TTRA buffers would adequately protect fish habitat in this watershed. There may be occasion in this watershed where reduction of RMA standard and guideline buffers along class three streams would not adversely affect the quality of fish habitat.

Coho Cove Creek (E33A)

Coho Cove Creek is a name given in this EIS. The watershed covers approximately 6 mi^2. Because there is no management activity proposed the PII score is 0 with a PII rank of 42. Approximately 2 percent of the watershed has been managed for roads or timber harvest which occurred at the headwaters.

Easy Creek (D96A)

Easy Creek covers approximately 6 mi^2. This watershed is not named on any maps and sets north of Marble Creek and South of Calamity Creek. The watershed extends inland from salt water to Misty Fiords National Monument boundary. The watershed ranked 32nd with a PII score of 5. If units identified in the unit pool for this watershed were harvested, cumulative harvest and road building would equal 38 percent of the watershed. This relatively low score is indicative of the high gradient (greater than 6 percent) stream channels throughout most of this watershed. This would be a watershed where critical riparian and fish habitat is generally restricted to the valley bottom and lower reaches of the watershed. There may be occasion in this watershed where reduction of RMA standard and guideline buffers along class three streams would not adversely affect the quality of fish habitat.

Fish Creek (D97A)

Fish Creek covers approximately 33 mi^2 making it the largest watershed in the Project Area. The Fish Creek watershed was not included in the Project area boundary for analysis because only 0.5 mi^2 of it was within the Project Area and no management is expected to occur there. If management did occur within this watershed the cumulative effects would be negligible. If units identified in the unit pool for this watershed were harvested, cumulative disturbance would equal 6 percent of the watershed within the Project Area. This watershed contains fewer than 10 acres of proposed harvest. The 10 acres are located on the northeastern watershed boundary and are not likely to have any adverse effects on the Fish Creek watershed.

Licking Creek (D91A)

Licking Creek watershed covers approximately six mi^2. The watershed extends inland from salt water to Misty Fiords National Monument boundary. The watershed ranked 27th for PII with a PII score of 9. If units identified in the unit pool for this watershed were harvested, 22 percent of the watershed would be roaded or harvested. Licking creek contains approximately two miles of pink and coho salmon habitat in the northern sub-watershed. The proposed harvest units identified in the unit pool surround the headwaters of this habitat. If critical riparian habitat remains intact, with buffers in excess of 140 feet, fish habitat would not likely be adversely affected.

Painted Creek (E76A)

Painted Creek watershed covers approximately 11.1 mi^2. The watershed ranked second for PII with a score of 75. If units identified in the unit pool for this watershed were harvested, cumulative harvest would reach 35 percent of the watershed. This watershed has the potential to be the most productive coho system on Revillagigedo Island. This assumption is based on channel types available in the watershed. Field visits were made to proposed units in this watershed including the Brand X timber sale. The units as planned can be effectively harvested while protecting critical riparian and fish habitat. There may be occasion in this watershed where reduction of RMA standard and guideline buffers along Class III streams would not adversely affect the quality of fish habitat. Appendix D, Watershed Report–Painted Creek contains a watershed analysis conducted for the sub-watersheds within this watershed.

Saddle Lakes (D79A)

The Saddle Lakes watershed covers approximately nine mi^2. The watershed contains over 480 acres of high quality resident fish lake habitat. Ten percent of the watershed was either roaded or harvested as part of the Shelter Cove EIS. Saddle Lakes watershed rates number 21 with a PII score of 14. There may be occasion in this watershed where reduction of RMA standard and guideline buffers along Class III streams would not adversely affect the quality of fish habitat.

Sea Level Creek (E79A)

Sea Level Creek covers approximately 20.1 mi^2 with approximately 9.5 within the Project Area. Sea Level Creek rates number 31 with a PII score of 6. The greatest potential for impact comes from placing a road to access the timber on the east side of the mainstem channel. One hundred to 300-foot implementation buffers along the mainstem would adequately protect the fisheries resources in this watershed. If units identified in the unit pool for this watershed were harvested, 6 percent of the watershed would be roaded or harvested. There may be occasion in this watershed where reduction of RMA standard and guideline buffers along Class III streams would not adversely affect the quality of fish habitat. Appendix D, Watershed Report–Sea Level Creek contains a watershed analysis conducted for the sub-watersheds within this watershed.

Spit Creek (E42A)

Spit Creek watershed covers approximately eight mi^2. Approximately half of this watershed makes up about half of the medium Old-growth LUD located on the southeast section of the Project Area. The watershed ranked 19 for PII with a score of 15. Based information from local anglers, this watershed contains some of the best steelhead habitat in the Project Area. If units identified in the unit pool for this watershed were harvested, cumulative harvest would equal 14 percent of the watershed. There may be occasion in this watershed where reduction of RMA standard and guideline buffers along class three streams would not adversely affect the quality of fish habitat.

Mitigation Measures

Road Management Considerations

Because roads route through many watersheds, the Project Area provides a more appropriate scale for management analysis of roads. USFS Fisheries Biologists evaluated the condition of existing roads (see Chapter 3 - Transportation and Facilities). The information in that section summarizes the number of existing stream crossings and number of fish passage pipes that currently impede fish migration. It also displays the number of class III and IV stream culverts that are not functioning properly. That section also addresses the acres of RMA affected by each alternative. Two recommendations for each Alternative, including the No Action alternative are to:

- Repair, remove, or replace stream crossing structures identified on existing roads as malfunctioning;
- Apply BMPs to improve crossings of class III, or IV streams, and road drainage ditches identified as potential or existing sediment sources; and
- Re-contour slopes where roads have either failed or will not need to remain open and pose a potential landslide or sediment source.

With site specific information available on existing roads, critical stream crossings and roads that are potential sediment sources can be effectively managed (funding dependent). This would be an effective first step towards watershed restoration while actively managing.

Enhancement Opportunities

Forest Service Biologists surveyed fish habitat on 38 streams within the Project Area. The primary objective was to identify effects on proposed harvest units i.e., dimensions and locations of Riparian Management Areas (RMA). In some surveys the crews reported watershed enhancement or rehabilitation opportunities. Potential projects have not been through environmental analyses or review to determine project feasibility. See *Knudsen-Vandenburg* (KV) *Appendix G* for discussion of potential projects and costs. The majority of the small instream structural projects, including projects such as large woody debris and gabion placement, mitigate past logging activities. These projects may be considered as rehabilitation rather than enhancement. All projects which are determined to be feasible, following environmental analysis, and on-site review, may be scheduled for implementation. Any funded riparian rehabilitation projects will be coordinated with watershed restoration projects.

No water quality improvement needs have been identified within the Sea Level Project Area. Watershed restoration opportunities and needs are documented in the Ketchikan Ranger District's Watershed Improvement Needs Inventory (WINI).

Ecological Landtypes

Key Terms

Alluvium—material deposited by rivers and streams including sediment laid down in river beds, flood plains, and at the foot of mountain slopes and estuaries.
Bedload—sand, silt, and gravel, or soil and rock debris rolled along the bottom of a stream by the moving water.
Bog—a wetland of slow-moving, nutrient poor, highly acidic water formed of peat derived predominantly from sphagnum moss.
Ecological Landtype—unit of land classification which combines the terrestrial biotic and abiotic components in an ecological relationship.
Ecosystem—a complete, interacting system of organisms together with their environment (for example a bog, forest, or lake).
Fen—a wetland of slow-moving, nutrient rich, often alkaline water with sedge peat forming the substrate.
Glacial Till—gravel, boulders, sand, and finer materials transported and deposited by a glacier.
Mass Movement Index (MMI)—rating used to group ecological landtypes that have similar properties with respect to the stability of natural slopes.
Muck—decomposed plant material, with little evidence of the original plant remaining.
Muskeg—a type of bog that has developed in depressions or flat areas; poorly drained, acidic, with organic soils that support vegetation that is predominantly sphagnum mosses and heaths.
Riparian area—the area including a stream channel, lake, or estuary bed; the water itself; and the plants that grow in and on the land next to the water.
Sediment—solid materials, in suspension or transported by water, gravity, ice, or air.
Slip plane—closely spaced surfaces along which differential movement takes place in rock.
Soil—the collection of natural bodies in the earth's surface, containing living matter and supporting or capable of supporting plant life.
Soil productivity—capacity of a soil to produce plant growth, due to the soil's inherent chemical, physical, and biological properties.
V-Notch—a shallow to deeply cut stream drainage, generally in steep, mountainous terrain; would look like a "V" from a frontal view.
Windthrow—areas where trees are uprooted, blown down, or broken off by storm winds.

Affected Environment

Ecological Landtypes

In Southeast Alaska, terrestrial ecosystems have been classified on the basis of natural soil-vegetation complexes (Stephens et. al. 1969; Babik, 1995). The ecological landtypes include biotic and abiotic components of the Southeast Alaskan landscape, and are grouped into "associations" with broad environmental similarities. The families are subdivided into "ecological landtypes". Within each type, species composition, productivity, secondary plant succession, and ecosystem functions are similar. Ecological landtypes are subdivided into "phases", based on soil and geomorphology characteristics such as soil depth, substratum character, or landform. The ecological landtypes in the Sea Level area are displayed in Table Ecological-1.

This classification system describes patterns in climatic, landform, soil and floristic conditions on the Ketchikan Ranger District and Misty Fiords National Monument that differ in some respects from other regions in the Forest and State. These variations are due primarily to latitude effects upon temperature gradients, differences in landform and parent materials, and associated vegetative composition and soil development. The Ecological Classification and Inventory was developed to obtain information, within an ecological framework, for integrated resource planning and management, including the conservation of biological diversity. The evolution of ecosystem management will depend, in part, upon how well we define ecosystems and their processes, and identify spatial distributions through long-term research and monitoring.

Landscapes of southern Southeast Alaska differ in age, geomorphology, hydrology, vegetation density, species composition, successional dynamics and productivity. The landscape is a complex ecological mosaic inadequately described by inventories that focus on geology, hydrology, soils or vegetation alone. The shallow rooted habits of most native tree species require characterization of more than just agricultural soil characteristics to understand tree growth and response. Extremes in moisture regimes and site hydrology affect species composition and growth. The ground flora may be more diverse than the forest canopy, may have important wildlife value, and is often silviculturally significant. Consequently, landscape ecosystems around Ketchikan have to be defined by combinations of geologic, vegetative, soil, hydrologic and ground surface features.

The Ecological Classification and Inventory divides the landscape into a nested spatial hierarchy, with a few exceptions. Upper levels, or Sections and Subsections, are defined by macroclimate and regional physiography. The Project Area is located within the Carroll Inlet/Swan Lake, Thorne Arm and George Inlet Ecoregion Subsections. The Carroll Inlet/Swan Lake Subsection consists of a complex of glacially carved, U-shaped valleys containing numerous lakes, and rounded alpine ridges. This Subsection includes much of east-central Revillagigedo (Revilla) Island. The principle streams, Carroll Creek and Falls Creek, drain into Carroll Inlet. Relief is generally mountainous and elevations range from sea level to more than 4,500 feet on the summit of Mount Reid. The vegetation includes alpine tundra, subalpine conifer forest, muskegs, coastal temperate rain forest and riparian spruce-hardwood forest. The George Inlet Subsection consists of coastal lowlands on south-central Revilla Island. This Subsection includes that area to the north and east of George Inlet and associated small islands. Local relief is low, generally ranging from sea level to just over 2,000 feet. The principle watersheds are Leask Creek and Salt Creek. This landscape is relatively flat, consisting of till plains, marine terraces and metasedimentary bedrock. The vegetation consists mainly of coastal temperate rainforest and muskeg. The Thorne Arm Subsection consists of coastal lowlands on Revilla Island. This Subsection includes that area surrounding Thorne Arm and associated small surrounding islands. The main watersheds include Fish, Gokachin and Sea Level Creeks. The Fish Creek watershed includes several large lakes: Big Lake, Basin Lake, Third Lake and Mirror Lake. Gokachin Lake and Mesa Lake are in the Gokachin Creek watershed. Local relief is low, generally ranging from sea level to just over 2,000 feet. This landscape is relatively flat, consisting of till plains, marine terraces and metasedimentary bedrock. The vegetation consists mainly of coastal temperate rainforest and extensive areas of muskeg.

Intermediate levels, or Landtype Associations (LTAs), are defined by geomorphology and gross differences in Potential Natural Vegetation (PNV). Lower levels, Ecological Landtypes (ELTs) and Ecological Landtype Phases (ELTPs), are defined by ground flora composition and abundance, soils, substrata, and local physiography. ELTs for the Sea Level Project Area are described in Table Ecological-1.

Table Ecological-1
Ecological Landtypes

		Acres within Project Area
Estuarine Meadow Ecological Landtypes		
E1	Sedge meadow wetland ecosystem	13
E2	Hairgrass meadow wetland ecosystem	21
E3	Beach ryegrass and silverweed wetland ecosystem	38
Forest Ecological Landtypes		
F1	Deep, well-drained soils, high site productivity, western hemlock plant series	2,674
F1t/f1t	Young forest ecosystems on alluvial soils, very high site productivity, Sitka spruce plant series	1,061
F12	Shallow to deep, well-drained soils, high site productivity, western hemlock plant series	261
F2	Shallow, well-drained soils over bedrock, high site productivity, western hemlock plant series	18,970
F2a	Shallow, well-drained soils over volcanic ash, high site productivity, western hemlock plant series	1,021
F2k	Shallow, well-drained soils over carbonate bedrock, high site productivity, western hemlock plant series	573
F2r	Very shallow, well-drained peat soils over bedrock, moderate site productivity, western hemlock plant series	2,471
F3b	Very deep, well drained beach soils, very high site productivity, Sitka spruce plant series	25
F4r	Moderately deep, somewhat poorly drained, low productivity soils, western hemlock or mixed conifer plant series	19,345
F5	Deep, poorly drained soils, very low site productivity, mixed conifer plant series	10,941
F6	Somewhat poorly drained soils of subalpine zone, mountain hemlock plant series	11,155
Muskeg Ecological Landtypes		
M1	Sphagnum bogs, deep fibrous peat	24
M2	Sedge and heath dominated bogs and fens	5,236
M3	Tall sedge fens, deep peat, and muck	334
MF5	Complex of sphagnum bogs, sedge fens and forested wetlands, mixed conifer plant series	8,390
Alpine Ecological Landtypes		
A1	Alpine heathlands	3,212
A2	Alpine sedge meadows	189
AF6	Complex of alpine meadows, heathlands and subalpine forestland, mountain hemlock plant series	5,299
Brush-slope Ecological Landtypes		
B	Avalanche tracts and snowload slopes dominated by Sitka alder	3,572
Alpine Rockland Ecological Landtypes		
R	Bedrock, mostly unvegetated, with only a partial cover of lichens, mosses, and a few alpine forbs and grasses	852

Source: Babik 1996.

This ecological landtype classification should not be confused with the soil classification system. Because the criteria used to classify soils are not always ecologically significant in Southeast Alaska, some soil types occur in more than one ecosystem type, and some ecosystem subtypes contain several closely related soils. The ecological landtype classification is designed to stratify the landscape of Southeast Alaska into practical ecological landtypes to serve as a basis for interpretation and management. For a more detailed description of the ecological landtypes of Southeast Alaska see, a *Field Guide to the Ecological Classification and Inventory System*, Babik 1995.

Plant Communities

Pojar and MacKinnon (1994), described the following forest and nonforest areas of regional vegetation for Southeast Alaska:

Alpine Heaths

Alpine heaths occupy high elevations throughout most of the northern Pacific coastal region, above 2,000 to 2,500 foot elevation. Heaths characteristically are dominated by dwarf, shrubby, evergreen members of the heather family, with other common species such as black crowberry, partridge-foot and bird's-beak lousewort. The ground cover forms a springy carpet, often so dense it obscures everything underfoot, including rocks and holes. Alpine heaths are similar to the A1 Ecological Landtype of Babik (1995) and typically include the Hydaburg soil series.

Mountain Meadows

Mountain meadows are less extensive than heaths, but are lush, intensely green, and dominated by herbs. Typical species include arrow-leaved groundsel, subalpine daisy, Sitka valerian, arctic lupine, Indian hellebore, gentians, sedges, and grasses such as purple mountain hairgrass. Mountain meadows are analogous to the A2 Ecological Landtype and typically include the Sunnyhay soil series.

Alpine Rocklands

Alpine rocklands include rock outcrops, cliffs, boulder fields, fellfields, talus and scree slopes, wet runnels, gullies, and avalanche tracks. The plant cover is usually sparse and discontinuous, but it includes many different saxifrages as well as ferns, buttercups, sedges and many species of lichens and bryophytes.

Subalpine Forest

Subalpine forest is characteristic of areas with a substantial, persistent winter snowpack. These conditions prevail only at high elevations, generally above 1,500 feet. Mountain hemlock and yellowcedar are the characteristic species, although subalpine fir can occur in drier, colder areas. Sitka spruce can also be a significant element of the subalpine forests. This is similar to the AF6 and F6 Ecological Landtype of Babik, 1995, and typically includes the St. Nicholas and Tolstoi soil series.

Perhumid Rainforest

Perhumid rainforest dominates low and middle elevations. Western hemlock is the most common tree in this zone. Sitka spruce is common throughout, especially along rivers and shorelines. Alaska yellowcedar and western redcedar are restricted to wet sites, where they are usually small or stunted and often occur with mountain hemlock. The perhumid rainforest includes the F1, F2, F4, and F5 Ecological Landtypes. The dominant soils are the Kupreanof, Tolstoi, and Maybeso series.

Freshwater Marshes and Fens

Freshwater Marshes and Fens occur where freshwater carries relatively high amounts of nutrients and is not highly acid. They are dominated by sedges and grasses: Sitka sedge, bluejoint grass, tufted hairgrass, and small-flowered bullrush. Shrubs, such as Douglas spirea, sweet gale, Pacific crab apple, and Sitka willow are common along marsh edges and streambanks. Freshwater marshes and fens are similar to the M2 and M3 Ecological Landtypes. Common soils include the Kina and Maybeso series. These areas make up the Riparian Fens Landscape Zone described in Chapter 2, Table 2-1.

Bogs or Muskegs

Bogs or Muskegs are highly acid peatlands with stagnant waters that originate as rain or snow falling directly onto the bog; they do not transport nutrients in runoff from adjacent areas. These wetlands are dominated by sphagnum mosses. Characteristic shrubs include Labrador tea, bog rosemary, bog blueberry, and cranberry. Stunted, gnarled shore pine, Alaska yellowcedar, western redcedar, and both hemlocks are typically scattered in these bogs. The colloquial term 'muskeg' is used to refer to the complex mosaic of fens, bogs, pools, streams, and scrubby forest that is common to the area. Bogs or muskegs are analogous to the M1 Ecological Landtype and typically include the Maybeso and Kogish soil series.

Rocky Shores

Rocky Shores are the most common type of shoreline within the Sea Level Project Area. Terrestrial plant cover is sparse, especially on exposed rocky headlands and cliffs. Adaptations to salt spray and moisture stress include cushion and matted growth forms and thick, waxy, succulent or densely haired leaves. Sea plantain, hairy cinquefoil, coastal strawberry, chocolate lily, and salal are typical of the hardy vegetation of exposed rocky shores.

Shingle Beaches

Shingle Beaches, composed of large gravels or cobbles, are also widespread in the Project Area. They usually support clumps of searocket, dunegrass, beach pea, giant vetch, coastal strawberry, springbank clover, and sand wort. Such plants are especially common on the upper beach and among the piles of driftwood at the winter storm high tide line. Included in this ecosystem are the Salt Chuck and Sokolof soil series.

Sand Beaches

Sand Beaches are uncommon in the Sea Level Project Area. They occur mainly as small pockets in Rocky Shores and Shingle Beaches. Vegetation is sporadic, but showy species including searocket, beach-carrot, and beach pea show up. Farther up the beaches large headed-sedge, dune grasses, paintbrushes, lupines, and silverweed become common.

Tidal Marshes

Tidal Marshes are the most productive maritime plant communities, especially those with brackish or low-salinity water, such as the relatively large estuary of the Carroll Creek delta. Soils are usually fine-textured and rich in organic matter and nutrients, supporting lush meadow vegetation. Grasses and sedges, especially tufted hairgrass, Lyngby's sedge and dune wildrye dominate, but these marshes also support silverweed, springbank clover, lupine, and giant vetch. Tidal marshes include the D1, D2, and D3 Ecological Landtypes of Babik (1995). The soils are typically Aeric Cryaquepts, coarse or fine-loamy.

Soils

The soils of Revilla Island are the foundation upon which the ecosystem is built and functions. The soil is the interface between the biotic and abiotic components of the ecosystem, the medium in which many of the complex interrelationships characteristic of forested ecosystems take place. The soil provides the medium for plant and animal growth and is the source of the productivity which drives the ecosystem.

Soils on Revilla Island are found on a variety of terrains shaped by glaciation and characterized by U-shaped valleys with mountains extending 2,000 to 3,000 feet above sea level. Glacial till of variable thickness occurs in the valley bottoms and up to 1,500 feet on the sideslopes. Many of the valleys have numerous rocky knobs scoured by glaciation. See the Geology section of this chapter for further information.

Soil development in Southeast Alaska is influenced by high levels of rainfall, cool maritime temperatures, and moderately-low annual soil temperatures. Under these conditions, organic matter decomposes slowly, resulting in a thick layer of organic material. Disturbances also play an important role in the development of Southeast Alaskan soils. Wind-throw, flooding, and landslides are important types of disturbance that alter the soil surface and subsoil. In general, the other ecosystem components, parent material, topography, vegetation, animals, and climate influence the features of soils that affect and are affected by timber harvest activities. Soils influence the overall ecosystem functions, vegetation composition, water quality, riparian area, and wetland values, and the productivity of timber, fish, and wildlife in the Sea Level Project Area.

A soil survey which identifies the soil types, their distribution, and extent, has been completed on the Sea Level Project Area (Soil Survey for the Ketchikan Area, USDA Forest Service, unpublished). Soil descriptions and pertinent soil references are available in the Ketchikan Area Supervisor's Office. Soil references include: the Tongass Land Management Plan (TLMP 1997) Chapters 2 and 5; the Forest Ecosystems of Southeast Alaska (Swanston 1974); the Southeast Area Guide (USDA Forest Service 1977); the Alaska Regional Guide (USDA Forest Service 1983); and soil survey maps and associated soil series and map unit descriptions. Additional information on riparian and wetlands soils is located in the Riparian Areas, Floodplains, and Wetlands section of Chapter 3.

Two different levels of information were used in the development of the Sea Level Draft EIS. Initially, information was derived from the Ketchikan Area Common Land Unit (CLU) data. The CLU was derived primarily from the Ketchikan Area Soil Survey , a broad level resource inventory designed to be used as a Forest level planning tool. This information was used in the initial development stages of the project to define issues and the general locations of resource concerns and opportunities. It was used in the Effects Analysis of the Draft EIS and in Chapter 3 of the Draft EIS to characterize the Affected Environment for the entire Project Area.

The CLU information however, is somewhat limited for some aspects of planning and implementation. This has required the supplementing of the CLU data with project level ecological landtype phase inventory information, more detailed and site specific than the CLU data, in the Sea Level Draft EIS. This information was collected over a more limited area, generally near potential harvest units and along proposed road corridors. This project inventory information is displayed in the Harvest Unit and Road Cards in Appendix H. This project level information has been used in the Sea Level Draft EIS to design harvest units, roads stream crossings, mitigation measures and monitoring needs. This information is also used in the Effects of the Alternatives in this section. Further site-specific information is available in the Sea Level Draft EIS harvest unit folders, located at the Ketchikan Ranger District office.

Landtype Properties

Long-term Ecological Productivity

Site productivity is a critical element of terrestrial ecology since it affects the productivity of the entire forest ecosystem. Tree growth, wildlife and fish habitat, rare plant species, and subsistence plant gathering are all dependent upon the productivity of the site. In the Project Area, timber site productivity and forage production ranges from very high on moist, well-drained floodplains, to medium and high on moderately well and well drained upland sites, to low on poorly drained sites. Site category is used as a classification of timber site productivity on the Ketchikan Area. Site Index is directly related to the height of a typical 50 year old Sitka spruce. On sites with a site index of 45, a 50-year old Sitka spruce would be 45 feet tall. On sites with a site index of 60, a 50-year old Sitka spruce would be 60 feet tall. Site categories 1 through 3 are defined as follows:

Site Category	Site Index
1	45 to 56 (low)
2	57 to 66 (medium)
3	+ 77 (high)

The acreage by site category, within the Sea Level Project Area, are listed below in Table Ecological-2.

Table **Ecological**-2
Ecological Site Productivity Classes in the Project Area (Acres)

Low 1	Medium 2	High 3
43,912	18,970	5,605

Source: Babik 1996.

Because of the role which organic matter plays in forest productivity, maintaining the organically enriched topsoil layers is important for maintaining long-term ecosystem productivity. Site productivity and its related nutrient content can be influenced in a number of ways by natural disturbances and timber management activities. Removal of the surface layer may be caused by windthrow, flooding, landslides, surface erosion, severe yarding disturbance, or from displacement by roads, skid trails, landings, or rock pits. Soils can be altered by puddling, which impairs soil porosity and drainage and therefore reduces productivity. Reductions in site productivity that last beyond the planning period are considered to be significant impairments. A 15 percent reduction in inherent site productivity potential is the threshold for setting values for change in measurable or observable site properties associated with long-term productivity (FSM 2554.03).

However, site disturbance should not be considered entirely detrimental. Site disturbance for example, whether natural or management induced, can increase biological diversity by providing a range of site conditions which enhance the regeneration of early mid-seral stage species, such as fireweed, salmonberry, red alder, and Sitka spruce. Flood waters and landslides also deposit soil materials which develop into some of the highest productivity floodplain and footslope sites in the area.

Erosion

Two major types of erosion occur within the Project Area: (1) surface erosion and (2) landslides.

Surface Erosion

Most undisturbed sites in the Project Area are resistant to surface erosion because they are generally protected by the surface layers of organic matter and the roots of vegetation. However, when mineral soils are exposed, erosion can occur. The rate of erosion depends primarily on the amount of vegetation ground cover, erodibility of the soil, and the steepness of slope. Locations where surface erosion and mass wasting are most likely are along stream banks, snowslide or avalanche slopes, and within V-notches. Timber harvest activities and road construction may increase the erosion rate by exposing mineral soil.

Landslides

Landslides are the dominant process of natural erosion in ecosystems of Southeast Alaska. Many landslides occur during or immediately after periods of heavy rainfall when soils are saturated. Landslides usually occur on steep slopes that have soils with distinct subsurface "slip" layers (slip-planes), such as compact glacial till or bedrock that slopes parallel to the ground surface. These areas have a high likelihood of landslides, either naturally occurring or if disturbed by blasting rock or road pioneering, side casting of excavated material, or logging practices that cause substantial surface disturbance.

Vegetation, particularly tree roots, seem to have a stabilizing effect on slopes, but tree roots tend to significantly decrease in strength five to seven years after a tree is cut (Swanston 1989). This decrease in soil holding capacity results in an increased likelihood of slope movement on steep slopes following clearcutting. Effects of partial cutting on slope stability in Southeast Alaska are relatively unknown. Under natural conditions, windthrow is an important triggering device of landslides in Southeast Alaska. Recent research in Southeast Alaska (Swanston 1989) has suggested that although less than 10 percent of all landslides in the past 20 years were related to logging or roads, logging and roads may increase the potential for landslides in a given area.

A broad analysis of slope stability conducted on the Project Area was based on the Ketchikan Area Soil Survey. Landslide potential, expressed as the mass movement index (MMI) ratings were used to group ecological landtypes that have similar properties with respect to the stability of natural slopes. Four classes of MMI, 1 (low), 2 (medium), 3 (high), and 4 (very high), have been assigned to ecological landtypes according to their relative potential for landslides, as indicated by their physical properties.

Naturally unstable slopes are common throughout the Project Area. Table Ecological-3 shows total acres of each MMI class in the Project Area by VCU. These MMI ratings are based on general characteristics of typical ecological landtypes found in the Ketchikan Area.

Table **Ecological**-3
Mass Movement Index Classes in the Project Area by Watershed (Acres)

Watershed	MMI = 1	MMI = 2	MMI = 3	MMI = 4
Calamity Creek	828	1,246	793	1,314
Painted Creek	1,151	1,210	3,655	914
Sea Level Creek	2,260	1,737	1,257	717
Licking Creek	791	624	2,105	565
Marble Creek	584	1,053	1,635	398
Saddle Lakes	1,916	830	1,241	138
All Other Watersheds	19,565	13,450	21,357	6,993
Total	**27,095**	**20,150**	**32,043**	**11,039**

Source: Babik 1996.

A more detailed project level ecological landtype phase inventory of the Sea Level Project Area, which included potential timber harvest units and proposed roads, was conducted during project development. Maps in the Sea Level Planning Record display the distribution of high and very high MMI sites, mapped in this inventory, in relation to roads and harvest units. These areas are also displayed for each unit in the Harvest Unit and Road Cards in Appendix H. Very high MMI sites are not suitable for timber harvest, as described in the TLMP (1997), Timber Suitability Classification, pp. A1-16.

Effects of the Alternatives

Direct and Indirect Effects

Ecological Site Productivity

The action alternatives have the potential to reduce ecological site productivity. However, application of ecosystem management practices for the maintenance or improvement of site productivity (FSH 2509.18) will limit these reductions below threshold levels (FSM 2554 R10 Supp. 2500-92-1). Furthermore, units were located and designed during the planning process to minimize adverse effects on site productivity.

An analysis of timber harvest on the site productivity classes is included in the Silviculture and Timber section of Chapter 3.

Ecological landtypes presently supporting productive ecosystems would be disturbed in all the proposed action alternatives to varying degrees. Disturbance of sites by road, landing, and rock pit construction will result in the loss of soil. Timber harvest may result in site disturbance, displacement or exposure, or puddling that could reduce site productivity. Road construction and timber harvest may result in an increase in the occurrence of landslides (Loggy 1974; Swanston 1989) and may result in reduced productivity on those sites.

Estimated amounts of soil displacement which may be expected within harvest units with the proposed silvicultural and yarding systems are displayed in Table Ecological-5. In making these estimates, several assumptions were made: (1) helicopter yarding systems will result in no soil exposure, regardless of silvicultural system; (2) soil exposure with all cable yarding and silvicultural systems will result in an average of 5.9 percent of the soil surface displaced or exposed within harvest units (based upon work by Landwehr 1992); (3) shovel yarding systems will result in an average of eight percent of the soil surface displaced within harvest units (Landwehr 1992); and (4) partial cutting (single tree, group selection, see Silviculture section of this chapter) will result in the same amount of soil displacement as clearcut silvicultural systems.

Table Ecological-4 displays the acres of site disturbance that may occur with each alternative.

Table **Ecological**-4
Acres of Site Disturbance by Alternative

	Alternative					
	1	**2**	**3**	**4**	**5**	**6**
Acres of Site Disturbance	0	153	92	65	44	22
Total Acres Harvested	0	2,843	1,620	1,225	848	390
Percent Disturbance Acres of Total Harvest Acres	0	5.4	5.7	5.3	5.2	5.6

Source: Babik 1996.

Site disturbances resulting from landslides and other surface disturbances may result in long-term reduction of site productivity. The amount of time required for rehabilitation depends on the severity of the disturbance and its exposure to continued aggravating forces.

Site disturbance enhances the capability of some tree species, particularly Sitka spruce and western red cedar, to regenerate and grow on a site. A certain level of soil scarification is desirable on spruce and red cedar sites to prepare a suitable seedbed. In the absence of site disturbance, regeneration conditions on most sites in Southeast Alaska typically favor western hemlock, a species that regenerates prolifically on undisturbed forest floor leaf litter.

Erosion

Some erosion and landslides may occur in all alternatives, including the no-action alternative. Erosion will most likely occur on areas where the soil surface has been exposed.

Two forms of erosion may be accelerated by timber harvest activity:

- **Surface Erosion**—includes sheet, rill, and gully erosion on exposed mineral soils in harvest units; caused by felling and yarding activities, on road surfaces, cutbanks, and rock quarry sites.
- **Landslides**—which may be triggered by: (1) windthrow, (2) soil disturbance through felling and yarding activities, and (3) road-building activities such as blasting,

excavating slope support, overloading slopes by sidecasting excavated soil materials, and directing and accumulating water.

Surface Erosion

Some erosion may occur in all alternatives. Erosion will most likely occur on areas where the soil surface has been disturbed. Soil surface disturbance commonly occurs as a result of windthrow, landslides, road construction and stream channel migration. The amount of erosion that occurs will be related to the amount of soil exposure that takes place (Table Ecological-5). Due to the considerable amount of ground cover remaining on areas after timber harvest, erosion rates are typically quite low. Soil productivity may be reduced and sediment production may increase for a short period of time, until the site is revegetated, typically three to five years. Since each alternative includes a different amount of timber harvest and road construction, the alternatives are expected to result in differing levels of soil erosion. Of the action alternatives, Alternative 2 will result in the greatest amount of surface erosion. Alternative 6 will result in the least amount of erosion. Alternatives 5, 4, and 3 rank second, third, and fourth in the amount of erosion taking place.

Landslides

The individual or group tree selection forest regeneration harvest methods described in the Silviculture and Timber section of Chapter 3 will help to minimize landslide potential. This silvicultural system maintains a portion of the existing stand, providing better protection of landslide prone sites by retaining a living root system. Where clearcut forest regeneration harvest methods are used, a greater risk of landslide potential may be assumed. Landslides are most likely to occur when roads are constructed on landscapes with very high mass movement indices (MMI=4). Landslides typically occur less frequently when roads are constructed or timber is harvested on areas with a lower MMI. In most cases landslides are not as common on areas with medium or low MMI. A minor degree of site disturbance is unavoidable under any reasonably practicable timber harvest activity.

For the Project Area, 11,039 acres of the land base occur on sites inventoried as having a very high MMI. These sites are classified as unsuitable for the production of commercial timber. Timber harvest proposed on areas identified in the ecological landtype inventory as very high MMI required site inspection. During field reconnaissance, these areas were inspected by a professional soil scientist and, where appropriate, reclassified as MMI = 3 and suitable for timber harvest. Ecological landtype inventory map units typically contain inclusions which may be more suitable for a particular use than the inventoried sites. Inventory data is useful for modeling effects analysis but is not of sufficient detail for use in harvest unit layout.

The site investigations conducted for the Sea Level Project were designed to identify areas of high landslide potential (risk). There is no assumption made that the timing, location and condition under which landslides occur may be accurately predicted. Numerous methods are available for predicting the stability of slopes and embankments. The two basic approaches are: (1) limit equilibrium analysis and (2) deformation analysis. Most methods fall into the former category. Although the performance of a slope is often dictated by allowable deformations, routine quantitative predictions of displacements are seldom undertaken. Instead, the performance of a slope is evaluated in terms of it's factor of safety (risk) using limit equilibrium methods. There are several reasons for this; foremost are cost, complexity and the requirement for very accurate soil constitutive relations in deformation analysis. Limit equilibrium methods explicitly take into account the major factors that influence the shear stress and shear resistance in the slope. In addition limit equilibrium methods are simpler to apply than the deformation analysis. However, limit equilibrium analysis methods do not result in calculation of expected slope deformation which may produce a landslide. This analysis has some other drawbacks, such as those difficulties encountered in applying stability analysis to natural slopes. Some examples of difficulties are, problems of progressive failure, representative sampling and testing of soil, and unequal mobilization of shear strength along failure surface. In spite of these drawbacks, limit equilibrium analysis provides insights into the factors and conditions governing the stability of slopes. It also provides a rational basis for assessing slope hazard and designing mitigation measures but it does not predict landslides.

For analysis of the effects of the Sea Level Project, a more detailed ecological landtype phase inventory was conducted. Units with high MMI ratings will receive special consideration by a soil scientist to apply appropriate BMPs to timber harvest units. Road construction may require geotechnical evaluation (see Mitigation Measures, Chapter 2).

Table Ecological-5 displays the amount of timber harvest that is proposed on each MMI class within the Project Area.

Table **Ecological**-5
Timber Harvest in Acres by Mass Movement Index Class

	Alternative					
Mass Movement Index Class	**1**	**2**	**3**	**4**	**5**	**6**
Low = 1	0	308	139	49	47	1
Medium = 2	0	1,168	832	663	518	160
High = 3	0	1,367	649	513	283	229
Very High = 4	0	0	0	0	0	0

Source: Babik 1997.

Road building activities are sources of landslides and sediment. Preliminary monitoring reports of landslides initiated by road construction within the 89-94 KPC Long-term Sale EIS showed that 13 landslides occurred within a 2-year period (Landwehr 1992). The total area disturbed from all 13 landslides was less than 3 acres. A plan that minimizes road building over potential landslide areas would lessen the possibility of landslide occurrence and associated impacts. Table Ecological-6 includes miles of road construction proposed on each MMI class for each alternative.

Table **Ecological**-6
Road Construction in Miles by Mass Movement Index Class

	Alternative					
Mass Movement Index Class	**1**	**2**	**3**	**4**	**5**	**6**
Low = 1	0	14	7	4	3	3
Medium = 2	0	27	19	15	13	4
High = 3	0	16	12	7	6	4
Very High = 4	0	2	0	0	0	0

Source: Babik 1997.

Of the action alternatives, Alternative 6 proposes building the least amount of road over high MMI=3 sites, and Alternative 2 proposes to build the most over these landtypes. There is a low potential for measurable impacts to water quality and fish habitat from management-induced landslides if any of the action alternatives are implemented. The results of a recently completed Tongass-wide landslide survey can help illustrate the potential for landslide impacts in the Sea Level Project Area (Swanston and Marion 1991). This regional landslide survey, which included only large landslides greater than 100 cubic yards of soil displacement, estimates a landslide rate of 1.7 slides over a 20-year period. However, these results also indicate that a relatively small percentage of sediment generated from large landslide events will reach a stream. Swanston (1989) estimated that the increase in the incidence of landslides over natural occurrences throughout Southeast Alaska was about 3.5 times greater on managed acres.

Swanston's Tongass landslide survey categorized 23 percent of all landslides as debris torrents that occur in deeply cut V-notch gullies. Long-term impacts (greater than 10 years) to channel form and function and to fish habitat would be anticipated for Class I channel segments directly affected by a large landslide (Hogan and Wilford 1989). Based on Swanston's results, there is about a one-in-four chance that any management-related landslide will have an impact on Class I streams and only a very slight chance that impacts on fish habitat could occur. It can be inferred that the majority of these landslides would affect primarily Class III stream channels, since only about 3 percent of all natural and management-induced slide events in this survey were shown to directly affect Class I streams.

Care should be taken in extrapolating these results to the Project Area. Road construction and harvesting technology changes, as well as greater sensitivity to water quality and fish habitat concerns (as reflected in BMPs, for example, and much improved soil and water inventory information), have resulted in more effective management practices for timber operations in landslide prone areas. These factors will tend to reduce management-related landslide incidences in the Project Area from the rate observed by Swanston. On the other hand, many of the areas included in Swanston's survey had road systems that were predominantly located on stable locations on lower valley slopes. Roaded segments in the Project Area are proposed on relatively steep slopes, a factor which would tend to increase the potential incidence of road-related landslides. Thus, the frequency of landslide occurrence in the area is difficult to predict; however, areas with a high potential for landslide occurrence were evaluated in the planning process, and timber harvest was deferred in many of these areas during unit design.

Some of the roads proposed in this project are located on steep slopes which require special construction techniques to minimize the potential for slope failure. One of the techniques commonly used on these steep slopes is the excavation and full bench construction of roads. Full bench road construction generates large quantities of waste rock and overburden, material which typically cannot be disposed of on these steep slopes. This material must be hauled away and disposed of at a suitable site. Wetlands, riparian areas, or sites with a high risk of slope failure are not suitable disposal sites.

Alternative 2 would have the greatest direct effect in the year 2007. Alternative 6 would result in the least amount of soil disturbance. Alternatives 5, 4, and 3, respectively, would result in increasing amounts of soil disturbance. In all instances, the actions proposed would minimize soil disturbance to the maximum extent practicable through implementing the BMPs in the Soil and Water Conservation Handbook (FSH 2509.22).

The existing condition (1998) shows construction of about 86 miles of roads in the Project Area, resulting in a loss of about 350 acres in road right-of-way and rock quarry development since 1954. Approximately 670 acres of the soil surface are estimated to have been exposed by timber harvest activity in the Project Area since 1954. Alternative 1 would maintain this existing condition through the year 2007.

Alternative 2 would result in a total of about 240 acres of road construction and rock quarry development by 2007. It is estimated that Alternative 3 would result in a total of about 160 acres of road construction and quarry development. Implementation of Alternative 4 results in about 120 acres of road construction and rock quarry development by 2007. Alternative 5 produces about 90 acres of roads and quarries by 2007. Alternative 6 would result in 45 additional acres lost to road construction and quarry development.

Ecological Landtypes: Cumulative Effects

TLMP (1997) analysis forecasts that by 2140, all suitable lands within the Project Area (approximately 21,800 acres) will consist of a mosaic of even-aged stands of varying age classes and all-aged stands, the product of even-aged silvicultural systems. These management activities will incorporate state-of-the-art ecosystem management practices as they are implemented. By maintaining site productivity in the upcoming decades, the cumulative effects of these actions will remain within site productivity threshold levels. A total of 480 acres of road and rock pits would eventually be developed to harvest all suitable and available timber in the Project Area.

Cumulative effects of these actions upon long-term site productivity are directly related to the amount of disturbance that occurs through time and the amount of recovery that takes place in the ecosystem during this time. The ecosystem is a complex system with the capacity to absorb and recover from many of the impacts resulting from management of this nature.

Floodplains and Wetlands

Key Terms

Bog—a wetland of slow-moving, nutrient-poor, highly acidic water formed of peat derived predominantly from sphagnum moss.
Ecosystem—a complete, interacting system of organisms together with their environment (for example a bog, forest, or lake).
Estuarine—deep-water tidal habitats and adjacent tidal wetlands that are usually semienclosed by land, but which have open, partly obstructed or sporadic access to the open ocean, and in which ocean water is diluted by freshwater runoff.
Fen—a wetland of slow-moving, nutrient rich, at times alkaline water with sedge peat forming the substrate.
Hydrophytic vegetation—plants typically found in wetlands and dependent upon wetland moisture regimes for growth and reproduction.
Muskeg—a type of bog that has developed in depressions or flat areas is poorly drained, acidic, and has organic soils that support predominantly sphagnum mosses and heaths.
Primary succession—vegetation development that is initiated on a surface exposed for the first time, which has never supported vegetation before.
Secondary succession—the process of reestablishing vegetation after normal succession is disrupted by fire, cultivation, timber harvest, windthrow, or any similar disturbance; also follows primary succession.
Wetlands—areas that are inundated by surface or ground water with a frequency sufficient, under normal circumstances, to support vegetation that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Affected Environment

Floodplains

Floodplains are composed of naturally-eroded sediments carried by the stream or river and deposited in slack water sections of channels during high-water periods. Floodplains are considered to be areas subject to a 1 percent (100-year recurrence) chance of flooding in any given year. Nutrient-rich sediments underlain by coarse-textured sediments make floodplains the most productive lowland-timber, wildlife, and fisheries resource sites on the Tongass National Forest.

Several major floodplains are located within the Sea Level Project Area. The principal floodplains are located along Calamity, Licking, Marble, Painted, and Sea Level Creeks. Floodplains are defined in FSM 2527.05. These floodplains range from 1 to 2 miles long, and range up to 500 feet in width. They contain well defined main channels, a number of overflow and side channels, and areas of beaver-influenced ponds. Some timber has been harvested in the Calamity, Licking, Marble and Painted Creek floodplains in the past. A 100-year precipitation event will inundate most of this area. Smaller areas of floodplains are located along many of the other streams in the Project Area. There are an estimated 1,312 acres of total floodplains within the Sea Level Project Area.

About 14 percent of all floodplain areas within the Project Area has been harvested between 1954 and 1997. Most of the timber harvest on floodplains, about 67 acres, has occurred within the Licking Creek watershed. Timber harvest on floodplains has also occurred in the Calamity and Marble Creek watersheds, with approximately 57 acres cut.

Floodplains previously harvested for timber are now in various stages of secondary-plant succession. Except where the ground is highly disturbed, the stand composition on the secondary-successional floodplains is similar to riparian vegetation prior to timber harvest, with Sitka spruce typically forming the canopy. On the more disturbed sites where mineral soil was exposed during timber harvest activities, the vegetation is often composed of early-successional species, such as red alder and salmonberry.

Table Floodplains and Wetlands-1 displays the acres of floodplain in each watershed within the Project Area.

Table Floodplains and Wetlands-1
Acres of Floodplains

Watershed	Floodplain
Calamity	135
Licking Creek	200
Marble Creek	81
Painted Creek	35
Saddle Lakes	12
Sea Level Creek	31
Gunsite Creek	47
All Other Watersheds	771
Total	**1,312**

Source: Babik, 1998.

Wetlands

Wetlands are defined as: "those areas that are inundated or saturated by surface or groundwater with a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." (40 CFR 230.41(a)(1)). Identification of wetlands is based on the U.S. Corps of Engineers (COE) three-parameter system described in the U.S. Army COE Wetlands Delineation Manual (COE 1987). Wetlands are identified as areas having hydric soils, hydrophytic vegetation, and wetland hydrology. Soil resource inventory maps, including correlations between soil series and plant communities, were used to determine the extent of wetlands in the Sea Level Project Area. Hydrologic parameters were inferred from the soil moisture regime.

The Tongass National Forest has developed its own system of wetland classification and delineation. This method (DeMeo and Loggy, 1989) was used to describe and analyze wetlands in the Sea Level Draft EIS. This system of classification uses the three-parameter approach (COE 1987) adapted to the unique vegetation, soils and hydrology of coastal Southeast Alaska. Using this method of wetland definition and delineation, approximately 50 percent (45,948 acres) of the Sea Level study area (Project Area) is classified as wetland. This extensive wetland area consists of at least 12 different types of wetlands. Each type has different soil and vegetative communities, occupies different landscape positions, and has somewhat different functions and values. The majority of these wetlands are palustrine open or palustrine forested in the United States Fish and Wildlife Service (USFWS) wetland classification system. The most common wetland type is the forested wetland. Areas of riparian-forest wetlands are located mainly along Marble, Painted and Sea Level Creeks. A significant area, about 20 acres, of estuarine-meadow wetlands is located where Painted Creek discharges into Shoal Cove.

Wetland Types

The 12 wetland types classified and mapped in the Project Area are described below.

Alpine Shrubland/Muskeg

Alpine-wetland plant communities occur on poorly drained organic soils. This wetland type is a combination of palustrine-emergent wetland and palustrine scrub-shrub wetland. It is included within the AF6 ecological landtype as described by Babik (1995). These wetlands function mainly as areas of snow storage, meltwater discharge and summer habitat for terrestrial wildlife species. There are about 1,314 acres of this wetland type in the Project Area. These wetlands are common throughout the Project Area at elevations above 2,500 feet.

Alpine Tall Sedge Fens

A combination of sedge-meadow fens on deep peat deposits in depressions and low growing blueberry and mountain heather heaths on higher rises comprise this wetland type. The soils are typically shallow, poorly drained peats and mineral soils. This wetland type is included within the AF6 ecological landtype (Babik 1995) and the palustrine-emergent wetland and palustrine-scrub-shrub wetland of the USFWS classification system. The functions that these wetlands serve include storage of winter snowpack, recharge of down-slope streams and aquifers, and summer season wildlife habitat. These wetlands are relatively scarce within the Project Area, comprising about 28 acres. High-elevation sedge meadows provide unique summer range grazing opportunities for black-tailed deer, black bears, and where they occur, mountain goats. The meadows occur in small patches, generally less than 2 acres, and are located around the edges of alpine lakes and in wet alpine meadows mainly in the north part of the Project Area, in the Calamity and Licking Creek watersheds.

Alder/Salmonberry Shrublands on Mountainslopes

This wetland type is found on steep avalanche tracts which support plant associations of predominantly Sitka alder-salmonberry and elderberry. These wetlands are made up mainly of poorly-drained, poorly-developed mineral soils. This wetland type is included within the B ecological landtype (Babik 1995). This wetland is included within the palustrine scrub-shrub wetland of the USFWS classification system. These wetlands function as areas of snow storage, groundwater and stream recharge, and terrestrial wildlife habitat. They are important foraging areas for Sitka black-tailed deer and black bears and make up 1,981 acres of the Project Area. These wetlands are located mostly in the heads of the valleys such as Calamity, Licking, Marble and Painted Creek valleys.

Estuarine Meadow

This wetland type supports mainly sedge and beach-ryegrass communities. The soils are poorly-drained silts, sands and gravels. It is similar to the D3 ecological landtype (Babik, 1995). This wetland is included within the estuarine-intertidal wetland of the USFWS classification system. These wetlands are among the most unique, valuable, and scarce in the Project Area. They provide for: tidal/freshwater mixing zones, shoreline protection, areas where chemicals and pollutants are diluted, areas of flood conveyance, and areas of deposition of sediment and nutrient storage. They make up highly valuable habitat which supports shorebirds, waterfowl, and aquatic, marine and terrestrial wildlife, including important foraging habitat for black bear (possibly brown bear), mink, and river otter. They are probably the most biologically diverse sites within the Project Area. They are important sources of faunal and floral diversity. This is also probably the most important wetland type for subsistence use in the Sea Level Project Area. Four acres of this wetland type are in the Project Area, mainly in Shoal Cove and similar bays and inlets in Thorne Arm. This wetland type is included within the Riparian Fens Landscape Management Zone described in Chapter 2, Table 2-1. Estuaries are discussed in more detail in the Aquatics Resources section of this chapter.

Short Sedge Meadow

This is one of the relatively common wetland types within the Project Area. This wetland includes poor fen and rich bog communities dominated by short sedges. The soils are typically deep, poorly-drained peats and mucks. It is included within the M2 ecological landtype (Babik 1995) and the palustrine-emergent wetland of the USFWS classification system. This wetland conveys ground and surface waterflow along the landscape hydraulic gradient from higher parts of the landscape to riparian and lacustrine areas at the lower end of the gradient. It is among the most valuable areas for recharge of groundwater and streams, and for storage of sediment, nutrients and other chemicals. It provides unique waterfowl habitat, particularly for Vancouver Canada geese and sandhill cranes and serves as terrestrial-wildlife habitat for black bear, mink, river otter, pine martin, and beaver. This wetland type makes up about 1,878 acres and is located on mostly lower elevation side slopes, footslopes and ridgetops scattered throughout the Project Area.

Forested Wetland

This wetland type includes forested wetland plant associations, including those with skunk cabbage and deer cabbage as a major ground cover component. This wetland type is similar to the F5 ecological landtype (Babik 1995) and is included within the palustrine-forested wetland of the USFWS classification system. This wetland recharges groundwater and streams, and stores sediment, nutrients and other chemicals. It makes up about 24,480 acres and is located on mostly lower elevation side slopes and footslopes scattered throughout the Project Area.

Lakes and Ponds

These areas are open freshwater systems and are the lacustrine wetlands of the USFWS classification system. They are important habitat for:

- most aquatic species, including coho salmon and cutthroat trout,
- waterfowl, particularly Vancouver Canada geese and sandhill cranes, and
- furbearers such as mink, river otter, and beaver.

These areas also provide for flood control, discharge to streams, and storage of sediment, nutrients and other chemicals. The Project Area contains about 1,056 acres of lakes and ponds. The major lakes are located in the Shelter Cove area. This wetland type is included within the Riparian Fens Landscape Management Zone described in Chapter 2, Table 2-1.

Sphagnum Peat Bog

This bog is characterized by deep, very poorly-drained accumulations of sphagnum moss. This is the M1 ecological landtype (Babik 1995) and is included within the palustrine-emergent wetland of the USFWS classification system. This wetland recharges groundwater and streams, and stores sediment, nutrients and other chemicals. It is relatively rare and unique within the Project Area. It is a valuable source of biological diversity, supporting a number of unique and locally rare plant species. There are about 757 acres of this wetland type in the Project Area. The largest areas are located in Minx Flats (south of Shoal Cove) and the South Saddle Lakes area (just south of Shelter Cove).

Tall Sedge Fen

This wetland type includes fen communities dominated by tall sedges, typically Sitka sedge *(Carex sitchensis)*. The soils are typically deep, very poorly-drained peats or alluvial sediments. This wetland is similar to the M3 ecological landtype (Babik 1995) and is included within the palustrine-emergent wetland of the USFWS classification system. Tall sedge fens occupy an intermediate landscape position and serve as the hydraulic connection between bogs and other wetlands on higher landscape positions which donate waters to the riparian, lacustrine, and estuarine wetlands at the lower end of the landscape hydraulic gradient. They are among the most valuable areas for:

- recharge of groundwater and important fish streams,
- storage of sediment, nutrients and other chemicals,
- waterfowl habitat, particularly Vancouver Canada geese and sandhill cranes, and
- terrestrial wildlife habitat, including black bear (rarely brown bear), mink, river otter, and foraging beaver.

They are relatively scarce. Only 676 acres of this wetland type are found in the Project Area. They are located mainly around the margins of beaver influenced ponds, other lacustrine wetlands and riparian areas. The location of this type, adjacent to many of the Area's important fish streams, makes it especially unique and important for stream recharge and trapping sediment. Areas of these wetlands are concentrated in the Painted Creek watershed, in the upper part of the Sea Level Creek valley, and in the Minx Flats area. This wetland type is included within the Riparian Fens Landscape Management Zone described in Chapter 2, Table 2-1.

Scrub-Shrub Muskeg

This wetland type consists of a combination of forested wetlands, bog-shrub vegetation and sedge meadow bogs. It is similar to the MF5 ecological landtype (Babik 1995) and falls under palustrine-forested and palustrine-emergent wetlands in the USFWS classification system. This wetland type recharges groundwater and streams, and stores sediment, nutrients and other chemicals. About 12,513 acres of this wetland type are included within the Sea Level Project Area. One variation of this wetland type occurs along the major streams and includes the Sitka spruce/devil's club/skunk cabbage, red-alder/stink current, and Sitka willow plant associations. These riparian wetlands are among the most valuable wildlife habitats in the area, providing foraging, nesting, and denning sites for most of the terrestrial and avian species present.

Riparian Forest

This wetland type is made up primarily of the Sitka spruce/salmonberry/skunk cabbage and similar plant associations. This wetland type is included within the f1t ecological landtype phase described by Babik (1995) and is included within the palustrine-forested wetland of the USFWS classification system. This type provides for:

- recharge of groundwater and important fish streams,
- storage of sediment, nutrients and other chemicals,
- waterfowl habitat, particularly Vancouver Canada geese and sandhill cranes, and
- terrestrial wildlife habitat, including black bear (rarely brown bear), mink, river otter, and foraging beaver.

It is a relatively scarce wetland type. Only 498 acres of it are found within the Project Area; located on valley bottoms and floodplains. This wetland type is included within the Riparian Fens Landscape Management Zone described in Chapter 2, Table 2-1.

Subalpine Forested Wetland

This wetland type includes forested wetland plant associations in the mountain hemlock series, including those with skunk cabbage and deer cabbage as a major ground cover component. This wetland type is similar to the F6 ecological landtype described by Babik (1995) and is included within the palustrine-forested wetland of the USFWS classification system. It provides for recharge of groundwater and streams, and storage of sediment, nutrients and other chemicals. It makes up about 763 acres of the Project Area. These wetlands are located on mostly upper elevation side slopes and ridgetops in the northern part of the Area, particularly the Calamity and Licking Creek watersheds.

Wetland types were generated using soil resource inventory maps, based on correlations between soil series and plant associations. Hydrologic parameters were inferred from the soil (soil moisture regime) and vegetation (hydrophytic index) parameters (DeMeo and Loggy, Forest Service Report, unpublished).

Wetland site information was collected for the entire project area. Wetlands were classified and mapped using a field survey and aerial photograph interpretation technique (Babik 1995). This project-level information for wetlands is displayed on the Sea Level Wetlands Type Map enclosed in this EIS map packet. Detailed information on use and management, and mitigation measures is described in the Unit and Road Cards, Appendix H of this EIS. This project level information is used in the Effects Analysis in this section. Further site-specific information on wetlands is available in the Sea Level Draft EIS unit folders, located at the Ketchikan Ranger District office.

The natural and beneficial values of each wetland type differ in terms of their benefit to wildlife habitat, fish habitat, hydrologic properties (flood flow moderation, groundwater recharge and discharge), site productivity, and water quality.

Skunk cabbage is a common indicator of local wetlands.

The total area of selected wetland types within the Project Area is shown in Table Wetland-2.

Table Floodplains and Wetlands-2
Acres of Selected Wetland Types Within the Project Area

Forested Wetland	Estuarine Meadow Wetland	Tall Sedge Fen	Sphagnum Peat Bog	Scrub-Shrub Muskeg
24,480	49	676	757	12,513

Source: Babik 1998.

For further information on wetlands and wetland habitats see the Sea Level Timber Sale Report, Ecosystem Resource Report (Babik 1997).

Value and Function

Wetland values are defined here as socioeconomic benefits derived from wetland functions, goods and services (quantifiable or not). Some of the most important wetland values in Southeast Alaska include:

- habitat for wildlife, fish and sensitive or endangered plant and animal species,
- timber harvest,
- berry and other edible plant harvest,
- water quality maintenance,
- flood control, and
- recreation opportunities.

Wetland functions are physical attributes of the wetland ecosystem and can be organized as follows:

- Hydro-geomorphic functions are: groundwater recharge and discharge, surface hydrologic control, streambank and shoreline maintenance, erosion control, sediment storage, temperature regulation, microclimate control, karst landscape formation, and maintenance of overall landscape diversity.
- Biochemical functions are: element cycling, maintenance of water chemistry, carbon and nitrogen storage, nutrient export and utilization, and decomposition.
- Biological functions are: primary and secondary productivity, biological diversity, and terrestrial and aquatic habitat for vascular and non-vascular plants, fish, mammals, gamebirds, nongame birds and invertebrates.

The biological significance of a wetland is related to the value of its functions and, at least in part, to the relative scarcity of the wetland type in the landscape. This is especially true in terms of biological diversity on the landscape scale. The relatively scarce fens and estuarine salt marshes in the Sea Level area have a greater biological significance than the more common bogs and forested wetlands which are widespread throughout the landscape.

The interdisciplinary team, made up of specialists in fisheries, forestry, vegetation, watershed and wildlife management, has assigned relative wetland values to the various wetland types found in the Project Area. These wetland values are based upon the social and economic benefits derived from the different types of wetlands, and the relative abundance and location of the wetland types. These wetland values were used in development and analysis of Project alternatives. Wetland values were also considered in making decisions concerning the minimization of development in, or avoidance of, wetlands and the design and implementation of mitigation measures. Further detail on this process is included in Wetland Values Matrix (Appendix G) of Volume II of this EIS.

High-value Wetlands

This value has been assigned to several wetland types including: estuarine meadows, lakes and ponds, tall sedge fens, and the riparian forest. These wetlands serve as important habitat for anadromous and resident fish. They provide important wildlife habitat for Sitka black-tailed deer, black bear, martin, mink and other fur bearers. They provide important elements of streambank and shoreline maintenance and serve to directly regulate stream flow and water quality. A number of unique or sensitive plant species are typically concentrated in these wetland types. Typically these are high-use subsistence areas. The riparian forests generally have a very high-timber-site productivity and support high-volume Sitka spruce stands. These wetland types are relatively scarce and are scattered throughout the Project Area. Maintenance of their important functions and values is a high priority. There are approximately 2,234 acres of high-value wetlands within the Area.

Medium-value Wetlands

These include the alpine tall sedge fens, alder/salmonberry shrublands, short sedge muskeg and sphagnum peat bogs. These wetlands serve as seasonally-important habitat for terrestrial wildlife, habitat for unique plant and animal species, groundwater recharge and discharge, and maintenance of landscape diversity. Sphagnum peat bogs and the short sedge muskeg are important berry harvesting areas. Several of these wetland types are in open terrain that provide enjoyable walking and scenic views. They generally are locally common, but are typically concentrated on certain parts of the landscape. There are approximately 4,644 acres of medium-value wetlands within the Project Area.

Low-value Wetlands

These include those types dominated by scrub forest or low-productivity forest land. These wetland types include the alpine shrubland/muskeg, forested wetlands, scrub-shrub/short sedge muskeg and subalpine forested wetlands. These wetland types cover extensive areas of the Project Area. They generally provide only marginal habitat for terrestrial wildlife and aquatic organisms. They have some value for groundwater recharge and maintenance of streamflow. Generally, the timber site productivity of these forested wetlands is low, and they often support noncommercial or only marginally-commercial forest stands. Usually the vegetation grows too thick and is too difficult to negotiate to provide an enjoyable recreation experience. There are approximately 39,070 acres of low-value wetlands within the Project Area.

Table Floodplains and Wetlands-3 displays which wetland types, found in the Sea Level Project Area, are of low, medium and high value. These values are intended to represent some of the most socially and economically significant values within the Project Area, but are by no means intended to represent all the possible social and economic values and benefits derived from these wetlands.

Table Floodplains and Wetlands-3
Values of Wetland Types Within the Project Area

High-value Wetlands	**Medium-value Wetlands**	**Low-value Wetlands**
Estuarine Meadow	Alpine Tall Sedge Fen	Alpine Shrubland/Muskeg
Lakes and Ponds	Alder/Salmonberry Shrublands	Forested Wetland
Tall Sedge Fen	Short Sedge Muskeg	Scrub-Shrub Muskeg
Riparian Forest	Sphagnum Peat Bogs	Subalpine Forested Wetland

Source: Babik, et. al. 1997.

Effects of the Alternatives

Direct and Indirect Effects

Floodplains

Executive Order 11988 directs Federal agencies to provide leadership and take action on Federal lands to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains. Agencies are required to: (1) avoid the direct and/or indirect support of floodplain development whenever there are practicable alternatives, (2) evaluate the potential effects of the proposed action on floodplains, (3) ensure that program planning and budget requests consider flood hazards and floodplain management, and (4) prescribe procedures to implement the policies and requirements of the Executive Order.

Many of the floodplains in the Project Area have been affected since the 1950s. Road construction and timber harvest in the Painted Creek valley during the 1950s and 1960s has affected about 30 acres. The lower reaches of the Calamity and Marble Creek floodplains and their tributaries have also been affected; about 57 acres of timber harvest have occurred. Impacts have included disturbance of floodplain soils and initiation of primary successions, resulting in replacement of spruce stands with even-aged stands of red alder.

During road construction, both direct and indirect impacts to floodplains may occur. There may be no detectable influence, or there can be flow alteration in minor streams because of routing by roadside ditches and culverts. Channel and flow alteration may locally affect the velocity of flows, width and depth of water, and the location of flow. Such factors may physically result in different erosion and sediment transport characteristics.

Table Floodplains and Wetlands-4 summarizes the number of roads that cross streams and that may affect floodplain areas. All proposed new road construction is included.

Table Floodplains and Wetlands-4
Number of Road Crossings in Floodplains

	Alternative					
	1	**2**	**3**	**4**	**5**	**6**
Number of Crossings	0	50	21	16	15	13

Source: Oien 1998.

Best Management Practices (BMPs) will be used to minimize impacts on floodplains as well as to protect roads and drainage structures. Examples of such practices include designing bridges and culverts to handle the expected flows and installing frequent cross drains or ditch-relief culverts at natural drainages, and also in places to minimize erosion from large concentrations of water moving overland.

Table Floodplains and Wetlands-5 shows the acres of floodplains within each watershed that have been proposed for inclusion in timber harvest units.

Table Floodplains and Wetlands-5
Proposed Timber Harvest in Floodplains (Acres)

	Alternative					
Creek	**1**	**2**	**3**	**4**	**5**	**6**
Calamity	0	0	0	0	0	0
Licking	0	0	0	0	0	0
Marble	0	0	0	0	0	0
Painted	0	3	3	3	3	0
Sea Level	0	0	0	0	0	0
Total	**0**	**3**	**3**	**3**	**3**	**0**

Source: Babik 1998.

Wetlands

A dozen forested and nonforested wetland types occur in the Project Area, as described in the Affected Environment portion of this section. Wetlands have value as habitat to a variety of wildlife species, some of which use wetlands seasonally or as travel-ways. Other wetland values which may be affected by the proposed alternatives include timber productivity, water supply, and flood control.

On the majority of sites, only low-value wetlands will be affected by planned Forest management activities. The Sea Level alternatives, timber harvest unit designs, and road location and construction design have been planned to avoid and minimize the effects upon medium- and high-value wetlands.

Executive Order 11990, as amended, requires Federal agencies exercising statutory authority and leadership over Federal lands to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands. Federal agencies are required to preserve and enhance the natural and beneficial values of wetlands in carrying out their responsibility for: (1) acquiring, managing, and disposing of lands and facilities, (2) providing federally undertaken, financed, or assisted construction and improvements, and (3) conducting Federal activities and programs affecting land use.

Effects to wetlands within the Project Area may be divided into two categories: (1) permanent loss and (2) disturbance. *Permanent loss* is a long-term effect in which wetlands are excavated or filled for features such as roads, landings and log transfer facilities. The most direct effect upon wetlands would be the fill associated with road construction, although Forest managers are required to consider alternative road locations and effects on wetlands. Roads are located outside of estuarine, lacustrine, and riverine wetlands, to the maximum extent possible, to maintain their function (see Table Floodplains and Wetlands-6, Road Construction and Timber Harvest on Wetlands by Alternative). When it is necessary to cross wetlands, appropriate BMPs and mitigation measures are incorporated into road designs. High-value wetlands, such as tall-sedge fens and riparian forest will be avoided if at all possible. Constructing roads on muskegs and forested wetlands requires rock overlay construction techniques which maintain the physical, chemical, and biological functions of the wetlands. Road construction does cover wetland vegetation with rock, and may result in local changes in wetland vegetation. By minimizing the amount of side-ditching, effects upon groundwater flow and alteration of soil moisture levels will be minimized.

Effects will be minimized by not using wetlands for overburden disposal whenever possible and by minimizing road clearing limits. The interruption of subsurface drainage by making wetlands either wetter or dryer affects long-term site productivity. Detrimentally altered wetness—identified when an area becomes perennially flooded or drained and the effective function or value of the wetland is lost—will be limited to those areas beneath, and within a few feet of, the road. Detrimentally altered wetness will occur on less than ½ of a percent of Project Area wetlands, a range of about 180 acres (Alternative 2) to 21 acres (Alternative 6), well within Regional standards for detrimentally altered wetness (FSH 2554 R-10 Supplement 2500-92-1). When possible, alternate locations on adjacent uplands are used.

Wetland vegetation will be affected by road construction. Monitoring results by Babik (1995) on the adjacent North Revilla Project Area and in the Shoal Cove vicinity indicate that road runoff may affect wetland vegetation composition. Sediment transported in road runoff and fugitive dust appears to add nutrients to roadside sites, lowering acidity and increasing fertility. These chemical changes are particularly apparent in the sphagnum peat muskeg and scrub-shrub evergreen/muskeg wetland types. A change in species composition from acid-tolerant bog vegetation to a more eutrophic, sedge-meadow fen type typically takes place within several meters of the road. Wetland moisture regimes change very little as a result of road construction. Groundwater flow through the typical wetland peat and muck is very slow. Slow ground water flow combined with high precipitation result in no significant drainage when peatlands are ditched. Effects of drainage are usually noticeable within only a meter or two of roadside ditches. These effects have been observed and confirmed by McClellen and Demore (1996) in a study on Wrangell Island.

Disturbance is an activity, such as removal of vegetation, which alters wetland ecological or hydrological functions. Timber harvest on forested wetlands will change the existing vegetation and may affect surface or subsurface hydrology. Site disturbance is not expected to have a significant effect upon wetland functions. Silviculturists on the Tongass National Forest have concluded that no short-term loss of wetland function on harvested forested wetlands has occurred during the past 20 years (USDA Forest Service 1995). However, Kissinger et. al. (1979) suggests that timber harvest on wetlands of south Kuperanof Island has resulted in stunted second-growth forest stands.

This issue of timber productivity on forested wetlands on certain soil types was addressed in the Tongass Land Management Plan Record of Decision (TLMP ROD 1997). The TLMP ROD directed the Forest Service to avoid harvesting timber on the Kaikli, Karheen, Kitkun, and Maybeso soil series, because the scientific information related to the effects of timber harvesting on these soils is incomplete. A scientific study (Julin and McClellan, 1997) which assesses the effects of timber harvest on these wetland soils is currently underway. This direction is to be given the full force and effect of Forest Plan Standards and Guidelines and has been applied in the Sea Level Project Area. Timber harvest has been deferred on areas where Kaikli and Maybeso soils have been identified. These soils are more poorly drained and typically have a lower timber site productivity than other forested wetland soils. Other soil series found in forested wetlands, including the Helm, Hofstad and Nakwasina series, tend to have better drainage, have not been deferred from harvest and are included in a number of units.

Best Management Practices designed to minimize effects upon water quality also serve to minimize the effects of timber harvest and road construction upon wetlands. Full suspension of logs and other low impact yarding systems minimize disturbance of wetland vegetation, as well as surface and subsurface hydrology. Timber harvest is expected to have minimal long-term effects upon the physical, chemical, and biological functions of wetlands.

The most biologically valuable wetlands—estuarine meadows, tall sedge fens, and riparian forests—will be minimally affected by the proposed action. Transportation facilities and timber harvest units are designed to avoid or minimize the effects upon these valuable wetlands. Best Management Practices and mitigation measures are applied to protect wetland resources (see Chapter 2 and the Unit Cards in Appendix H). Wildlife habitat values of forested wetlands may be affected by timber harvest by altering the forest structure. Virtually all of the proposed timber harvest in this project takes place on low value forested and subalpine forested wetlands.

Approximately 50 percent (45,948 acres) of the Project Area is classified as wetlands. At the present time, an estimated 53 percent (24,480 acres) of these forested wetlands supports commercial forest stands. Many of the wetlands on the Project Area do not support commercial or economic stands of timber and are not scheduled for harvest in this or future plans. Larger muskegs supporting no commercial timber will not be harvested, but may be affected by yarding operations within the unit. Table Floodplains and Wetlands-6 presents data on proposed harvest on wetlands by alternative. Of the action alternatives, Alternative 6 harvests the least amount of forested wetlands, while Alternative 2 harvests the most acres. Alternatives 3, 4, and 5 rank second, third, and fourth, respectively, in terms of the most acres of forested wetlands proposed for harvest.

Timber harvest on forested wetlands involves manipulation of the vegetation, which temporarily changes the hydrology of the site. Patric (1966) suggests an increase in water yield may result from timber harvest. A temporary increase in soil moisture is expected until vegetation is established.

Timber site productivity on wetland soils is typically lower than on better drained soils. Growth rates on wetland sites are expected to be slower than nonwetland sites, and rotation lengths may be slightly longer than 100 years. Areas where slow growth is expected range from 32 percent (914 acres) in Alternative 2, to 66 percent (260 acres) of the total timber harvest in Alternative 6.

Table Floodplains and Wetlands-6
Road Construction and Timber Harvest Activity on Wetlands by Alternative

	Watershed				
	Calamity Creek	Painted Creek	Sea Level Creek	All Other Watersheds	Total
Alternative 1					
Road Miles	0	0	0	0	**0**
Timber Harvest Acres	0	0	0	0	**0**
Alternative 2					
Road Miles	0	0	6.1	28.6	**34.7**
Timber Harvest Acres	64	54	160	636	**914**
Alternative 3					
Road Miles	0	0	1.3	21.1	**22.4**
Timber Harvest Acres	0	44	44	468	**556**
Alternative 4					
Road Miles	0	0	0	16.8	**16.8**
Timber Harvest Acres	0	44	44	356	**444**
Alternative 5					
Road Miles	0	0	1.2	21.5	**22.7**
Timber Harvest Acres	0	0	0	309	**309**
Alternative 6					
Road Miles	0	0	0	11.8	**11.8**
Timber Harvest Acres	0	0	0	260	**260**

Source: Babik 1998.
Notes: Most of the proposed timber harvest occurs on the low-value, forested and subalpine forested wetland types; small areas of other wetland types may be included in some harvest units.
Road construction will occur mainly on low- and medium-value wetland types.

New road construction on wetlands will be limited to the needed transportation components of roads, landings, and drainage structures. Best Management Practices will be used, especially with regard to the use of wetlands as filter strips to capture sediment. Ditch construction will be minimized on open muskegs to the extent consistent with minimizing sediment production and water accumulations on the road surface. Roads through wetlands can affect the flow of water in the wetland. Placement of culverts and other road drainage features will ensure that flow and reach of water in the wetland are maintained at a natural level. Impacts from roads will be limited to the wetland directly underlying the road prism and associated cuts and fills.

Rock overlay construction on wetlands covers the vegetation, but provides a highly permeable fill that minimizes changes in hydrologic conditions. No changes in chemical conditions are anticipated.

Application of BMPs during construction will assure that waterflow, circulation patterns, and chemical and biological characteristics of the water within wetlands will not be impaired. Additionally, use of BMPs will assure that adverse impacts to the aquatic environment will be minimized. In terms of terrestrial environment, wildlife use of wetlands for travel-ways and predation may be reduced during periods of vehicular traffic on the roads.

Indirect Effects of Timber Harvest on Wetlands

The indirect effects of road building and logging of forested wetlands within watersheds over time are another concern. The assumptions described in the following list will be used to assess these effects.

- The suitable timber base will remain the same. All analysis will be based on the operable timber within the Value Comparison Unit (VCU).
- Standards and guidelines for harvest and road construction activities will remain constant over the life of the project.
- Future accessibility of timber in relation to wetlands will be similar to the accessibility encountered in this sale.
- Distribution of wetlands is similar in all VCUs.

Prior to 1998, approximately 12,220 acres of timber were harvested in the Project Area. Approximately 250 of those acres (2 percent), are forested wetlands. During the Project operating period (1998-2007), between 0 and 914 acres of forested wetlands are scheduled for harvest, depending on alternative (see Table Floodplains and Wetlands-6). Implementation of Alternative 1 would result in a continuation of the existing condition.

Indirect Effects of Roads on Wetlands

Prior to 1998, approximately 20 miles of road have been constructed over wetlands in the Project Area. This equates to less than 1 percent of all wetlands within the Area. Alternative 2 would result in the construction of 34.1 miles of roads on wetlands within the Area by 2007 (TableWetlands-6). Implementation of Alternatives 3,4, 5, and 6 would result in the construction of 22.4, 16.8, 22.7 and 11.8 miles of road respectively by 2007. Scheduled timber harvest within the Project Area (TLMP 1997) will result in the construction of 22 miles of roads on wetlands by 2007, regardless of which alternative is selected at this time. Clearing limits of 75 feet along proposed roads are assumed for the purpose of this analysis. Actual road design will vary. Specified roads will typically include a road surface of approximately 16-foot width and a varying width roadside ditch and/or fill-slope, depending upon slope, topography, soil type, and drainage. Typically, wetlands occur on relatively gentle slopes which require a minimum of clearing, excavation, filling, and ditching.

Cumulative Effects

Floodplains, and Wetlands

By 2140, within the Project Area, approximately 37 additional acres of floodplains, and 7,730 acres of forested wetlands will be harvested. The product of uneven-aged management, these areas support a mosaic of all-aged stands and even-aged stands of varying age classes. About 60 total miles of roads will have been constructed on wetlands. These management activities will incorporate the TLMP (1997) standards and guidelines. By maintaining floodplains, and wetland values and functions in the upcoming decades, the cumulative effects of these actions will remain within acceptable levels.

Forest Health

Key Terms

Endemic—peculiar to a particular locality; indigenous.
Epidemic—rapid spread or sudden prevalence of a disease.
Phloem—the tissue in plants that conducts foods such as sugar.
Xylem—the tissue in plants that conducts water and substances in solution.
Sapwood—the softer part of wood, between the inner bark and the heartwood which conducts water up to the leaves.

Affected Environment

Forest insects and diseases are normal components of the forested sites in the Sea Level Project Area. Some of them exist, and will continue to exist, at endemic levels. Even at low levels of infestation or infection, forest insects and diseases have considerable effects on forest dynamics and resource management values. When they proliferate and become epidemic, the consequences to the forest can be dramatic. Currently there is no indication that insects or diseases are a potential problem in the Sea Level Project Area.

Insects

The two most common types of destructive insects found in the Sea Level Project Area are defoliators and bark beetles.

Forest Defoliators

Forest defoliators eat the leaves or needles of forest trees. Unlike bark beetles, defoliators usually do not kill trees, but slow down tree growth and increase susceptibility to secondary attack by other insects and diseases. All species of trees are not equally susceptible to injury from defoliation. Hardwood species can usually withstand several years of defoliation because they store large food supplies and can refoliate in the same year. Conifers, on the other hand, may be killed by a single defoliation if it occurs prior to bud formation in midsummer.

The two most common forest defoliating insects that occur within the Project Area at endemic levels include the following:

Black-Headed Budworm

Black-headed budworm, Acleris gloverana (Wals) is one of the most destructive forest insects in coastal Southeast Alaska. In the 1950s, almost one-third of the net timber volume was lost on some hemlock sites due to budworm defoliation. Larvae usually confine their feeding to new growth. In large concentrations, the larger larvae will feed on older needles. Budworm defoliation can result in growth reduction, top-kill, and, at times, tree mortality. Budworm populations are characterized by sporadic spectacular increases followed two to three years later by equally rapid declines.

Hemlock Sawfly

Hemlock sawfly, Neodiprion tsugae (Middleton) is a serious defoliator of western hemlock throughout Southeast Alaska. Outbreaks tend to be more severe and of longer duration in the area south of Frederick Sound, especially along Clarence Strait. Larvae feed on mature foliage rather than the current year's foliage. Most sawfly outbreaks do not cause tree mortality, but some trees are top-killed and radial growth may be reduced. Tree mortality becomes more likely when sawfly and black-headed budworm populations coincide. This is due to the feeding habits of the two defoliators; the budworm feeds on the current year's foliage, whereas sawflies consume previous year's foliage. Natural controls usually reduce epidemic sawfly populations within a few years. Wetter than normal summers help reduce sawfly populations by favoring conditions for fungal growth. Fungi readily infect and kill sawfly larvae under warm, damp conditions. Low summer temperatures can also delay sawfly development and reduce the opportunities for successful egg laying. Eventually starvation and poor nutrition brought about by depletion of the host foliage will also contribute to the population collapse.

Bark Beetles

Bark beetles are probably the most destructive forest insect in Alaska. Bark beetles prefer to breed in weakened host material. However, during favorable climatic periods for beetle development, populations may build up rapidly and healthy trees are successfully attacked. Bark beetles girdle the phloem which, in turn, disrupts the downward movement of nutrients. Some bark beetles, notably those of the genus Dendroctonus, have a symbiotic relationship with blue-stain fungi. The blue-stain fungi can completely penetrate the sapwood within a year. The fungi plug up the outer conducting tissues in the xylem which halts upward water movement. This action, plus that of the bark beetles, can cause the death of a host tree.

Spruce Beetle

Spruce Beetle, Dendroctonus rufipennis (Kirby) outbreaks have been noted across the Tongass National Forest and adjacent lands in previous years. The spruce beetle life cycle is 2 years, with adult beetles emerging in late May to early June in search of susceptible host material (spruce logs). Dispersing adults can fly for long distances, over 7 miles nonstop. Adult mortality during dispersal is quite high. Female beetles are attracted to windthrow and other downed material. Beetles prefer to attack the sides and bottoms of downed material because of favorable temperature and moisture regimes for brood development. Males are attracted to the site via airborne chemicals produced by the female beetles.

Most outbreaks originate in blowdown or logging residuals (cull logs) and spread to adjacent standing timber. Mortality in unmanaged Sitka spruce stands varies and can be as high as 75 percent.

Diseases

Some of the more common diseases and other forms of damage are discussed below.

Hemlock Dwarf Mistletoe

Hemlock Dwarf Mistletoe, Arceuthobium tsugense (Rosendhal, G. N. Jones) is a destructive disease of western hemlock throughout the Project Area. Infestation levels vary in old-growth hemlock stands. Dwarf-mistletoe is absent in some stands and in other stands almost every hemlock is infected. The volume of western hemlock trees heavily infected with dwarf-mistletoe can be reduced as much as 50 percent over a 100-year period. Dwarf-mistletoe is species specific and rarely infects Sitka spruce and mountain hemlock.

The spread of dwarf-mistletoe in young hemlock stands is often the result of leaving standing infected hemlock in cutover areas (TLMP 1997). Dwarf-mistletoe responds to light with increased seed production. Rates of spread to adjacent and lower canopy trees will increase in partial cuts where infected hemlocks remain.

Other

Alaska Yellowcedar Decline

Alaska Yellowcedar Decline, which leads to reduced growth and eventual death of Alaska yellowcedar, is a widespread problem throughout the Project Area. This decline is associated with wet, poorly drained sites, and recent research has demonstrated that the primary cause of decline cannot be attributed to any contagious organism (TLMP 1997). Since it is not contagious, Alaska yellowcedar decline will not spread to sites where it is not found now (TLMP 1997). Because Alaska yellowcedar has high timber value, this annual mortality represents a significant loss in timber value. In addition, substantial acres of old-growth cedar forests have been harvested and are regenerating to other species. The regeneration of Alaska yellowcedar needs to be specifically considered where it forms a significant component of a site proposed for harvest.

Hemlock Fluting

Hemlock Fluting results in deeply incised grooves and ridges that extend vertically along the trunk of the tree. This condition reduces the value of hemlock logs because they yield less sawlog volume and because some of the milled wood contains bark. The cause of hemlock fluting is not completely known but is believed to be genetically controlled. Some sites are heavily affected, to the point of making the stand unsaleable, while other sites have relatively light or no damage.

Decays

Decays that affect the stem and root systems are probably the major cause of volume loss within the Project Area. Many decay fungi enter through tree wounds. The accidental wounding of trees during partial cuts and commercial thinnings will increase the impact from decay organisms in managed stands.

Trees are susceptible to a sequence of diseases at different stages of their growth. Early susceptibility thins a forest stand resulting in more vigorous crop trees. In turn, late susceptibility removes the older and more decadent trees, making room and preparing the way for new trees.

Effects of the Alternatives

Specific pests will be affected differently by each of the alternatives. In general, increasing timber harvest will decrease the impacts of the spruce beetle and timber volume loss by pests such as wood decay fungi and hemlock dwarf mistletoe. From the perspective of timber management, the health of the forest is increased through timber harvesting. However, many of these pests also contribute significantly to ecosystem diversity and long-term stability in old-growth stands by providing increased canopy diversity and animal habitat, and by causing the formation of small scale gaps.

In general, endemic levels of insect and disease activity in mature and overmature forests will be allowed to run their course. Tree losses will be accepted. Salvage logging that exceeds the intent of "minor changes" as defined under the timber sale contract and/or direct control measures will require additional NEPA analysis prior to implementation. The action alternatives all have the same relative environmental consequences from a pest management standpoint regardless of whether viewed from a timber production or a biodiversity perspective.

The previous statement is true as long as the range of silvicultural systems applied remains constant across all alternatives. Partial cuts that retain overstory trees can result in western hemlock (the most tolerant species) forming a much larger percentage of the future stand composition. Sitka spruce, western redcedar, and Alaska yellowcedar occurrence in these sites would be greatly reduced. Partial cutting would increase dwarf-mistletoe infection. Unless a large investment were made to sanitize the stand (remove infected trees) periodically, the future value of the site for timber production could be reduced from an economic standpoint.

Geology, Minerals, and Cave Resources

Key Terms

Alluvium—sand, silt, clay, and gravel laid down by a river or stream.
Carbonate rock—rocks, such as limestone and marble, which contain a high content of calcium carbonate, $CaCO_3$.
Cirque—a circular basin, a natural amphitheater formed at the head of mountain valleys by glacial erosion.
Diorite—a granular igneous rock made up of mainly feldspar and hornblende.
Epikarst—is the surface of the karst. It is intensely dissolved veneer consisting of an intricate network of intersecting dissolution-widened fissures, cavities, and tubes.
Fjord—a long, narrow arm of the sea, bordered by steep cliffs, formed by glacial erosion.
Gabbro—a granular igneous rock made up of mainly dark colored minerals, labradorite and augite.
Glacial till—gravel, boulders, sand, and finer materials transported and deposited by a glacier.
Graywacke—fine-grained, sedimentary rock made up of fragments of slate or schist.
Isocline—a fold of geologic strata so tightly compressed that the parts of each side dip in the same direction.
Karst—a type of topography that develops in areas underlain by soluble rocks, primarily carbonate rocks such as limestone. Sinkholes and caves are formed when the subsurface layer dissolves.
Lithology—the science dealing with the mineral composition and structure of rocks.
Phyllite—a slaty rock with lustrous surfaces due to the high content of mica flakes.
Pleistocene—the epoch forming the first half of the Quaternary period, originating about one million years ago.

Affected Environment

The geology of the central part of Revillagigedo (Revilla) Island affects all of the area's other physical and biological characteristics. The geological characteristics of the Project Area may be described by the geomorphological, lithological, and structural geology.

Geomorphology

The Sea Level Project Area has been heavily modified by Pleistocene and post-Pleistocene glaciation. The Project Area is characterized by fjords, glaciated valleys, and ridges that trend in an east-west direction from the former centers of glacial origin in the mountains to the east. The features characteristic of glaciated coastal areas are easily recognized in the Project Area. Southeast Alaska has one of the best developed fjord systems in the world with deep sea channels, such as Carroll Inlet and Thorne Arm, carved to great depths by coastal glaciers. The steep topography adjacent to the shore in much of the Project Area does not provide good sites for log transfer facilities (LTFs) and other shore access developments. One of the most striking characteristics of a well-developed glaciated valley is the U-shape of its cross profile, with a nearly level valley floor, filled with glacial debris, and considerably over-steepened side-walls, approaching vertical in places. Terrain of this nature typically has good sites for the growth of commercial tree species on the valley floor and lower sideslopes. The valley side-walls are usually difficult to access and much of this extremely steep ground is unsuitable for the production of commercial wood products. The Calamity and Marble Creek valleys are examples of glacial influence. The surrounding ridge-tops, with their rounded profiles and relatively low relief, are characteristic of areas overridden by glacial ice. These ridge-tops are often above tree-line or are relatively wet sites which do not support stands of commercial timber. While road construction on many of these ridges would be relatively easy, access from the valley below is difficult. Painted Peak, in the Shoal Cove area, is the remnant of a volcanic cone. The surrounding landscape, especially to the south, is carpeted by a layer of volcanic cinder and ash, ranging to tens of feet in thickness. Karst terrain is also scattered across this landscape, typically occurring in narrow strips, particularly in the Calamity and Marble Creek valleys.

Lithology

The lithology or bedrock geology of the central part of Revilla Island consists mainly of a group of metamorphosed and deformed rock strata including dark-gray slate, phyllite and graywacke, marble, andesitic or basaltic volcanic rocks, conglomerates and inclusions of gabbro, and diorite. Running through these bedded rocks are locally abundant dikes and sills of granodiorite and quartz-diorite. While the masses of gabbro and diorite which make up the core of these mountains form relatively stable structures, the slates, phyllites, and graywackes which overlay or are adjacent, form landscapes susceptible to landslides and other erosional processes. Much of the area around, and to the south of Painted Peak is blanketed by relatively recent deposits of volcanic ash. These deposits have been locally quarried and used for road surfacing in the Shoal Cove area. Marble and quartz-diorite probably make the most competent road surfacing material in the Project Area. The gabbro and diorite are typically less competent. Slates, phyllites, and graywackes break down rapidly into fine material when used on road surfaces. Narrow bands of carbonate rock, marble and limestone occur in the Project Area, particularly in the Calamity and Marble Creek valleys. All of these rocks are adequate for base material, although the quartz-diorite and granodiorite are often difficult to reduce into proper sized material.

Structural Geology

The geologic structure of the Project Area consists mainly of a series of southwest trending, overturned isoclines that are cut by high-angle faults. The bedded nature of the slates, phyllites and graywackes that make these isoclines, particularly when oriented parallel to the ground slope, provide failure plains that facilitate landslides and other slope failures. Numerous minor faults give the landscape much of its characteristic structure, with numerous parallel, acutely, and obtusely intersecting drainage features.

Minerals

Minerals are legally divided into three groups: locatable minerals, leasable minerals, and saleable minerals.

Locatable Minerals

A locatable mineral is any mineral which is "valuable", in the usual economic sense, or has a property that gives it distinct and special value. Examples of locatable minerals on the Tongass National Forest are gold, silver, copper, molybdenum, iron, nickel, lead, and zinc. There are historic mines located within the Project Area near the mouth of Sea Level Creek. The potential for location and development of locatable minerals in the Project Area appears to be low (Coldwell 1989).

Leasable Minerals

Federally-owned leasable minerals include oil, gas, coal, geothermal resources, potassium, sodium, phosphates, and sulfur. Presently, there are no leasable mineral applications or pending applications, prospecting permits, or geophysical exploration permits on the Project Area. No leasable mineral commodities are presently being produced on the Tongass National Forest. The anticipated demand for leasable minerals is expected to remain low. There are no known geothermal areas in the Project Area, although the Bell Island hot spring is located just to the north of Revilla Island.

Saleable Minerals

Saleable, or "common variety", minerals include sand, rock, building stone, gravel and other similar materials. The predominant saleable commodity in the Project Area is crushed rock used to construct roads. There are also deposits of sand and gravel throughout the area.

Cave Resources

Carbonate rock, limestone and marble occur within the Project Area at a number of locations. The main occurrences include the Calamity and Marble Creek valleys, the North Saddle Lakes vicinity, Elf Point and Eve Point areas (Berg 1988). Karst features on this landscape are relatively small in scale and very localized in occurrence. The possibility of significant cave resources existing on this karst terrain are small. Cave resources on the karst terrain in the western part of the Project Area were identified as being not significant during the Shelter Cove Timber Sale implementation (Johnson 1993). Where the carbonate rock is found, dissolution features typically are found in association with it. Some features found appear to be entrances to subterranean passages, but the opening widths typically do not permit entry.

Potential karst lands within the Project Area were first identified with the use of geologic maps (Berg, 1988). Geologic units which consist primarily of carbonate rock were considered to be potential karst lands. An inventory of karst landscapes and cave resources was conducted during field reconaissance of the Project Area. The presence of karst features and the degree of development was recorded. An assessment of the vulnerability of of identified karst terrain to management activities was made. All karst lands in the Project Area were determined to be within the low to moderate vulnerability classes, as defined by TLMP, 1997.

There are caves located within the volcanic ash deposits in the Painted Peak area. At least two caves are located within the vicinity of proposed timber harvest units. These caves have been eroded in steep slopes or cliffs, typically above stream courses. More detailed information on these caves is described in the individual Harvest Unit and Road Cards in Appendix H.

Effects of the Alternatives

Geomorphology

None of the alternatives will have an effect on the geological characteristics or cave resources of the Project Area.

Minerals

The proposed project will have minimal effect upon the locatable and leasable minerals within the Project Area. Expansion of the present transportation system could open more areas for exploration or facilitate future development.

Alternatives 2, 3, 4, 5 and 6 will develop sources of saleable mineral material, crushed rock, for use in the construction of roads throughout the Project Area. Future demand for common varieties of mineral materials in the Project Area is anticipated to remain low.

Cave Resources

The potential for identifying significant cave resources within the karst landscape of the Project Area during implementation is low. Alternative 2 includes timber harvest on 379 acres of low vulnerability karst lands. Alternative 3 harvests timber on 176 acres of low vulnerability karst lands. There are caves located within the volcanic ash deposits in the Painted Peak area. At least two caves are located within the vicinity of proposed timber harvest units. These caves have been eroded in steep slopes or cliffs, typically above stream courses. Appropriate mitigation measures, as outlined in the TLMP (1997) Karst and Caves Standards and Guidelines, will be applied during harvest unit layout where cave resources that may be affected by the proposed activities have been identified. The results of field reconnaissance and site specific mitigation measures are described in the Harvest Unit and Road Cards in Appendix H.

Other Resources

Successful regeneration of commercial tree species on areas underlain by carbonate bedrock has been expressed as a potential concern in the Project Area. This concern is based upon a belief that shallow soils, formed on carbonate bedrock become droughty and incapable of supporting regeneration following timber harvest. In these areas, even the complete loss of soil and litter from the surface of the carbonate rock will not prohibit the re-establishment of a forest, since the displaced surface materials are retained within the epikarst channels (Harding and Ford 1993). Regeneration surveys, conducted over the past couple of decades in the Project Area, have not indicated any shortage of regeneration in second-growth stands underlain by carbonate bedrock. Epikarst features are not highly developed in these areas, and the soils that form are typically deep, with adequate moisture holding capacity to support a regenerating forest stand.

Old Growth and Biodiversity

Key Terms

Biodiversity—the variety of life and its processes.
Canopy—the middle and uppermost layers of foliage in the forest.
Corridor—a patch or strip of habitat linking or providing connectivity between larger patches.
Edge—boundary between two distinct ecosystems, such as between forest and muskeg.
Forage—to search for food.
Fragmentation—reducing the size and connectivity of habitat patches; the degree and impacts of fragmentation depend on scale (in space and time) and the life requirements of the affected species.
Patch—an assemblage of similar vegetation, such as old-growth forest.
Patch-size Effectiveness--the usefulness of habitat patches for a particular species, based on the patch size requirements of that species and the size of the habitat patches available. Usually expressed as a percentage of the total habitat available.
Planning area—for the purpose of analyzing viable populations, the planning area is the ecological province, i.e., Revilla Island/Cleveland Peninsula.
Snag—standing dead tree.
Viable population—a population with the estimated numbers and distribution of reproductive individuals to maintain the population over time.
Wildlife Analysis Area (WAA)—a division of land designated by Alaska Department of Fish and Game (ADF&G) and used by the USDA Forest Service for wildlife analysis.

Affected Environment

Old-growth Forest

Most of the commercial forest land (CFL) in the Tongass National Forest that has not been previously harvested has been undisturbed for centuries and is considered old growth. The definition of old-growth forest varies by habitat and includes such factors as age and size of trees, spacing, snags, canopy layers and structure, and the amount of down (on-the-ground) material (USDA Forest Service 1991a).

Old-growth forest is also important as wildlife habitat for old-growth associated species such as Sitka black-tailed deer, martens, black bear, Vancouver Canada geese, and cavity or snag-dependent species such as flying squirrels, woodpeckers, and owls. Many species have evolved to use the structural attributes of old-growth forests. The combination of a dense canopy with scattered small openings (typically 20 to 40 feet across) allows forage growth under openings, while the large limbs within the canopy intercept enough snowfall to provide winter food and thermal cover for deer and other species. The large, dense stems also provide some measure of thermal insulation in the winter, as well as during cold rains in the spring and summer. Large dead or defective trees become nesting sites for martens, owls, eagles, wrens, and chickadees, as well as feeding sites for woodpeckers, sapsuckers, brown creepers, and others.

The value of old-growth forest for wildlife habitat is also thought to transcend individual stands. Large, contiguous, unfragmented blocks of old-growth forest are important to forest interior species, such as the northern goshawk and marbled murrelet. The large old growth blocks provide expansive hunting territories and protection from predators, and promote genetic mixing among populations that would be less likely to breed if they were spatially separated by forest fragmentation. Deer use these large old growth blocks for migration routes between winter and summer ranges.

Table Old Growth-1
Roadless Areas and Acreage Within and Adjacent to the Sea Level Project Area

Roadless Area* No.	Roadless Area Name	Roadless Area Acreage
523	South Revilla	52,209
526	North Revilla	217,818
535	Carroll	11,671
	Misty Fiords NM	234,930**
Total		**516,628**

Source: TLMP 1997.
* These roadless areas are Forest Plan, not Rare II Roadless Areas (See Appendix E, TLMP Final EIS (1997)).
** Misty Fiords National Monument acreage represents only the acres on Revillagigedo (Revilla) Island.

Within and immediately adjacent to the Project Area are large, roadless blocks (Table Old Growth-1) as identified in the roadless inventory in the TLMP Final EIS (1997). The South Revilla block (No. 523) is partially included in the south end of the Sea Level Project Area. The Sea Level Project also includes portions of the North Revilla block and the Carroll block. Both the South Revilla and the North Revilla blocks are adjacent to the 2.1 million acre Misty Fiords National Monument. For more information on roadless areas, see the Roadless Area discussion in the Recreation section of Chapter 3.

For additional discussion of old growth and connectivity, see Connectivity and Viable Populations later in this section.

Biological Diversity

National Forest Management Act (NFMA) regulations define diversity as the distribution and abundance of different plant and animal communities and species. Biological diversity, or biodiversity, refers not only to the variety of organisms in an area; it also includes their genetic composition, the complex pathways that link organisms to one another and to the environment, and the processes that sustain the whole system. Biodiversity plays a key role in how well an ecosystem functions. It can be evaluated at different scales, ranging from genetic diversity to landscape diversity.

The extinction of species is a serious and irreversible threat. Habitat loss and fragmentation are prime causes of extinction today. Fragmentation occurs whenever a large continuous habitat is transformed into smaller patches that are isolated from each other, such as occurs from catastrophic windstorms or from extensive clearcutting. The changed landscape functions as a barrier to dispersal for species associated with the original habitat. These smaller and more isolated habitats also support smaller populations, which are more vulnerable to local extinction.

Research shows that forest fragmentation results in an increased ratio of forest "edge" to forest "interior" habitat, and can have a strong negative effect on forest interior species. One such effect is that as more edge habitat becomes available as a result of fragmentation, the edge-dwelling species invade the interior environment and become a major threat to the survival of the forest interior species.

The amount of contiguous habitat, and the extent to which similar habitats connect by corridors, are considered key concepts in managing for biological diversity (Harris 1984, 1985; Hunter 1990). Because of the importance of unfragmented old-growth forest patches and the role of these areas in maintaining viable wildlife populations, old-growth habitat and an analysis of patch-size effectiveness will be used in this EIS as tools to evaluate impacts on biodiversity and Old-growth Forests..

Patch Size Requirements of MIS and TES

In 1989, an interagency group of biologists, henceforth called the Workshop, from the Alaska Department of Fish and Game (ADF&G), the Forest Service, and the USDI Fish & Wildlife Service (USFWS) participated in a workshop to categorized management indicator species (MIS) and threatened and endangered species (TES) into one of three groupings based on how the species generally utilize or respond to their environment with regard to needing minimum habitat patch sizes and/or dispersal corridors. The effects analysis for the Sea Level Project uses information generated at this workshop to estimate impacts to old-growth dependant MIS.

Patch Sizes

The analysis of forest fragmentation in the Sea Level Project Area was based on the total number of old-growth forest patches within specific size classes. Patch-size classes were selected to represent management indicator species (MIS) requirements based on the species patch-size effectiveness curves (Tables Old Growth-2 and Old Growth-3).

The relationship of patch size to the effectiveness of that habitat to support a particular species was analyzed, and index graphs were developed. Table Old Growth-3 displays a summary of the effectiveness of various patch size classes for patch-size dependant MIS.

For the purposes of patch-size analysis, old-growth forest patches were defined as the amount of contiguous old-growth timber of size class 4 and above. In other words, mature forests with diameter 9 inches or greater and at least 150 years old. Forest blocks meeting these criteria were identified using GIS. The blocks were then buffered 300 feet on all sides to account for edge effects. Figures Old Growth-1 and Old Growth-2 show the resulting old-growth blocks in 1954 and 1997 (current condition).

Table Old Growth-2
Patch-size Class Relationships

Patch Size (Acres)	Species Relationship
0-25	Incorporates optimal patch size for red squirrel
26-100	Incorporates optimal patch size for brown creeper
101-500	Incorporates optimal patch size for marten
501-1,000	Incorporates optimal patch size for woodpeckers
> 1,000	Incorporates optimal patch size for deer

Source: Workshop to recommend patch size relationships and corridor requirements for the management indicator species (MIS) and threatened, endangered and sensitive (TES) species (1989).

Table Old Growth-3
Patch-size Effectiveness Values* for Old-growth Dependent Species by Patch Size Class

	Patch Size Classes (Acres)				
Species	**0-25**	**26-100**	**101-500**	**501-1,000**	**> 1,000+**
Sitka black-tailed deer	0.3	0.35	0.5	0.83	1.0
marten	0.2	0.5	1.0	1.0	1.0
red squirrel	0.4	1.0	1.0	1.0	1.0
hairy woodpecker	0.1	0.42	.7	1.0	1.0
brown creeper	0.8	1.0	1.0	1.0	1.0

Source: Workshop to recommend patch size relationships and corridor requirements for the MIS and TES species (1989).
* Represents the median curve value within each patch size class from the species effectiveness curves.

Prior to timber harvest (1954), the Project Area contained extensive amounts of unfragmented forest patches. Approximately 81 percent of the old growth throughout the Project Area was in forest patches greater than 1,000 acres (Table Old Growth-4). Past timber harvest has decreased the acreage in this patch size class from 26,412 acres to 5,695 acres (Table Old Growth-5, existing condition). The 1,000+ acre blocks currently (1997) comprise 32 percent on the total old-growth blocks. Smaller block sizes have increased as the total old growth available has decreased. Total old growth has been reduced by 46 percent from 1954 conditions.

Table Old Growth-4
Acreage of Unfragmented Old-growth Forest in 1954

Unit	**0-25 Acre Blocks**	**26-100 Acre Blocks**	**101-500 Acre Blocks**	**501-1,000 Acre Blocks**	**1,000+ Acre Blocks**	**Total**
WAA 405	321	672	2,379	1,327	8,089	**12,788**
WAA 406	628	1,481	3,964	0	30,821	**36,894**
Project Area	487	1,099	3,245	1,327	26,412	**32,569**

Source: GIS Database, Burns, 1997.

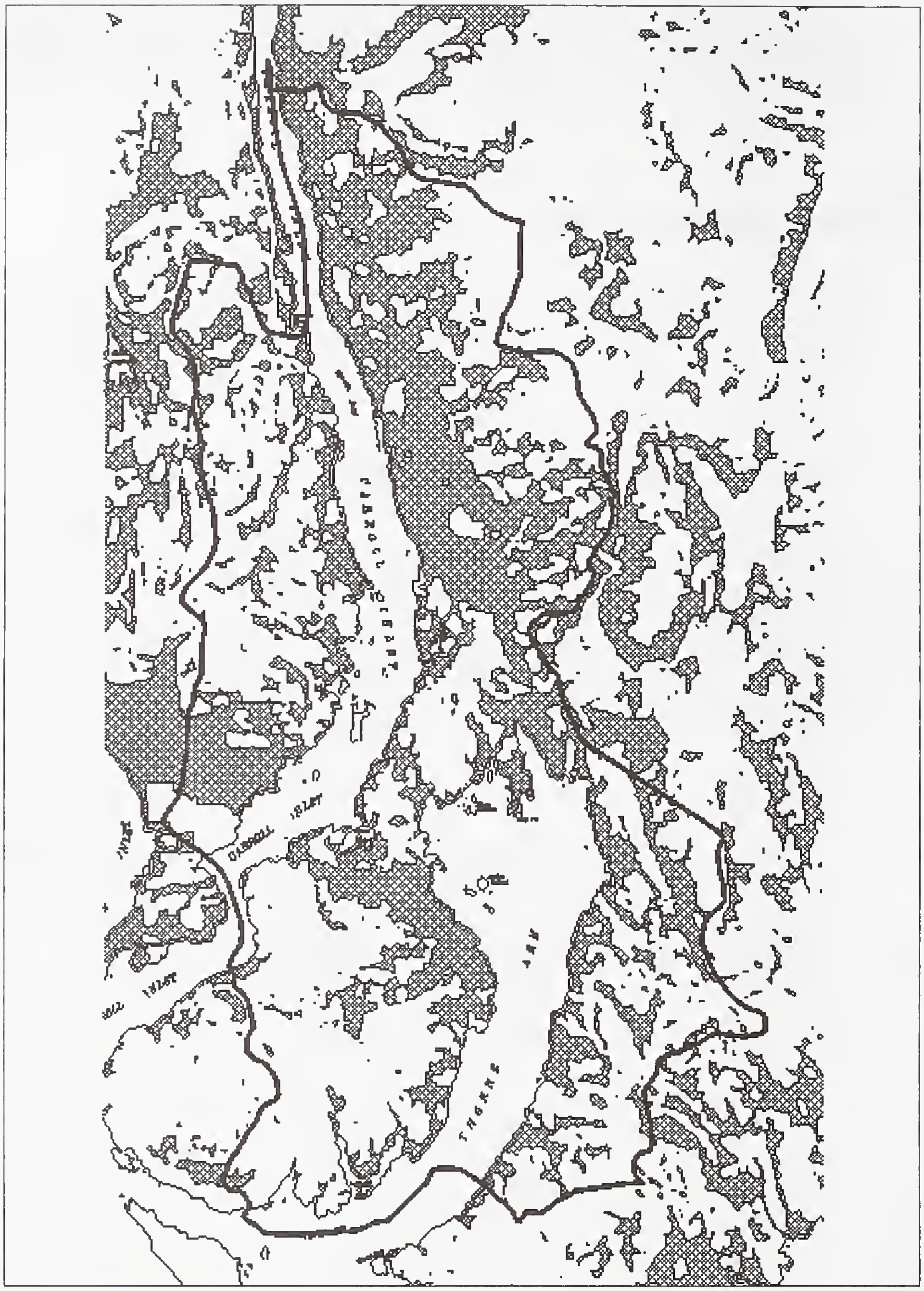
Figures for the whole Wildlife Analysis Areas (WAA) 405 and 406 show similar conditions. WAA 405 had approximately 63 percent of the old growth in blocks greater than 1,000 acres in 1954. Approximately 46 percent of these blocks remain in 1997. WAA 406 had 84 percent of the old-growth blocks greater than 1,000 acres in 1954. Approximately 37 percent of these blocks remain in 1997. Both WAAs show a slight increase in the number of small old growth blocks. Both also show a decrease in the total amount of old growth acreage since 1954.

Table Old Growth-5
Acreage of Unfragmented Old-growth Forest in 1997

Unit	0-25 Acre Blocks	26-100 Acre Blocks	101-500 Acre Blocks	501-1,000 Acre Blocks	1,000+ Acre Blocks	Total
WAA 405	492	997	2,555	1,560	3,737	**9,340**
WAA 406	963	2,158	4,779	3,991	11,511	**23,402**
Project Area	877	1,833	4,732	4,397	5,695	**17,534**

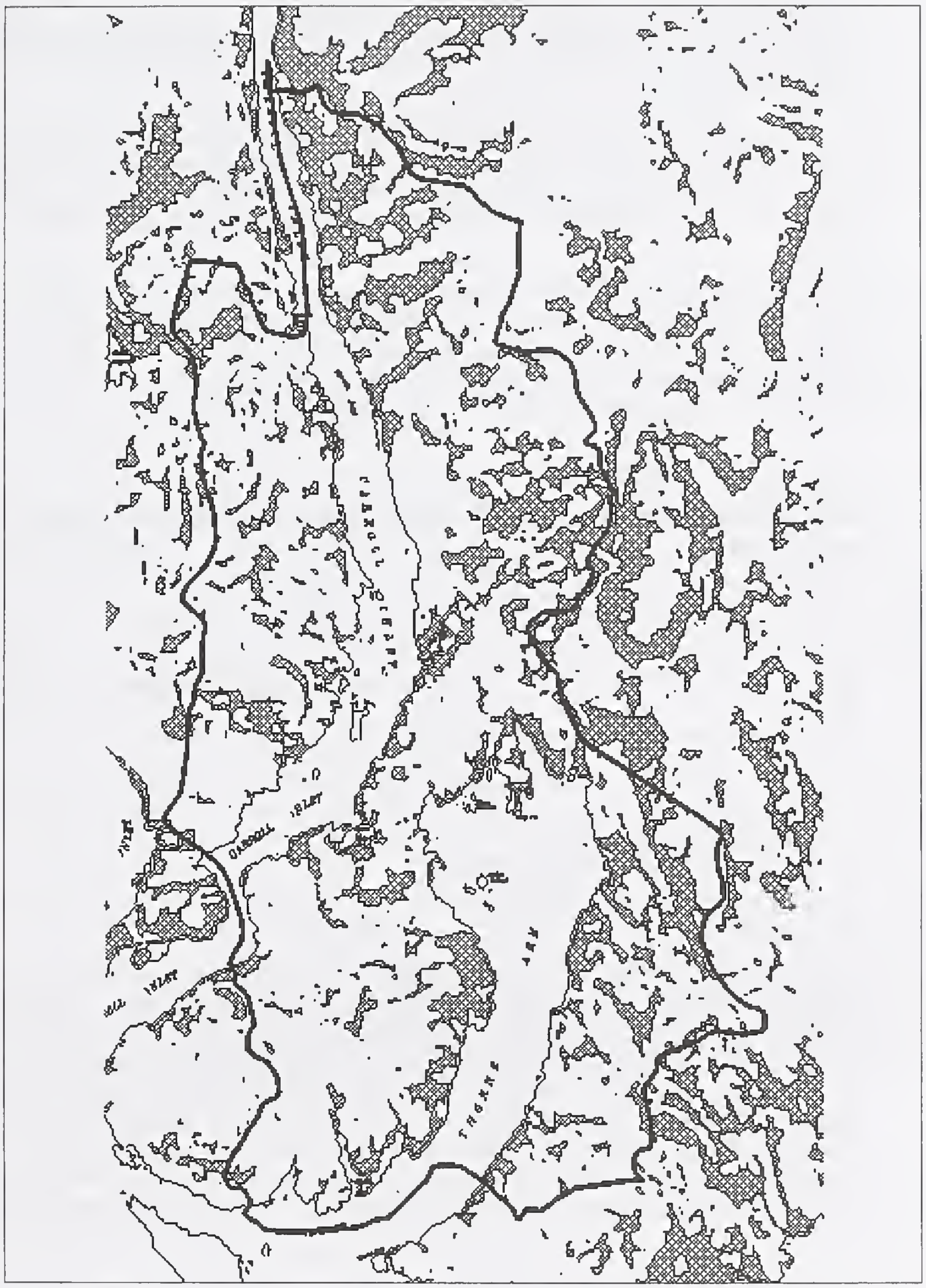
Source: GIS Database, Burns 1997.

Figure Old Growth-1
Old-growth Patches in the Sea Level Project Area in 1954



Source: GIS Database

Figure Old Growth-2
Old-growth Patches in the Sea Level Project Area in 1997



Source: GIS Database

Fragmentation of existing old growth results in a reduction in the effectiveness of remaining patches as wildlife habitat. Individual species respond to natural and human-induced fragmentation differently. Species like brown creepers and hairy woodpeckers can be supported by smaller patches of forest habitat than species such as deer and marten (proceedings of workshop to recommend patch-size relationships and corridor requirements for the MIS and TES) (Table Old Growth-4).

Patch-size effectiveness for the Project Area can be calculated using the acreage in Table Old Growth-5 and the effectiveness values in Table Old Growth-3. Patch-size effectiveness is an attemp to account for habitat fragmentation.. For example, an area with many small patches would show a lower patch-size effectiveness than the same area with a small number of large patches.

Patch-size effectiveness percentages for 1997, range from 71.9 percent (deer) to 90.8 percent for marten (Table Old Growth-6). Deer show a lower patch size effectiveness because they are more dependant on larger contiguous blocks of old growth than are marten. The patch-size effectiveness can then be applied to the habitat capability to show the effects of fragmentation on habitat capability (Table Old Growth-6).

Table Old Growth-6
Patch-size Effectiveness and Adjusted Habitat Capabilities for the Sea Level Project Area.

Species	1997 Patch Size Effect. %	1997 Habitat Capability*	1997 Habitat Capability**
Sitka black-tailed deer	71.9	2411	1735
marten	90.8	160	146

Source: MIS Habitat Capability Models.
* Without patch-effectiveness percent applied.
** With patch-effectiveness percent applied.

The connectivity, or corridors, between habitat patches in a landscape may be at least as significant to maintaining diversity as the size of the patches (Noss 1983). Forman and Godron (1981) defined corridors as being of four types: (1) line corridors, those which are all edge and possess no interior habitat; (2) strip corridors, those which maintain interior habitat; (3) stream corridors, those bordering a water source; and (4) network corridors, those which intersect and form patterns. Corridors can function as more than one type; for example, when a stream corridor is wide enough to incorporate interior habitat, it also functions as a strip corridor. Forman and Godron's work also highlighted the fact that some interior species will not live in or even migrate through extensive lengths of unsuitable habitat, and that strip corridors were preferable to line corridors. Management of corridors as well as habitat patches should strive to mimic natural patterns (Noss and Harris 1986).

Prior to timber harvest activities, the main dispersal corridors throughout the Project Area were most likely along major creeks and near the beach. Major creek valleys, such as Fish Creek, Gokachin and Sea Level Creeks, Painted Creek, Marble Creek, and Calamity Creek, probably served as migration or dispersal corridors between Carroll Inlet and what is now Misty Fjords National Monument. On the west side of Carroll Inlet, Buckhorn Creek, Gunsight Creek, and the North and South Saddle Lakes areas probably served the same function between George and Carroll Inlets. These valleys contained extensive amounts of old growth which were mostly connected (Figure Old Growth-2).

The forest in some of these connecting valleys has been harvested and no longer provides interior old-growth connections (Figure Old Growth-3). Marble and Calamity Creeks (east side of Carroll Inlet) are two examples. Some of the beach fringe was also harvested during the A-frame era, causing breaks in the connectivity. There is a large patch of young growth north of Shoal Cove that interrupts the old-growth beach connection. The beach fringe south of Shelter Cove (west side of Carroll Inlet) has also received past harvest that has reduced old-growth connectivity.

A more detailed discussion of Tongass National Forest direction for managing biological diversity can be found in the TLMP Final EIS (1997).

Viable Populations

The Forest Plan (1997) identified areas of commercial forest land for the protection of wildlife and fish that are dependent upon old-growth habitat for their survival. These areas are called Old-growth Prescription (retention) areas. In addition to Old-growth Prescription areas, additional old growth areas would be designated to benefit wildlife through 2054 (the end of the first 100-year harvest rotation), in lands classified as follows (1989-94 Long-term Sale EIS):

- Inoperable commercial land,
- Lands in extended rotation,
- Lands in Aquatic Habitat Management old-growth prescriptions and
- Lands reserved for recreation purposes.

The TLMP Final EIS (1997) provided for regional management and maintenance of population viability at the planning area level. "Planning Area," for defining viable populations, is the ecological province level (TLMP Final EIS 1997). Under the TLMP Final EIS (1997), individual project areas are not expected to independently maintain viable populations, but only to contribute to and not cause a decline of overall viable populations for the province. However, their contribution to well-distributed populations through the maintenance of connectivity can be critical.

The Sea Level Project Area lies within the Revillagigedo (Revilla) Island/Cleveland Peninsula Ecological Province (No. 15), as defined by the TLMP Final EIS (1997).

The Revilla Island portion of the ecological province is undeveloped on the east side, and is part of the Misty Fiords National Monument. The Cleveland Peninsula portion of the North Revilla/Cleveland Peninsula Ecological Province is part of the mainland in the Southeast Alaska panhandle. The entire mainland from Hyder/Misty Fiords National Monument north to the Juneau / Skagway area is in a natural (unaltered by human activities) state, except for some small isolated developments.

Under the TLMP Final EIS (1997), a variety of different Land Use Designations (LUDs) preserve particular old-growth areas from timber harvest (i.e. beach and estuary fringe, stream protection, LUD II, special interest areas and old-growth reserves). This designation of no programmed harvest LUDs is intended to allow for seasonal wildlife migration from lowland to higher elevation ranges, to provide adequate acreage for forest interior and old-growth dependent species, and to facilitate genetic exchange between wildlife populations.

The Sea Level Project incorporates the viable population strategy from the TLMP (1997). The TLMP Final EIS (1997) maintains wildlife populations through a complex of large, medium, and small old-growth habitat reserves laid out across the Tongass National Forest totaling one million acres, outside congressionally designated areas. These reserves are identified as old-growth habitat prescriptions in the TLMP. This strategy implements the concepts recommended by the Viable Population (VPOP) Committee. More information on the viable population strategy on the Tongass National Forest and VPOP Committee can be found in the Effects of the *Alternatives on Viable Populations of Wildlife* later in this section and in the TLMP (1997).

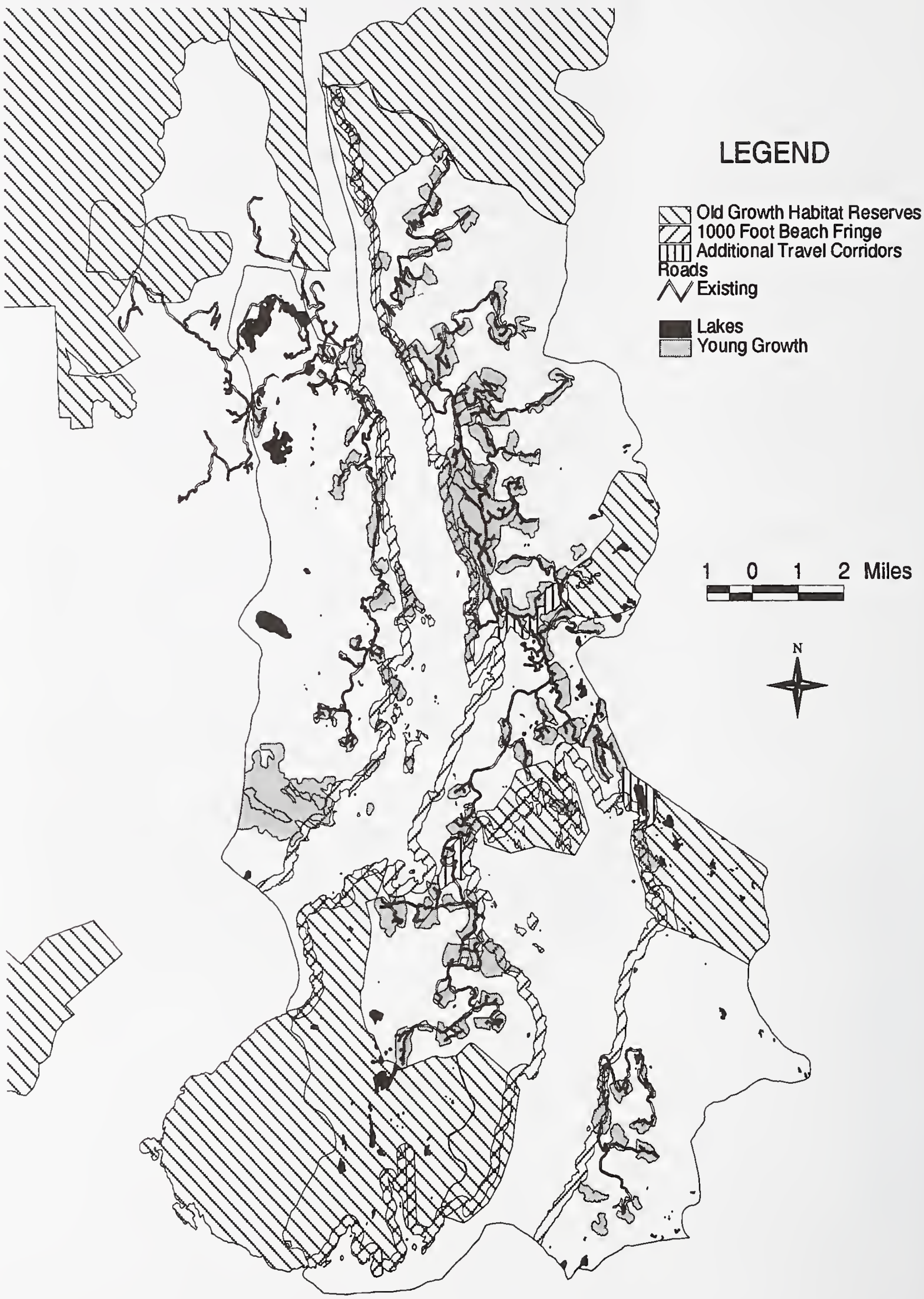
Figure Old Growth-3 shows the location of small, medium, and large old-growth habitat reserves (prescriptions) within the Sea Level Project Area. Large and medium old-growth reserves surrounding the Sea Level Project include the Naha Block to the north, the Swan Lake block to the north, Misty Fiords National Monument to the east, and one block south of Gnat Cove on the peninsula between Carroll Inlet and Thorne Arm (Carroll Point Reserve). Five small old-growth reserves have been located in the Project Area. They are located north of Licking Creek on the east side of Carroll Inlet (Licking Creek), at the head of Painted Creek near Shoal Cove (Painted Creek), at the head of Thorne Arm (Minx Flats), in the Gokachin Creek area (Gokachin), and on the west side of Thorne Arm (West Thorne).

The Carroll Point medium Old-growth Reserve contains a large portion of encumbered lands. About 78 percent of the old-growth reserve is in encumbered lands (14,300 acres). Approximately 4,020 of productive old-growth forest are in encumbered lands. These lands are not currently being considered for conveyance to private property. Very little interest has been shown in selecting the area. However, if the area gets selected, conveyed, and becomes private property in the future, it could be altered so that it no longer functions as an old-growth habitat reserve area.

The old-growth reserve would then be about 4,100 acres. The productive old-growth within the reserve would be about 1,180 acres, about 4,020 acres less than the current situation. The remaining portion of the old-growth reserve would not meet the intended requirements for size and spacing of medium old-growth reserves. This would leave a gap in the TLMP (1997) viable population strategy. If this were to happen, the Carroll Point Old-growth Reserve would need about 4,020 acres of productive old-growth to return to current conditions. These productive old-growth acres would have to come from the Minx Flats area near Gnat Cove. The old-growth reserve would need to be enlarged almost to Shoal Cove to pick up the needed productive old-growth. Harvesting units in the Minx Flats area (units 31, 32, 33, 34, 37, 171, 172, 173, 174, 175, 176, 153, 168, 166, 168 and 250) will make it difficult to meet the medium old-growth reserve requirement if the encumbered lands are selected and harvested. These units are proposed in Alternatives 2 and 3. As a comparison, the neighboring VCU 7560 contains about 4,700 acres of productive old-growth. Alternatives 4, 5 and 6 propose no harvest in most of VCU 7560 and Minx Flats.

The Minx Flats small old-growth reserve is about 150 acres less in total acreage than required in TLMP. However, the amount of productive old growth is about 140 acres more than is required in TLMP. All other old-growth reserves meet the requirements of TLMP.

Figure Old Growth-3
Old Growth Prescription Blocks and Connecting Corridors



Connecting Corridors and Viable Populations

It is recognized that maintaining appropriate habitat corridors or connections between blocks of old-growth forest habitat is important to minimize isolation and gradual decline of wildlife species associated with the old-growth blocks (Harris 1984, 1985; Hunter 1990). Some of the corridors between these blocks have been affected by previous timber harvest activities.

Other areas (including stands deemed inoperable for timber harvest because of unstable soils, steep slopes, economic isolation, or other factors) could also be interspersed and provide additional opportunities to connect old-growth blocks. While there has been historic timber harvest within the beach, estuary, and stream-course buffers, these old harvest sites will mature in time and could provide travel corridors for some wildlife species for genetic interchange.

The TLMP (1997) directs us to provide corridors of old-growth forest among large and medium old-growth habitat reserves and other natural setting LUDs at the landscape scale. These corridors are part of the overall viable population strategy on the Tongass National Forest. The TLMP considers the existing features of the old-growth strategy, such as beach fringe, riparian buffers, or other lands unsuitable for development, as contributing to maintaining connectivity among large and medium old-growth habitat reserves and natural setting LUDs. Where these features do not provide sufficient productive old-growth forest connectivity, the TLMP directs us to provide stands , where they exist, of productive old-growth forest to function as connecting corridors. These designed corridors should be of sufficient width to minimize edge effect and provide interior forest conditions.

These guidelines have been implemented for the Sea Level Project Area. Figure Old Growth-3 shows the locations of the old-growth habitat reserves (prescriptions) and connecting corridors within the Sea Level Project Area. All medium and small old-growth habitat reserves are sufficiently connected to other large or medium old-growth habitat reserves or natural setting LUDs except for one. The medium old-growth habitat reserve between Thorne Arm and Carroll Inlet requires additional connecting corridors. This is mainly due to the amount of previous harvest that has occurred in the Shoal Cove area and in the beach fringe north of Shoal Cove. Therefore, additional connecting corridors were designed as shown in Figure Old Growth-3. These corridors are located along Painted Creek, Fish Creek, and on the narrow neck of land between Thorne Arm and Carroll Inlet.

Effects of the Alternatives

Analysis conducted for the TLMP Final EIS (1997) indicates that 66 to 94 percent of the productive old-growth forest would remain distributed throughout the planning cycle (150 years) within the Revilla Island/Cleveland Ecological Province to potentially support viable populations of management indicator species (MIS). All alternatives proposed by this EIS provide areas that would remain connected by existing roadless areas, beach fringe, estuary fringe, stream corridors, and the myriad of over-steepened slopes and other areas unsuitable for timber harvest. Managed stands would change from multi-aged old-growth timber to even-aged stands of timber in the early succession/understory colonization stage.

Following clearcut logging of old-growth forest, the stands that subsequently develop are even-aged (Harris and Farr 1974) and tend to contain a higher percentage of Sitka spruce and a lower percentage of the cedars. Clearcutting differs from natural disturbances in that it represents a large-scale change (up to 100 acres, typically) rather than dispersed small (one to 20 acres, typically) partial blow-down patches. It also differs in that nearly all trees are felled, whereas in natural disturbances many trees remain standing or partially standing (Hansen et al. 1991).

Effects of Alternatives on Old-growth Forest and Biodiversity

There has been a national concern over the limited and dwindling supply of old-growth forest, as exemplified by the spotted owl controversy in Oregon and Washington. Approximately six percent of the old-growth forest in the Revilla Island/Cleveland Peninsula has been harvested. Under the TLMP Final EIS (1997) Preferred Alternative, approximately 16 percent of the old-growth forest in the Revilla Island/Cleveland Ecological Province will eventually be converted from old-growth forest to successive crops of younger trees which will be harvested before they mature into old-growth forest. The subsequent crops of younger trees will yield more usable wood fiber per acre. At the same time, this conversion of old-growth forest to younger stands will cause some changes in the value of certain forest products, changes in value of wildlife habitat, reductions in diversity of ecosystem function and composition, and changes in inherent aesthetic qualities. Figure Old Growth-2 displays the amount of old-growth habitat within the Project Area that existed in 1954.

Old Growth Fragmentation and Patch-size Effectiveness

To help identify important blocks of old-growth habitat, a map was generated using the Geographic Information System (GIS) that displayed all blocks of old-growth timber Size Class 4 and greater. The patches were then categorized into the various acreage classes. This procedure was completed for the years 1954 (prior to logging) and 1997 (the current condition, Alternative 1, Figure Old Growth-2).

For the purposes of patch-size analysis, old-growth forest patches were defined as the amount of contiguous old-growth timber of Size Class 4 and above. In other words, mature forests with diameter nine inches or greater and at least 150 years old. Forest blocks meeting these criteria were identified using GIS. The blocks were then buffered 300 feet on all sides to account for edge effects. Table Old Growth-7 displays the acreage in each patch-size class, for the year 1954, the existing condition (Alternative 1), and Alternatives 2 through 6.

Table Old Growth-7
Patch-size Acreage for the Sea Level Project Area by Alternative

Alt.	0-25 Acre Blocks	26-100 Acre Blocks	101-500 Acre Blocks	501-1,000 Acre Blocks	1,000+ Acre Blocks	Total
1954	487	1,099	3,245	1,327	26,412	**32,570**
1	877	1,833	4,732	4,397	5,695	**17,534**
2	1,028	2,423	5,676	714	4,287	**14,128**
3	979	2,006	4,172	3,641	4,901	**15,699**
4	973	1,973	4,137	3,673	5,464	**16,220**
5	904	2,030	4,738	3,353	5,553	**16,578**
6	940	1,666	4,554	4,397	5,695	**17,252**

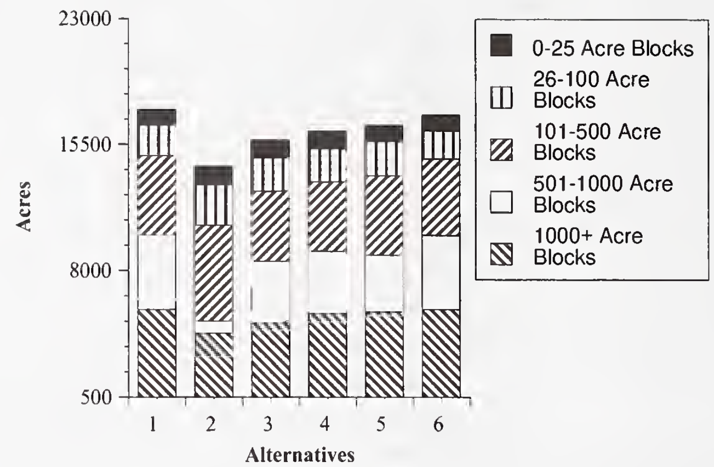
Source: Burns 1996, GIS database.

Direct Effects

The analysis of direct effects of the project shows that all alternatives except Alternative 1 will cause a reduction in overall old-growth acreage within the Project Area (Figure Old Growth-4). Alternative 1 is the "No Action" alternative. It presents the best alternative for maintaining current old growth conditions and biodiversity. Of the action alternatives, Alternative 6 provides the best option for maintaining old growth and biodiversity.

Alternative 2 shows the highest degree of impact on old growth and biodiversity. This alternative shows a 19 percent reduction from existing (1997) conditions in overall old growth. Of particular interest is the reduction in 501 to 1,000 acres blocks (Figure Old Growth-4). The acreage in this block size is reduced by 84 percent from current (1997) conditions while the three smallest block sizes are increased. This is a result of the spacial distribution of the units and the way in which they fragment the existing old-growth patches. Old-growth blocks greater than 1,000 acres are reduced by 25 percent in Alternative 2.

Figure Old Growth-4
Acres of Old Growth Patches in the Project Area, by Alternative



Source: Based on data in Table Old Growth-7, Burns 1997.

A similar comparison can be made for Alternatives 3 through 6 (Figure Old Growth-4). Reductions in total old growth range from 10.5 percent in Alternative 3 to 1.6 percent in Alternative 6. Reductions in blocks greater than 1,000 acres range from 13.9 percent in Alternative 3 to no change in Alternative 6. Reductions in the 501 to 1,000 acres blocks range from 23 percent in Alternative 5 to no change in Alternative 6. Alternatives 3, 4, and 5 show a decrease in the two largest block sizes and an increase in the two smallest block sizes; an indication of old-growth fragmentation.

Of the action alternatives, Alternative 2 fragments old growth the most, followed by Alternatives 3, then 4, then 5. Alternative 6 fragments the old growth the least.

Cumulative Effects

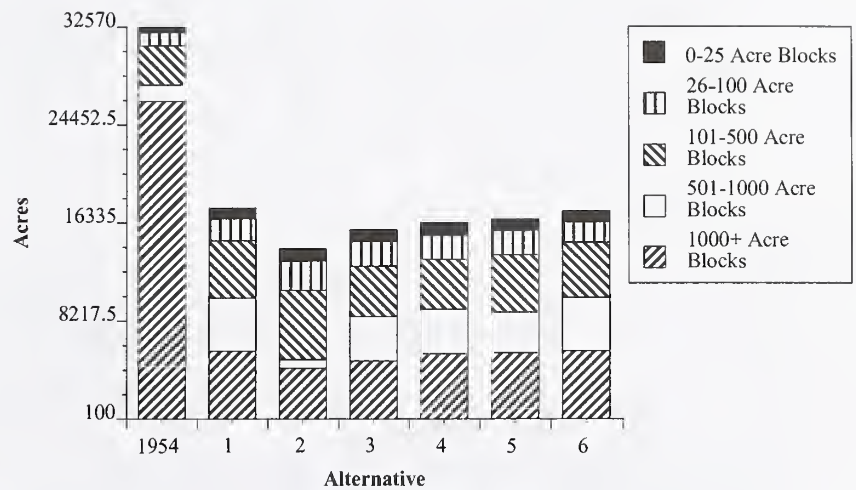
The previous discussion compares the direct effects of the Sea Level Project to the existing conditions (Alternative 1) in the Project Area. To get a better picture of cumulative effects, we compared the alternatives to the conditions that existed in 1954, before major timber harvesting began.

All alternatives show an obvious decrease in old-growth forest acres since 1954 (Figure Old Growth-5). The existing condition (Alternative 1, no action) shows a 46 percent reduction in the overall old-growth forest acreage, a 78 percent reduction in blocks greater than 1,000 acres, and an increase in the acreage of the remaining block sizes. This is an indication that past activities have caused some fragmentation within the Project Area.

The action alternatives show additional reductions in old-growth patches compared to 1954 conditions. Reductions in total old-growth forest ranges from 47 percent for Alternative 6 to

57 percent for Alternative 2. For blocks greater than 1,000 acres, reductions range from 78 percent for Alternative 6 to 84 percent for Alternative 2.

Figure Old Growth-5
Acres of Old Growth Patches in the Project Area, Compared to 1954 Conditions



Source: Based on data in Table Old Growth-7, Burns 1997.

All alternatives show an increase in the acreage for the three smallest block sizes. This, combined with the decrease in the acreage for the larger block sizes, indicates the relative fragmentation occurring under each alternative. Alternative 1 shows the least amount of fragmentation and Alternative 2 shows the highest amount of fragmentation.

The effects of this fragmentation on old growth dependant wildlife MIS are shown in Table Old Growth-8. The percent effectiveness in Table Old Growth-8 was determined by applying the patch-size effectiveness values for old-growth dependent species (Table Old Growth-3) to the patch size acreages (Table Old Growth-7). This percent effectiveness was then applied to the habitat capability models to calculate the resulting habitat capabilities adjusted for patch-size effectiveness.

Deer show the greatest effects from fragmentation, ranging from 62.8 percent effective in Alternative 2 to 72.0 percent effective for Alternative 6. Habitat capabilities for marten range from 85.6 percent effective in Alternative 2 to 90.8 percent effective in Alternatives 1 and 6. These habitat effectiveness figures can be compared with existing conditions in Table Old Growth-8.

Table Old Growth-8
Adjusted Habitat Capabilities for the Sea Level Project Area Based on Patch Size and the Percent Effective by Alternative

Species	Existing Condition	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Sitka black-tailed deer	1,735	1,735	1,452	1,647	1,687	1,678	1,728
percent effective	71.9	71.9	62.8	70.1	71.3	70.5	72.0
marten	146	146	132	139	140	142	145
percent effective	90.8	90.8	85.6	88.6	89.1	89.5	90.8

Source: Burns 1997, GIS database.

While the previous analysis of the Project Area provides a site specific look at the project, an analysis by Wildlife Analysis Area (WAA) provides a look at the project in relation to a larger landscape scale. The Sea Level Project includes portions of WAAs 405 and 406.

The data for old-growth patches in WAA 405 is shown in Table Old Growth-9. A graphical representation of the data in Table Old Growth-9 is shown in Figure Old Growth-6.

Table Old Growth-9
Old-growth Block Acreage in WAA 405 (Thorne Arm), by Alternative.

Alternative	0-25 Acre Blocks	26-100 Acre Blocks	101-500 Acre Blocks	501-1,000 Acre Blocks	1,000+ Acre Blocks	Total
1954	321	672	2,379	1,327	8,089	**12,788**
1 (1997)	492	997	2,555	1,560	3,737	**9,341**
2	512	1,073	2,973	647	2,634	**7,839**
3	521	983	2,429	1,527	3,099	**8,559**
4	504	1,019	2,270	1,560	3,588	**8,941**
5	497	1,023	2,440	1,560	3,677	**9,197**
6	492	997	2,555	1,560	3,737	**9,341**

Source: GIS Database, Burns 1997.

Total old-growth acreage in WAA 405 is currently (1997, Alternative 1) at 73 percent of what was present in 1954. Old-growth blocks greater than 1,000 acres in size are currently at 46 percent of that which existed in 1954. All other old-growth patch sizes have increased since 1997, mainly at the expense of the patches greater than 1,000 acres in size.

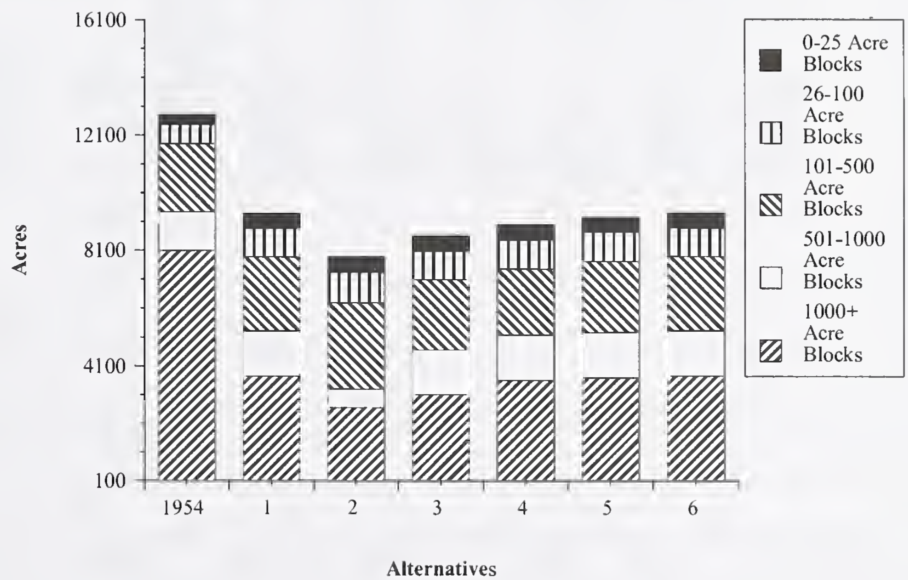
Alternative 2 shows the most change from 1954 conditions. Total old growth acreage in WAA 405 would be 61 percent of 1954 acreage under Alternative 2. The three smallest block sizes would be increased at the expense of the two larger block sizes. Blocks greater than

1,000 acres in size would be 33 percent of the 1954 acreage. Alternative 2 would reduce the 501-1,000 acre block size to 49 percent of 1954 conditions.

Alternatives 3 through 5 show a decrease in the blocks greater than 1,000 acres and an increase in the two smallest block sizes compared to 1954 conditions. Of these alternatives, Alternative 5 maintains old-growth forest the best in WAA 405.

Alternatives 1 and 6 maintain the most old-growth blocks in WAA 405 since neither harvest units in WAA 405

Figure Old Growth-6
Acreage of Old Growth Patches in WAA 405, by Alternative.



Source: Data taken from Table Old Growth-9.

The data for old-growth patches in WAA 406 is shown in Table Old Growth-10. A graphical representation of the data in Table Old Growth-10 is shown in Figure Old Growth-7.

Total old-growth acreage in WAA 406 is currently (1997, Alternative 1) at 63 percent of what was present in 1954. Old-growth blocks greater than 1,000 acres in size are currently at 37 percent of that which existed in 1954. All other old-growth patch sizes have increased since 1997, mainly at the expense of the patches greater than 1,000 acres in size.

Alternative 2 shows the most change from 1954 conditions. Total old growth acreage in WAA 406 would be 58 percent of 1954 acreage under Alternative 2. Blocks greater than 1,000 acres in size would be 36 percent of the 1954 acreage. The four smaller block sizes would be increased at the expense of the larger block size.

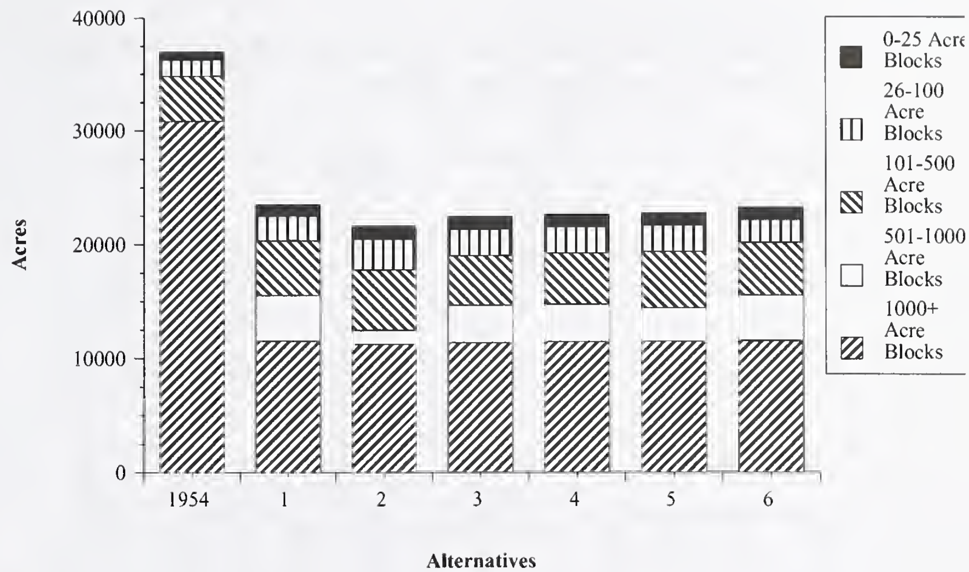
Table Old Growth-10

Old-growth Block Acreages in Wildlife Analysis Area 406 (Carroll Inlet), by alternative

Alternative	0-25 Acre Blocks	26-100 Acre Blocks	101-500 Acre Blocks	501-1,000 Acre Blocks	1,000+ Acre Blocks	Total
1954	628	1,481	3,964	0	30,821	**36,894**
1 (1997)	963	2,158	4,779	3,991	11,511	**23,402**
2	1,094	2,671	5,306	1,221	11,208	**21,500**
3	1,036	2,345	4,345	3,268	11,355	**22,349**
4	1,047	2,276	4,468	3,268	11,430	**22,489**
5	985	2,328	4,899	2,947	11,430	**22,589**
6	1,026	1,990	4,601	3,991	11,511	**23,119**

Source: GIS Database, Burns 1997.

Figure Old Growth-7
Acreage of Old-growth Patches in WAA 406, by Alternative.



Source: Data taken from Table Old Growth-10.

Alternatives 3 through 6 show a decrease in the blocks greater than 1,000 acres and an increase in all other block sizes compared to 1954 conditions. Blocks greater than 1,000 acres would be at 37 percent of 1954 conditions for Alternatives 3 through 6. Total old-growth acres in WAA 406 would range from 61 percent for Alternative 3 to 63 percent for Alternative 6.

Alternative 1 would result in the least amount of old-growth fragmentation in WAA 406 while Alternative 2 would result in the most. Of the action alternatives (Alternatives 2-6), Alternative 6 would result in the least amount of fragmentation in WAA 406, followed by Alternative 5, then Alternative 4, Alternative 3, and finally Alternative 2.

Using this patch data, the patch-size effectiveness can be calculated for deer and marten for these WAAs (Table Old Growth-11). Once again, the most prominent difference is seen in deer habitat. Deer habitat capability in WAAs 405 and 406 currently (1997, Alternative 1) have been reduced to 89 percent and 73 percent of 1954 conditions, respectively. Alternative 2 shows the largest change in deer habitat capability.

Table Old Growth-11
Adjusted Habitat Capabilities for Deer and Marten in WAA 405 and 406, Based on Patch-size and the Percent Effective, by Alternative

Species	1954	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
WAA 405							
Sitka black-tailed deer	1,722	1,532	1,359	1,473	1,523	1,532	1,532
percent effective	83.8	72.9	66.2	71.1	72.9	72.8	72.9
marten	99	89	84	86	87	88	89
percent effective	95.4	90.4	87.9	89.4	89.8	90.1	90.4
WAA 406							
Sitka black-tailed deer	2,891	2,099	1,982	2,067	2,070	2,057	2,099
percent effective	90.8	78.0	75.1	77.7	77.8	77.2	78.3
marten	184	160	153	156	157	157	159
percent effective	96.6	92.1	89.7	91.0	91.2	91.4	92.1

Source: Burns 1997, GIS database.

The final step in analyzing cumulative effects is to look at future treatments and their potential effects on old-growth patches. To do this, we projected the potential effects of harvesting on all commercially operable lands through one complete rotation (to the year 2095). The resulting old-growth patch distribution is shown in Figure Old Growth-8. This map can be compared to Figures Old Growth-1 and Old Growth-2 (earlier in this section) to see changes since 1954 and 1997.

There are some basic assumptions to this analysis. First, it is assumed that the current Forest Plan (1997) will be in affect throughout the rotation. As a result, it is assumed that most harvesting in the next 100 years will be partial cuts to meet the marten and goshawk standards and guidelines. Secondly, it is assumed that all existing young growth will mature and be harvested again with partial cutting methods. Third, it is assumed that all commercially available timber will be harvested over the next 100 years.

The map in Figure Old Growth-8 is provided as a best estimate of future conditions. One must understand that it is difficult at best to predict actual conditions on the ground 100 years from now.

Figure Old Growth-8
Old-growth Patches in the Sea Level Project Area in 2095

Source: GIS Database

Effects of the Alternatives on Viable Populations of Wildlife

The Tongass National Forest now has a Viable Population Strategy as identified in the Forest Plan (TLMP 1997). The Sea Level Project maintains the options for implementation of such a population viability strategy by maintaining large, medium, and small old-growth habitat reserves and other nondevelopment areas such as Misty Fiords and Naha LUD II areas. Since all alternatives will not be affecting the large and medium old-growth habitat reserves identified in the TLMP Final EIS (1997), the size and spacing requirements identified in that strategy will be met.

Small old-growth habitat reserves have been identified under TLMP as well (Figure Old Growth-3). These small reserves can be changed if project level analysis finds it is necessary. The current locations appear to be the best when considering old-growth patches in the Project Area (Figure Old Growth-2). These small old-growth reserves will not be affected by the alternatives in the Sea Level Project.

TLMP (1997) indicated that project analysis would include an analysis of the small old-growth reserves and whether they met the intended size and spacing requirements in TLMP. Our analysis shows that all VCUs meet the size, spacing, and productive old growth requirements for small old-growth reserves, except the Minx old-growth reserve.

The Minx old-growth reserve is about 150 acres less than the total acreage required in TLMP. However, the productive old-growth acreage within the reserve is about 140 acres more than the TLMP requirement. Enlarging the Minx reserve would not necessarily result in more habitat for old-growth dependant species.

Effects on Connecting Corridors

Figure Old Growth-3 shows the important travel corridors in the Sea Level Project Area. The beach fringe provides a good corridor in most cases. However, the beach fringe north of Shoal Cove has received extensive past harvest, making it less suitable as a connecting corridor. Therefore, additional connecting corridors have been identified for this project (Figure Old Growth-3).

Alternatives 1, 4, 5, and 6 maintain all corridors in the existing condition. Alternatives 2 and 3 harvest two units in the Painted Creek Corridor (Units 5 and 60). These units reduce the width of the corridor to about 100 feet in places. The corridor is already less than 1000 feet (the preferred width for maintaining interior old growth conditions) in many places due to second growth from past harvest activities. This would greatly reduce the effectiveness of this connecting corridor. Alternatives 2 and 3 also harvest a small unit in the corridor between Carroll Inlet and Thorne Arm. This unit is small and results in minimal impacts to that corridor.

Alternative 1 maintains connectivity better than other alternatives. Of the Action alternatives, Alternatives 4 and 5 were developed to address connectivity concerns between the Carroll Point medium Old-growth Habitat Reserve and other reserves and non-depelopment LUDs. These alternatives avoid harvesting in the Minx Flats area to facilitate connectivity between the Carroll Point Old-growth Habitat Reserve and Misty Fjords National Monument.

None of the alternatives propose harvest units in the Fish Creek corridor. All alternatives maintain the beach fringe as connecting corridors.

It is assumed that the TLMP strategy of maintaining large, medium, and small old-growth reserves and connecting corridors that exist within the Project Area and adjacent areas will maintain well-distributed, viable populations of old-growth associated wildlife species.

Comparison of Alternatives

Based on old-growth habitat and patch-size effectiveness, Alternative 1 would do the most to preserve the natural biological diversity of the Project Area and maintain natural ecosystem processes. Of the action alternatives, Alternative 6 maintains the most acreage in large old-growth patches and Alternative 2 maintains the least.

Table Old Growth-8 displays the results of patch-size effectiveness for deer and marten (the Sea Level MIS with patch-size criteria requirements). Note that none of the action alternatives are significantly different.

The species most affected by changes in patch-size effectiveness is the Sitka black-tailed deer. The results of patch-size effectiveness shows a decrease from 1997 conditions in the effectiveness of deer habitat. Habitat capability for deer in 1997 was 71.9 percent effective. The habitat capabilities for the action alternatives range from 62.8 percent effective for Alternative 2 to 72 percent effective for Alternative 6 (Table Old Growth-8). Deer habitat capability in WAAs 405 and 406 currently (1997, Alternative 1) have been reduced to 89 percent and 73 percent of 1954 conditions, respectively. Alternative 2 shows the largest change in deer habitat capability based on patch-size effectiveness.

Silviculture and Timber

Key Terms

Commercial Forest Land (CFL)—land that is capable of producing continuous crops of timber (20 cubic feet of tree growth annually, or at least 8 MBF).

Diameter at Breast Height (DBH)—the diameter of a tree, in inches, 4½ feet above the root collar on the uphill side.

Desired future condition or goal—a concise statement that describes a desired future condition normally expressed in broad, general terms that are timeless, in that there is no specific date by which the goal is to be achieved (36 CFR 219.3).

Duff layer—vegetative material covering the mineral soils in forests, including the fresh litter and well-decomposed organic material and humus.

Even-aged—management techniques that result in the creation of stands in which trees of essentially the same age grow together.

Managed stand—a stand of trees in which stocking level control is applied to achieve a desired condition.

MBF—thousand board feet.

Logging System Transportation Analysis Plan (LSTA)—interdisciplinary design and mapping of all potential timber harvest units, including associated logging and transportation systems, within a Project Area.

Mid-market analysis—the value and product mix represented at the quarter in which the pond log value (end-product selling price less manufacturing cost) for the species and product mix most closely matches the point between the ranked quarters of the Alaska Index Operation pond log value, adjusted to Common Year Dollars, where one half of the harvest of timber from the Tongass National Forest has been removed at higher values and one half of the timber has been removed at lower values, during the period from 1979 to the current quarter (FSH 2409.22 R10 Chapter 531.1-2).

MMBF—million board feet.

Partial cut—method of harvesting trees where any number of live trees are left standing in any of various spatial patterns; not clearcutting.

Reserved—lands that have been withdrawn from the timber base by an Act of Congress, the Secretary of Agriculture, or the Chief of the Forest Service.

Selling Value—Summation of Stumpage, Production costs (stump to truck costs), Manufacturing costs (value added costs) and Profit and Risk costs of an end product.

Uneven-aged—management techniques that results in the creation of stands that exhibit a range of diameter or age classes.

Windfirm trees—trees that have been exposed to the wind throughout their life and have developed a strong root system or trees that are protected from the wind by terrain features.

Windthrow—the act of trees being uprooted by the wind. Three types of windthrow include: endemic, when individual trees are blown over; catastrophic, when a major windstorm can destroy hundreds of acres; and management related, when the clearing of trees in an area make the adjacent standing trees vulnerable to windthrow.

Silviculture: Affected Environment

Introduction

Ecosystem management is a new term that emphasizes an old concept, incorporating management by objectives with due consideration for biological, physical, and ecological factors. The two salient points are: (1) management of the forest resources must consider a full range of resource objectives, not only commodity outputs, and (2) management must be practical and achievable. The physical and biological limitations serve to restrict the range of treatments and objectives that can be achieved on a particular site. Choices are based on matching the attributes of the silvicultural systems with specific management objectives and the ecological characteristics of specific stands.

Silviculture can be defined as the theory and practice of manipulating forest vegetation; that is, controlling the establishment, composition, and growth to meet various resource objectives in a manner that is biologically, ecologically, and environmentally sound, cost effective, and socially and politically acceptable. Management objectives may include aesthetics, water quality, fisheries, timber, wildlife, or recreation. Wood production may or may not be a primary objective of silvicultural systems.

Silvicultural systems are used to manage forest stands. A stand is a forest community possessing sufficient uniformity in composition, age, spatial arrangement or condition, to be distinguishable and capable of being mapped from adjacent communities. A silvicultural system is a program of treatments applied throughout the life of the stand; it is the process by which the stand is manipulated for a specific purpose and it is the means of reaching a desired future condition. This process may include harvest or regeneration of the stand, intermediate cuttings, or other cultural treatments necessary for the replacement and development of the forest stand. No single silvicultural system can produce all desired combinations of products and amenities from a particular stand or project area. Silvicultural systems are applied through prescriptions, which are written records of the examination, diagnosis, and treatment regimes prescribed for the stand. Prescriptions are prepared and written by a certified silviculturist.

Forested Plant Communities

The natural vegetation of the Sea Level Project Area is a mosaic of coniferous forest, alpine tundra, muskeg (bog), shrubland, estuarine and beach fringe plant communities. The Project Area has been classified into forested plant associations, using the *Tongass Forest Plant Association Management Guide* (DeMeo 1992), which are based upon the climax plant community. The climax plant community is the result of the interaction between landform, climate, and soils. All forested plant associations having the same climax tree(s) are referred to as a series and are named based upon the climax tree(s). The Sea Level Project Area has seven plant series. Forested plant communities, displayed by value comparison unit (VCU) in Table Silviculture-1, are described below.

Sitka Spruce Series

Plant associations in this series are generally associated with riparian areas and disturbed sites such as stringers between avalanche chutes. This series can also occur in combination with mountain hemlock at higher elevations. Sitka spruce is the dominant overstory tree species but western hemlock can be a co-dominant. Red alder may also be present. Common shrub species include devil's club, blueberry, and salmonberry. Ferns and skunk cabbage are the dominant herbs. The Sitka spruce series is generally highly productive, and the heights of mature spruce often exceed 150 feet.

Western Hemlock Series

Plant associations in this series generally occur in the uplands on mountain-, hill-, and foot-slopes with moderate to well-drained soils. The predominate overstory tree species is the western hemlock, but Sitka spruce occurs in the overstory in relation to the frequency of disturbance. The shrub layer is dominated by blueberry and rusty menziesia; devil's club, however, can be a major component in some areas. Bunchberry and five-leaf bramble dominate the herb layer, but skunk cabbage can be a major component in areas with poorly drained soils. Plant productivity is generally high, with mature hemlock often exceeding heights of 125 feet.

Most sites harvested to date on the Project Area have been of the Western Hemlock Series.

Western Hemlock-Western Redcedar Series

This series represents a transition from the less productive, poorly drained mixed conifer series, to the more productive, better drained western hemlock series. It occurs on a wide variety of landforms, but is most characteristic of rolling hill country and lower hill- and mountain-slopes. Near the northern limit of its range on the Project Area, redcedar growth is limited by light and temperature. Consequently, while it may be found up to 1,000 feet above sea level, it is most common below 500 feet.

The overstory is dominated by western hemlock. Redcedar commonly occupies 10 to 25 percent of the forest canopy. Yellowcedar may also occur. Other species are incidental. The understory is characterized by blueberry, although salal may be locally common on warmer sites below 500 feet elevation. Site productivity is typically low to moderate on rolling hills and moderate to high on hill- and mountain-slopes.

Western Hemlock-Yellowcedar Series

This series can be considered a subset of the western hemlock series on the Ketchikan Administrative Area. It is most common on mountains and hillslopes around 1,000 feet elevation, but can be found from sea level to the subalpine zone. Dominant overstory tree species are western hemlock and yellowcedar; western redcedar may also be present. Blueberry is the dominant shrub, with rusty menziesia being common. Dominant herbs vary and include ferns, bunchberry, dogwood, skunk cabbage, and five-leaf bramble. Site productivity is best described as moderate.

Mountain Hemlock Series

These plant associations are generally found on cold high-elevation sites above the western hemlock series. Mountain hemlock is the dominant overstory tree species, with Sitka spruce and yellowcedar occurring to a lesser degree. The shrub layer is dominated by blueberry. As the treeless alpine zone is approached, copperbrush and cassiope become more common. Deer cabbage is a common herb. Plant productivity is limited by the shorter growing season at high elevations and by reduced soil drainage common to some of the associations.

Mixed Conifer Series

Mixed conifer associations designate sites with limited productivity due to poor soil drainage or shallow soil, or both. These plant associations generally occur in the uplands, often near muskegs. Dominant overstory tree species are mountain hemlock, western hemlock, western redcedar, and yellowcedar. Sitka spruce and shore pine can also occur. Blueberry and rusty menziesia are the dominant shrub species. Dominant herbs vary and include skunk cabbage, five-leaf bramble, deer cabbage, and ferns.

Shore Pine Series

This group of associations is on the transition line from mixed conifer to nonforest muskeg. Soils are poorly drained and productivity is very low. Understory vegetation, because of the abundant light available, is very diverse. Muskeg plants such as Labrador tea, crowberry, bog kalmia, bog blueberry, and sedges are common. Salal may occur on some sites.

Table Silviculture and Timber-1 displays the approximate percent of area occupied by each forested plant series found in the Sea Level Project Area.

Table Silviculture and Timber-1
Percent of Forested Plant Communities (by VCU and Plant Series)

VCU	Sitka Spruce	Western Hemlock	Mountain Hemlock	Shore Pine & Mixed Conifer	Western Hemlock-Alaska Cedar	Western Hemlock-Western Redcedar	Total Forested Land
746	1.88	43.92	12.09	25.94	6.52	4.96	**95.31**
753	1.18	26.31	4.37	26.31	2.99	25.65	**86.81**
754	3.72	67.49	0	25.08	0	2.17	**98.46**
755	.53	34.86	0	28.11	4.62	20.25	**88.37**
756	.85	47.87	.01	37.74	0	9.73	**96.20**
757	1.24	8.39	2.99	22.77	9.71	41.61	**86.71**
759	2.61	2.27	7.58	25.90	4.73	44.13	**87.22**

Source: Trulock 1997.
Note: This information derived from Ketchikan Area GIS, CLU data layer.

Nonforested Plant Communities

Various nonforest plant communities occur in estuaries, riparian areas, muskegs, alpine meadows, and alpine lichen rock outcrops in the Sea Level Project Area. Additional information on nonforested communities can be found in the Ecological Landtypes section of this chapter.

Silvicultural Systems

Silvicultural systems are named for the method of regeneration cutting by which the stand is replaced. These regeneration cuttings are selection (single tree and group), seed tree, shelterwood, and clearcut. They can be grouped into even-aged and uneven-aged systems, depending on the type of age structure that is created.

Even-aged Systems

Even-aged systems produce stands that consist of trees of the same or nearly the same age. A stand is considered even-aged if the range in tree ages normally does not exceed 20 percent of the rotation age — the age at which the stand is harvested. Seed tree cutting, shelterwood cutting, and clearcutting will produce even-aged stands. Even-aged stands have a beginning and an end point in time. Even-aged systems produce distinct successional stages and there are even-aged stands of various ages and sizes distributed throughout the managed forest. Therefore, even-aged forests have relatively low vertical diversity, but have a high degree of horizontal diversity;the forest is a mosaic of forest and openings. The low vertical diversity is a result of the comparatively simple structure of the even-aged stand.

Clearcutting Method

This method involves the removal of the entire stand in one cutting, and reproduction is obtained artificially or by natural seeding from adjacent stands. In the narrowest sense, the cutting operation includes all standing woody vegetation. A variant of this method includes felling only merchantable trees, and with careful harvest technique, retaining the existing advance regeneration. This method is mimics large-scale natural disturbances such as wildfire or windstorms. The primary objective of this method is to reestablish an even-aged stand by removing the mature one. Decisions to clearcut are usually based on a number of factors such as insect epidemics, disease, fire, decadent stand conditions, desire to change species, desire to introduce genetically superior trees, or desire to meet the needs for regulating volume production through area control.

The clearcutting method with natural regeneration is historically the most commonly used system on the Tongass National Forest. The system works well, but natural regeneration is usually too abundant. The reproduction is derived partly from wind-dispersed seed and partly from advance reproduction that survived the logging operation.

Landscape View of Clearcuts and clearcuts with reserves.

Silvicultural advantages of the clearcutting method can be listed as follows: (1) it permits longer cable yarding distances than would be practical in partial cutting, allowing wider road spacing, reduced road costs, and less soil disturbance due to road construction, (2) exposure to the sun raises soil temperatures, which speeds decomposition of the organic forest floor, thereby improving the productivity of the forest site, (3) favors regeneration of Sitka spruce by destroying advance hemlock regeneration (reduces competitive advantage of the hemlock) and disturbing the forest floor, creating seed beds that are more favorable for post-logging reproduction of spruce, (4) eliminates residual overstory trees infected with dwarf mistletoe (preventing infection of western hemlock in the new stand), (5) eliminates the risk of blowdown in residual stands (stands left within the cutting boundary), (6) no logging damage to adjacent standing timber, and (7) logging costs are lower than with other methods.

Silvicultural disadvantages of clearcutting are: (1) seedling distribution is uneven and parts of an area may become understocked or overstocked, (2) species control is poor, (3) the chance of blowdown along cutting boundaries is increased, but can be reduced through proper design of cutting units, (4) it tends to reduce protection against erosion, landslides, and rapid runoff of water, (5) is aesthetically the least desirable method, because of the heavily altered appearance of recently harvested areas, and (6) unmerchantable trees may have to be cut.

Currently, the Project Area contains 12,164 acres of seedlings and saplings. Seedlings and saplings are trees less than or equal to 4.9 DBH. There are 56 acres of pole timber and young sawtimber (5 inches to 9 inches DBH) sized stands. Nearly all of these sites were previously harvested using the clearcut silvicultural method.

Seed-tree Method

This method involves the removal of an old stand in one harvest entry, except for a small number of trees left singly, in small groups, or narrow strips, as a source of seed for natural regeneration. This method mimics a large-scale disturbance such as severe windthrow, which leaves a few mature trees per acre that serve as a seed source. Traditionally these remaining seed trees have been removed in a later entry after regeneration has been established.

Silvicultural advantages of the seed-tree method are: (1) better distribution of seed occurs as compared with clearcutting, (2) better species composition than with clearcutting, (3) it can regenerate extensive areas of timber in areas too large to be seeded naturally from adjacent stands, (4) logging costs are low, (5) slightly better aesthetics than clearcutting, and (6) seed trees add some vertical diversity.

Silvicultural disadvantages of the seed-tree method are: (1) it is limited to windfirm trees and it is not feasible where seed-trees will be blown over by wind, (2) control of spacing and timing of the new crop is difficult, (3) it is costly to harvest seed trees and damage occurs to regeneration, (4) soil protection is not much different than clearcutting, (5) it is commonly limited to lighter weight-seeded species, (6) it is inappropriate when the seed-trees have infestations of hemlock dwarf mistletoe (parasitic plant), and (7) seed trees are vulnerable to damage during logging.

Shelterwood Method

This method involves the establishment of a new stand under the canopy of the old stand. Shelterwood cuttings mimic large-scale natural disturbances in which many trees are lost and the residual large trees may provide seed, and shelter the natural regeneration from extreme heat and cold. Hemlock and spruce lend themselves to shelterwood cutting because both species can become established under a forest canopy.

Silvicultural advantages of the shelterwood method are: (1) it allows ultimate control of site conditions for the regeneration of even-aged stands, (2) natural regeneration is usually more certain than in the seed-tree or clearcut method because there is a more abundant source of seed, (3) good soil protection is provided, (4) it is superior to all methods, except selection, with respect to aesthetic considerations and protection of site, (5) it can be applied to large areas, (6) it provides the best control over species composition, amount, and distribution, and (7) sheltering trees add some vertical diversity.

Silvicultural disadvantages of the shelterwood method are: (1) logging costs are much higher because of the small volume per acre, the frequent entries to each stand required, the complexity of the logging systems, and the care necessary to hold damage to an acceptable limit, (2) it requires a fairly windfirm species and it is not feasible where the sheltering trees will be blown over—hemlock and spruce rarely exhibit windfirm characteristics, (3) unavoidable damage to residual stand and reproduction occurs during logging, particularly on cable ground, (4) it is inappropriate when the sheltering trees have infestations of dwarf mistletoe, (5) several Oregon studies in hemlock-spruce stands suggest that overstocking of regeneration can be expected, (6) it is difficult to maintain spruce in the understory, because it is out-competed by hemlock which can tolerate more shade, and (7) growth rate of seedlings is slower under shade.

Uneven-aged Systems

Uneven-aged systems create stands that include three or more distinctly different age classes, with no beginning or end point in time. Uneven-aged systems produce stands of high structural diversity because of the intermingling of the different age classes. Regulation of the forest is based on development and maintenance of a range of tree diameters, with many trees in the smaller diameter classes and progressively fewer in the larger diameter classes. These forests have a high degree of vertical diversity, but horizontal diversity will be low. The system produces large blocks of continuous forest cover dominated by relatively mature trees; there is a gradual reduction of shade intolerant trees and understory plants. This system has not been formally tested in the hemlock-spruce type of Southeast Alaska.

Regulation of even-aged management is based on the area and time required to grow trees to a merchantable size; regulation of uneven-aged stands requires the establishment of: (1) maximum tree diameter, (2) residual stocking levels or volume required to maintain growth and yield, and (3) the desired structure which controls the diameter distribution.

Individual Tree Selection Method

With the individual tree selection method trees are removed individually, by prescription, from a large area in an overall random pattern. This method simulates natural disturbances caused by the death of scattered trees. Regeneration occurs under the partial shade of larger trees, and seedlings must be able to grow in a shaded environment. Sitka spruce and western hemlock are adapted to grow in a shaded environment. Under the selection method, the stand always has some relatively old trees. Some of the cuttings may be intermediate in timing in immature age classes. Each tree is evaluated for its contribution to the desired characteristics of the stand.

Silvicultural advantages of the individual tree selection are: (1) it is capable of maintaining an uneven-aged stand, (2) reproduction of tolerant species is easily obtained, (3) seedbed site protection is excellent with little or no exposure to insolation (exposure to sunlight) and wind, (4) stands can be readily adapted to changing market conditions, and (5) it usually has the highest aesthetic rating.

Silvicultural disadvantages of the single-tree selection method are: (1) highly skilled people are needed to practice it, (2) logging costs are much higher because of the small volume per acre, the frequent entries to each stand required, the complexity of the logging systems, and the care necessary to hold damage to an acceptable limit, (3) crop trees are scattered throughout the stand, (4) risk of wind damage within the stand increases with partial cutting, (5) a more extensive road system needs to be constructed and maintained to secure the same volume of timber as obtained by use of other systems, (6) it would not be suitable for hemlock stands infected with dwarf mistletoe, (7) frequent light entries can result in accelerated stand deterioration as the stand is opened up to wind, and damage can be done to boles and roots of residual trees from felling and yarding tall, large-diameter, defective trees, and (8) shade tolerant western hemlock would eventually replace spruce and cedar species within the stand.

Before and After an individual tree selection.

Group Selection Method

Trees are harvested in small groups (usually less than 2 acres). The openings created in the stand resemble miniature clearcuts and the uneven-aged stand is composed of a mosaic of even-aged groups; the small openings simulate small natural disturbances.

Silvicultural advantages of the group selection method are: (1) the regeneration in the small groups grows up under even-aged conditions and better stem form is obtained, (2) harvesting is more concentrated so logging costs are lower than individual tree, (3) harvesting in groups lowers damage to the residual stand, (4) it tends to increase diversity of plants and animals because of a temporary increase in shade intolerant plants in the small openings, (5) intermediate cuts may be made less frequently without sacrificing diameter class distribution although composition may be affected, (6) the small groups may be aesthetically more acceptable to some people, and (7) the small openings would be more favorable for spruce and cedar regeneration.

Silvicultural disadvantages of the group selection method are the same as the individual tree method but to a lesser degree. The major limitations on its use are the operational difficulties in the steep, rugged topography found in the Project Area.

Criteria for the Selection of Harvest Cutting Method

Criteria for the selection of harvest cutting methods to be used on National Forests in Alaska are provided in 36 CFR 219.27(b) and the Alaska Regional Guide (USDA November 1983). The selected method must meet all of these criteria:

1. Capable of meeting special management and multiple-use objectives (36 CFR: Criteria 1 and 6, Regional Guide: Standard 2),
2. Permit control of vegetation to establish desired species composition, density, and rates of growth (36 CFR: Criteria 4 and 6),
3. Promote a stand structure and species composition which minimizes risks from solar radiation, disease, and windthrow (36 CFR: Criterion 4, Regional Guide: Standard 2),
4. Use available and acceptable logging methods (36 CFR: Criterion 4, Regional Guide: Standard 2),
5. Assure that lands can be adequately restocked (36 CFR: Criterion 2),
6. Be practical and economical in terms of transportation, harvesting, preparation, and administration of timber sales (36 CFR: Criterion 7, Regional Guide: Standard 2),
7. Not be selected solely on the basis of greatest dollar return or highest output of timber (36 CFR: Criteria 3 and 5), and
8. Not permanently reduce site productivity or impair conservation of water and soil resources (36 CFR: Criteria 3 and 5).

In addition to the applicable laws and regulations, on June 4, 1992 the Chief of the Forest Service issued national direction on reduced use of clearcutting. Clearcutting would be limited to areas where it is essential to meet forest plan objectives such as the following:

1. To establish, enhance, or maintain habitat for threatened, endangered, or sensitive species,
2. To enhance wildlife habitat or water yield values,

3. To provide for recreation, scenic vistas, utility lines, road corridors, facility sites, reservoirs, or similar developments,

4. To rehabilitate lands adversely impacted by events such as fires, windstorms, or insect or disease infestations,

5. To preclude or minimize the occurrence of potentially adverse impacts of insect or disease infestations, windthrow, logging damage, or other factors affecting forest health,

6. To provide for the establishment and growth of desired trees or vegetative species that are shade intolerant,

7. To rehabilitate poorly stocked stands due to past management practices or natural events, and

7. To meet research needs.

Factors Influencing the Choice of Silvicultural Systems

The choice of silvicultural systems will depend on the silvical characteristics—that is, the reproductive habits and growth requirements—of the tree species, the operational environment (physical and biological setting), the management objectives that are to be achieved, and the operational feasibility of all logging systems (e.g., highlead, skyline, tractor, helicopter, etc.).

Silvical Characteristics - Commercial Species

Sitka Spruce

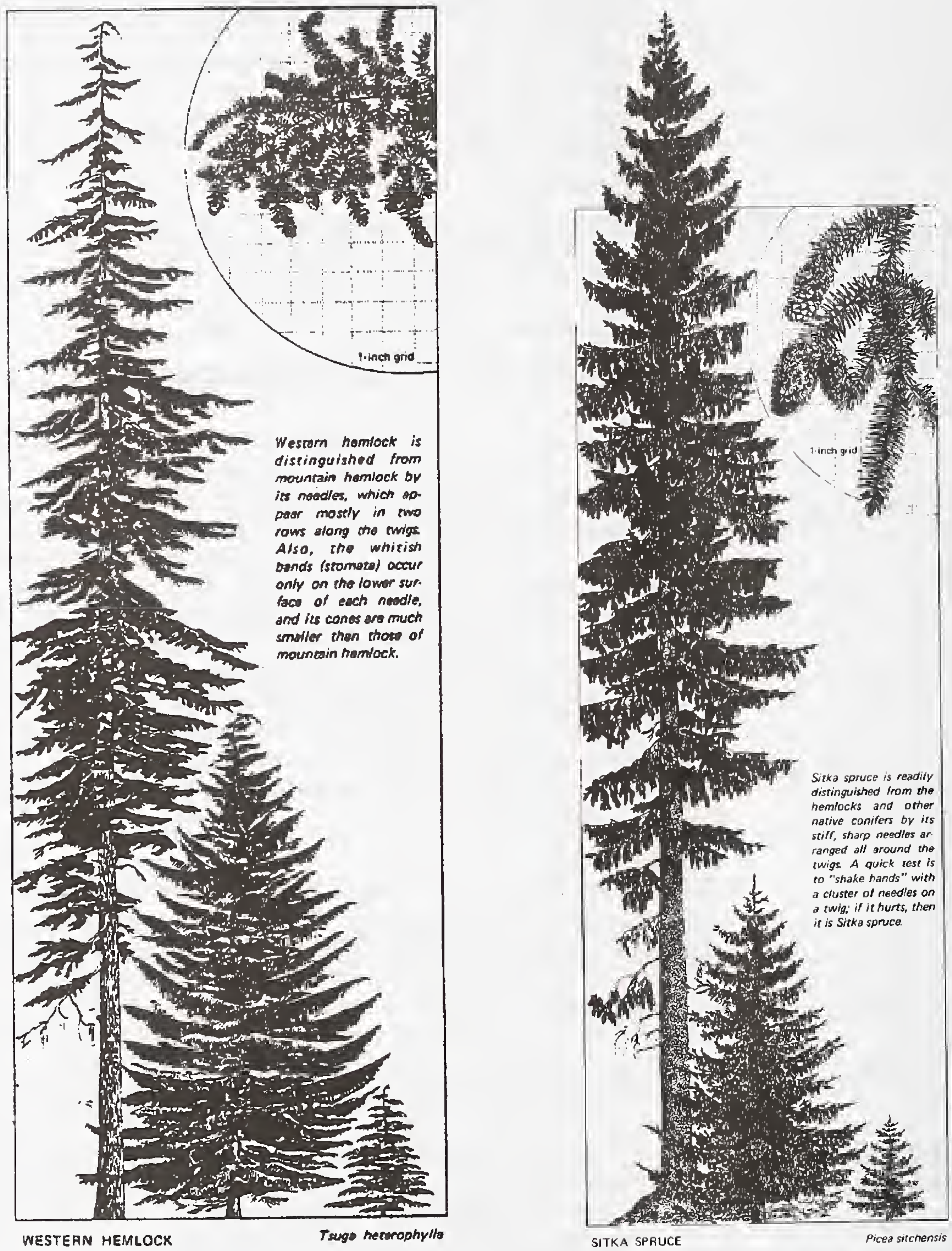
Sitka spruce (*Picea sitchensis*) is the largest and one of the most valuable trees; both biologically and economically. This species is classified as intermediate in tolerance ("tolerance" is defined as the ability to grow and prosper in the understory; light, moisture, or other environmental variables may be the limiting factor) and demands more light than its associate western hemlock (Harris and Farr 1974). Sitka spruce is a prolific seed producer. It produces small seed that can be carried long distances. Sitka spruce seed will germinate on almost any kind of seedbed if moisture is abundant. Natural regeneration can, consequently, be obtained through various reproduction methods. Establishment is best on mineral soil with organic matter and with side shade and overhead light. Spruce has an advantage over hemlock on bare soil. The percentage of spruce reproduction often can be increased by clearcutting and exposing more mineral soil during the logging operation. The rooting characteristics of Sitka spruce show great variability, but in Southeast Alaska, the species tends to be shallow rooted. Consequently, the species is vulnerable to compaction and blowdown. The bark is relatively thin which makes it susceptible to logging injury and subsequent decay. Blowdown is the most serious damaging agent to Sitka spruce.

Western Hemlock

Western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) is also a major component of the Tongass National Forest. Western hemlock is classified as very tolerant and dominates the reproduction of the old-growth forests, which makes it an ideal species for management that includes partial cutting. Other associated conifers include western redcedar, Alaska yellowcedar, lodgepole pine, Pacific silver fir, subalpine fir, and mountain hemlock. Western hemlock is a prolific seed producer. It produces seed almost every year, with heavy crops every 5 to 8 years; the seed is small and can be carried long distances in strong winds. The species can thrive on a wide variety of seedbeds; consequently, natural reproduction can be obtained through various reproduction methods from individual tree to clearcutting. Most stands contain advanced regeneration and through careful logging are often adequately stocked or overstocked. Hemlock does not develop a taproot and is a shallow-rooted species, thus is susceptible to windthrow. Most of the roots, particularly the fine roots, are near the surface and are susceptible to damage from compaction. Like spruce, this species also has thin bark and is susceptible to logging injury and subsequent decay. Hemlock dwarf mistletoe is a common disease and is usually best controlled by clearcutting.

Figure Silviculture and Timber-1 illustrates characteristics of the western hemlock and Sitka spruce.

Figure Silviculture and Timber-1
Characteristics of the Western Hemlock and Sitka Spruce



Western Redcedar

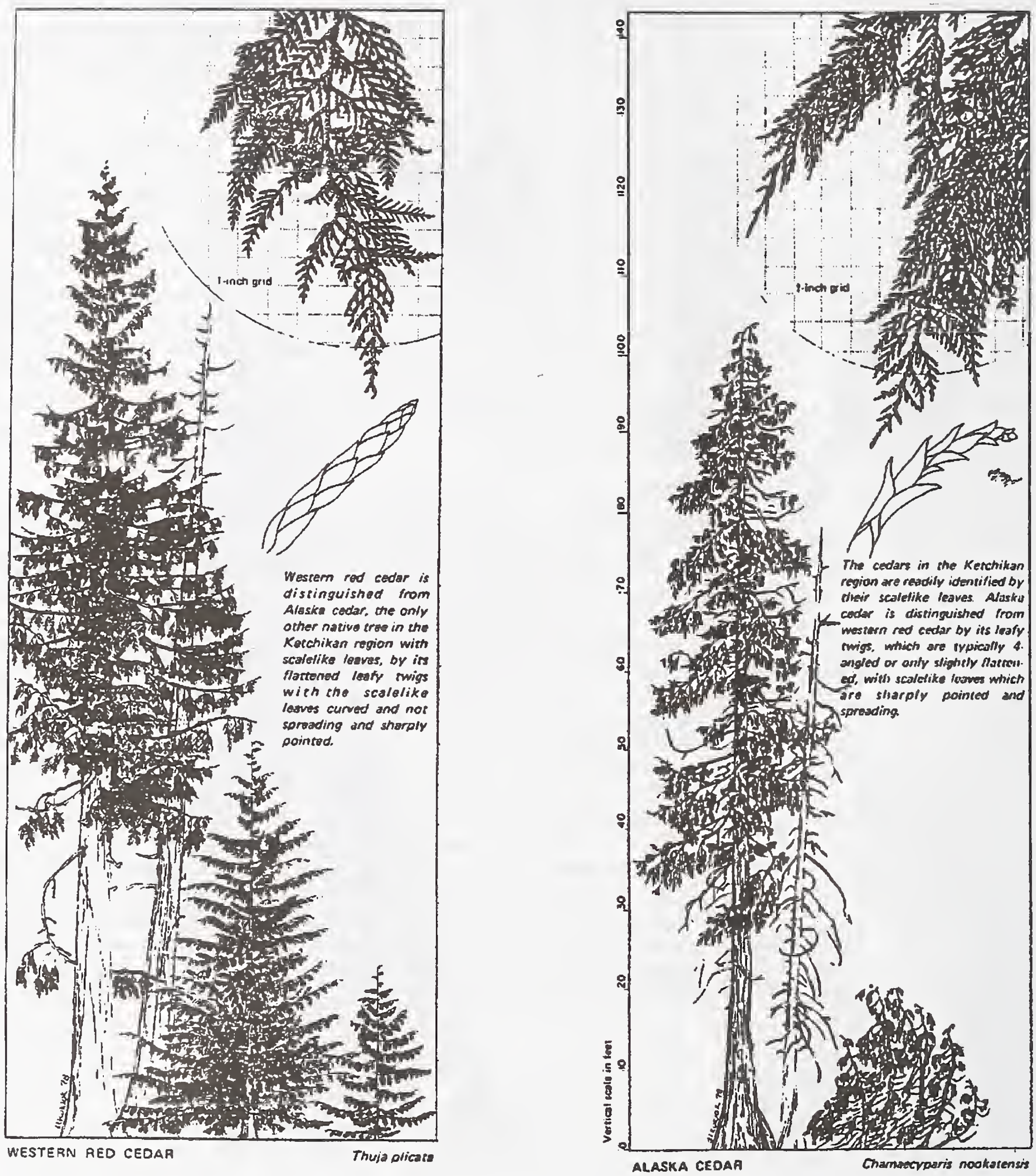
Western redcedar (*Thuja plicata* (Donn)) is an important tree species both economically and from a cultural perspective as well. Because of its straight grain, size, light weight, and workable texture, Southeast Alaska Natives use this species for totem poles, clan houses, canoes, etc. The stringy bark is used for making mats, baskets, and ropes. Western redcedar is commonly found in association with Alaska yellowcedar, western hemlock, lodgepole pine, and Sitka spruce.

Western redcedar is less tolerant than western hemlock and Sitka spruce. Western redcedar is near the northern edge of its range in the Project Area and is typically found on poorly drained organic soils in combination with Alaska yellowcedar, lodgepole pine, western hemlock, and Sitka spruce. The best growth is achieved on better sites, where it forms a minor component of the stand with hemlock and spruce dominating. Western redcedar is a prodigious seed producer, but because of the small surface area of the seed wing, the seed does not travel far from the source. The best germenation occurs on sites that have exposed mineral soil and full light which warms the soil. Although the germination percentage is often quite good, the seedling mortality rates are usually quite high, particularly when exposed to full light. Like most cedars, the tree is long lived and highly resistant to insect and disease attacks. The shallow water table on most organic soils makes western redcedar susceptible to windthrow. It is considered less windfirm than either spruce or hemlock and is used only as a last resort for tailholds or guyline anchors.

Alaska Yellowcedar

Alaska yellowcedar (*Chamaecyparis nootkatensis* (D. Don, Spach)) is a minor, but valuable, commercial tree species found within the Project Area. At lower elevations it is commonly found on poorly drained organic soils in association with western redcedar, western hemlock, lodgepole pine, and Sitka spruce. At elevations above 1,000 to 1,500 feet western redcedar is no longer a stand component and mountain hemlock replaces western hemlock. At elevations above 1,200 to 1,500 feet Alaska yellowcedar may only be of firewood quality. Good cone crops are irregular, occurring only one out of every four to seven years. The seed is heavy and will disperse 132 to 264 feet (2 to 4 chains). Alaska yellowcedar is classified as an intolerant species like western redcedar and, as such, it is less shade tolerant than hemlock or spruce. Alaska yellowcedar is especially susceptible to winter drying where warm, sunny weather, in combination with frozen soils, causes top kill. Warm weather in the winter of 1956, resulted in extensive top kill that is still evident today. Yellowcedar decline is another problem (possibly the same as winter drying) that is resulting in dead tops and mortality. The upper third of the crown is the most productive for cone production and seed viability. The harvesting of old-growth cedar forests through large clearcuts has resulted in regeneration to other species. Whether this is due to the periodicity of the seed crops, the heavy seed with limited dispersal distance, cedar decline, or some other cause is not known. Some form of partial cutting which favors yellowcedar or artificial regeneration may be needed to ensure its continued presence. Alaska yellowcedar is not particularly windfirm, but trees with dead tops provide much less resistance to the wind and may therefore be quite windfirm.

Figure Silviculture and Timber-2
Characteristics of the Western Redcedar and Alaska Yellowcedar



Pacific Silver Fir

Pacific silver fir (*Abies amabilis*) is a medium-sized resinous and aromatic tree occasionally found in small pockets in extreme Southeast Alaska. This tree is found infrequently within the Project Area and is considered to have wood properties very similiar to hemlock.

Shore Pine

Shore pine (*Pinus contorta*) is known also as lodgepole pine, bull pine, and by various other common names. This is the common pine throughout Southeast Alaska, and is often low spreading and scrubby. This species has cultural value as a Christmas tree and for use of the boughs for ornamental purposes.

Silvical Characteristics—Noncommercial Species

Pacific Yew

Pacific yew (*Taxus brevifolia nutt.*) is a small tree or shrub that has been found in the Project Area; scattered trees have been located throughout the southern portion of Revillagigedo (Revilla) Island (T. Demeo, USDA FS, Ketchikan Area Ecologist, personal communication 1992). Pacific yew is at the very northernmost portion of its range. It is typically found within 500 feet of saltwater as it depends upon the warm maritime climate to exist at this latitude. The bark from Pacific yew is high in taxol, which has been shown to have medicinal value for the treatment of cancer. The bark from Pacific yew trees located across the country is currently being tested for its taxol content. Cancer treatments are currently using taxol on an experimental basis.

Alder

Alder (*Alnus species*), both red and Sitka alder, are found throughout the Project Area. Sitka alder tends to be shrublike in form, with multiple stems, and rarely exceeds 30 feet in height. In contrast, red alder usually has a single, well-defined stem and can reach heights of up to 50 feet in the Project Area. Alder is commonly found along beaches and streams, and on avalanche tracks and landslide chutes. Alder is also common on roadsides, landings, and wherever soil has been highly disturbed. Alder is a primary succession species (one of the first to recolonize highly disturbed sites) and is usually shaded out 40 to 50 years after first being overtopped by Sitka spruce. Red alder is rarely found above 1,000 feet in elevation, but Sitka alder may grow up to and above 2,500 feet in the Project Area. Alder seed is extremely light and can be spread great distances by the wind. A mineral soil seedbed is required and both species of alder are extremely shade intolerant. During its maximum growing period, alder can achieve 5 feet of height per year. Both species have the ability to fix nitrogen from the air. Because of this ability to fix nitrogen, and because of abundant leaf fall which adds needed humus, alder is important for stabilizing or improving disturbed forest soils. Red alder is used for smoking fish and for carving, and is currently being researched for its viability as a commercial product in the Ketchikan area. Sitka alder currently is not used commercially.

Operational Environment

Climate

The forest has a maritime climate with abundant moisture throughout the year and has relatively mild winter temperatures and cool summers. Lack of a pronounced drought is probably the most important factor in affecting vegetation. The combination of warm water from the Japanese currents and prevailing westerly onshore winds result in mild, humid conditions throughout the Project Area. The weather patterns of Southeast Alaska develop strong winds and winter storms tend to be very intense. Gale force winds may occur during any month, however, the strongest winds are most likely to occur in fall and winter months. The strong winds are usually accompanied by rainfall which saturates soils, contributing to blowdown.

Table Silviculture and Timber-2 displays the number of days, by month, when gale force winds (over 30 miles per hour) occurred between 1953 and 1978 according to the National Oceanographic and Atmospheric Administration (NOAA) Meteorological Station at Annette Island, Alaska.

Table Silviculture and Timber-2
Number of Days, by Month, with Winds Over 30 Miles Per Hour

	Miles Per Hour						
Month	**31-35**	**36-40**	**41-45**	**46-50**	**51-55**	**56-60**	**Total Days**
July	3						**3**
August	5	4					**9**
September	11	7	3		1		**22**
October	67	45	13	4	3		**132**
November	58	41	5	8	1		**113**
December	64	39	9	9	2	3	**126**
January	70	29	5	6	2	2	**114**
February	60	31	2	8			**101**
March	25	9	8	4			**46**
April	32	9	7	2			**50**
May	8	5	2				**15**
June	11	1	1				**13**
Total	**414**	**220**	**55**	**41**	**9**	**5**	**744**

Source: Wind in the Forests of Southeast Alaska and Guides for Reducing Damage, A. S. Harris, PNW-GTR-244.

Over 80 percent of the gale-force winds reported between the years 1953 and 1978 were from the south or southeast and occur during the fall and winter months when heavy rains have saturated the soils; however gale force winds occur during every month of the year and come from all directions.

The management implications of these climate conditions are: (1) moisture is not a limiting factor in tree regeneration, (2) wildfire is not a major problem, (3) high winds can cause heavy losses of timber by windthrow; the relative risk of windthrow determines the range of silvicultural options available to meet the management objectives for a given site, and (4) the strong fall winds favor natural regeneration.

The rooting habits of western hemlock and Sitka spruce make these species susceptible to windthrow; both species are shallow rooted and depend on mutual support for wind resistance. Western hemlock does not develop a tap root. Both species are susceptible to stem and root rots which make them more vulnerable to wind damage. Wind is a major disturbance factor in Southeast Alaska, altering the structure of the forest. Scattered windthrow of large overmature trees is a prime cause of mortality and it creates small openings in which the advance growth in the understory may develop (group selection would mimic this effect). Spruce is able to maintain itself as a stand component because of these small openings created by windthrow. Stands covering many acres can also be blown down and many young-growth stands originate following the blowdown of the previous stand. The traits of windfirm stands and stands susceptible to damage by wind are documented in Table Silviculture and Timber-3.

Table Silviculture and Timber-3
Traits of Windfirm Stands and Traits of Stands Susceptible to Windthrow

Trait	Windfirm Stands	Susceptible Stands
Age	Young	Old
Age Structure	Even-aged	Uneven-aged
Defect	Little Defect	Large amounts of defect
Height	Short	Tall
Stocking	Open stocking on less productive sites, muskeg or scrub stands	Dense Stocking on Productive Sites
Species Composition	Have a high percentage of cedar and hardwoods	Predominately spruce and hemlock
History	Intact with little evidence of recent openings	Previously damaged by blowdown Even-aged pole or young sawtimber opened by thinning or partial cutting

Source: Wind in the Forests of Southeast Alaska and Guides for Reducing Damage, A. S. Harris, PNW-GTR-244.

Topography

Topographic features influence the probability of windthrow occurring. The following features may result in decreased windfirmness:

- westerly or easterly aspects where storm winds are accelerated around ridges,
- southerly aspects exposed to onshore winds,
- sideslopes or flats parallel to water channels oriented in a general northwest-southeast direction (especially along the west side of channels),
- flats and valley bottoms at heads of inlets or bays exposed to southerly winds,
- small islands, promontories, or slopes at constrictions of channels with open water to windward, and
- low ridges or upper leeward slopes.

Topography influences the choice of logging methods and silvicultural methods. Historically, most yarding has been downhill because roads are usually located in valley bottoms to avoid the unstable soils on the steep slopes. Cable logging downhill in partial cuts is especially difficult because of inadequate deflection for full suspension and lack of large enough tree root systems for adequate tailholds. Spruce and hemlock are prone to logging damage because of their thin bark and the risk of damage to residual trees is extremely high when attempting to remove trees, particularly on steep slopes using cable logging methods. Stands typically consist of large old trees with significant defect and require large yarders to remove the logs. To control residual stand damage the logging plan must incorporate and the logger must conduct operations following these guidlines: (1) eliminate cross-slope yarding where dragging of logs is involved, (2) during lateral yarding, the skyline must be positioned so that the entire log turn will be suspended above the ground when the logs enter the skyline corridor, (3) yard with the skyline positioned high above the ground to reduce skyline corridor width (lateral excursion), (4) log turns must fly free of the ground in downhill yarding and (5) skyline setting size must be restricted to control the clearcut effect from fan-shaped settings. The inability to meet all of these conditions on most areas generally makes cable logging partial cuts impractical. Other, more costly options, such as helicopters, would have to be used.

Process for Selection of Silvicultural Systems

Both even-aged and uneven-aged silvicultural systems are available for selection within the suitable productive forest lands. Factors other than the silvicultural or ecological limitations of the species weigh heavily in the choice between uneven- and even-aged management and among the several silvicultural systems that can be used to create even-age stands. These include:

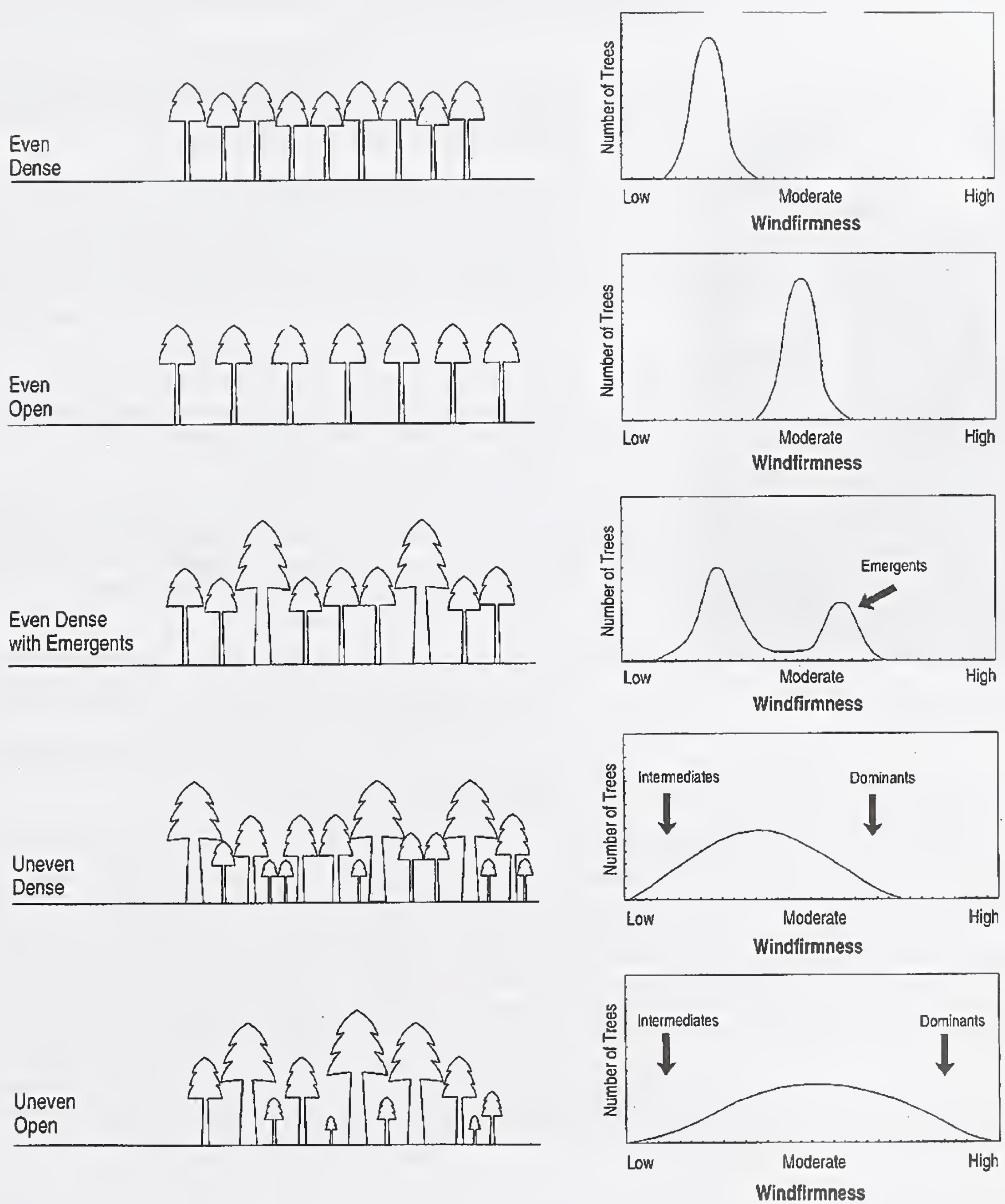
- economic considerations,
- other resource values,
- terrain considerations with its limitations on logging systems, and
- other operational environmental considerations such as the presence or absence of dwarf mistletoe, susceptibility to windthrow, and susceptibility to logging damage.

The first step in the selection of an appropriate silvicultural system for an individual site is the diagnosis or range of acceptable treatments including a deferred (no action, Alternative 1) entry. An acceptable treatment is one that is feasible and has a reasonable expectation of achieving sound silvicultural objectives. Silvicultural objectives typically include species composition, stand condition class, growth rate, density, insect and disease control, and stand development over time.

The next step is to use the Forest Plan, management concerns, and public issues to determine the objectives for the site, then select the silvicultural system that best meets the objectives. In order to meet the issues and concerns reflected in the various alternatives, one or more silvicultural system may be selected for the same site, depending upon the alternative.

In Southeast Alaska, the range in silvicultural options is limited by numerous factors, but the most dominant is the risk of windthrow. Areas of high windthrow risk offer the option to defer entry or to clearcut. Other forms of regeneration harvest have little or no probability of success where long-term timber production is at least one of the objectives for the site. The one exception to the above statement is where cedar forms a significant component of the stand structure. Because of the extensive top kill caused by cedar decline, the tops of these trees pose little resistance to the wind and are, therefore, relatively windfirm. This is especially true at higher elevations where the soils are frozen rather than saturated during the winter months when the majority of gale-force winds occur. Figure Silviculture and Timber-3 displays the distribution of relative windfirmness of individual trees comprising stands with different structural characteristics.

Figure Silviculture and Timber-3
Comparison of Distribution of the Relative Windfirmness of Individual Trees.



Clearcut

Areas of moderate-to-low windthrow risk have a full range of silvicultural options available. Clearcutting is generally selected for these areas for the following reasons:

1. It is the most effective means of controlling dwarf mistletoe. The removal of infected trees interrupts the life cycle of dwarf mistletoe and reduces the chance for infestation of the future stand. (36 CFR: Criterion 4, Regionàl Guide: Standard 2, Chief's Policy Letter: Criterion 4)

2. It eliminates the risk of blowdown in residual stands. The potential for windthrow increases along cutting boundaries but can be reduced through proper design of cutting units. (36 CFR: Criterion 4, Regional Guide: Standard 2, Chief's Policy Letter: Criterion 4)


Felling and yarding large trees often damages the remaining stand

3. It eliminates the risk of stand damage to the residual stand. The spruce-hemlock stands are composed of large trees and require large pieces of logging equipment which can cause significant damage to the residual stand. Spruce and hemlock tend to be shallow rooted, and therefore, susceptible to damage from ground based systems; clearcutting reduces these risks. (36 CFR: Criterion 4, Regional Guide: Standard 2, Chief's Policy Letter: Criterion 4)

4. It favors spruce and cedar. The logging operation will destroy some of the advance hemlock regeneration and thus take away its initial advantage. The increased sunlight also favors the spruce. (36 CFR: Criteria 4 and 6, Chief's Policy Letter: Criterion 5)

5. It can improve productivity. The cold air temperature and soil temperature do not favor decomposition of the organic forest floor. Exposing the site by clearcutting raises temperatures, which speeds the decomposition of raw humus and recycling of nutrients, particularly nitrogen. (36 CFR: Criterion 5, Chief's Policy Letter: Criterion 5)

6. It requires less road development. Less road construction is needed to remove a given amount of timber. Clearcuts favor longer spans which also allows for increased spacing between roads. (36 CFR: Criterion 5)

7. It is less costly. Fixed costs are spread over large volumes per acre and logging and road building is more concentrated. (36 CFR: Criterion 3 and 5, Regional Guide: Standard 2)

8. Natural regeneration is generally adequate. Experience with clearcutting since the 1950s, has shown that, except for certain situations, attaining natural regeneration is not a serious problem in the Sea Level Project Area. Natural regeneration is abundant and generally averages 3,000 to 5,000 stems per acre 10 years after harvest. Competition among seedlings for growing space and nutrients results in reduced growth rates at about age 15 to 20. Stocking control is intended to increase the rate of diameter growth of the remaining trees; tree size has a significant impact on log values, it improves crown ratios, favors commercially valuable trees (spruce), favors species (forage) or age classes which are most valuable to wildlife, windfirmness may be increased with early thinnings, and other multiple-use objectives may be achieved. (36 CFR: Criterion 2, Chief's Policy Letter: Criterion 4 & 5)

Partial Cut

Land Use Designations (LUD) that contain selection or group selection harvest systems are lands that will be managed primarily for maintenance and enhancement of resource values other than timber. Generally, any management of the timber resource on these lands will be for stand maintenance purposes only and will approach an uneven-aged silvicultural system. Production of high, current or future, timber yields is not a consideration. This prescription is primarily applied within stream riparian area boundaries.

Stand Maintenance

Stand maintenance is not, strictly, a silvicultural system. Under this management regime or concept, individual trees or small groups of trees are removed if conditions indicate: a disease or pest threat to the stand, imminent mortality, severe decline in growth, or if trees are in cable corridors. Stand maintenance, while a form of uneven-aged management, is different than the selection system (group or individual-tree) of management. Selection implies strict stocking control and a high intensity of management to maintain a predetermined ratio of tree ages and diameter classes in every stand. The intent with stand maintenance is to manage the timber stands in order to maintain or bring them to the best condition possible until selection silviculture becomes feasible, or until even-aged management can be made environmentally acceptable. The other possibility is that these stands could be classified as unsuitable.

Shelterwood

In addition to stand maintenance prescriptions, the other form of partial cutting that is being proposed in the Sea Level Project Area is called a shelterwood harvest. Technically this is referred to as the seed cut in a two-step shelterwood. The purpose of the seed cut is to provide seed and shelter to promote a new crop of trees. The seed cut is followed (usually 10 to 20 years later) by an overstory removal that removes the trees left as seed and shelter during the first entry. However, in this project the second entry will not be made and the seed trees will be retained for the full rotation. The purpose of this prescription is to respond to an issue raised during public scoping and an internal concern that following clearcutting, natural regeneration of yellowcedar is generally lacking. Alaska yellowcedar forms a significant portion of the following plant associations:

- Western hemlock-yellowcedar- all associations
- Mixed conifer- all associations
- Mountain hemlock-yellowcedar- all associations.

The yellowcedar sites will regenerate naturally if clearcut, but the species composition is primarily western hemlock, mountain hemlock, Sitka spruce or western redcedar, depending upon the elevation. Yellowcedar will usually not be represented and must be planted to re-establish the species. Sites that are clearcut using a helicopter will require a helicopter to move people and planting stock to and from the unit. Helicopter costs to support planting activities can vary significantly depending upon the number of acres available to spread fixed costs over. Costs typically range from $700 to $1,200 per acre. The quality or grade of yellowcedar declines with increasing elevation. At lower elevations, sawlog quality cedar is of the highest value, while at higher elevations, yellowcedar is primarily utility grade. Helicopter logging of utility grade yellowcedar followed by expensive artificial regeneration efforts make it more expensive to retain the yellowcedar on high elevation, helicopter logged sites.

Silvicultural systems other than clearcutting have not been applied on a large-scale basis in Southeast Alaska. The anticipated results are based primarily on research and experience from other parts of the country.

Reserve Tree Harvest Strategy (Legacy Structure)

In the reserve tree harvest strategy, clearcutting with reserves maintains a portion of an existing stand (individual trees, clumps, and groups) creating a two-layered structure with two or more age classes. This stand management system would be incorporated where site-specific conditions permit; 10-20 percent of the trees in each timber harvest unit would be left uncut to improve the habitat quality of second-growth stands in the future (TLMP Final EIS 1997).

The rationale behind using this system is to:

- Provide biological and structural diversity in stands by leaving standing green trees individually or in groups,
- Reduce the impacts to scenic resources, and
- Provide better protection of landslide prone sites by retaining a living root system.

Reserve Tree Selection Criteria

During the planning process, some acreage within the CFL classification is identified as non-suitable for timber harvest. These areas are often high value habitat, riparian areas, Class I and II stream buffers, MMI 4 soils, wildlife corridors, estuary and beach buffers, eagle nest buffers, etc. These areas are usually located adjacent to identified harvest units and are considered a large part of the reserve tree strategy. If site specific conditions permit, additional reserve tree acreage is identified within harvest units during the layout phase of the project.

In a legacy structure system, live reserve trees are retained indefinitely in groups (within or adjacent to harvest units) or as individually scattered trees throughout harvest units. If site specific conditions permit, the following criteria for selection of reserve areas within a conventional cable harvest unit would be used during the layout phase of the project:

- Blind lead areas, rock outcrops, small unstable areas, or small wetland areas of concern could be utilized for reserve tree islands.
- Additional reserve tree clumps at unit boundaries could be designated where logging feasibility allows.
- Identified stream buffers could be utilized within a unit; these buffers may also be increased in width if additional reserve tree areas are needed.
- Previously unbuffered streams within a unit could be utilized if needed.
- Reserve tree islands could be designed between roads if no other option is available and additional reserve tree acreage is needed.

In units where shelterwood harvest is prescribed by implementing a diameter limit cut, individual scattered trees would be left. These units would require helicopter yarding which would leave smaller diameter trees (usually Alaska yellowcedar) as a seed source.

During harvest unit layout, minor changes to planned tree reserves may be considered if the majority of the reserve tree area is left intact. Planned or layout reserve tree area selections should not be considered no-cut zones or retention areas. There are various reasons for adjusting reserve tree areas; two examples are not isolating otherwise harvestable patches of timber and correcting setting boundaries to facilitate logging feasibility.

It should be noted that when trees are prescribed to be left within harvest units, Alaska Department of Labor and Occupational Health and Safety Act (OHSA) regulations become paramount. Forest operatives working around reserve trees are exposed to a higher risk of danger then would otherwise be encounted in a clearcut with no reserve trees. The Region 10 publication *Reserve Tree Selection Guidelines* (R10-MB-215, March 1993) is used in the Sea Level planning process for reserve tree strategies as well as in developing guidelines for reserve tree strategies within harvest units. A more thorough discussion of this publication is presented in the Timber Section, Chapter 3, Logging Systems.

Silvicultural Treatment

A silvicultural system describes a general silvicultural treatment that will be applied to the units in the Project Area. Clearcut is one such type; below are modifications to the standard clearcut system that will be applied where necessary to protect resources, provide for reserve tree areas, ensure logging feasibility, and provide timber volume.

Type 1 Clearcut—unit boundary implementation would use the following criteria wherever the opportunity arose and was practicle; however, in most cases they are not requirements.

- Retain tree islands or fingers behind identified blind leads.
- Leave trees in clumps at unit boundary, where feasible.
- Utilize or expand buffers of Class 1 and 2 streams that flow within and adjacent to the unit.
- Utilize the buffers of previously unbuffered Class 3 streams within the unit, if required.
- Retain tree islands or fingers where there are rock outcrops, slope, or areas of MMI 4 soils or wetlands concern.
- Attempt to leave sub-merchantable and unmerchantable wherever practical.

Type 2 Clearcut—replaces Type 1 clearcuts where the legacy structure prescription is required. Operator implementation would use the following criteria.

- Follow Silvicultural Prescription for the quantity and type of leave-trees within the unit.
- Retain snags and sub-merchantable trees throughout unit as safety conditions allow (see Reserve Tree Selection Guidelines, Timber Section, Chapter 3, Logging Systems).
- Retain 10 to 20 percent of the original stand structure.
- Retain 4 large trees per acre which are 20 to 30 inches in DBH.
- Retain 3 decadent standing trees per acre which are 20 to 30 inches in DBH.
- Retained trees should have a reasonable assurance of windfirmness and clumping should be used whenever it provides obvious benefits.
- Utilize some Type 1 Clearcut criteria, if required for resource protection.

Size of Harvest Units

The National Forest Management Act of 1976 (NFMA) specifies a limit on the size of a forest opening which may be created based on the forest type. For the western hemlock/Sitka spruce forest type associated with Southeast Alaska, this maximum opening size is 100 acres. The NFMA provides leeway for extending this opening size to 150 acres under certain conditions, such as timber economics, regeneration requirements, wildlife or fisheries habitat needs, transportation or harvest system requirements, etc., and for exceeding 200 acres under extreme circumstances such as major insect and disease outbreak, fire, windthrow, or other form of catastrophic damage.

None of the alternatives propose harvest units over 100 acres in size.

Proposed Harvest by Site Class

Because some site classes are more productive than others, they are rated by a site index and are assigned a class of low, medium, or high. The site index is based on the expected height to which a tree will grow on that site within a given number of years (in this case 50 years). On low sites, trees would be expected to grow between 45 and 56 feet in height in 50 years. On medium sites, trees would be expected to grow between 57 and 66 feet in height in 50 years. On high sites, trees would be expected to grow more than 77 feet high in 50 years. In general, more timber can be grown at less cost on a high site than on a medium or low site, and more timber can be grown at less cost on a medium site than on a low site (Davis 1966). However, by mixing high, medium, and low sites, average logging costs for low sites can be reduced and more land is available for timber management over the rotation.

Table Silviculture and Timber-4 displays the acres of proposed harvest for each alternative by site class.

Table Silviculture and Timber-4
Acres of Proposed Harvest by Site Class (Productivity)

	Low		Medium		High		Total	
Alt.	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
1	0	0	0	0	0	0	**0**	**0**
2	37	1	1,251	44	1,555	55	**2,843**	**100**
3	25	2	670	41	925	57	**1,620**	**100**
4	1	1	570	46	655	53	**1,226**	**100**
5	1	1	322	37	524	62	**847**	**100**
6	1	1	258	66	131	33	**390**	**100**

Source: Trulock 1997.
Note: This information derived from Ketchikan Area GIS, CLU data layer.

Alternative 2 proposes to bring the highest number of acres in medium and high site classes under management (2,806 acres or 99 percent of the acres within this alternative proposed for harvest). Alternative 3 proposes to bring the second highest number of acres in medium- and high-site classes under management (1,595 acres, or 98 percent of the acres proposed for harvest), followed by Alternative 4 (1,225 acres or 99 percent of the acres proposed for harvest), Alternative 5 (846 acres or 99 percent of the acres proposed for harvest) and Alternative 6 (389 acres or 99 percent of the acres proposed for harvest). Alternative 1 proposes no timber harvest at this time and therefore does not provide an opportunity to bring medium and high sites under management.

Management Objectives American Marten

The American Marten Standards and Guidelines set forth in TLMP 1997 are extremely prescriptive (for more information please see TLMP 1997 for the actual Standards and Guidelines).

Legacy Structure Prescription—If less than 33 percent of the VCU has been previously harvested and openings greater than 2 acres will be created in high value marten habitat, silvicultural systems used must maintain on average the following structural characteristics:

- Ten to 20 percent of original stand structure.
- Four large trees per acre which are 20 to 30 inches in DBH.
- Three decadent standing trees per acre which are 20 to 30 inches in DBH.
- Retained trees should have a reasonable assurance of windfirmness and clumping should be used whenever it provides obvious benefits.

Variable Structure Prescription—In VCUs where over 33 percent has been previously harvested and openings greater than 2 acres will be created in high value marten habitat, the silvicultural systems used must maintain the following structural characteristics on average:

- Thirty percent canopy closure evenly distributed; however, clumping may occur.
- Eight large trees per acre which are 20 to 30 inches in DBH.
- Three decadent standing trees per acre which are 20 to 30 inches in DBH.
- Three down pieces per acre which are 20 to 30 inches in DBH.
- Retained trees should have a reasonable assurance of windfirmness; clumping is acceptable in certain circumstances.

A site-specific silvicultural prescription that incorporates these concepts will be prepared in coordination with a wildlife biologist prior to implementation.

Indirect and Cumulative Effects

Regeneration

All of the areas proposed for timber harvest will be restocked within 5 years as required under the National Forest Management Act of 1976 (NFMA). A combination of natural regeneration and artificial regeneration (tree planting) will be utilized to restock harvested areas. Prescribed fire for site preparation is not being proposed for any of the alternatives.

Natural regeneration or planting results in the growth of a new stand of trees.

Harvested sites must contain a minimum of 300 well dispersed trees per acre by the 5th year following harvest to be considered successfully regenerated. Survival (staked tree) surveys will be conducted on all planted sites the first and third full growing seasons after being planted. Regeneration stocking surveys must be conducted on all harvest units the third full growing season after yarding is complete. The 3rd year survey is used to determine whether, if any, additional reforestation efforts are required. The fifth year survey is used primarily to certify that the regeneration process has been successful on areas which did not meet the requirements the third year. Table Silviculture and Timber-5 shows the acres of essential reforestation treatments to be performed by alternative. It should be recognized that areas requiring artificial regeneration cannot be accurately identified until after harvest when the third year stocking surveys indicate inadequate natural regeneration. Thus, these acreage figures may change at the time planting would occur.

Table Silviculture and Timber-5
Anticipated Essential Reforestation Treatments, by Alternative in Acres

Alternative	Natural Regeneration Surveys 3 & 5 years	Plantation Stocking Surveys 1 & 3 years	Prescribed Tree Planting
1	0	0	0
2	2,843	72	72
3	1,620	43	43
4	1,226	29	29
5	847	14	14
6	390	2	2

Source: Trulock 1997.
Note: This information derived from Ketchikan Area GIS, Sea Level Silviculture Coverage.

Long-term Timber Productivity (Yield)

The effects of all action alternatives on long-term yield would be the conversion of unmanaged, overmature stands to managed, faster growing, primarily early seral, even-aged stands. Overmature stands have lower forest floor temperatures than even-aged stands thus reducing biological activity. Organic decomposition slows, and as a result, the supply of available nutrients is reduced. With decreased biological activity, less nitrogen is available for tree growth and nutritional status is lowered. While overmature stand growth and vigor remain nearly constant, they are at a level below that of even-aged stands (Harris et al. 1974). Table Silviculture and Timber-6 displays the average structural characteristics of managed stands by site classification—low, medium, and high.

Table Silviculture and Timber-6
Average Structural Characteristics of Managed Stands (by Site Classification)

Stand Age (years)	Height (feet)	DBH	Volume/Acre (board feet)*
Low Site			
5-20	26	1.4	0
20-50	56	4.9	1,900
50-80	82	8.5	14,100
80-100	96	10.8	25,500
100-120	107	12.8	37,100
120-160	122	16.4	56,800
Medium Site			
5-20	29	3.5	0
20-50	66	9.8	7,400
50-80	98	13.6	29,800
80-100	114	15.7	46,100
100-120	126	17.8	61,400
120-160	144	21.3	81,900
High Site			
5-20	31	4.0	100
20-50	77	11.0	13,900
50-80	111	15.2	43,400
80-100	127	17.5	62,400
100-120	139	20.1	78,000
120-160	157	24.1	100,300

Source: Forest Service 1991.
* Net Sawlog.

Regeneration quantity, quality, and sustainability have been on-going issues with regards to organic forested wetlands and karst landscapes. The Project Area has some areas underlain by carbonate bedrock with karst features of limited development and extent. Similiar areas within the project that are underlain by carbonate rock and that have been previously harvested show no significant problems regarding regeneration or growth rates. On the low to moderate vulnerability karst lands where mineral or glacially-derived soils fully or partially cover the epikarst, forest regeneration is exceptional. In these areas even the complete loss of soil and litter from the surface of the limestone will not prohibit the re-establishment of a forest, since the displaced surface materials are retained within the epikarst channels (TLMP 1997).

Certain organic wetlands have been excluded from harvest with the exception of inclusions less than 2 acres within harvest units (TLMP ROD 1997). These soils are currently the topic of ongoing research to determine their suitability for timber harvest. Historically these sites were planted as a mitigation measure to harvest. The Sea Level Project excludes these soil types from units and attempts to protect or mitigate impacts to other organic wetland soils wherever possible within the project. The Ketchikan Ranger District has recently begun gathering growth information informally from a number of areas on the district and plotting these growth rates for stands up to 40 years in age. These informal glimpses show a reduced rate of growth on organic wetlands that is comensurate, as would be expected, with the reduced site productivity and site index rating given to that soil type. This should in no way preclude the sites from harvest but should call for longer rotations, provided the site rating qualifies as commercial forest land. (See the Riparian Areas, Floodplains, and Wetlands portion of this chapter for more specific information on wetlands).

The magnitude of the effect of converting unmanaged, overmature stands to managed, even-age stands will vary depending upon the number of acres harvested in each site class. Table Silviculture and Timber-7 shows that Alternative 2 converts the most acres to managed condition (2,843 acres), followed by Alternative 3 (1,620 acres), Alternative 4 (1,226 acres), Alternative 5 (847 acres), and Alternative 6 (390 acres). Alternative 1 proposes no timber harvest and will not convert any stands to a managed condition.

All stands proposed for harvest are overmature and well beyond the age of maximum average annual growth of the stand. They are representative of uneven-aged western hemlock stands that commonly take hundreds of years to develop under natural conditions (that is, unless they are changed by natural events such as windthrow or manipulated by intensive forest management practices).

The open conditions created by clearcutting allow both Sitka spruce and western hemlock to regenerate rapidly. Even-aged stands are generally comprised of 10 to 75 percent spruce, depending on the soil type and age of the stand. On average, the volume of spruce in even-aged stands 75 to 100 years after harvest is about 50 percent (Taylor 1934) compared to 28 percent in existing overmature stands. With the use of precommercial thinning, an additional 10 percent increase in the spruce component is expected.

Precommercial Thinning

Regeneration of naturally disturbed or harvested areas may result in stocking levels of seedlings/saplings on many upland sites with an average of 4,000 stems per acre. Although these stands will eventually thin naturally, production of useable wood fiber would be hastened if stocking were made less dense through the use of precommercial thinning (Harris and Farr 1974). Growth and yield models indicate that for every acre precommercially thinned, timber yield increases by 6.9 MBF on medium and 8.9 MBF on high sites, over a 100-year rotation. Precommercial thinning reduces the competition for sunlight, moisture, and nutrients in, what is often referred to as, growing space. This additional growing space results in the understory plants and remaining conifers growing at accelerated rates for longer time periods than unthinned, second-growth stands.

Precommercial thinning can also be used to change species composition and windfirmness of the stand. It should be recognized that precommercial thinning is performed approximately 15 to 20 years after harvest and is dependent upon site, stocking, and other resource needs. While it would be desirable to precommercially thin many of the medium and high sites, the acres identified reflect historic funding levels and projected future management regimes. Table Silviculture and Timber-7 shows the number of acres that have been identified, by alternative, for potential precommercial thinning in the future.

Table Silviculture and Timber-7
Precommercial Thinning Acres by Alternative

	Potential Precommercial Thinning Sites, 15 to 20 Years after Harvesting	
Alternative	**Scheduled**	**Potential**
1	0	0
2	2,843	2,843
3	1,620	1,620
4	1,226	1,226
5	847	847
6	390	390

Source: Trulock 1997.
Note: This information derived from Ketchikan Area GIS, Sea Level, Silviculture Coverage.

Although log quality in young-growth stands is expected to be lower than in existing overmature stands (even on sites that have been precommercially thinned), total yield per acre will be higher in second-growth stands. The lower quality will be reflected in the log grades, with second-growth timber stands having fewer top grade logs than existing overmature stands. In addition, second-growth stands will have less volume in the larger diameter classes. Nevertheless, total yield will be significantly greater in second-growth stands than in over-mature stands. The long-term result of precommercial thinning is more useable wood fiber. Precommercial thinning also allows the option of reducing the economic rotation age. This is because merchantable size logs are produced at an earlier age if the site is thinned.

Most second-growth even-aged stands will exhibit less variation in tree diameter and height than the overmature stands they replace. At 100 years of age, average diameters for unmanaged second-growth stands will range from 13 inches on medium sites to 15 inches on high sites. With precommercial thinning, it is possible to produce average stand diameters that approximate old-growth averages. At age 100, diameters can range from 16 inches on medium sites to more than 18 inches on high sites (Forest Service 1990).

Precommercial thinning prolongs understory vegetation and enhances growth rates on the remaining trees.

Young-growth Management for Other Resource Values

Fisheries Rehabilitation

A sinificant percentage of the riparian management areas within the Project Area were harvested between 1954 and 1993. Much of this timber harvest occurred in watersheds, such as Painted Creek, 10 to 20 years ago, before any significant stream protection measures were implemented. As a result, many Class I and Class II streams that today would receive a stream buffer were harvested up to the bank.

Riparian management areas previously harvested for timber are now in various stages of secondary plant succession. Except where the ground was highly disturbed, the stand composition on the secondary successional riparian areas is similar to riparian vegetation prior to timber harvest, with Sitka spruce typically forming the canopy. On the more disturbed sites, where mineral soil was exposed during timber harvest activities, the vegetation is often composed of early successional species, such as red alder and salmonberry.

Many studies have established the need for large woody debris (LWD) material in streams. It is an important component to bedload dynamics as well as providing structure, habitat, and nutrients. Existing riparian stands of extremely dense conifers or alder, similar to those in Painted Creek, for example, will require a long period of time (150-200 years) to develop large material for recruitment. Management of these existing riparian stands could produce the same size material for recruitment much sooner. In a high site index stand (most riparian sites are very productive), a precommercial thinning at age 15 (to maintain growth rates and promote windfirmness), followed by a second precommercial thinning at age 40 to 50 (with variable spaced thinning of lower DBHs and a higher DBHs that would girdle rather than fell the trees) could produce 5 to 24 snags over 15 inches in diameter per acre. This would also promote the initial development of a two-storied stand. A third noncommercial entry at age 75, utilizing a combination of high and low thinning by girdling rather than felling, could create as many as 6 to 10 snags over 24 inches in diameter per acre. The objective of this type of treatment would be to promote a multi-storied canopy layer over time, promote habitat for snag-dependent wildlife, and as the snags fall over, begin to provide LWD much sooner than would occur naturally. A site-specific silvicultural prescription that incorporates the concepts listed above could be prepared if funding is available for fisheries rehabilitation work.

Wildlife Management

The structure and composition of young-growth stands are dramatically different than those of old growth. Second-growth management is not intended to mimic or replace the need for old growth (see Biodiversity section, Chapter 3). It is possible to achieve commodity production objectives in a way that lessens the negative impacts upon certain wildlife habitat needs through the application of ecosystem management principles.

Young-growth stands that before harvest were part of historic wildlife travel corridors or important winter habitat (low elevation, south aspect, productive site) would benefit from precommercial thinning. The key to this strategy is to extend the rotation (example 200 years) and not manage for short-term benefits at the beginning of the rotation, but to emphasize wildlife values over the last 100 years of the extended rotation. For example, a combination of low thinning and girdling could create snag habitat by age 50-60 years; subsequent girdling every 30-40 years would maintain snag habitat as well as allow for recruitment of forbs and shrubs back into the site much sooner than would occur naturally. The extended rotation would assure that these benefits accrue over a longer period of time.

A site-specific silvicultural prescription that incorporates these concepts would be prepared in coordination with a wildlife biologist prior to implementation, should funding be available. Due to the fact that most second-growth management prescriptions to promote other resource values are somewhat experimental (very few examples of managed older second-growth exist), the potential benefits were not used in modeling future wildlife/fisheries or other resource values.

Plant Community Successional Stages Including Old Growth

After reforestation, managed forests grow through several distinctive successional stages which generally are applicable to all units proposed for harvest under the action alternatives. Characteristics such as height, diameter and productivity vary according to site class (discussed previously in this section). Different components dominate the stand at different stages and the overall forest structure changes over time.

Seedling/Sapling Stage

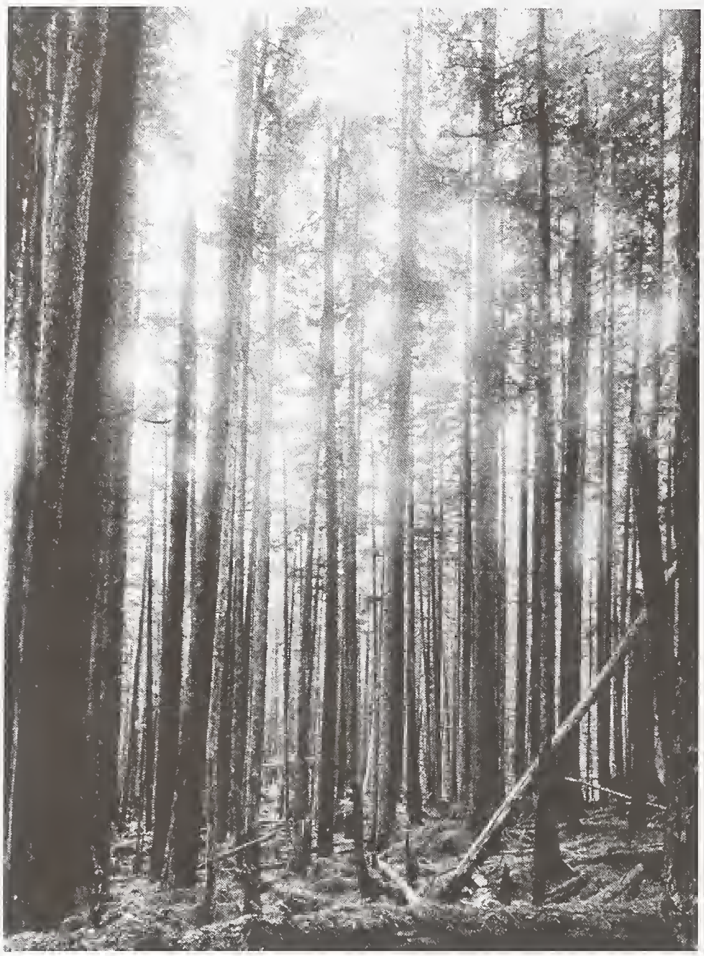
The first 20 years following harvest is referred to as the seedling-sapling understory colonization stage. During the first 5 years of this stage, the young stand receives maximum sunlight, resulting in the rapid establishment of a variety of shrubs, forbs, and grasses. There is little incidence of damage or mortality from disease or infestation at this stage. The changed structure of the harvested stand affects the structure of adjacent stands—windthrow potential increases with greater wind exposure and understory development accelerates due to increased sunlight through the newly developing stand.

In years 5 to 20, seedlings grow into a vigorous new forest of trees, averaging about 20 feet in height and 1 to 3 inches DBH. Understory production of woody-stemmed species is at its highest at this stage, especially on blueberry dominated sites. Larger dead materials from the original stand begin to decompose, and the stand edge is stabilized, resulting in less windthrow to the adjacent stand(s). At the end of this successional stage, the stand can be considered for precommercial thinning, leaving a species composition of about 60 percent western hemlock, 40 percent Sitka spruce, and a small cedar component.

Future harvest through 2007 would add to the total acreage in this stage in the Project Area. Alternative 2, which harvests the maximum amount of timber allowed under Forest Plan Standards and Guidelines, has been used to project the level of harvest through 2007. It is assumed that a reduced level of harvest in a current alternative will result in more harvested volume in a future entry. To do otherwise, would require a change in the land use allocation, which is beyond the scope of this document.

Pole/Young Sawtimber Stage

The next successional stage occurs during years 20 to 50 following harvest and is referred to as the understory exclusion stage. It is characterized by accelerated tree growth (approximately 1 foot per year) and a rapidly closing tree crown canopy. At age 50, tree heights range from 48 to 72 feet and diameters range from 5 to 10 inches, depending on the site class. Tree crowns begin to grow closer together, causing the understory to change from a dense shrub, herb and seedling-dominated structure to one of dense moss. Stands which have been precommercially thinned will have a two-layered canopy with western hemlock in the lower story. Canopy closure will occur more slowly in precommercially thinned sites.



Managed forests progress through several distinctive successional stages.

In years 50 to 80, the stand remains closed. At age 80, tree heights range from 74 to 107 feet and diameters range from 8 to 13 inches, depending on site class. Little sunlight reaches the forest floor, and the understory continues to be dominated by moss. Tree diameter growth slows to about 1 inch every 10 years, as competition between trees increases. It is not currently economically feasible to commercially thin trees at this stage, but thinning would increase growth and diversity of the shrub layer, as well as increase diameter growth of the remaining trees. The Ketchikan Ranger District is proceeding with plans to attempt some commercial thinning, for purposes not directly related to timber production, with the hope that the product will pay for the proposed treatment.

The only change that occurs is the growth of some of the existing harvest units into the pole/young sawtimber stage. Thus, each alternative shows the same number of acres in this successional stage before and after implementation.

Mature Sawtimber Stage

When the stand becomes 80 to 100 years old it has reached the mature, even-aged forest and understory reinitiation stage. At age 100, tree heights range from 88 to 123 feet and average stand diameters range from 10 to 15 inches, depending on site class. Some trees may die, while others become clearly dominant in size. Diameter growth remains at less than 1 inch every 10 years. Moss continues to dominate the understory, except in places where the canopy has opened and allowed sufficient light for herbaceous plants. These structural characteristics continue into the later stages of the stand (approximately 100 to 160 years) with continued slow growth and occasional openings in the canopy (Forest Service 1989).

Old-growth Stage

The final successional stage for a forest is the old-growth stage, which pertains to stands that are prescribed for old-growth conditions or stands that have been deferred from harvest. This stage is characterized by a multi-storied structure with a large over-mature overstory composed of live and dead trees and an understory of mostly shade-tolerant western hemlock. There would be a substantial component of downed large trees and occasional openings in the forest canopy. Patches of shrubs, tree saplings, and herbs alternate with patches of overmature timber, creating a complex, multi-layered mosaic. The stand declines in growth and has the highest degree of variation and the most structurally diverse understory of any successional stage.

The cumulative effects of harvesting old-growth will result in the conversion of large areas to a mosaic of second-growth sites of differing age classes.

Timber: Affected Environment

Forest Land Classification

The 91,747 acres of land within the Sea Level Project Area are defined as National Forest System lands and are categorized as all forested or nonforested lands.. Figure Silviculture and Timber-4 displays the breakdown of the various forest land classifications within the Project Area.

Nonforested

Nonforested land means National Forest System land that is biologically unable to support a cover of predominantly timbered vegetation. This includes muskeg, rock out-croppings, talus slopes, and water bodies, among others. About 4.7 percent (approximately 4,282 acres) of the Project Area falls into this category.

Forested

Forested land refers to National Forest System land that consists largely of timbered vegetation and is further categorized as commercial forest land or noncommercial forest land. There are about 87,465 acres (95.3 percent) of the Project Area that fall into this category.

Noncommercial Forest Land (non-CFL)

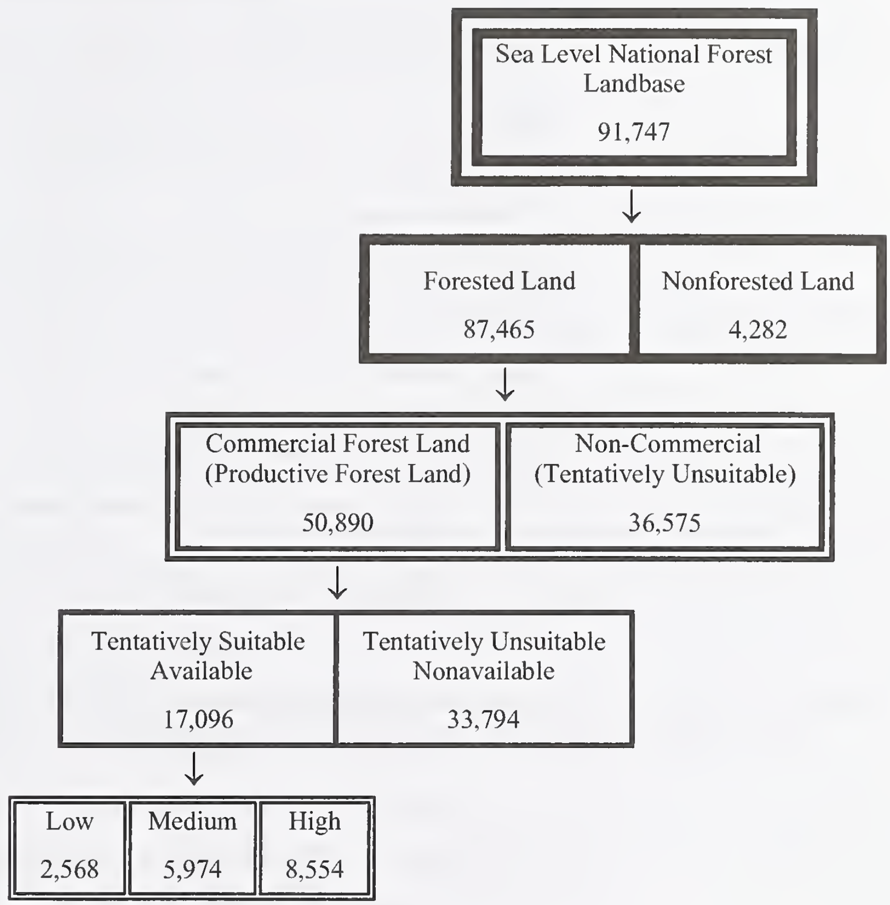
Noncommercial forest land does not support enough timber volume to meet the criteria for CFL or is on oversteepened slopes and a Mass Movement Index (MMI) 4 or very high hazard soils. The Project Area forested land area contains about 41.8 percent (36,575 acres) of noncommercial forest land.

Commercial Forest Land (CFL)

Commercial Forest Land is capable of producing continuous crops of timber. The Forest Service has specified that each acre of CFL must be capable of producing 20 cubic feet of tree growth annually or must contain at least 8MBF of net timber volume (USDA Forest Service 1977a). Old-growth and second-growth stands may qualify as CFL. The Sea Level Project Area (forested area) is composed of about 58.2 percent (50,890 acres) CFL.

Figure Silviculture and Timber-4 identifies the components of the CFL.

Figure Silviculture and Timber-4
Sea Level National Forest Landbase (Acres)



Source: GIS Database information 1997.

Tentatively Suitable Forest Lands

Commercial forest land suitability is further subdivided as to its suitability undergoing review as identified in Appendix A of the TLMP Final EIS (1997).

To be considered Tentatively Suitable, the CFL must:

- have both the biological capability to produce crops of industrial wood,
- not be developed for nontimber production uses,
- be harvestable with available technology to ensure timber production without irreversible resource damage to soil productivity or watershed conditions,
- be restockable within 5 years after harvest,

- have adequate information available to project response to timber management practices, and
- have not been withdrawn legislatively from a timber production classification.

Suitable Forest Lands

Tentatively Suitable is further subdivided into suitable and unsuitable forest lands. For the purposes of this analysis, all lands which have a management prescription or proposed management prescription that precludes timber harvest are eliminated from the tentatively suitable base. The remainder are classified as suitable.

To be considered suitable for harvest, these forested lands must have a LUD which allows commercial timber harvest.

For this process, Project Area lands have also been deferred from the suitable base if they have a TLMP Final EIS (1997) LUD prescription that does not permit commercial timber harvest.

Lands withdrawn from the Tentatively Suitable, not contributing to the suitable base considered for this project, include:

- encumbered lands (see Chapter 1),
- buffers mandated by the Tongass Timber Reform Act on certain fish-bearing streams,
- 100-foot buffers around all lakes greater than five acres in size,
- 1,000-foot buffers around the saltwater shoreline,
- oversteepened slopes of 72 percent and greater,
- MMI four or very high hazard soils,
- riparian and estuarine soils,
- small, medium, and large old growth reserves,
- existing second growth,
- 1,000-foot buffers around estuaries, and
- 330-foot buffers around all known eagle nests.

About 45 percent of the Project Area (approximately 40,857 acres) is non-CFL. Approximately 34 percent (17,096 acres) is tentatively suitable within the CFL (see Figure Silviculture and Timber-4).

Suitable Base

Previous harvest within the Project Area has largely used clearcut logging methods. Previous timber harvests have occurred within the Project Area for both the long-term and the independent sale program. Previously harvested timber stands (second growth) were considered unavailable for timber harvest for this project analysis. About 13.2 percent of the CFL (approximately 6,705 acres), has been previously harvested from the Sea Level Project Area, excluding encumbered lands.

Volume Strata

CFL in the Tongass National Forest has been classified into different volume class ranges based on per acre volume estimates. In the mid 1970s the Forest Service contracted an independent consulting firm to assign volume per acre for all lands on the Ketchikan Administrative Area. This inventory estimated timber and landform conditions based upon aerial photo interpretation. This volume per acre data was stratified into four different volume classes which were used to describe the volume range of timber per acre in thousands of board feet (MBF).

Several concerns and subsequent studies regarding the reliability of this information (usually referred to as the TIMTYP map) have been expressed both within and outside the agency (TLMP 1997). Jim Brickell (USDA-Forest Service, Region 1 Biometrician) was commissioned in 1989 to address concerns about the TIMTYP map reliability. Brickell found that: 1) there is no practical or statistical difference in three of the four sawtimber strata with respect to mean board feet per acre; 2) the prospect of being able to interpret the existing timber type map in terms of sawtimber volume per acres seems dim; and 3) from information taken in the field in the forest inventory, it appears that a fairly large proportion of the polygons were not classified correctly as to stratum.

Because of these and other issues, alternative methods of assigning site quality (or the capability to produce different timber volumes) to lands currently supporting old-growth forests have been considered for purposes of the Forest Plan revision. Five different options were studied and evaluated. Statistical analysis indicates that three strata can be distinguished for the available timberlands (lands not legislatively or administratively withdrawn) using the existing inventory with additional information on soils and slopes. The polygon characteristics of the three strata approach are displayed in Table Silviculture and Timber-9.

Table Silviculture and Timber-8
Volume Range Within TIMTYPE Volume Classes as Identified in the 1979 Forest Plan (Amended 1985) and the 1997 Forest Plan (TLMP 1997, Timber 3-255, Table 3-72)

Three Strata Volume classes	Volume/Acre (MBF/Acre)
Low	13.9
Medium	23.3
High	29.9

Source: TLMP 1997.

Volume Estimates

Stand inventory data contributing to the original volume per acre data was composed of on-the-ground evaluations of stand characteristics and capabilities. For the Project Area, cruise certified Ketchikan Ranger District field crews performed stand examination plots on the unit pool identified in the Project Position Statement. In addition, these plots were also measured as actual cruise plots and will be used to supply timber volume data in the planning process and through project implementation. These stand exam/cruise plots were randomly distributed throughout all of the initial Logging and Transportation Analysis (LSTA) identified harvest units (potential harvest unit pool).

Based on the above project volume analysis, this data is statistically relevant for Project Area estimations (overall Project Area sampling error for Alternative 2 is 9.61 percent) and is an adequate predictor of volume per acre by volume class. Table Silviculture and Timber-10 displays the net volume per acre excluding utility and Right-of-Way (ROW) volume by volume class.

In the past, spruce and hemlock utility volume on the Ketchikan Area was calculated as a percentage of the gross standing cull (gross defect within trees) and added back into the total net volume per species. In 1997, a Ketchikan study on 2 million scaled logs was performed (Joe Thompson, SO Timber Staff, 1997). This study showed that generally, timber cruises were accurate in predicting sale volumes but, significant opportunity existed to obtain more accurate results by changing the procedure for calculating utility volumes. The study showed that spruce and hemlock utility volumes are actually a part of the sawlog component, not part of the standing log cull component as previously calculated. A letter dated May 6, 1997, directs Ketchikan Area District Rangers to calculate spruce and hemlock utility based on sawlog content, not gross standing cull.

Table Silviculture and Timber-9

Estimated Average Net Volume per Acre by Alternative (including Utility) and Volume Class

	Volume Class MBF/Acre		
	Low	**Medium**	**High**
Alternative 2	11.40	23.41	26.66
Alternative 3	12.62	20.39	27.03
Alternative 4	12.72	19.07	25.00
Alternative 5	10.92	19.08	27.36
Alternative 6	13.04	14.06	29.21

Source: Marks 1997.

These volume per acre figures are used to calculate planned harvest unit volumes throughout the Sea Level EIS planning process as exhibited in Table Silviculture and Timber-10 as well as in mid-market calculations.

Effects of the Alternatives

Table Silviculture and Timber-10
Proposed Harvest Volume by Alternative

	Total MBF Volume					
VCU	**Alt. 1**	**Alt. 2**	**Alt. 3**	**Alt. 4**	**Alt. 5**	**Alt. 6**
Total Volume	0	71,021	38,884	27,417	19,786	8,191
Right-of-Way Volume*	0	5,840	3,378	2,105	1,810	638
Total Volume	**0**	**76,861**	**42,262**	**29,523**	**21,596**	**8,829**

Source: Ketchikan Area GIS, Oien, Trulock, Marks 1998.
*Right-of-way volume calculated using average volumes per acre by alternative and adjusting for right-of-way through muskegs and low volume timber stands. Includes temporary road volume outside units.

A result of the harvest of timber, as identified in designed harvest units, is the harvest of timber within designated right-of-ways (ROWs). ROWs are designed to be the most economical access to the present and future timber resource; in line with protecting and serving other resource needs and meeting Forest Service Standards and Guidelines. Consequently, the volume and type of timber harvested within ROWs is considered incidental to the proposed timber harvest. Table Silviculture and Timber-11 displays the estimated volumes of ROW timber proposed for incidental harvest with each alternative. These estimates are based on cruise data taken by District stand exam crews and planned road locations generated electronically through the Ketchikan Area's Geographic Information System (GIS). Actual area and volume will be established prior to the offering. For more ROW information see the Roads and Facilities section of this chapter.

Cumulative Effects

Cumulative effects result from the incremental effect of an action when added to the past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor, but collectively significant actions taking place over a period of time. This section summarizes the effects of the proposed Sea Level harvest upon the environment in combination with the effects of past and proposed future actions. The suitability analysis performed for this project (see Affected Environment) identified a total of 17,096 acres of suitable forest land, (6,705 acres previously harvested is not included in this fingure) and available for future harvest.

Table Silviculture and Timber-11
Available Tentatively Suitable Acres

Total Available Tentatively Suitable Acres by Volume Strata

Strata	Acres
Low	2,568
Medium	5,974
High	8,554
Total	**17,096***

Source: Ketchikan Ranger District GIS 1998.
* See Silviculture/Timber Figure

Table Silviculture and Timber-12 displays the acres and percentage of each volume class proposed for harvest, by alternative.

Table Silviculture and Timber-12
Distribution Percent and Acres, for Proposed Harvest Units by Volume Strata and Alternative

	Volume Strata Low		Volume Strata Medium		Volume Strata High		Total
Alternative	Acres	Percent	Acres	Percent	Acres	Percent	Acres
1	0	0	0	0	0	0	**0**
2	181	6	817	29	1,844	65	**2,843**
3	131	8	478	27	1,011	65	**1,620**
4	127	8	374	27	725	65	**1,226**
5	118	10	243	26	486	64	**847**
6	37	12	185	41	168	47	**390**

Source: GIS/Nightingale, Marks 1998.

Project Purpose and Need

By the year 2007, approximately 17 percent (2843 acres) of the suitable base (17,096 acres) is available for harvest. The scheduled acreage in Alternative 2, combined with the acreage previously harvested (6,705 acres of second-growth), equals approximately 56 percent of the suitable base. By the end of the forest rotation, in approximately 2095, all suitable volume would be scheduled for harvest to attain the desired future condition. Future timber harvest within the Project Area could occur as summarized in Table Silviculture and Timber-13.

Table Silviculture and Timber-13
Cumulative Effects of Timber Entry into the Project Area

Alt.	Acres of Proposed Harvest	Percent of Suitable Base Harvested this Draft EIS	Acres of Potential Harvest 2000-2007	Percent of Suitable Base Harvested by 2007	Acres of Future Harvest 2007-2095	Percent of Suitable CFL Harvested between 1955-2095 (Cumulative)	Percent of CFL Harvested 1955-2095
1	0	0	2,843	17	14,253	100	47
2	2,843	17	0	17	14,253	100	47
3	1,620	9	1,225	17	14,253	100	47
4	1,226	7	1,613	17	14,253	100	47
5	847	5	1,999	17	14,253	100	47
6	390	2	2,451	17	14,253	100	47

Source: GIS/Nightingale, Grundy 1998.

Logging Systems

Yarding is the process of conveying logs from the stump to the landing. The method used depends upon many factors including access, topography, slope, and resource protection needs (log suspension requirements).

Ground-based Yarding

Moist, soft soil conditions in relation with steep slopes found in the Project Area prove difficult for ground-based equipment operation. Except for a limited amount of shovel logging with track mounted log loaders, there has been little opportunity for this type of equipment.

Shovel Yarding

Shovel logging yarding systems utilize a lower center of gravity making these machines more stable, lighter, and agile. They also produce a lighter footprint or ground pressure. Partial suspension requirements are met by this type of yarding system. Shovel yarding is a system of short-distance logging in which logs are moved from the stump to the landing by repeated swinging with a swing-boom log loader. The loader is walked off the haul road and out into the harvest unit. Logs are moved and decked progressively closer to the haul road with each pass of the loader. When logs are finally decked at roadside, the same loader, or a different loader, loads out trucks. On gentle ground (<20 percent slope), logs are either heeled and swung or dragged by the boom as it rotates. While the Project Area LSTA process classified units as either cable or helicopter yarded, certain portions of cable units, especially along ROWs, were identified suitable for shovel yarding. Currently, approximately ten percent of an average sale area is being shovel yarded. The decision to actually specify shovel yarding within a given unit is made at the time of unit layout.

Cable Yarding

Traditional cable yarding throughout the Ketchikan Area was comprised of approximately 20 percent slackline yarding, 30 percent running skyline, and 35 percent highlead (Marks 1997). With the advent of the newly released TLMP American Marten Standards and Guidelines, cable yarding configurations will change to include systems which have lateral yarding capability, especially within timber units designated for partial cutting prescriptions (see Silviculture section for American Marten prescriptions). Within the Project Area, a majority of small skyline systems (rigged live or running with carriage) and a minor usage of slackline and high lead (Grabinski), will account for harvest methods proposed in each alternative (see Table Silviculture and Timber-16). Skyline yarding systems inherently provide partial suspension or log lift in a majority of situations, and when required, this system can be designed to provide increased log suspension to meet required management objectives. Figure Silviculture and Timber-7 displays different systems of cable yarding.

By direction, the Forest Service plans and appraises for the most economical yarding system feasible for a particular harvest setting, provided it meets management objectives and suspension requirements for the unit. Within the planning process, the running skyline yarding system is used in place of highlead yarding because it is more economical. If at the time of actual unit layout there are no management objectives that require partial suspension (increased log suspension), the highlead yarding system may be utilized.

Highlead Systems

Highlead systems (including Grabinski or rider block) were previously used more than any other cable system. A two-drum yarder is used. These yarders are typically 90 to 110 foot towers which have telescoping tubes and are tied down with six or eight cables or guywires. One drum holds the mainline which attaches to butt rigging with chokers. The other drum holds the haulback line which supports the rider or bull block. The haulback also continues on through a block (pulley) and attaches to the other side of the butt rigging. The mainline and haulback control the inhaul and outhaul of the butt rigging. The term highlead refers to the location of the mainline block which is elevated above the ground by the spar. The mainline block (bull or rider block) provides some vertical lift enabling logs to override obstacles, thus minimizing soil disturbance as a "turn" of logs is inhauled to the landing. This system provides some partial suspension and is usually designated in areas that have minimal risk of soil disturbance. This system's maximum yarding distance is 1,500 feet uphill and 600 feet downhill. Additional suspension requirements, as well as entry into more difficult terrain requiring longer reaches, favors other systems with expanded capabilities.

Running Skyline Systems

Running skyline systems require a three-drum "swing" or a tower yarder which include a mainline, haulback and slackpulling lines with hydraulic interlocking capabilities. These yarders are typically shorter (50 to 70 feet) and in the case of a swing yarder, are usually a leaning lattice type tower that can swing to either side allowing a turn of logs to swing toward a log loader. The interlock system hydraulically ties all three drums together (which rotate at different speeds) to increase overall lifting capability, especially when rigged in a downhill yarding configuration (where braking the haulback line provides the actual log lift or suspension). This system can utilize either a mechanical slack pulling carriage or a mechanical grapple. Both are directly supported by the haulback line. When a grapple is utilized, the slackline and mainline drums control the operation of the grapple which open and close around selected logs which, in turn, are yarded to the landing. When a mechanical slack pulling carriage is utilized, the same two drums are used to control the inhaul or outhaul of the skidding line/chokers. While each type of carriage is in common use and provide distinct production advantages, they both provide partial suspension capabilities required to meet most soil management objectives. This system inherently provides increased log lift due to its hydraulic interlocking capabilities. Maximum yarding distance is 1,000 feet uphill and 600 feet downhill.

Live Skyline (Shotgun/Flyer) Systems

Live skyline (shotgun/flyer) systems feature a moving skyline cable which raises and lowers a simple carriage with chokers to a turn of logs. The mainline on a highlead yarder (two-drum tower) is used as the skyline and the haulback is used as the mainline, to control carriage inhaul/outhaul. The carriage is gravity outhauled with the mainline controlling both inhaul and outhaul. The term shotgun refers to the high speed that the carriage reaches while outhauling to a turn of logs. The skyline/carriage is then lowered to allow the logs to be choked for inhaul to the landing. This system provides good suspension or log lift to meet management objectives of partial or full suspension requirements. Maximum yarding distance is 1,500 to 2,000 feet uphill.

Slackline Systems

Slackline systems are a configuration of live skyline systems. A three-drum yarder (tower) includes a skyline, mainline, and a haulback for the inhaul/outhaul of a simple carriage with chokers attached. The main difference is that a haulback line rather than gravity is used to outhaul the carriage. Slackline systems provide excellent lifting capabilities and are employed when management objectives require full or large areas of partial suspension to avoid soil disturbance. Maximum yarding distance is 2,000 to 2,500 feet uphill or 1,000 feet downhill.

Standing Skyline (Long Span) Systems

Standing Skyline (long span) systems are similar to a live skyline system. Long-span skyline is the most common and has two main differences. The first is a non-moving skyline, and the second is the use of a radio controlled carriage. A radio-controlled carriage is used with a two-drum yarder (large towers 90 feet or greater) which employs the use of a skyline and a mainline to support the carriage and to provide inhaul. The radio-controlled carriage has an internal engine which provides the pulling power to skid or inhaul the logs to it. Outhaul of the carriage is by gravity. Skidding line outhaul is controlled by radio; the carriage is stopped and clamped above a turn of logs where the skidding line is dropped to choke the logs. The carriage is then commanded to skid or inhaul the logs up to it where the yarder's mainline inhauls the carriage with the suspended logs to the yarder. This system is used when yarding distances of up to 5,000 feet are required. Shorter span versions of this system include the use of three-drum yarder-controlled carriage or a more simple falling block type carriage which utilizes a two-drum yarder. These include the North Bend (uphill yarding), South Bend (downhill yarding), and the multi-span system (uphill yarding). The multi-span system utilizes intermediate skyline support jacks similar to those found in ski lodge chair lifts. These enable the carriage to carry a load of logs over a topographic break in slope which would otherwise be a blind lead (the running and lift lines rubs the ground). These systems provide excellent lift and log suspension in areas that require full or partial suspension to meet management objectives.

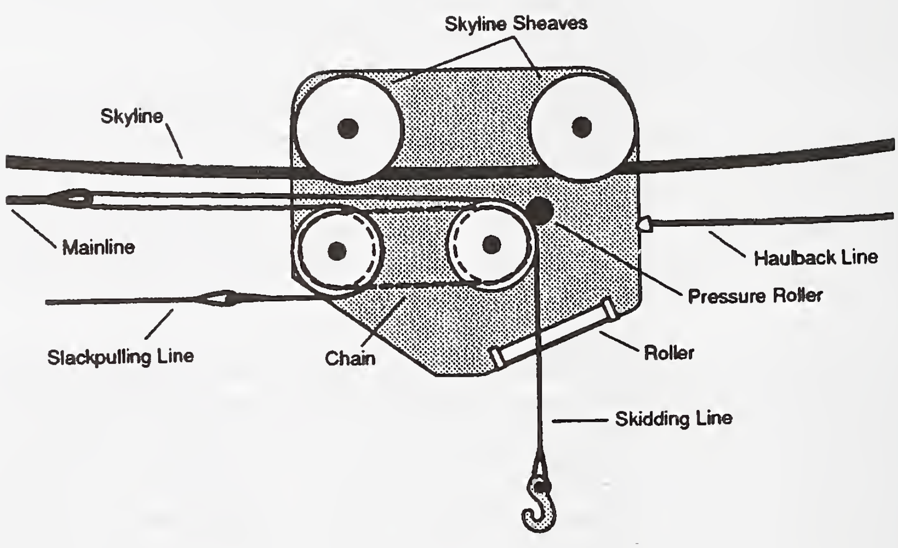
Lateral Yarding Carriages

Carriages may be classified as slackpulling or non-slackpulling, and the slackpulling carriages may be further classified by how they accomplish the slackpulling function. Slackpulling carriages provide the skyline with lateral yarding capability and therefore can be used in a variety of silvicultural prescriptions. Non-slackpulling carriages can include either chokers or grapples and are used in clearcuts. For a skyline system to operate efficiently, the carriage must be matched to the number of lines and the line diameters on the yarder (Studier, 1993).

Slackpulling carriages are further broken down into manual slackpulling carriages where the skidding line is pulled through the carriage by hand, or mechanical slackpulling carriages which use either an internal carriage engine or the yarder to pay out the skidding line.

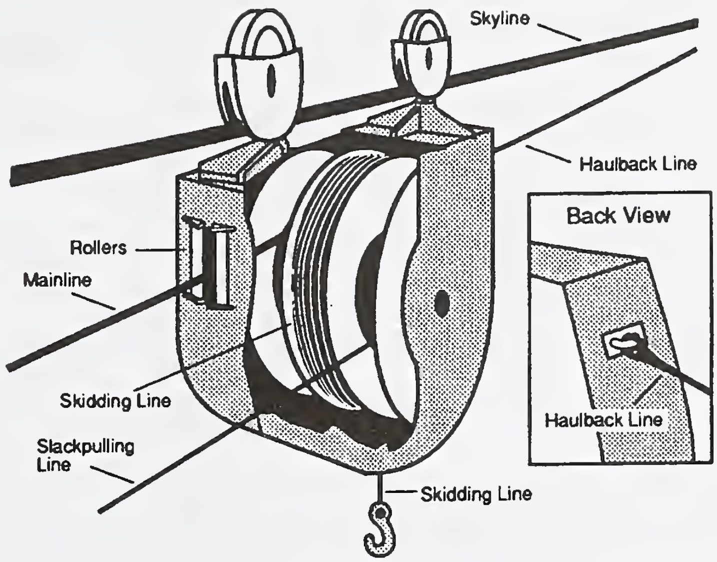
Yarder controlled mechanical slackpulling carriages are more commonly used in harvest operations due to cost, weight, and flexibility. Two types of yarder-controlled mechanical slackpulling carriages include those like the Danebo MSP (Figure Silviculture and Timber-8), and the Danebo "S" series three drum carriage (Figure Silviculture and Timber-9).

Figure Silviculture and Timber-5
Danebo MSP



Source:

Figure Silviculture and Timber-6
Danebo "S" Series Three Drum Carriage



Source:

Helicopter Yarding

Helicopter yarding is proposed in all alternatives. Helicopter yarding has been successfully used on all areas of the Tongass National Forest within recent years. On the Ketchikan Administrative Area, Revilla Island, large portions of the North Revilla Project Area are currently being helicopter yarded. Portions of the Upper Carroll Timber Sale are also planned for helicopter yarding. With this system, logs are lifted off the ground (fully suspended) and flown to a specially prepared landing. This yarding system causes the least amount of ground disturbance of all the yarding systems, but has the highest yarding cost.

Helicopter yarding, as a rule of thumb, is commonly three times or more expensive then conventional cable systems logging. When analyzing economic efficiencies between the cost differences of helicopter and conventional yarding systems, the cost of road building must be assessed against the increased cost of helicopter yarding. Cost may not be the main deciding factor in logging systems design, as resource protection measures often mandate the use of helicopter yarding (full suspension) to meet standards and guidelines.

The economic feasibility of helicopter yarding is more closely affected by market values than cable yarding. Maximum yarding distance is regulated by economics. Helicopter flight time costs between $2,000 and $5,000 per hour. Maximum flight time between loads or turns of logs is approximately three minutes. Factors that affect flight time and economic feasibility include elevational differences between stump and landing, number of logs or volume per acre, species mix and subsequent value, and payload capabilities of the aircraft.

Table Silviculture and Timber-14
Distribution Percent of Proposed Yarding System by Acres and Silvicultural Prescription (Rx) per Alternative

		Alternative					
Yarding Type	**Rx**	**1**	**2**	**3**	**4**	**5**	**6**
Running Skyline (RS)	ITM	0	3	5	0	2	0
Live Skyline (LS)	ITM	0	3	2	0	0	0
Shovel (SH)	ITM	0	2	2	1	1	0
Slackline (SL)	ITM	0	0	0	0	0	0
Helicopter (HE)	ITM	0	7	3	3	4	0
	ITM Total	**0**	**15**	**12**	**4**	**7**	**0**
Running Skyline (RS)	group/patch/CC	0	67	74	84	75	87
Live Skyline (LS)	group/patch/CC	0	5	3	4	5	0
Shovel (SH)	group/patch/CC	0	4	6	3	4	2
Slackline (SL)	group/patch/CC	0	8	5	5	9	11
Helicopter (HE)	group/patch/CC	0	1	0	0	0	0
	Group Selection, Patchcut and Clearcut Total	**0**	**85**	**88**	**96**	**93**	**100**

Source: GIS, Marks 1997.

Effects of Proposed Yarding Systems

All yarding proposed is in conformance with National and Regional Standards and Guidelines. Yarding systems were assigned to settings in an interdisciplinary process after extensive field reconnaissance to minimize any potential or unforeseen effects. On-site ground reconnaissance and actual field evaluations during the layout and harvest process will ensure the designed yarding system will provide the required suspension to meet management objectives as specified by reviewing specialists. For effects analysis see the Ecological Landtypes section of this chapter.

Reserve Tree Selection Guidelines

In 1993, a committee was formed that included members from the Wood Products Industry, the Forest Service, and the Alaska Department of Labor, Occupational Safety and Health Administration (OSHA), to develop guidelines in the selection of reserve trees. Their main objective was to provide a technical framework to achieve safer working practices in concert with forest and wildlife management goals. The *Reserve Tree Selection Guidelines* booklet (USDA, Forest Service, Alaska Region R10-MB-215, March 1993) is dedicated to the principal that no worker shall be exposed to a danger tree.

These guidelines are used in both the Sea Level planning process as well as during the layout process for project implementation. The reserve tree selection criteria process, described in the Silviculture part of this section, use many the technical guidelines recommended by the committee.

Elements of successful reserve tree planning include definitions and strategies for selecting reserve trees that are compatible with safe, modern forest practices. Long-range planning on a large scale allows more design options for safe ways to reserve trees for meeting wildlife needs.

The arrangement of reserve trees is key to meeting distribution objectives in a manner compatible with safe work practices. Uniform distribution of reserve trees on every acre is not necessary. Reserve trees can be retained along yarding breaks or clumped within the unit to accommodate operational needs. Reserve tree retention on excessively steep slopes (greater than 72 percent) is not always feasible due to limited falling corridors during the cutting stage of the harvest process. Long-range plans should provide criteria for tree selection and distribution that are flexible enough to account for ongoing tree decay processes and changes in harvest plans. Many of the difficulties in retaining reserve trees during harvest can be eliminated through careful site evaluation, considering the specific abilities of harvest equipment and processes, and implementation in both the planning and layout process.

Operational Guidelines

Cable Yarding

The type of yarding system and topography will determine where reserve trees can be safely retained. As a general rule, harvest systems capable of using a slack-pulling carriage are the most able to retain trees within the unit and systems. Systems with no lateral yarding capability and down-hill yarding usually require that reserve clumps, groups, and individual trees be left only along the edges of settings.

Systems with Lateral Yarding Capability

In uphill yarding with lateral yarding capability (slack pulling carriages), individual trees, clumps, and groups may be left in mid-setting. To suspend logs over or yard through the reserve areas can only be done if there is sufficient deflection (operating lines must not be within hazard areas, see Reserve Tree Selection Guidelines).

Helicopter Yarding

Helicopter logging allows flexibility to leave reserve trees nearly anywhere in the unit because it can access logs from various directions. However, it creates special problems with rotor down-wash, such as flying limbs and chunks. Logs swinging against standing trees during log pick up may also dislodge portions of reserve trees. The hazard area may need to be enlarged to address this increased hazard.

Timber Economics Efficiency Analysis

Current Forest Service Handbook direction FSH 2409.18—Sale Preparation Handbook, WO Amendment 2409.18-95-1, 2, 3, and 4 and further described in the R-10 Supplement No. 2409.18-93-3 requires an economic efficiency analysis to compare benefits and costs of a project. Values used in the analysis must reflect mid-market timber value estimates that are based on median or mid-level timber market values. In order to account for market fluctuations, weighted average timber values over the past 10 years are used in this analysis.

Forest Service Handbook (FSH) direction also provides for including an allowance for at least 60 percent of normal profit, which must be included when calculating costs and returns. This economic-efficiency analysis is performed by comparing expected gross revenues against estimated costs and arriving at an estimate of net revenues.

Pond Log Values

Pond log values represent the delivered price of logs at the mill minus the cost to manufacture them into usable products. On the Ketchikan Area, the lower volume classes generally have a higher yellowcedar component, which has the highest selling value. On the Project Area, this sometimes results in a high pond log value for the lower volume classes. For this analysis, pond log values reflect lower chip manufacturing costs, rather than higher pulp maunfacturing costs due primarily to the recent closure of pulp manufacturing facilities in SE Alaska.

Stump to Truck Logging Costs and Pond Log Values

Stump-to-truck logging costs are subtracted from the pond log values to arrive at a delivered price to the mill. Stump-to-truck logging costs include felling, bucking, yarding, loading, and administrative costs. Logging costs are closely tied to volume per acre (represented by volume class data). Generally, the higher the volume per acre the lower the logging cost. Table Silviculture and Timber-17 shows the stump-to-truck logging costs and associated pond values for each volume class.

Additional Costs that Affect Timber Sale Economics

In addition to stump to truck logging costs, other costs (i.e. watering, rafting, tow, specified road construction and reconstruction, temporary road construction, LTF construction, camp development, and helicopter support) need to be considered when determining the economics of timber sales. For the purposes of this analysis these costs were included in total logging costs. All three LTF sites do not require any further reconstruction or modification. Mid-market costs are summarized by alternative. Because Alternative 1 does not propose any timber harvest, it is not displayed in the table.

Table Silviculture and Timber-15
Summary of Mid-market Stump to Truck Logging Costs and Pond Log Values per MBF, by Alternative.

Logging Costs by System (Dollar Amount per MBF)*	
Skyline - Running	67.12
Skyline - Live	50.51
Slackline	78.59
Shovel	50.52
Helicopter **	120.00

	Alternative (Dollar Amount per MBF)				
	2	3	4	5	6
Pond Log Value	539.25	542.03	543.91	544.04	594.90
Logging Costs plus Profit and Risk	467.47	509.81	509.65	541.71	603.80
Pond Value less Costs	71.78	32.22	34.26	2.33	(8.90)

Source: Fletcher 1998
* Logging system costs/MBF were adjusted for the analysis to reflect site specific conditions per alternative.
** Range of helicopter costs are based on area averages adjusted to R10 costs. Actual helicopter yarding costs by alternative are based on averages from previous timber sales. These costs are used for mid-market analysis.

The implications of Table Silviculture and Timber-15 are summarized below:

- Logging cost per MBF is highest for Alternative 6 ($603.80). This alternative requires a substantial amount of road construction to access the relatively lesser amount of volume which results in higher construction and transportation costs per MBF .
- Conversely, average cost per MBF is lowest for Alternative 2 ($467.47) because the greater proposed volume will offset incurred transportation and construction cost. Overall, Alternative 2 would increase the Area's ability to offset the cost of harvesting the more difficult and isolated components (see Operability, this section).
- The higher than average costs per MBF associated with Alternatives 3, 4, and 5 are a resultant of lower than average cedar volumes estimated for these alternatives.
- In addition, transportation and harvest cost are not offset due to lower volumes.
- Average helicopter costs were derived from using adjacent sale area averages. Helicopter yarding cost per harvest unit is based on the following: unit elevation, landing elevation, type of aircraft, and stand data (volumes, stems per acre, pounds per board foot, etc.). Helicopter payloads and flight distances (flight time) are adjusted by the various input factors to produce the end result of unit yarding days which is further refined to total cost per unit. Unit yarding costs are further adjusted to R10 requirements.

Comparison of Alternatives Based on Estimated Net Mid-market Values

Estimated net timber value is arrived at by subtracting all associated costs from the pond value for all proposed harvest units in each action alternative. Consequently, individual units which may be uneconomical to harvest by themselves are offset by combining them with other units which are more economical to harvest. This results in less productive land or land where the timber is highly defective being made more economically viable for timber harvest. These lands are then brought under management, thereby increasing future timber yields, and postponing entry into more environmentally sensitive areas.

These projected construction costs, transportation costs, and pond log values are estimates, not actual costs, which form a constant by which all alternatives may be compared. Before the timber is sold, the volume within the units and ROWs will be cruised and appraised to determine the actual volume and value of the timber. Because all action alternatives are measured against the same yardstick of estimated costs, it is appropriate to rank the alternatives in order by net value. Table Silviculture and Timber-16 shows the estimated value (based on mid market analysis) and ranking of each alternative based upon the net value. Net values are shown rounded, since the figures are based on estimates. Because Alternative 1 has no timber harvest costs or values, it is not listed.

Table Silviculture and Timber-16
Estimated Stumpage Values ($/MBF) by Alternative Volume (MBF) Based on Mid-market Analysis

Alternative	Estimated Total Volume	Total Pond Value*	Total Logging Costs**	Total Road. Costs***	Total Production Costs and P & R****	Estimated Net Value @ Mid Market	Rank Order
2	76,862	539.25	235.92	194.28	467.47	**5,517,154**	**1**
3	42,263	542.03	235.17	241.67	509.81	**1,361,713**	**2**
4	29,523	543.91	245.67	229.95	509.65	**1,011,458**	**3**
5	21,596	544.04	233.98	278.07	541.71	**50,319**	**4**
6	8,830	594.90	249.45	329.35	603.80	**−78,587**	**5**

Source: Fletcher, Oien 1998.
* Values are for comparative purposes only.
** Logging costs include all costs normally connected to logging, such as: fall, buck, yard, sort, water tow, spur road costruction.
*** Road costs include costs associated with road construction and reconstruction, such as: pit development, clearing, grubbing, embankment, haul, excavation, and related material, bridges and culverts.
**** P & P refers to Profit and Risk of 60 percent.

Based on this analysis all mid-market values for each alternative show positive net stumpage rates expect for Alternative 6. Costs for temporary road construction and specified road reconstruction may fluctuate when updated for the offering appraisal. Changes in logging costs and selling values can also have an undetermined effect on overall stumpage values; changes in these values will not alter the economic ranking of alternatives because they are applied equally to all alternatives. Only modification of an alternative(s) will alter economic ranking.

Threatened and Endangered Species

Key Terms

Endangered—A species in danger of extinction throughout all or a significant portion of its range.
Threatened—A species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
Species of Concern—A species or group of species being considered by the U.S. Fish and Wildlife Service for listing as endangered or threatened, but for which conclusive data is lacking on its biological vulnerability and degree of threat. Formally known as a Category 2 Candidate Species.
Sensitive—species (identified by the Regional Forester) whose population viability is of concern on National Forests within the region, and which may need special management to prevent their being placed on State or Federal threatened and endangered species lists.
Haul Out—area of large, smooth, exposed rocks used by seals and sea lions for resting and pupping.

Affected Environment

Federally listed threatened and endangered species are those plant and animal species formally listed by the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS), under the authority of the Endangered Species Act of 1973, as amended. Candidate species are those being considered for listing as threatened or endangered by the USFWS and NMFS. Species of concern are those species (formally known as Category 2 Candidate species) for which there is information indicating the species might qualify for endangered or threatened status, but for which further evaluation is needed. The State of Alaska has an Endangered Species Law which authorizes the commissioner of the Alaska Department of Fish and Game (ADF&G) to list Alaska endangered species. The Regional Forester can also designate species as "Sensitive."

A Biological Assessment has been prepared for the Sea Level Project and is located in Appendix C. For additional information on threatened, endangered, or sensitive species, please refer to Appendix C.

Threatened or Endangered Species

Plants

No plant species known to occur in the Project Area have been determined as threatened, endangered, or candidate. Several sensitive plant species have been discovered during botanical surveys of the Project Area.

Marine Mammals

Humpback whales *(Megaptera novaeangliae)* and Steller sea lions *(Eumetopias jubata)* are occasionally found in waters bordering the Project Area (Pennoyer 1992).

Humpback Whale

The local distribution of humpbacks (listed by NMFS as Endangered) in Southeastern Alaska appears to be correlated with the density and seasonal availability of prey, particularly herring *(Clupea harengus)* and euphausiids (shrimp-like crustaceans). Important feeding areas include Glacier Bay and adjacent portions of Icy Straight, Stephens Passage/Frederick Sound, Seymour Canal, and Sitka Sound. Other areas of Southeastern Alaska may also be important for humpbacks and need to be evaluated. These include Cape Fairweather, Lynn Canal, Sumner Strait, Dixon Entrance, the west coast of Prince of Wales Island, and offshore banks such as the Fairweather Grounds; none of which are within the Project Area.

Steller Sea Lion

The Steller sea lion *(Eumetopias jubatus)*, listed by NMFS as Threatened, ranges from Hokkaido, Japan, through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, Gulf of Alaska, Southeast Alaska, and south to central California. Currently, information on Steller sea lion population trends in Southeast Alaska is limited. However, available information suggests that Steller sea lion populations are stable in Southeast Alaska. There are no known Steller sea lion haul out areas identified in the Project Area, although they may occasionally be seen swimming in Carroll Inlet and Thorne Arm.

Fish

No threatened or endangered fish species are found in the freshwater river systems in the Project Area. Two threatened species, the Snake River fall Chinook salmon *(Oncorhychus tshawytscha)* and the Snake River spring/summer Chinook salmon, and one endangered species, the Snake River sockeye salmon *(O. nerka)* may be present in the general vicinity in saltwater during the marine rearing period of their life cycle. The presence of these Pacific Northwest salmon is not documented for these waters, but their occurrence is possible.

American Peregrine Falcon

The endangered American peregrine falcon may migrate through the Sea Level Project Area. The American peregrine falcon (*Falco peregrinus anatum*) is primarily associated with interior Alaska for breeding, nesting, and rearing of young. The falcon is highly migratory, wintering as far south as northern Argentina and occurring in Southeast Alaska only during migration periods. Reproduction has increased population numbers three-fold in Alaska. Population numbers of the American peregrine falcon are continuing to increase (Ambrose, et al. 1988). In coastal areas of Washington, the primary prey species for peregrine falcons were shorebirds and waterfowl species; passerines were also identified in the diet, (Anderson and Debruyn 1979; Anderson et al. 1980).

The Arctic peregrine falcon was delisted in 1994, but the Endangered Species Act requires that the species be monitored for five years following delisting. No other endangered or threatened wildlife species are known to occur in the Project Area (Holmberg 1992).

Sensitive Species

Sensitive species are identified for listing by the Regional Forester. These are species that are susceptible to habitat loss or disturbances.

Trumpeter Swan

The trumpeter swan *(Cygnus buccinator)* is classified as a sensitive species in Forest Service Region 10. The swan is the largest waterfowl species in the world. Its present range is only a vestige of the once vast region of North America that it frequented in both summer and winter (Bellrose 1980). Trumpeter swans breeding in Alaska spend the winter along the Pacific Coast from the Alaska Peninsula to the mouth of the Columbia River where they take advantage of open waters of saltwater estuaries and freshwater lakes and rivers. Trumpeter swans are present in the Project Area primarily during the fall and early spring migration periods and during winter.

Field personnel have not reported swans in the summer. They arrive in the area in mid-October as they are migrating south. Numbers increase as migration continues. Swans typically leave for their breeding area by mid-April. Records show swans using Gnat Cove during the winter and during spring and fall migration. There are a few records of swans using Low Lake. Field crews have reported swans occasionally using some of the smaller ponds in the Project Area during migration periods. Swans that spend the winter here usually move to large estuaries such as Carroll River once the weather turns cold.

Queen Charlotte Goshawk

The Queen Charlotte goshawk (*Accipiter gentilis laingi*) is a raven-sized raptor associated with forests having tall trees and dense canopies. These features allow goshawks to hunt beneath the tree canopy, and to capture prey before the prey escapes into the trees or shrub layer. The dense canopy in tall trees fosters a more abundant prcy species population and provides a microclimate suitable for nesting. Goshawks forage over home ranges that are typically 6,000 to 8,000 acres, though home range may be twice that size in fragmented forests (C. Crocker-Bedford 1991).

The northern goshawk has been listed as a Species of Concern for all of its range, including the Queen Charlotte subspecies which is present in Southeast Alaska. A status review was completed, and a decision was made that listing the species as threatened or endangered at this time is not warranted (U.S. Fish and Wildlife Service News Release 1995). Since that time the courts have directed the USFWS to reconsider their determination. The USFWS recently determined that the goshawk did not warrant listing.

The TLMP Final EIS (1997) contains the following guidelines for preserving habitat around all confirmed and probable nests. These guidelines have been incorporated into the Sea Level Project.

> *Nesting Habitat*—Maintain an area of not less than 100 acres of productive old-growth forest (if it exists) generally centered over the nest tree or probable nest site. Include prey handling areas, perches, roosts, inactive nest stands, hiding cover and foraging opportunities for young goshawks. Vegetative structure should include a multi-layered, closed (over 60%) forest canopy, a relatively open understory, with large trees (usually 20+ inches DBH) and low ground vegetation. These conditions generally equate to the high timber volume strata used in the 1997 Forest Plan.
>
> *Management:* No commercial timber harvest is permitted. Existing roads may be maintained. New road construction is permitted if no other reasonable roading alternatives outside the mapped nesting habitat exist. Permit no continuous disturbance likely to result in nest abandonment within the surrounding 600 feet from March 15 to August 15. Activity restrictions are removed for active nests that become inactive or are unsuccessful.

Field crews completed surveys along 84 routes (transects) that included 505 broadcast stations. Approximately 387 call stations were located in or adjacent to potential harvest units. Of the total potential unit pool, 103 potential harvest units contained at least one call station. Field crews found no goshawk nests. A crew recorded one possible goshawk detection on 6/28/95 near Unit 21, but conditions were such that they could not positively identify the raptor. The crew reported another raven-sized raptor detection in the same area on 7/25/95. Crews found plucking posts in Units 98 and 66, but they could have been from a sharp-shinned hawk since the prey species was quite small.

District records and databases indicate several incidental goshawk sightings within the Sea Level Project Area. The two most dependable sightings, both in 1996, were reported about 1000 feet east of Unit 60 and near Unit 45. Wildlife crews surveyed these areas in 1996 but did not locate a nest or record additional goshawk detections. The crew recorded a red-tailed hawk vocal detection near Unit 60 on 8/6/96.

Osprey

Ospreys (*Pandion haliaetus*) occur in low numbers in Southeast Alaska during the spring/summer nesting period from late April through August. They are believed to overwinter in Mexico and Central America. The closest known nest is over 40 miles to the north. Nest trees in these areas consist of broken-top spruce (live or dead) and snags of western hemlock in hemlock/spruce forest types near streams or coastal beaches. Historically, the Southeast Alaska population of osprey appears to have remained stable but low. It is unknown why osprey occur in relatively low numbers in this region, but available nest sites and foraging areas do not appear to be limiting factors.

Osprey have been known to stop at some lakes on the District during migration. Small lakes in the Project Area provide an opportunity for migrating osprey to rest and feed. No nests have been recorded near the project.

Peale's Peregrine Falcon

The Peale's Subspecies of the peregrine falcon *(Falco peregrinus pealei)* nests on the outer islands west of Prince of Wales Island. This species is not listed as endangered or threatened, but is covered by a provision of the "similarity of appearance" which broadens the scope of protection for all peregrine falcons. The nest distribution of this subspecies is closely associated with large seabird colonies, and seabirds are believed to be the major prey of the falcon.

Goose Grass Sedge *(Carex lenticularis var. dolia)*

This sedge is known to occur in the coastal mountains of Alaska and British Columbia and the Rocky Mountains from Jasper, B.C., south to Glacier National Park, Montana. Its range in Alaska is limited to the alpine of coastal Southcentral and Southeast Alaska and the Aleutian Islands. There are nine documented occurrences in Alaska (Forest Service 1994), in Southeast, at the Mendenhall Glacier, Bailey Bay on Cleveland Peninsula, and the Chickamin Glacier. This species is not known to be found within the Project Area. Its habitat is wet alpine meadows and bare edges of snowbeds.

Edible Thistle *(Cirsium edule)*

This regionally endemic thistle species is distributed primarily along coastal Oregon, Washington, and British Columbia and barely reaches southern-most Southeast Alaska. The only documented occurrence is near Hyder in interior Southeast Alaska near the border of Canada (Forest Service 1994). It is unknown whether this species occurs in the Project Area. Its habitat in Alaska is characterized as wet meadows and open woods along glacial streams.

Davy Mannagrass *(Glyceria leptostachya)*

This grass species is distributed from Southeast Alaska to central California. Its distribution in Alaska is limited to central and southern Southeast Alaska. It is known to occur in only two documented locations: near Wrangell, Alaska and on Prince of Wales Island; however, it is easily overlooked and likely to be more widespread in Southeast Alaska (Forest Service 1994).

Wright Filmy Fern *(Hymenophyllum wrightii)*

This fern species occurs in coastal areas of Southeast Alaska and British Columbia. Three sightings have been documented in Alaska and are limited to Biorka and Mitkof Islands (Forest Service 1994). It is unknown if the species occurs in the Project Area. This species appears to prefer humid shaded boulders, cliffs, tree trunks, and damp woods in the wettest maritime regions. In Alaska, it has been found in small populations on the base of trees and rock outcrops in damp woods.

Truncate Quillwort *(Isoetes truncata)*

This rooted aquatic species is known from a few widely isolated populations on Vancouver Island and Southcentral Alaska on the Copper River Delta (Forest Service 1994). It is unknown if this species occurs in the Project Area. Truncate quillwort occurs in shallow water of lakes and streams.

Calder Lovage *(Liqusticum calderi)*
This plant species occurs in British Columbia and Southcentral and Southeast Alaska. Documented occurrences in Alaska are limited to two disparate areas on Kodiak Island and Dall Island (just west of Prince of Wales Island) in Pleistocene refugia on limestone substrate (Forest Service 1994). It is unknown if this species occurs in the Project Area. Calder lovage occurs on rocky cliffs, open boggy or rocky slopes, and edges of coniferous forests. In Alaska it is known from alpine meadow habitats and edges of subalpine mixed coniferous forest.

Choris Bog Orchid *(Platanthera chorisana)*
In Alaska, this bog orchid species is limited to the Aleutian Islands and southern coastal areas (Forest Service 1994). Recent botanical surveys on Revillagigedo Island have revealed a number of populations of this species, some of them within the Sea Level Project Area. This species has also been found on Revillagigedo Island in the Mahoney Lakes area and elsewhere. With the increasing number of observations, it is possible that this species is not as rare as previously thought.

Botanical surveys discovered populations of the plant in Units 2, 80, 126, 134 and along road #8341160.

Bog Orchid *(Platanthera gracilis)*
This species of bog orchid is limited to a small geographic range in southern most Southeast Alaska and adjacent British Columbia (Forest Service 1994). Two documented sightings have been made in Alaska near Pearse Canal and on Dall Island. It is unknown if this species occurs in the Project Area. No observations were made of this species during field surveys.

This plant occurs in wet open meadow habitat. It is undetermined whether the taxon of this species is distinct; if it is not, it may be more common than previously believed (Forest Service 1994).

Loose-flowered Bluegrass *(Poa laxiflora)*
The distribution of this grass species is scattered between Southeast Alaska and Oregon. Seven sightings have been documented in Southeast Alaska near Hoonah, Sandborn Canal at Port Houghton, and Admiralty Island (Forest Service 1994). It is not known if this species occurs in the Project Area. Loose-flowered bluegrass is associated with moist, open lowland woods and open-forest meadows.

Straight-beak Buttercup *(Ranunculus orthorhynchus)*
This species of buttercup is distributed from coastal southern Southeast Alaska to adjacent British Columbia and Vancouver Island (Forest Service 1994). The closest documented occurrences to the Project Area include near Loring and Yes Bay. It is unknown if the species occurs in the Project Area. It occurs in moist, open lowland meadows and other moist open habitats.

Queen Charlotte Butterweed *(Senecio moresbiensis)*
This species of butterweed is limited to the Queen Charlotte Islands of British Columbia and to disjunct populations in southeastern Alaska and northwestern Vancouver Island (Forest Service 1994). Five occurrences have been documented in Alaska on Prince of Wales, Coronation, and Dall Islands. It is not known if this species occurs in the Project Area. Queen Charlotte Butterweed occurs in shady wet areas and bogs of montane to alpine habitats, to open, rocky or boggy slopes, and in open, rocky heath or grass communities (Douglas 1982 in Forest Service 1994).

Other Species of Concern

Alexander Archipelago Wolf
For analysis of effects on wolves, see the Biological Evaluation in Appendix C, or the Wildlife Section in this chapter.

Keen's Myotis

Records suggest that the range of Keen's myotis (*Myotis keenii*) is restricted to Pacific coastal forests from western Washington to southeastern Alaska (Nagorsen and Brigham 1993 and van Zyll de Jong and Nagorsen 1994 as sited by Parker 1996). Three specimens have been collected at Wrangell, northern Prince of Wales Island, and Hoonah (Parker 1996). Parker (1996) suggests these bats are year-round residents. Keen's myotis apparently roosts in snags, hollow trees, rock crevices and caves (van Zyll de Jong 1985 and sited in Parker 1996).

Marbled Murrelet

The marbled murrelet (*Brachyramphus marmoratus*) is a robin-sized seabird that is found throughout the North Pacific; the North American subspecies ranges from Alaska's Aleutian Islands to central and occasionally southern California. The marbled murrelet feeds in near-shore ocean feeding areas, inland saltwaters, and occasionally inland freshwater lakes. The bird feeds below the water's surface on small fish and invertebrates.

Based on at-sea surveys, 85 percent of the estimated 300,000 marbled murrelets in North America occurs in Alaska, with approximately 96,000 in the Alexander Archipelago (Ralph et al. 1995). Agler et al. (1995) determined the early-summer, on-water population (plus or minus 95 percent CI) in Southeast Alaska to be 434,129 (plus or minus 166,525). Agler et al. (1995) shows the density in Carroll Inlet at less than ten birds per square kilometer, while the average for marbled and Kittlitz's murrelets together throughout Southeast Alaska was 19.4 birds per square kilometer.

The marbled murrelet is currently listed as a Species of Concern in Alaska. The USFWS has listed the marbled murrelet as threatened in Washington, Oregon, and northern California. In the Pacific Northwest and Southeast Alaska, the bird normally nests in old-growth forests; however, a ground nesting marbled murrelet has been discovered on Prince of Wales Island (Thorne Bay Ranger District 1993).

Marbled murrelet habitat requirements are not well established for Southeast Alaska, and there is a need for research on both nesting and foraging habitat requirements as well as mortality factors such as oil spills, fishing nets, and predation. However, the available information indicates that habitat for regional marbled murrelet populations is probably adequate.

The TLMP Final EIS (1997) includes standards and guidelines for leaving a 600 foot windfirm buffer around all nests discovered, so that the nesting site can be studied in order to gain a better understanding of the nesting habitat requirements of marbled murrelets in Southeast Alaska. Disturbance activities within this buffer are to be minimized during the nesting season (May 1 - August 15). The buffer protection may be removed if the site remains inactive for two or more seasons.

Murrelets have been observed in the saltwater in Thorne Arm and Carroll Inlet. Survey methods were such that many undiscovered nests probably exist on land in the area. It is unknown how many occur in the Project Area. No nests have been found in the Project Area. Since all inland forests are less than 25 miles from salt water, all could be potential marbled murrelet nesting habitat.

Harlequin Duck

The harlequin duck's (*Histrionicus histrionicus*) range is divided into two distinct regions: eastern and western. The eastern range embraces Iceland, parts of Greenland, and Labrador, with the winter range extending as far south as New Jersey. The western range includes northeast Siberia west to the Lena River, east to the Kamchatka Peninsula and the Commander Islands, and north to the Arctic Circle, then across the Bering Sea to the Aleutian Island, much of the interior Alaska, south to northwest Wyoming and central California (Bellrose 1980). In Alaska, the harlequin duck as been reported as a fairly common year-round resident, and at one season or another, has been recorded over much of the State except the Arctic coast (Gabrielson and Lincoln 1959).

Available evidence indicates that the species breeds locally over much of southern Alaska, probably the Aleutians, and north to Anaktuvuk Pass. Ornithologists who have worked during the spring and summer months in the Alexander Archipelago and other parts of Southeast Alaska have commented upon the numbers of these ducks, frequently summarizing their observations by stating that they were common or abundant (Gabrielson and Lincoln 1959).

Harlequins nest along inland fast-moving rivers and streams, usually within six feet (but up to 60 feet) of water (DeGraaf et al. 1991). The nest site generally has shelter overhead: a recess in a streambank or among rocks, or under shrubs, trees, or stranded debris. Occasionally the nest is in an open area or even on a stream bar, but under shrubbery or other low vegetation. During the winter the harlequin duck is common to abundant in the coastal waters of Southeast Alaska, Prince William Sound, Cook Inlet, the bays of the Alaska Peninsula, the Aluetians, and the Pribilofs (Gabrielson and Lincoln 1959). Preferred winter habitat is reported to be areas along surf-pounded rocky coasts, rather than sheltered bays and fjords, where water is one to two fathoms deep and turbulent, and where bottom fauna abounds (Palmer 1975). Harlequins feed on mollusks, crustaceans, insects, fish, and echinoderms (Bellrose 1980).

Olive-sided Flycatcher

The olive-sided flycatcher (*Cantopus borealis*) breeds in wooded regions from central Alaska east to Newfoundland and south to northern Baja California and central Arizona in the west, central Minnesota and northern Michigan in the central states, and North Carolina and Tennessee in the east. The species winters in South America.

It inhabits open coniferous forests and forest edges along lakes, streams, and muskegs (Bent 1942). Godfrey (1979) described the habitat of the species as "burntlands with standing dead trees, bogs. Lakeshore with water-killed trees, lumbered areas, and other clearings in woodlands." DellaSala et al. (1994) noted that the species was often observed using habitats associated with lakes and muskegs during a breeding bird study on central Prince of Wales Island.

Field crews reported two olive-sided flycatcher observations. Both were singing males and both were detected at the edge of an old clearcut. One was at the edge of an old clearcut east of Unit 70. The other was at the north end of an old clearcut near Unit 90.

Spotted Frog

The spotted frog (*Rana pretiosa*) occurs in or near freshwater including marshy ponds, streams, and lakes as high as 9,842 feet (3,000 meters) in parts of its range (Stebbins 1985). This species is believed to range from south of the Taku River to other transboundary rivers and some islands of Southeast Alaska and British Columbia (Holmberg, 1992). Spotted frogs have been documented in the Stikine River basin (Waters 1992), and most recently have been observed by the USFWS in the Unuk River.

Amphibian surveys have been completed within the Project Area. No spotted frogs were found during the surveys.

Ascending Moonwort Fern *(Botrychium ascendens)*

This plant species occurs widely scattered in grassy fields at 0 to 2,500 meters elevation in British Columbia, Ontario, Yukon, Alaska, California, Montana, Nevada, Oregon, and Wyoming (Wagner 1993). It is unknown if this species occurs in the Project Area. Potential habitat occurs in the area.

Willow ***(Salix reticulata ssp. glabellicarpa)***
This subspecies of willow occurs as a prostate shrub on alpine cliffs and ledges above 2,400 feet elevation. The subspecies is limited to the Queen Charlotte Islands (Argus 1965) and one documented occurrence on an alpine peak near Juneau, Alaska.

Effects of the Alternatives

Proposed actions in each of the alternatives are not anticipated to adversely affect, directly, indirectly, or cumulatively, the humpback whale, Steller sea lion, or the American peregrine falcon. A Biological Assessment is included in Appendix C.

Threatened or Endangered Wildlife Species

Humpback Whale
Two types of boat activity associated with LTFs—log raft towing and recreational boating by workers—may have an effect on whales. Log raft towing frequency would vary between camps, seasons, and years; a general average may be about once a week during the working season (U.S. Forest Service 1989-94 Operating Period for the KPC Long-term Contract). The speed and direction of tugs and recreational boats may affect whale behavior; however, log raft towing routes are generally well established, and adverse effects from log raft towing have not been documented.

Recreational boating activity would vary between seasons and years from the community of Ketchikan. The effect of such recreational activity on whales would depend on factors such as size of the bay, depth of the water in the bay, number of boats, and individual behavior responses of the whales. There currently is not a quantifiable way to estimate these possible effects.

No direct or indirect effects on whales from implementation of forest management activities are anticipated. Forest-wide Standards and Guidelines have been developed and are included in the TLMP Final EIS (1997) to prevent and/or reduce indirect effects due to Forest Service permitted or approved activities. The following standards and guidelines have been developed for application on all Forest Service permitted or approved activities.

- Provide for the protection and maintenance of whale habitats.
- Ensure that Forest Service permitted or approved activities are conducted in a manner consistence with the Marine Mammal Protection Act, the Endangered Species Act, and National Marine Fisheries Service regulations for approaching whales, dolphins, and porpoise. "Taking" of whales is prohibited; "taking" includes harassing or pursuing or attempting any such activity.

Steller Sea Lion
Proposed actions in each of the alternatives are not anticipated to adversely affect, directly, indirectly, or cumulatively, Steller sea lion populations. No areas within the Project Area have been listed by the NMFS as critical habitat.

Forest-wide Standards and Guidelines have been developed to prevent and/or reduce indirect effects of harassment or displacement of marine mammals due to Forest management activities. These guidelines will be followed.

Fish
According to the NMFS (letter to USFS, May 10, 1996), the presence of threatened or endangered Pacific Northwest salmon is not documented for these waters, but their occurrence is possible. No significant impacts are anticipated because none are found in any freshwater river system in the Project Area. Impacts to saltwater fisheries are mainly associated with log transfer facilities and log storage and towing. There is a limited potential

for effects to occur while fish are in the saltwater life stages in the area. Due to the infrequent occurrence of Snake River sockeye salmon, Snake River spring/summer chinook salmon, and fall chinook salmon in the Project Area, no adverse effect on their population by any of the alternatives is anticipated.

American Peregrine Falcon

The American peregrine falcon occurs in Southeast Alaska only during migration. During migration through Southeast Alaska, the abundance of prey species will most likely be the primary habitat factor affecting peregrine falcons. In coastal areas of Washington, the primary prey species were shorebirds and waterfowl species. Passerine birds have also been identified in their diet. It is assumed that food sources would be similar for coastal Alaska.

Forest-wide Standards and Guidelines have been developed for protecting seabird rookeries and waterfowl concentrations (USDA Forest Service, TLMP Final EIS 1997). A wide variety of passerine (perching and song) birds will be available from the numerous open and forested communities under all alternatives associated with the Sea Level Project. No adverse effect on American peregrine falcon populations is anticipated with any of the alternatives.

The Arctic peregrine falcon is primarily associated with the area north of the Brooks Range and Seward Peninsula. It is highly migratory, wintering as far south as northern Argentina (Ambrose et al. 1988). It occurs in Southeast Alaska only during migration periods. As described for the American peregrine falcon, no effect on the population or habitat of the Arctic peregrine falcon is anticipated due to any Sea Level action alternative.

Sensitive Species

Trumpeter Swan

Timber harvest activities incorporate the TLMP (1997) Standards and Guidelines for trumpeter swans. Harvest activities are not expected to effect trumpeter swans because swans are not present in the Project Area when most of the timber harvest activity occurs. There is a potential for conflict when swans are migrating through or returning to wintering areas at Gnat Cove, Low Lake, and some of the ponds throughout the Project Area.

Standards and guidelines in TLMP direct us to avoid disturbance of trumpeter swans, particularly during nesting, brood-rearing, and wintering periods. As a general guideline, development should be avoided during these time periods within 0.5 miles of these areas (TLMP 1997).

Noise from road construction, timber harvest, and hauling of logs could frighten swans away from their preferred resting and feeding areas. However, limiting timber harvest operations to periods when swans are not present (April 1 through November 1) will mitigate these potential impacts for the units that are within a half mile of the Gnat Cove estuary and Low Lake. (See Mitigation Measures, Chapter 2). Units 48 and 173 are located within 0.5 miles of these areas.

Queen Charlotte Goshawk

There have been no confirmed goshawk nests near the Sea Level Project Area. The closest known nest is in the Carroll Creek drainage. Goshawks are extremely difficult to locate, so it is possible that there could be a breeding territory in the Sea Level Project Area. All action alternatives will harvest stands capable of providing nesting habitat (old-growth forests) for goshawks. Alternatives 2, 3, 4, 5, and 6 reduce old-growth forest in the Project Area between one and five percent from existing conditions; therefore, goshawks may be affected.

Any goshawk nests found during field reconnaissance or unit layout will be protected from harvest by implementing the current project specific mitigation measures (see Mitigation Measures, Chapter 2).

Osprey
The Sea Level Project is not expected to affect nesting osprey because no known nest site occurs in the Project Area, and availability of nesting and foraging areas do not appear to be a factor limiting population growth. In addition, minimal or no effect on osprey habitat is expected from project activities, because uncut buffers will be maintained near streams, lakes, and coastal areas. If nests are discovered in the Project Area, standards and guidelines outlined in the Forest Plan will be followed.

Peale's Peregrine Falcon
The nest distribution of this subspecies is closely associated with large seabird colonies, and seabirds are believed to be the major prey of the falcon. The Sea Level Project is not near any of the known nest sites of the Peale's peregrine falcon or large seabird colonies and no effect is anticipated.

Goose Grass Sedge *(Carex lenticularis var. dolia)*
No observations of this species were made during field reconnaissance of harvest units and roads. This species is not known to occur in forested areas; therefore, no effects are anticipated from timber harvest.

Edible Thistle *(Cirsium edule)*
No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since timber harvest activities generally avoid wet meadows and stream margins where this species would be expected to be found, no direct effects from timber harvest are anticipated even if the species were to occur in the Project Area.

Davy Mannagrass *(Glyceria leptostachya)*
No impacts to this species as a result of road construction and timber harvest are anticipated because stream and lakeshore buffers should provide adequate protection for this plant. Because it grows in shallow fresh water and along streams and lake margins, the TLMP (1997) Standards and Guidelines should protect its habitat from disturbance.

Wright Filmy Fern *(Hymenophyllum wrightii)*
No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since Wright filmy fern is not known to occur in the Project Area, no effects are anticipated from Sea Level timber harvest activities. However, potentially undetected specimens could be affected by the removal of trees from damp woods of the Project Area. Therefore, the Sea Level Project may affect individuals, but is not likely to affect population viability.

Truncate Quillwort *(Isoetes truncata)*
No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Furthermore, due to its rooted aquatic nature, this species does not occur in forested areas; therefore, no direct effects from the Sea Level Project are anticipated. Even if the species does exist in the Project Area, stream and lakeshore buffers should provide adequate protection for this plant.

Calder Lovage *(Liqusticum calderi)*
No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since Calder lovage is not known to occur in the Project Area, and since its habitat is at a higher elevation than project activities, no effects are anticipated from Sea Level timber harvest activities.

Choris Bog Orchid *(Platanthera chorisana)*
Botanical surveys thus far have located eight populations of this species within the Project Area. This species has also been found in a number of other locations on Revillagigedo

Island during 1995. With the increasing number of observations, it is possible that this species is not as rare as previously thought.

Botanical surveys discovered populations of the plant in Units 2, 80, 126, and 134, and along road #8341160. Units 2 and 80 avoid the populations found there. The populations in unit 126 are along the boundary. If the unit boundary is adjusted, there will be no effects on the population. Unit 126 is included in Alternatives 2 and 3.

This species is found in three locations within unit 134. One population is in the center of the unit, making protection difficult if the unit is harvested. Given the high incidence of this species in portions of the unit that were surveyed, more pockets may occur in other parts of the unit. This unit is included in Alternatives 2 and 3.

Given the frequency of occurrence of this species in surveyed portions of the Project Area, more populations may occur in those areas not surveyed. Therefore, the project may affect choris bog orchids. However, due to the number of known populations, the project is not likely to cause a trend towards listing, nor disrupt the general distribution of the species.

Bog Orchid *(Platanthera gracilis)*

No observations of this species were made during field reconnaissance of harvest units and roads. This species is not known to occur in forested areas; therefore, there are no effects anticipated from timber harvest or road construction activities.

Loose-flowered Bluegrass *(Poa laxiflora)*

No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since loose-flowered bluegrass is not known to occur in the Project Area, no effects are anticipated from Sea Level timber harvest activities. However, potentially undetected specimens could be affected by the removal of timber from harvest units encompassing open lowland woods and open-forested meadows.

Straight-beak Buttercup *(Ranunculus orthorhynchus)*

No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since straight-beak buttercup is not known to occur in the Project Area, no effects are anticipated from Sea Level timber harvest activities. Even if this species does occur in the Project Area, direct effects due to removal of timber from Sea Level harvest units are not anticipated to be significant as preferred open, moist habitats are generally avoided for timber harvest.

Queen Charlotte Butterweed *(Senecio moresbiensis)*

No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since Queen Charlotte butterweed is not known to occur in the Project Area, no effects are anticipated from Sea Level timber harvest activities. Even if this species does occur in the Project Area, direct effects due to removal of timber from Sea Level harvest units are not anticipated to be significant as preferred open, moist habitats are generally avoided for timber harvest.

Other Species of Concern

Alexander Archipelago Wolf

The analysis for effects on wolves is located in the Wildlife section of Chapter 3. It is also discussed in the Biological Evaluation in Appendix C.

Keen's Myotis

Harvest units could remove potential habitat of Keen's Myotis in the form of snags and hollow trees. The amount of habitat removed is not expected to be sufficient to cause a threat to population viability. Therefore, this project may affect individuals, but is not likely to affect population viability.

Marbled Murrelet

All action alternatives will harvest stands capable of providing nesting habitat (old-growth forests) for marbled murrelets. Alternatives 2, 3, 4, 5, and 6 reduce old-growth forest in the Project Area between one and five percent from existing conditions.

Based on current information, a reduction in available nesting habitat may occur; therefore, marbled murrelets may be affected. However, because of the many large unroaded blocks of habitat that exist in and adjacent to the Project Area (Misty Fiords National Monument—2,136,000 acres; Cleveland Peninsula—250,000+ acres; Orchard Lake—10,000 acres; and the Naha River area—20,000 acres), the regional population of marbled murrelets is not anticipated to be adversely affected. Any nests located during field reconnaissance or unit layout will be protected from timber harvest and blowdown using the management guidelines in the TLMP (1997). The TLMP Final EIS (1997) proposes using a 600-foot buffer around each nest. Disturbance activities would be minimized during the nesting season and the buffer zone would be maintained and monitored for at least two nesting seasons following discovery. If the nest remains inactive for more than two years, the buffer protection may be removed.

In areas with timber harvesting, the amount of nesting habitat for marbled murrelets will be reduced. Murrelets would not likely re-occupy a clearcut area until the regenerating forest attained a suitable degree of complexity and individual trees attained a suitable size, perhaps no sooner than 150 years (*Assessment of the Marbled Murrelet*, TLMP Final EIS 1997). It is not known what the actual effects of timber harvest will be, other than the total amount of habitat will be reduced. Fragmentation or increased edge effects may also reduce habitat capability for marbled murrelets.

Even if the breeding population were reduced in proportion to the percentage of productive old-growth forest harvested under the action alternatives (one to five percent), the population in the Sea Level Project Area would still be strong. Therefore, the effect on the huge Southeast Alaska population (434,000 plus or minus 166,000) would be negligible. Therefore, the Sea Level Project may effect individual marbled murrelets, but will have no effect on population viability.

Harlequin Duck

Nesting habitat for the harlequin duck occurs along in-land rivers and streams. Riparian habitats along all rivers and streams in the Project Area will be managed according to the Riparian and Lake Standards and Guidelines in the TLMP Final EIS (1997).

Nesting habitat requirements are expected to be maintained. Winter habitat occurs in the marine environment, in areas of high surf and rocky beaches. A small chance exists that the Sea Level Project could effect a few individual harlequin ducks. Still, it will not cause a trend towards listing.

Olive-sided Flycatcher

Olive-sided flycatchers may occur in the Project Area along some of the forest edges in the spring, summer, and fall. Olive-sided flycatchers use forest edges and are not considered an old-growth dependant species. Habitat alteration will be insignificant and will not cause a loss of population viability. Based on this information, it is determined that this project will not affect olive-sided flycatchers or their habitat.

Spotted Frog
Riparian habitats along all lakes, rivers, and streams will be managed according to the Riparian and Lake Standards and Guidelines in the TLMP Final EIS (1997). With implementation of these measures, no affect on the spotted frog is anticipated by the Sea Level Project, even if it was found to occur within the Project Area.

Ascending Moonwort Fern
It is unknown if this species occurs in the Project Area. Potential habitat occurs in the area. Undetected specimens could potentially be affected by harvest activities, but effects are not likely to cause a trend towards listing the species.

Willow *(Salix reticulata ssp. glabellicarpa)*
It is unlikely this species will be affected by harvest activities since activities will not occur near alpine. Based on this information, no effects are anticipated on this willow subspecies from this project.

Shelter Cove Road Connection

A connection is currently proposed to construct a road connection between Ketchikan and Shelter Cove in Carroll Inlet. This project is discussed here as a reasonably foreseeable action. The road connection would provide opportunities for many more Ketchikan residents to recreate in the Shelter Cove area.

Increased access would have the most affect on wolves through increased deer harvest, the main prey base for wolves, and increased wolf harvest. The analysis of impacts on wolves is discussed in the Wildlife section of Chapter 3.

Trumpeter swans may be affected if they stop at North Saddle Lakes during migration. This impact is not expected to threaten population viability. The situation would be similar to the situation at Ward Lake when swans stop there.

All other threatened, endangered, and sensitive species are not expected to be affected by the road connection. As part of the Sea Level Project, all newly constructed roads in the area would be closed following project completion. Some existing roads are also planned for closure for wildlife and other resource reasons. These road closures would be accomplished by the use of physical barriers such as tank traps, culvert and bridge removal, or through the use of gates. Only the mainline roads in the Shelter Cove area would remain open. This activity should partially mitigate effects associated with the road connection.

Wildlife

Key Terms

Carrying capacity—the maximum number of a wildlife species that a certain area will support through the most critical period of the year.
Habitat—the sum total of environmental conditions of a specific place that is occupied by an organism, population, or community of plants or animals.
Habitat capability—an estimated number of animals that a habitat can sustain.
Large Woody Debris (LWD)—any large piece of relatively stable woody material having a diameter of at least four inches and a length greater than three feet that intrudes into the stream channel.
Management Indicator Species (MIS)—species of vertebrates and invertebrates whose population changes are believed to best indicate the effects of land management activities.
Viable population—a population with the estimated numbers and distribution of reproductive individuals to maintain the population over time.
Wildlife Analysis Area (WAA)—divisions of land used by the Forest Service that correspond to Minor Harvest Areas used by the Alaska Department of Fish and Game (ADF&G).

Affected Environment

Alaska's wildlife are valuable for aesthetic, economic, recreational, ecological, and subsistence reasons. Over 350 species of mammals, birds, amphibians, and reptiles occur on the Tongass National Forest, and most of these, except brown bear, can be found in the Sea Level Project Area. They occupy a diverse range of land types and plant communities, and are variably adapted to climatic extremes, change in habitat, predation, and hunting pressure.

Wildlife Analysis Areas (WAAs)

Wildlife Analysis Areas (WAAs) represent divisions of land that the Alaska Department of Fish and Game (ADF&G) uses for data collection purposes, and the Forest Service uses for wildlife analysis purposes. WAAs included in the Sea Level Project Area are 405 and 406 (Figure Wildlife-1). Specific VCUs that are included within Project Area WAAs are listed in Table Wildlife-1. See the Subsistence section of this chapter for a further analysis of wildlife species by WAA.

Figure Wildlife-1
Wildlife Analysis Areas

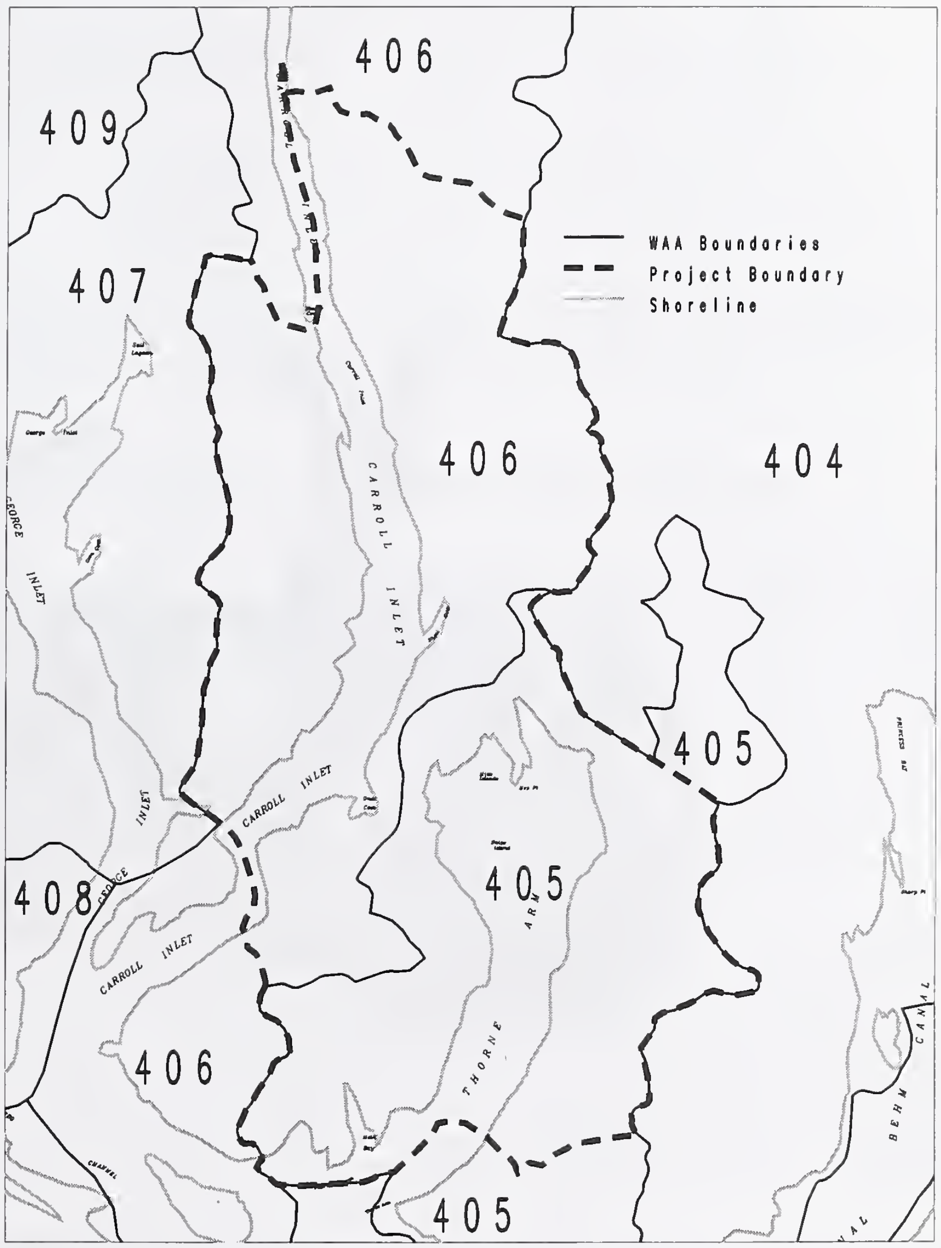
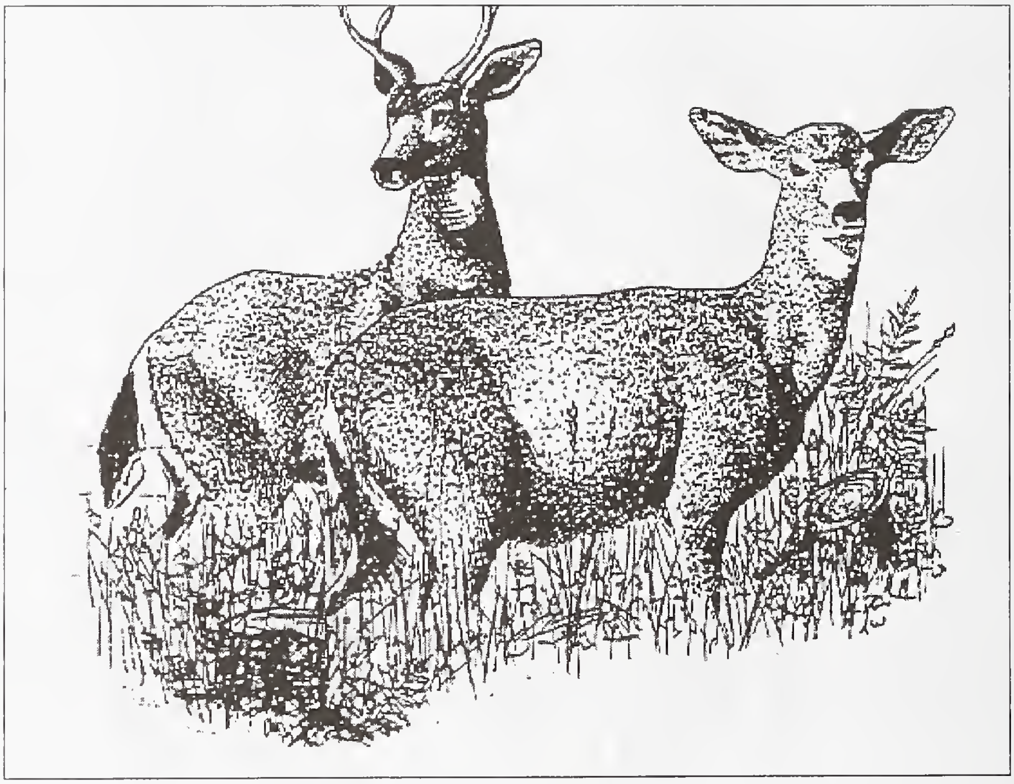


Table Wildlife-1
VCUs Within Wildlife Analysis Areas (WAAs) and Percent of the WAA that Includes the Project Area

WAA	Percent in Project Area	VCUs
405	78.3	7540, 7542, 7550, 7552, 7570, 7560, 7590, 7600
406	45.0	7440, 7450, 7460, 7530, 7580

Source: Burns 1997. Data derived from GIS data base.



Major Habitat Categories

The following categories are types of environment in which a species occurs. The environment can be described in physical or biological terms, which often includes elevation, topography, and type of vegetative community. A species may occupy a range of different habitats or more than one distinct kind of habitat in different seasons. Terrestrial habitats in the Sea Level Project Area include:

- Beach/estuary fringe
- Riparian
- Forest
  - Old-growth forest
  - Young-growth forest
- Alpine/subalpine

A brief description of these habitats follows. Table Wildlife-2 displays an acreage inventory of each habitat by WAA. Note that because several categories overlap each other (e.g., beach fringe may contain some old-growth and some riparian habitats), the sum of the total acres will not be the same as the total acreage announced for the Project Area.

Table Wildlife-2
Major Habitat Categories in the Project Area, 1997 (by Wildlife Analysis Area), in Acres*

WAA	1,000-foot Beach Fringe	1,000-foot Estuary Fringe	Riparian Management Area	Forest	Old-growth Forest	Young-growth Forest	Subalpine/ Alpine
405	4,149	3,049	4,946	35,461	32,221	3,240	256
406	5,660	3,264	9,907	56,899	46,336	10,563	5,378
Total	**9,809**	**6,313**	**14,853**	**92,360**	**78,557**	**13,803**	**5,634**

* Certain use areas overlap. For example, old-growth and young-growth forest are also included in beach and estuary fringe habitats.

Beach Fringe

For the purposes of this analysis, beach fringe is the land within 1,000 feet of the mean high tide and includes estuarine habitats. Areas within 1,000 feet of the ocean shoreline are transitional zones between land and water, salt and freshwater, and vegetated and nonvegetated conditions (USDA Forest Service 1979a). Forested areas in this transitional zone are heavily used by species with high economic, recreational, subsistence, or aesthetic values. Black bear, river otter, bald eagle, marten, Sitka black-tailed deer, and Vancouver Canada goose concentrate their activities during some seasons in these forest stands. Past timber harvest activity was concentrated in this habitat. No alternatives in the Sea Level EIS propose any additional timber harvest within beach fringe.

Estuary Fringe

Estuary fringe habitat is a 1,000-foot zone around estuaries. Bears, waterfowl, furbearers, and eagles are the primary users of the estuary fringe habitat. The estuary fringe is similar to beach fringe, but because of species diversity, it has a greater value to wildlife, especially black bears, river otters, mink, bald eagles, and waterfowl. No harvest is proposed within the estuary fringe.

Riparian

The riparian habitat is recognized as some of the most productive wildlife habitat in Southeast Alaska. It occurs along rivers and streams or around inland lakes, and contains elements of both aquatic and terrestrial ecosystems. Many wildlife species use riparian zones to a much greater extent than other areas (USDA Forest Service 1985), and riparian habitats are extremely important for eagles, furbearers, and black bears (USDA Forest Service 1986). Riparian areas are important migration routes for some wildlife species, and serve as travel routes for numerous species because of the presence of water, food, and cover.

Alternatives described in this EIS do not propose any harvest adjacent to Class I or Class II streams or lakes larger than 5 acres, except for road construction. The width of all proposed buffer strips is at least 100 feet. For additional information see the Water Resources and Fisheries sections of this chapter.

Forest

Forest habitat includes all areas with forest cover, including old growth and second growth described below, and noncommercial forest land as described in the Silviculture and Timber section of this chapter. Many wildlife species, including those associated with old-growth stands, use all forested areas within the Project Area.

Old-growth Forest

Old-growth forest is characterized by stands of trees usually well past the age of maturity with declining growth rates and signs of decadence, such as dead and dying trees, snags, and downed woody material. The stand usually includes large diameter trees, multi-layered canopies, a range of tree diameter sizes, and the notable presence of understory vegetation. These and other characteristics make old-growth forests important habitat for Sitka black-tailed deer, martens, black bears, and cavity nesting birds such as the hairy woodpecker. These forests are in a dynamic, steady state where the death of old trees is balanced by the growth of new trees. This category of old growth also includes the unproductive forest as well as the productive commercial forest lands. Old-growth forest acres are also included in beach fringe, estuary fringe, riparian, and other habitat areas. For a more detailed discussion of old-growth vegetation, see the Silviculture and Timber section and the Biodiversity section of this chapter.

Young-growth Forest

Young-growth forest is defined for the purposes of this section as consisting mostly of areas that have been harvested. Large-scale young-growth stands are of lower value to wildlife such as deer, martens, bears, and cavity nesters. Conifer seedlings aggressively invade and eventually shade out desirable herbaceous vegetation and provide fewer trees and snags suitable for excavation by woodpeckers and other cavity users. This habitat type was inventoried to help display the amount of past timber harvest activity that has occurred within the Sea Level Project Area. Some young-growth forest has been created naturally by windthrow, landslides, and avalanches.

Alpine/Subalpine

The alpine/subalpine category includes all sites at or above treeline, including open meadows of grasses, forbs, and shrubs; and scrub forest (Sidle and Suring 1986). Subalpine habitat includes a mosaic of forested, scrub, and nonforested sites that occur at higher elevation than the upland forest, at the lower edge of the alpine zone (Sidle and Suring 1986). Alpine/subalpine habitat within the Sea Level Project Area is generally above 1,500 feet in elevation. These habitats are important summer foraging areas for deer and black bears.

Wildlife Habitat Capability Models

Wildlife models were used to calculate habitat capability for deer, black bear, marten and wolf in the Project Area. For specific information on the models used, see Suring (1988) for black bear, marten, and wolf, and the TLMP (1997) for deer. Because of the amount of timber harvest on non-National Forest System lands throughout the Ketchikan Administrative

Area, a maximum potential impact was assumed, and no habitat capability was calculated for State and private lands.

The terms "habitat capability" and "populations" are not interchangeable. Habitat capability is synonymous with carrying capacity or the estimated number of animals the habitat can support through the most critical period of the year. Population is the estimated number of animals actually present at a given time. Populations may temporarily exceed habitat capability (for example, due to a series of mild winters). However, populations may be below what the habitat is capable of producing, due to predation, winter mortality, or other ecological factors in some years.

Given data limitations, the complexity of ecological relationships, and the need to simplify variables for use in the models, actual population sizes in some areas may vary considerably from those predicted by the analysis. However, the procedures provide estimates of habitat capability that over time are expected to be a reasonable indicator of relative potential impacts and population trends as they relate to the amount and quality of habitat only. Actual populations at any given point in time can be greatly influenced by weather, hunting, trapping, disease, predation, and related factors. Table Wildlife-3 estimates the current wildlife habitat capability in the Project Area.

Table Wildlife-3
Wildlife Habitat Capability within the Sea Level Project Area*

Selected MIS	1997 Habitat Capability
Sitka black-tailed deer**	2410.9
marten**	160.4
black bear	172.4
gray wolf	7.0

Source: Burns 1997. Data derived from GIS data base and interagency habitat capability models.
* Habitat capability for just the portion of WAAs in the Project Area.
** Patch-size effectiveness calculations are displayed in the Biodiversity section.

Management Indicator Species (MIS)

Management Indicator Species (MIS) are species of vertebrates and invertebrates whose population changes are believed to best indicate the effects of land management activities (USDA Forest Service 1982). Through the MIS concept, the total number of species occurring within a Project Area is reduced to a manageable set of species that collectively represent the complex of habitats, species, and associated management concerns. The MIS are used to assess the maintenance of population viability (the ability of a population to sustain itself naturally) and biological diversity and to assess effects on species in public demand (TLMP Final EIS 1997).

The following have been selected as MIS for this project and will be discussed in detail in this chapter:

Species	Rational for Selection
Sitka black-tailed deer	Important game species
marten	Old growth; important furbearer
black bear	Represents estuarine habitat; game species
bald eagle	Old-growth coastline; high public interest
river otter	Represents riparian habitat; furbearer
hairy woodpecker	Cavity excavator
brown creeper	Represents large, high volume, old-growth trees
red squirrel	Utilization of old growth and second growth
Vancouver Canada goose	Represents riparian habitat; game species
gray wolf	Species of concern
mountain goat	Represents cliffs, alpine, subalpine, and old growth

The following species were selected as Tongass National Forest MIS, but have not been selected as MIS for the Sea Level Project:

Species	Rationale for Nonselection
brown bear	Does not normally occur in Project Area
red-breasted sapsucker	Abundant and adaptable in Project Area

Sitka Black-tailed Deer

The Sitka black-tailed deer was chosen as an MIS because it is an important game and subsistence species and is seasonally associated with old-growth forests.

Historically, population fluctuations of Sitka black-tailed deer in Southeast Alaska have been linked with winter severity (Merrian 1970) and predation pressure (Van Ballenberge and Hanley 1984). Deep snow and late springs associated with severe winters have occurred several times in the past 80 years. Deer die-offs are common during severe winters, even in the best old-growth winter ranges. Predators of deer, such as gray wolves, bears, and hunters, can also contribute to the population decline during these winters, inhibiting subsequent recovery of the deer population. In general, winter severity increases with latitude and with a decreased maritime influence in Southeast Alaska (Longhurst and Robinette 1981).

Research conducted throughout Southeast Alaska indicates that high volume, old-growth forests at lower elevations are essential to maintaining a sustainable deer population during severe winters (Schoen et al. 1985; Hanley and Rose 1987; Yeo and Peek 1992). Large, strong branches, characteristics of the old-growth stands, intercept snow, providing for deer mobility while maintaining available forage. High volume stands of old-growth forests support adequate herb and shrub layers of deer forage. In most cases, timber harvest of deer winter range reduces the long-term quality of deer winter range. Effects on deer populations are compounded by the combination of deep-snow winters and large amounts of deer winter range converted to second growth. Snow significantly reduces forage availability in clearcuts during the winter. Closed canopy young-growth stands provide little forage in winter or summer. The amount of young growth and winter severity are key factors in determining the capability of the land to support deer populations.

An interagency model (Suring et al. 1992) was developed to evaluate the potential quality of winter habitat for Sitka black-tailed deer. The model was updated for the TLMP (1997). Analysis for the Sea Level Project uses the updated model the TLMP (1997) used in its analysis. This was based on various parameters, including, snow depth, aspect, elevation, and whether areas have been harvested.

Results of the deer model indicates there is a habitat capability for approximately 2,410.9 deer in the Sea Level Project Area (Table Wildlife-3). Table Wildlife-4 shows habitat capability by WAA at current conditions and before 1954.

Table Wildlife-4
Deer Habitat Capability for 1954 and 1997 for the Entire WAA

WAA	1954 Habitat Capability	1997 Habitat Capability	Percent Change
405	2,055.6	1,850.0	10.0
406	3,182.6	2,691.0	15.4
Total	**5,238.1**	**4,541.0**	**13.3**

Source: Burns 1997. Data derived from GIS data base and Sitka black-tailed Deer Habitat Capability Model, TLMP 1997.

The best deer habitat in the Project Area appears to be in the Sea Level Creek area on the east side of Thorne Arm. Field crews reported a high occurrence of deer sign including many beds and trails. Field crews also reported a high number of wolf sightings in this area.

Other areas with good deer winter habitat include the head of Thorne Arm, the beach fringe south of Shoal Cove, the beach fringe north of Calamity Creek in Carroll Inlet, and the area surrounding Gnat Cove in Carroll Inlet.

Marten

The marten was selected as an MIS to represent old-growth associated species and because it is an important furbearer. Marten populations are moderate in the Project Area. High pelt prices, susceptibility to trapping pressure, and liberal trapping regulations have created a large demand for marten.

Martens prefer mature old-growth forests with a well developed overhead canopy. Snags and downed woody debris are important to martens for winter and summer dens and resting sites and cover habitat for prey species. The distribution and abundance of martens is determined to a large extent by the availability of cover and the presence of prey species (Simon 1980).

Throughout the year, especially in the winter, small mammals are an important food source for martens. During the summer their diet is supplemented by birds, insects, fruits, and berries.

The model was developed to evaluate the potential quality of winter habitat for the marten (Suring et al. 1988a). The underlying assumption is that if adequate winter habitat is available, habitat requirements throughout the rest of the year will not be limited. The model incorporated the following factors in the analysis: (1) classes of timber volume in old-growth forests (2) stand size classes [stand age] (3) beach fringe habitat (4) riparian habitat (5) elevation and (6) old-growth patch size.

The marten model (without patch-size effectiveness taken into consideration) indicates there is habitat capability for an estimated 160.4 martens in the Sea Level Project Area (Table Wildlife-3).

The TLMP (1997) identified high value marten habitat as stands below 1,500 feet elevation in high volume productive old growth strata. There are approximately 19,821 acres of high value marten habitat in the Project Area as defined in the TLMP.

Black Bear

The black bear was selected as an MIS to represent estuarine habitat and because it is an important game species. Black bears occur throughout the Project Area, and populations are currently stable. As of the 1990/91 black bear harvest season, nonresident hunters have been limited to one black bear, while Alaska residents may harvest two black bear.

Black bears are highly adaptable and can tolerate moderate disturbances, such as habitat alteration, as long as the basic requirements for food and cover are satisfied (Lawrence 1979). As clearcut stands mature, both forage resources and numbers of denning sites may decline.

After emergence from dens in the spring, black bears seek sources of new plant growth for food (Mondafferi 1982). Grass flats of estuaries, low elevation forests near the beach (beach fringe habitats), and avalanche slopes provide the needed high quality forage. Estuaries like those in Gnat Cove, Shoal Cove, and near the head of Thorne Arm receive frequent use. During the summer, black bears feed on forbs, berries, and salmon. In the fall they feed on berries and forbs (Sidle and Suring 1986) in the subalpine areas.

Bear den sites include: (1) cavities in trees and stumps (2) caves and (3) excavated and natural depressions under tree roots, stumps, and fallen logs. Black bears search for food in clearcuts that provide access to cover, which is found in mature and old-growth forests. Clearcuts 10 to 15 years old are preferred because of the production of large amounts of berries (Lindzey and Menslow 1977).

The model for black bears incorporated the following factors in the analysis: (1) the average annual value of upland habitats, (2) the average annual value of riparian habitats and potential salmon production, and (3) the average annual value of beach fringe habitats. (For more information regarding the model see: Suring et al. 1988b.)

The black bear model indicates there is habitat capability for an estimated 172.4 black bears in the Sea Level Project Area (Table Wildlife-3).

Bald Eagle

The bald eagle was selected as an MIS because the public has a strong interest in the species and the species has special habitat requirements. Bald eagle habitat is defined as beach fringe habitat. The majority of eagles in Southeast Alaska nest in coniferous forest habitats along the coastline and associated saltwater inlets (Suring et al. 1988c). Eagles prefer to nest in continuous stands of old growth rather than in narrow leave strips of old-growth trees. Of the 3,850 nests surveyed in Southeast Alaska, 92 percent were within 300 feet of the shoreline (Hodges and Robards 1982).

Bald eagles nest adjacent to the habitat that provide the best opportunities for foraging or searching for food, such as over open water and on tidal flats. Eagles primarily feed on fish, but are also known to feed on waterbirds, marine invertebrates, and drifting carrion. Perching sites near the nest and foraging areas are also important components of bald eagle habitat. The bald eagle and its habitat have been given special protection through the Bald Eagle Protection Act as implemented by an Interagency Agreement between the Forest Service and the U.S. Fish and Wildlife Service (USDA Forest Service and USDI Fish and Wildlife Service 1990). Among the provisions of the Interagency Agreement are: requirement of a 330-foot vegetation protection buffer around eagle nests, timing restrictions for blasting within 1/2 mile of known nests, and a requirement that formal consultation with the U.S. Fish and Wildlife Service take place when any portion of the agreement cannot be implemented.

The U.S. Fish and Wildlife Service has identified 60 nest sites in the Sea Level Project Area. During field inventories, four new nests were found in Thorne Arm. Table Wildlife-5 displays the number of identified eagle nests which occur in each WAA.

Table Wildlife-5
Number of Eagle Nests by WAA in the Sea Level Project Area

WAA	# Nests
405	38
406	26
Total	**64**

Source: Burns 1997. Data derived from GIS data base.

Most bald eagle nesting habitat is protected under the Forest-wide standards and guidelines (TLMP 1997) with the 1000-foot beach and estuary buffers. The Sea Level Project incorporates these standards and guidelines in all alternatives.

River Otter
The river otter was selected as an MIS to represent riparian habitats and because it is an important furbearer. River otters concentrate along intertidal zones and the adjacent narrow beach fringe. They also travel extensively throughout streamside habitats. The old-growth forests in Southeast Alaska are assumed to provide optimum habitat for river otters (Suring et al. 1988d), with seedling and sapling (i.e. clearcut) and pole timber stands providing limited habitat. Otters avoid clearcuts extending to the beach in Southeast Alaska (Larsen 1983) because of lack of cover and density of shrub growth. High value otter habitat must provide adequate shelter in addition to sufficient food (Melquist and Hornocker 1983). River otters feed on fish (primarily sculpins and rockfish), crabs, and occasional invertebrates other than crabs (Sidle and Suring 1986).

River otters depend on large woody debris (LWD) in streamside, lakeside, and beach habitats. The large extensive root systems, downed tree trunks, and overturned root wads of old-growth trees create undercuts and hollows that maintain den and resting sites, and cover. From May through July, female otters use old-growth habitats near streams for inland dens (up to 0.5 miles from the coastline). The annual harvest of river otter on the Tongass National Forest has varied from a high in 1979-80 of 652 animals, to a low of 373 animals in the 1986-87 harvest season. Harvest numbers are a function of both otter abundance and trapper effort.

Red Squirrel
Optimum habitat for red squirrels provides opportunities for food sources, food caching sites, and nesting cover (Vahle and Patton 1983). This includes forested stands with two or more species of conifers of cone-bearing age for food, snags for den sites, and downed logs for cache sites. These conditions are best provided in old-growth Sitka spruce forests in Southeast Alaska. Other forest types provide life requirements of red squirrels, but food

resources are not as plentiful as they are in spruce forests. Red squirrels represent a species that can survive fairly well in second-growth timber stands at seed-producing age.

Hairy Woodpecker

The hairy woodpecker was chosen as an MIS representing cavity users because of its preference for stands of old-growth western hemlock and Sitka spruce, and for its association with snags (standing dead trees). Hairy woodpeckers are year-round residents in Southeast Alaska and use snags and partially dead trees for nesting and foraging. These woodpeckers feed on larvae of wood-boring beetles, other insects, and seeds and berries in winter (Sidle and Suring 1986).

The hairy woodpecker is important as a primary cavity excavator because by drilling holes in trees it creates habitat needed for other wildlife species (Kesseler 1979; Noble and Harrington 1977). Forty-two species of mammals and birds in Southeast Alaska nest or den in tree cavities, including woodpeckers, owls, hawks, waterfowl, bats, squirrels, martens, and otters. Several of these species depend exclusively on cavities in the large diameter snags characteristic of old-growth stands for nest and den sites. Most cavity nesting or denning species would be represented by hairy woodpeckers and respond similarly to proposed activities.

Hairy woodpecker habitat is defined as high volume stands below the subalpine category. Availability of suitable winter habitat for roosting and foraging is considered an important constraint on the habitat suitability of the hairy woodpecker.

Brown Creeper

The brown creeper was chosen as an MIS because it is associated with large, old-age trees and represents the old-growth forest community. Brown creepers and other bark foraging birds also select larger diameter trees as foraging sites during cold, windy weather to lessen their exposure (Grubb 1975, Webber 1986). The diet of brown creepers consists of larvae, pupae, and eggs of insects gleaned from the crevices of bark, spiders, other small invertebrates, and occasionally seeds (Pearson 1923, Reilly 1968). Large diameter trees are preferred because a bird can feed longer on a large tree and capture more prey per visit (Airola and Barrett 1985).

The abundance of large coarse-barked trees and the length of the vertical foraging height appears to affect the territory size (Apfelbaum and Hanley 1977); the area necessary to support the birds increases as the number of large, tall trees decreases. Brown creepers spend most of their time foraging on live parts of trees rather than dead trees (Morrison et al. 1987).

Slightly more than one tenth of the number of brown creepers observed in stands with 30,000 board feet per acre were observed in stands with 20-30,000 board feet per acre (Hughes 1985). Other habitats in Southeast Alaska were not considered to provide suitable habitat for brown creepers.

Vancouver Canada Goose

The Vancouver Canada goose was selected as an MIS to represent old-growth and riparian habitats. The Vancouver Canada goose is also a game species.

Banding studies have indicated Vancouver Canada geese are primarily nonmigratory (Ratti and Timm 1979) and are found almost exclusively in Southeast Alaska. These geese use forested habitats for nesting and brood rearing; they place nests in trees, use trees for perches during incubation, and rely primarily on forest understory plant species for food during this part of their life cycle (Doyle et al. 1988). Lebeda and Ratti (1983) suggest that the three most important factors for nesting Vancouver Canada geese are: (1) dense understory vegetation, (2) forest surrounding surface water, and (3) an abundant food source.

Gray Wolf (Alexander Archipelago Wolf)

The gray wolf was selected as an MIS because of public concerns over what effects additional timber harvest and higher road densities would have on the wolf population within the Sea Level Project Area. Wolf sign has been observed throughout the Project Area. Pack home range and numbers are not known.

The Alexander Archipelago wolf is a small subspecies of the gray wolf (Goldman 1937, Pederson 1982), similar in appearance to the Vancouver Island wolf.

On December 17, 1993, the US Fish and Wildlife Service (USFWS) received a petition from the Biodiversity Legal Foundation to list the Alexander Archipelago wolf of Southeast Alaska as threatened pursuant to the Endangered Species Act. On May 13, 1994, the USFWS found that the petitioners had presented substantial information indicating that listing may be warranted and a status review of the species was initiated. On February 16, 1995, the USFWS determined that listing was not warranted. Since that time the courts directed the USFWS to reconsider their determination. The USFWS recently determined that the wolf did not warrent listing.

The primary food of most Southeast Alaskan wolves is deer (Wood 1990, Person 1993). Beaver, mountain goat, and moose are also primary prey in some mainland areas and spawning salmon are fed on when available (Wood 1990).

Based on field observations, discussions with trappers, and anecdotal information, the wolf population in Southeast Alaska was estimated to be 635 to 690 individuals, distributed in 85 packs (Morgan 1990). However, Person et al. (1996) estimates the current Southeast population at about 908 individuals with about 20 percent of them occurring in Game Management Unit (GMU) 1A (Revillagigedo Island and surrounding mainland). The Sea Level Project contains portions of Wildlife Analysis Areas (WAA) 405 and 406, which are included in GMU1A.

A 1984-85 wolf study (Smith et al. 1985) suspected that there were eight packs of wolves on Revillagigedo Island with an early winter population of 29 to 51 and 26 to 37 in spring.

Application of the Tongass habitat capability model indicates there is a habitat capability for an estimated 7.0 wolves in the Sea Level Project Area (Table Wildlife-3).

Habitat most valuable to deer during the winter period is characterized by low elevation mature forest on south facing slopes. We conducted an analysis on the amount of low elevation (<800 feet) productive old-growth forest (>8,000 MBF/acre) on south facing slopes (135 degrees to 225 degrees). The results are displayed later in this section under Effects of the Alternatives.

Many studies have shown that wolf abundance may be inversely correlated with road density (Theil 1985, Jensen et al. 1986, Mech et al. 1988, Fuller 1989, Person et al. 1996). Person et al. (1996) noted that wolf harvest rates increased sharply in Wildlife Analysis Areas on Prince of Wales Island where road density exceeded 0.49 miles per square mile. The TLMP recommends maintaining open road densities below the threshold of 0.7 mi/sq mi to help protect wolf populations from over-harvest. This recommendation is based on the work in Person et al. (1996). The primary threat of high road densities is the increased access to humans who kill wolves by shooting, snaring, or trapping (Van Ballenberghe et al. 1975, Mech 1977).

There has been an increase in road density associated with logging activities. Total road density is currently about 1.08 miles per square mile for the Project Area. About 16 miles of road have been blocked to car and truck access. Open road density is currently approximately

0.97 miles per square mile across the Project Area. Most of these roads are not connected to the Ketchikan road system.

Mountain Goat

Mountain goats represent species using cliffs, alpine and subalpine, and old-growth forest habitats. Hunted populations are sensitive to overharvest and human disturbance. The quality and quantity of winter habitat is the most limiting factor for mountain goats in Southeast Alaska. Old-growth trees with large dense crowns have the highest value because they intercept the most snow and provide understory forage plants. Lack of snow interception in early successional stages, and lack of forage in middle successional stages, reduces their value as habitat (TLMP Final EIS (1997)).

Mountain goats have been introduced onto Revilla Island over the past 15 years. A substantial population now exists near Mount Reid, just north of the Project Area. The population ranges from the ridge above Swan Lake north to the ridge above Orchard Lake. A few goats may range as far south as the head of Calamity Creek.

Suring et al. (1988f) identified productive old growth near escape terrain as the most important winter habitat. The primary factors in evaluating goat habitat is its proximity to escape terrain and availability of food. Winter habitat is identified as old-growth forest habitat in close proximity to steep cliffs and steep, rocky slopes that provide escape terrain

Endemic Terrestrial Small Mammals

The Forest Plan (1997) contains standards and guidelines for managing endemic small mammals. The objective of the small mammal Standard &Guidelines is to maintain habitat to support viable populations and improve knowledge of habitat of rare or endemic terrestrial mammals that may represent unique populations with restricted ranges (Forest Plan 1997). TLMP directs us to conduct surveys on islands larger than 50, 000 acres (Revillagigedo Island) if there is a high likelyhood that endemic taxa are present that may be affected by the proposed project.

There is one endemic taxa that possibly occurs within the Sea Level Project. MacDonald and Cook (1994) list a subspecies of southern red-backed vole (*Clethrionomys gapperi solus* Hall and Cockrum) that occurs on Revillagigedo Island. This is a different subspecies than those on Cleveland Peninsula and the southern Southeast Alaska mainland. MacDonald and Cook (1994) concluded that red-backed voles were ubiquitous with generalized habitat requirements.

Effects of the Alternatives

This analysis considers the direct, indirect, and cumulative effects of timber management in the Project Area. Direct effects are projected to 1999, the anticipated end of the current proposed action; to 2007, which includes the reasonably foreseeable future; and to 2095, to show the cumulative impacts of harvesting all the suitable lands through the first 100 years.

Direct and Indirect Effects

Comparison of Alternatives: Effects on Wildlife Habitat

Each action alternative includes harvest of wildlife habitat. Project unit design criteria, BMPs (FSH 2509.22, 1991), and/or legislated protective measures (TTRA) and Forest Standards and Guidelines significantly reduce or eliminate potential impacts to beach fringe, estuary fringe, and riparian habitats in each alternative. Alpine/subalpine habitat is also affected only slightly in Alternative 2 only (less than 33 acres) by road and unit location because of inaccessibility and/or low productivity. Changes throughout the Project Area in these habitats are less than one percent for each alternative (Table Wildlife-6). Impacts to MIS that depend on these habitats are low. Alternative 1, the no-action alternative, will harvest no acreage, with the effect that existing wildlife habitats will remain at current levels, with changes over time due only to natural succession or future timber harvest.

Table Wildlife-6
Proposed Acres for Harvest and Percent Change from 1954 in Wildlife Habitats by Alternative

			Alternative											
			1		2		3		4		5		6	
Habitat Categories	1954 Acres	Existing Acres	Acres Cut	Percent Change	Acres Cut	Percent Change	Acres Cut	Percent Change	Acres Cut	Percent Change	Acres Cut	Percent Change	Acres Cut	Percent Change
Beach Fringe	9,809	9,809	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Estuary Fringe	6,313	6,313	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Riparian	14,853	14,853	0	0.0	127	0.9	60	0.4	46	0.3	35	0.2	8	0.1
Old-growth Forest	92,360	78,557	0	14.9	2,843	18.0	1,620	16.7	1,226	16.3	848	15.9	391	15.4
Alpine/Subalpine	5,634	5,634	0	0.0	33	0.6	0	0.0	0	0.0	0	0.0	0	0.0

Source: Burns 1997. Data derived from GIS data base.

Beach Fringe
None of the alternatives propose any timber harvest within the 1000-foot beach fringe zone as prescribed in the TLMP (1997).

Estuary Fringe
None of the alternatives were designed to harvest timber within the 1,000-foot estuary fringe zone.

Riparian
For the purpose of this analysis, riparian habitat was identified by using riparian soils and the Riparian Area Prescriptions as shown in Appendix B. TTRA buffers, or 100-foot minimum buffers around lakes larger than five acres, are not proposed for harvest.

Forest
Forest sites comprise 92,360 acres of which 78,557 acres is old-growth forest in the Project Area. Within some harvest units are scattered patches of nonforested or low productivity forest types. The biggest difference among the alternatives is the total number of acres scheduled for harvest for each particular alternative. Alternative 2 proposes to harvest 3.6 percent of the existing old-growth forest. Alternatives 3, 4, 5, and 6 propose to harvest from 0.2 to 2.1 percent. The effects of old-growth habitat loss on old-growth associated species are reflected in Habitat Capability for MIS later in this section. For a discussion of the amount of timber harvest by volume strata, see the Silviculture and Timber section of this chapter.

Alpine/Subalpine
Alternative 2 proposes a minor amount of timber harvest (32.9 acres) in the subalpine habitat.

Comparison of Alternatives: Effects on Habitat Capability
The previous section discusses changes to wildlife habitats used by the MIS. This section discusses how those changes in habitats affect the potential habitat capability for each MIS. As mentioned in the Affected Environment earlier in this section, the models that estimate the

capability of habitats to support selected species are not necessarily accurate reflections of actual populations in the Project Area. Actual population levels are not known for a given period in time and probably never will be due to weather, hunting/trapping, disease, predation, and other related factors which are difficult or impossible to predict for any given time in the future.

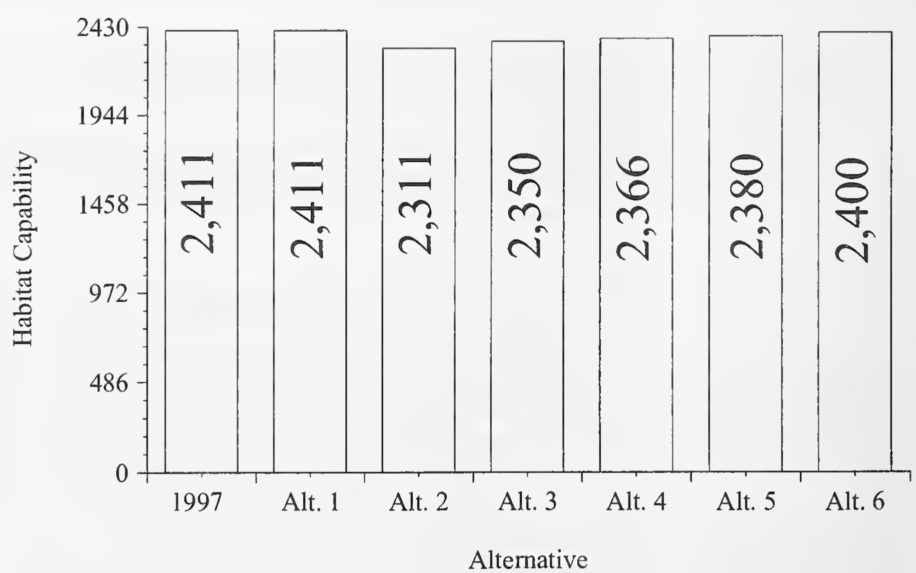
Several MIS show a habitat/use relationship with the size of preferred habitats. The wildlife models for this analysis take into account those patch-size relationships for Sitka black-tailed deer and marten. Direct impacts to black bears, otters, and bald eagles have been greatly reduced in all action alternatives through avoidance of timber harvest in beach fringe, estuary fringe, stream corridors, riparian, and alpine/subalpine habitats.

Sitka Black-tailed Deer

Sitka black-tailed deer are dependent on low elevation, high volume, old-growth stands during severe winters, and are affected by proposed timber harvest under the action alternatives. Alternative 2 would decrease habitat capability 4.1 percent in the Project Area while Alternatives 3, 4, 5, and 6 would decrease habitat capability 2.5, 1.9, 1.3, and 0.4 percent, respectively. Figure Wildlife-2 shows the habitat capability for deer.

Second-growth canopy closure in timber stands 20 to 30 years after harvest may be delayed by thinning to promote forage production (Hanley et al. 1989). Second-growth forest management has been widely used in Southeast Alaska, but recent research has not documented benefits to Sitka black-tailed deer from thinning and canopy gaps. Potential areas for thinning are listed in Appendix I.

Figure Wildlife-2
Deer Habitat Capability Following Implementation for Each Alternative



Source: Burns 1997. Data derived from GIS database and interagency habitat capability model.

At first glance, Figure Wildlife-2 appears to underestimate the impacts to deer winter habitat. A reduction in habitat capability of only four percent from harvesting over 2,000 acres seems low. The figures were checked by hand for accuracy. The relatively low loss of habitat capability is due to the fact that relatively few units are located in high value deer winter habitat. Much of the high and moderate value winter habitat was removed during previous timber harvest operations which harvested much of the habitat at low elevations. This is shown in Table Wildlife-4 as a relatively high amount of habitat capability was lost between 1954 and 1997.

The definition of high value deer habitat was determined using the revised deer habitat capability model used in the TLMP (1997). All areas having a positive HSI (Habitat Suitability Index) value were identified using GIS. These acres were then broken into thirds based on acreage for each WAA. This means that approximately a third of the acres were in each of the high, medium, and low habitat value. The HSI value for each WAA was determined from these breaks. High value deer habitat in WAA 405 is those acres with a HSI value greater than or equal to 0.567. In WAA 406 it is those acres having a HSI value greater than or equal to 0.400.

Table Wildlife-7 shows the amount of high, medium and low value habitat, based on HSI, harvested for each alternative. Most of the harvest will occur in habitat of medium or low value (according to the model) and ten to twenty percent is located in high value habitat.

Table Wildlife-7
Harvest of Deer Habitat Capability, by Habitat Suitability Index in Acres

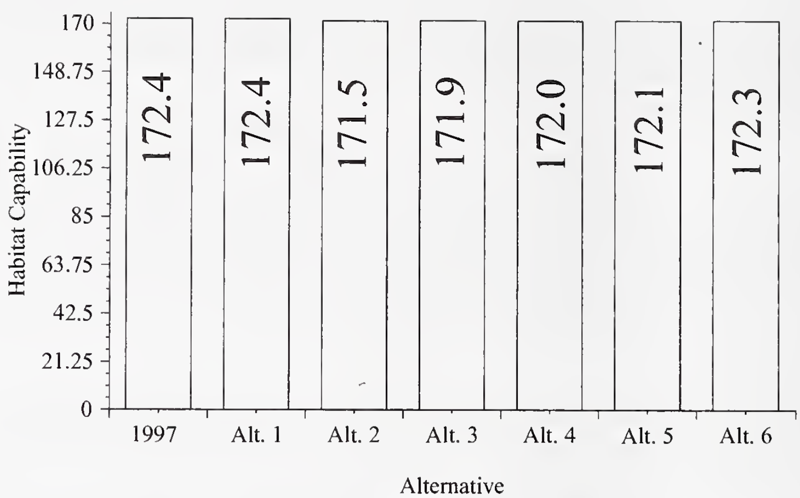
Habitat Suitability Index Rating	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
none	0	129	13	13	13	0
low	0	749	435	324	188	97
medium	0	1,345	798	592	423	231
high	0	308	205	175	142	18

Source: Burns 1997. Data derived from GIS data base.

Black Bear

Avoidance of beach fringe, estuary fringe, stream corridors, and riparian habitat with timber harvest is reflected in a less than one percent decline in black bear habitat capability for all action alternatives (Figure Wildlife-3). Alternative 2 harvests the most bear habitat, and would harvest habitat capable of supporting an estimated one black bear. Alternative 6 reduces the habitat capability for bear by 0.1 bear (0.1 percent), which is the lowest reduction of habitat capability of all the action alternatives .

Figure Wildlife-3
Black Bear Habitat Capability Following Implementation for Each Alternative



Source: Burns 1997. Data derived from GIS database and habitat capability model.

The definition of high value black bear habitat was determined using the black bear habitat capability model (Suring 1988). All areas having a positive HSI (Habitat Suitability Index) value were identified using GIS. These acres were then broken into thirds based on acreage for each WAA. This means that approximately a third of the acres were in each of the high, medium, and low habitat value. The HSI value for each WAA was determined from these breaks. High value bear habitat in WAAs 405 and 406 is those acres with a HSI value greater than or equal to 0.6, low-value habitat is that which is below 0.5.

Table Wildlife-8
Harvest of Black Bear Habitat Capability, by Habitat Suitability Index in Acres

	Alternative					
Habitat Suitability Index	**1**	**2**	**3**	**4**	**5**	**6**
0 (none)	0	22	0	0	0	0
0.01-0.49 (low)	0	0	0	0	0	0
0.5-0.59 (medium)	0	317	185	137	116	84
0.6 + (high)	0	2,238	1,295	989	670	267

Source: Burns 1997. Data derived from GIS data base.

Most of the harvest occurs in high value HSI habitat, as shown in Table Wildlife-8. Black bears are highly adaptable and can tolerate moderate disturbances, such as habitat alteration, as long as the basic requirements for food and cover are satisfied (Lawrence 1979). As clearcut stands mature, both forage resources and numbers of denning sites may decline.

None of the alternatives will threaten black bear population viability. Black bear population viability will be maintained through the application of the Viable Population Strategy outlined in the TLMP (1997).

Effects of Roads

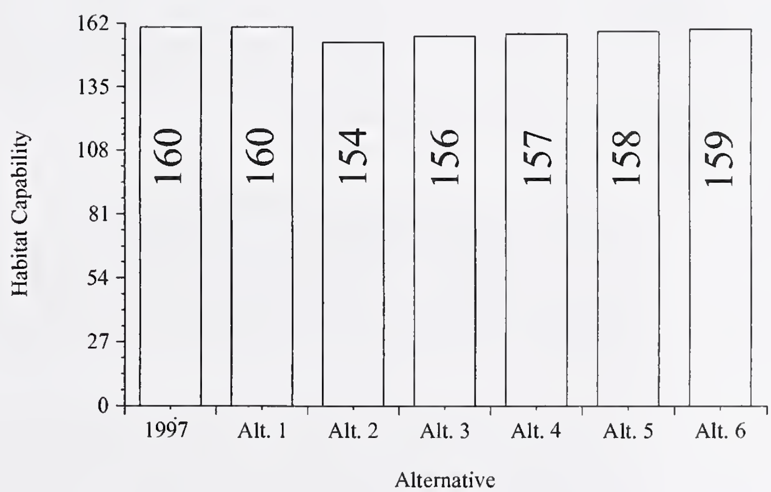
Although black bears can adapt to changes in their environment induced by humans, increased access by humans often leads to increased human-related mortality (legal harvest, poaching, and defense of life and property). The black bear habitat capability model has factors that attempt to take this increased mortality into consideration.

For habitat near a heavily used transportation system, the habitat capability of the areas within two miles of a road is reduced by 20 percent. For the analysis of the effect of road density, it is assumed that all areas of the Project Area are within 2 miles of a road. Currently, the road systems in the Project Area receive low use. However, road use can be expected to increase as the human population in Southeast Alaska increases. The black bear habitat capability would be reduced by 20 percent as road use increases in the future.

Marten

The marten is an old-growth associated species that uses a wide range of old-growth volume classes, tree species, and landscape zones. Alternative 2 would cause a 4.2 percent decline in habitat capability from existing conditions. Alternatives 3, 4, 5 and 6 would decrease habitat capability by 2.5, 1.9, 1.3 and 0.6 percent, respectively (see Figure Wildlife-4).

Figure Wildlife-4
Marten Habitat Capability Following Implementation for Each Alternative



Source: Burns 1997. Data derived from GIS and interagency habitat capability model.
Habitat Capability does not include road effects.

High value marten habitat was looked at in two ways. The first technique involves looking at relative values of existing habitat suitability indices. The second technique looks at the amount of high value marten habitat harvested, as defined in the Forest Plan (1997).

Relative Habitat Suitability Index Values

The definition of high value marten habitat was determined using the marten habitat capability model (Suring 1988). All areas having a positive HSI (Habitat Suitability Index) value were identified using GIS. These acres were then broken into thirds based on acreage for each WAA. This means that approximately a third of the acres were in each of the high, medium, and low habitat value. The HSI value for each WAA was determined from these breaks.

High value marten habitat in WAA 405 is those acres with a HSI value greater than or equal to 0.6, and low value habitat is those acres below 0.2 HSI. In WAA 406 high value habitat is those acres having a HSI value greater than or equal to 0.6, and low value habitat is those acres below 0.27 HSI.

These values for low, medium and high value habitat are used in Table Wildlife-9. Most timber harvesting would occur in high value HSI marten habitat.

Table Wildlife-9
Harvest of Marten Habitat Capability, by Habitat Suitability Index in Acres

	Alternative					
Habitat Suitability Index	**1**	**2**	**3**	**4**	**5**	**6**
0	0	115	12	12	12	0
Low	0	126	75	56	52	12
Medium	0	330	217	157	104	75
High	0	1,973	1,153	885	607	263

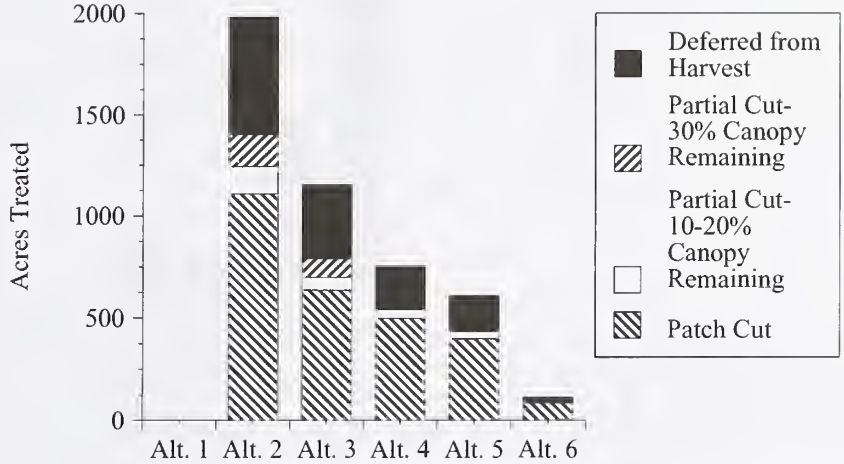
Source: Burns 1997. Data derived from GIS data base.

Forest Plan (1997) High Value Marten Habitat

The TLMP (1997) identified high value marten habitat as stands below 1,500 feet elevation in high volume productive old growth strata. There are approximately 19,821 acres of high value marten habitat in the Project Area as defined in TLMP. Figure Wildlife-5 shows a comparison of the amount of TLMP high value marten habitat harvested under each alternative.

In all alternatives, over half of the TLMP high value habitat is treated using patch cuts. About twice as many acres are patch cut as are deferred from harvest (Figure Wildlife-5). Acres with partial cut treatments fall into two categories. Those in VCUs with less than 33 percent of the productive old growth harvested retain 10 to 20 percent of the original stand structure per TLMP marten standards and guidelines. Those VCUs with over 33 percent of the productive old growth harvested retain 30 percent canopy closure to meet TLMP marten standards and guidelines.

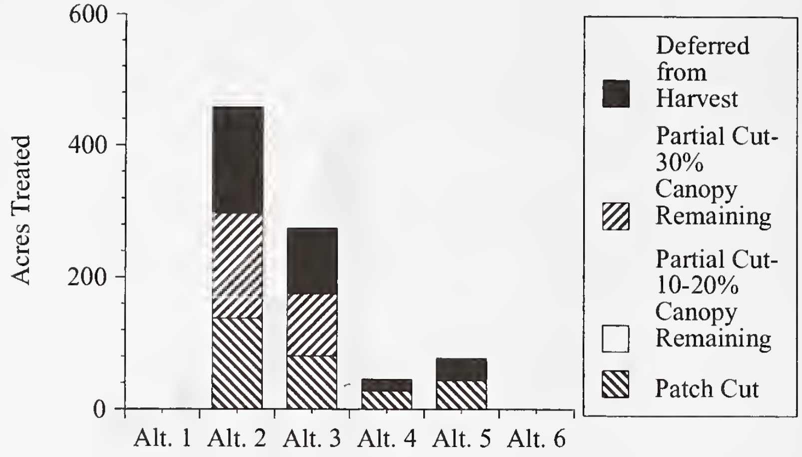
Figure Wildlife-5
Acres of TLMP High Value Marten Habitat Treated in the Sea Level Project Area, by Alternative



Source: Burns 1997. Data derived from GIS database.

One VCU in the Project Area (7560) has over 33 percent of the productive old growth harvested. In this VCU, more partial cuts are used and deferred acres are roughly equal to patch cut acres (Figure Wildlife-6).

Figure Wildlife-6
Acres of TLMP High Value Marten Habitat Treated in VCU 7560, by Alternative



Source: Burns 1997. Data derived from GIS Database.

Road Effects

Martens are easily trapped and can be overharvested, especially where trapping pressure is heavy (Strickland et al. 1982) and not effectively controlled. There is concern that marten densities will decrease (due to their susceptibility to overtrapping) as road densities exceed 0.2 miles of road per square mile, and marten densities will be reduced 90 percent as road densities approach 0.6 miles of road per square mile (Suring et al. 1992). Currently, this is not a concern in the Project Area since none of the roads are connected to Ketchikan. Current road use and marten harvest levels are low. Direct impacts are expected to be minimal due to limited access. For more information on marten harvest level, see the Subsistence Section. For information on the proposed Shelter Cove road connection, see Cumulative Effects later in this section, and the Subsistence Section of Chapter 3.

However, future use of Project Area roads may increase as human populations increase in Southeast Alaska and as some of the road systems are connected to the Ketchikan road system. If this happens in the future, then potential cumulative effects could reduce marten habitat capability by as much as 90 percent since all have open road densities over 0.6 miles per square mile (Table Wildlife-10). This suggests that it may be necessary in the future to close some of roads in the Project Area. The Sea Level Project proposes to block many of the roads, but access by off road vehicles would still be permitted.

Viable populations of marten will be maintained through application of the Viable Population Strategy in the TLMP. For further discussion on viable populations, see the Old Growth and Biodiversity section of Chapter 3.

Table Wildlife-10
Marten Habitat Capability Adjusted for Open Road Density

	Alternative					
	1	2	3	4	5	6
Open Road (miles per square mile)	0.97	0.71	0.69	0.68	0.66	0.66
Adjustment Factor	0.10	0.10	0.10	0.10	0.10	0.10
Adjusted Habitat Capability	16.00	15.30	15.60	15.70	15.80	15.90

Source: Burns 1997.

River Otter
The otter is another species that benefited from measures taken during unit design which limited timber harvest in beach fringe, estuary fringe, stream corridors, and riparian habitat. None of the alternatives are expected to significantly affect otter populations due to implementation of Forest-wide standards and guidelines which protect these habitats.

Red Squirrel
The red squirrel is most successful in old-growth stands. As a worst-case scenario habitat can be expected to be reduced in proportion to the amount of old-growth forest harvested (Table Wildlife-6). Red squirrels represent a species that can survive fairly well in second-growth timber stands at seed-producing age, so actual effects will probably be some-what less.

Hairy Woodpecker
The hairy woodpecker is a primary excavator that prefers high volume, old-growth timber, but can also effectively use lower volume stands. Hairy woodpeckers represent cavity and snag dependent species. Hairy woodpeckers may also benefit from snag retention in clearcuts as a mitigation of timber harvest.

Snag Analysis
The TLMP Final EIS (1997) Standards and Guidelines call for maintaining snags and reserve trees to provide habitat for cavity nesting wildlife species. An analysis was completed for all VCUs within the Project Area to determine if prior harvest has reduced the number of snags below Forest Standards and Guidelines.

This analysis was accomplished by using snag densities for the various plant associations that were sampled during stand examinations of units in the unit pool within the Project area. In the evaluations, only snags greater than ten inches DBH were counted. Areas that had been previously harvested were assumed to have one snag per acre. The maximum number of snags per acre assumed to be usable was eight per acre. It was assumed that more than eight snags per acre were in excess of nesting and courtship needs of the hairy woodpecker, which was the MIS chosen to represent cavity dwellers and users of snags for the Sea Level Project Area. Average snag densities were greater than eight snags/acre for all plant associations.

The analysis indicates that there is an adequate number of snags existing in all VCUs. All VCUs average at least eight snags per acre. Additionally, all planned harvest units below 1,500 feet elevation in the high volume strata will have at least three snags per acre left to meet marten standards and guidelines. Based on this information, snag habitat for hairy woodpeckers and other snag dependant species will be maintained throughout the Project Area.

Brown Creeper

The brown creeper prefers large old-growth trees. Brown creeper habitat can be expected to decline approximately proportional to the amount of old-growth forest harvested by the project. The amount of old-growth forest harvested ranges from none in Alternative 1 to 2,843 in Alternative 2 (Table Wildlife-6). This translates to a 15 percent reduction from 1954 conditions for Alternative 1 and an 18 percent reduction for Alternative 2.

Vancouver Canada Goose

The Vancouver Canada goose nests in forested areas in proximity to open water and preferred food plants. Forest-wide standards and guidelines (TLMP 1997) incorporated into this project protect estuary, beach, stream and lake buffers. Application of these standards and guidelines will protect most goose habitat. None of the alternatives harvest in these habitats. Forest-wide standards and guidelines for waterfowl management include providing a minimum distance of 330 feet between human activities and significant waterfowl areas. This, combined with the beach and estuary buffers, will protect significant waterfowl areas.

Bald Eagle

Scheduling development activities away from beach fringe, estuary fringe, lake buffers, and Class I and II streams will effectively reduce impacts to bald eagle nesting habitat. No decrease in nesting habitat capability is predicted for any alternatives. Management activities within 1/2 mile of an eagle nest site are restricted by an Interagency Agreement between the Forest Service and the U.S. Fish and Wildlife Service (USDA Forest Service and USDI Fish and Wildlife Service 1990). Blasting, usually associated with road building, is prohibited within 0.5 miles of active bald eagle nests during the nesting period. All nests are considered active from March 1 to May 31. Nests are considered active from June 1 to August 31 if nesting adult pairs, eggs, or young eagles are present . The following units in the Sea Level Project are within 1/2 mile of known bald eagle nests.

Table Wildlife-11
Units within 0.5 miles of Bald Eagle Nests in the Sea Level Project Area

	Alternative					
Unit Number	1	2	3	4	5	6
1		x	x	x	x	
5		x	x			
9		x				
24		x			x	
25						
26						
33		x	x			
36		x	x			
43		x	x			
80		x	x	x		
88					x	
94						
113		x	x	x		
118		x	x	x		
119		x	x	x		
120		x	x	x		
142						
165		x				
166		x				
167						
217		x				
218		x				
238		x				
239		x				

Source: Burns 1997. Data derived from GIS database.

The interagency agreement also establishes a 330-foot buffer zone around each nest where disturbance activities are prohibited. None of the alternatives propose harvest within the

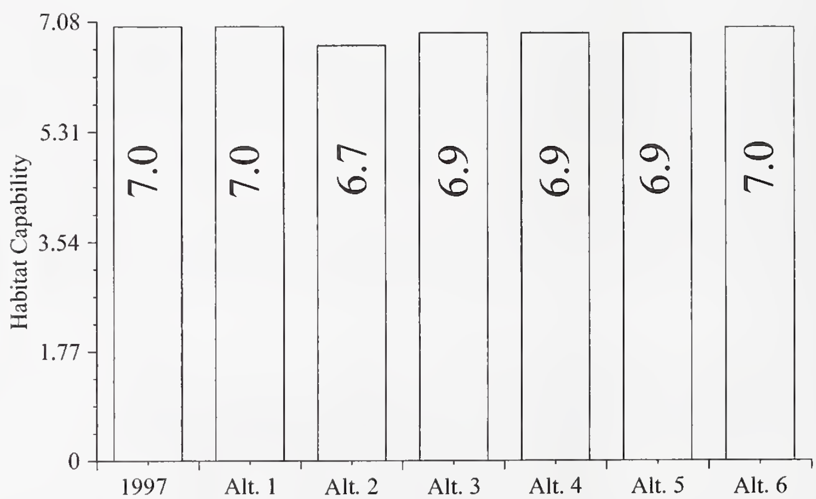
330-foot buffer zone. This is mainly due to the establishment of the 1000-foot beach and estuary buffers.

Alexander Archipelago Wolf

Habitat Capability

The gray wolf habitat capability model runs off the Sitka black-tailed deer habitat capability model, since there are not any significant numbers of moose or mountain goats in the Project Area. None of the action alternatives influence the deer numbers enough to show a significant change from the current wolf habitat capability. Figure Wildlife-7 shows wolf habitat capability resulting from each alternative. The habitat capability does not include the effects of road density, due to the fact that all the road systems are isolated and not connected to any large population centers. The Cumulative Effects section includes a discussion of effects that might be anticipated if project and Ketchikan road systems are connected.

Figure Wildlife-7
Wolf Habitat Capability Following Implementation for Each Alternative



Source: Data derived from GIS database.

Implementing any of the Sea Level Project action alternatives will result in a reduction in deer habitat capability. Wolf habitat capability is predicted to be reduced in proportion to the reduction in deer habitat capability. The wolf habitat capability reduction is predicted to range from 0.1 percent for Alternative 6 to 3.7 percent for Alternative 2 (Table Wildlife-13).

Deer Habitat and Deer Density

This section discusses the relationship between deer habitat, deer population levels, and wolf population levels. Deer are the primary prey species for wolves in WAAs 405 and 406.

Habitat most valuable to deer during the winter period is characterized by low elevation mature forest on south facing slopes. We conducted an analysis on the amount of low elevation (<800 feet) productive old-growth forest (>8,000 MBF/acre) on south facing slopes

(135 degrees to 225 degrees). There are approximately 6,858 acres meeting these criteria within the Sea Level Project Area. This is about 83 percent of that which existed prior to extensive logging. These conditions would be maintained under Alternative 1. Alternative 2 would decrease this valuable deer habitat to about 71 percent of historical (prior to 1954) conditions. Alternatives 3, 4, 5 and 6 would reduce this habitat to about 77, 78, 79 and 82 percent of historical levels, respectively.

WAA 405 contains about 4,081 acres of mature forest below 800 feet elevation on south facing slopes. This is about 93 percent of historical levels. These conditions would be maintained under Alternative 1. Alternative 2 would decrease this valuable deer habitat to about 83 percent of historical (prior to 1954) conditions. Alternatives 3, 4, 5 and 6 would reduce this habitat to about 88, 90, 91 and 93 percent of historical levels, respectively.

WAA 406 contains about 6,657 acres that meet these criteria, which is about 83 percent of historical conditions. These conditions would be maintained under Alternative 1. Alternative 2 would decrease this valuable deer habitat to about 77 percent of historical (prior to 1954) conditions. Alternatives 3, 4, 5 and 6 would reduce this habitat to about 80, 80, 81 and 83 percent of historical levels, respectively.

The stability of deer and wolf populations depends on several factors, including predation by wolves, hunters, and other predators. Some of the most important deteminants are growth rate and stochastic events such as severe winters. Severe winters or reductions in quality deer habitat can result in widely fluctuating wolf and deer populations. If alternate prey is not available or if the reproductive potential of the deer population is reduced because of habitat loss, then recovery from a population crash could take a long time (Person et al. 1996).

Person et al. (1996) estimates approximately 18 deer per square mile are needed to sustain wolf populations (for a high probability of maintaining viable populations). Falling below this level, decreases the probability of maintaining viable populations.

Applying this density to the Sea Level Project Area, about 2,574 deer would be needed to support wolf populations in the Sea Level Project Area. Deer habitat capability is currently about 2,411 deer (17 deer per square mile). This is below what Person et al. (1996) recommends. Alternatives 2 and 3 reduce the deer density to 16 deer per square mile in the Project Area.

Habitat capability for WAA 405 is currently about 1,850 deer (25 deer per square mile), well above that recommended by Person et al. (1996). Deer density is estimated to remain at 25 deer per square mile for all project alternatives. This is a decrease from an estimated 28 deer per square mile in 1954. WAA 405 should retain a high probability of maintaining viable wolf populations.

Habitat capability for WAA 406 is currently about 2,691 deer (13 deer per square mile), well below that recommended by Person et al. (1996). Deer density will remain at about 13 deer per square mile for all alternatives. This is a decrease from about 16 deer per square mile in 1954 (TLMP 1997). This WAA never had high levels of deer habitat capability and is estimated being below 18 deer per square mile prior to major timber harvesting.

WAA 406 shows a lower probability of maintaining viable wolf populations. All of the alternatives, including the no action alternative, show the same estimate for deer density(13 deer per square mile). The resulting 13 deer per square mile includes those acres in old-growth habitat reserves. Therefore, the areas between the reserves probably support somewhat less that 13 deer per square mile. This suggests that WAA 406 may serve as a drain to neighboring deer and wolf producing areas. This also suggests an increased importance of connectivity.

WAA 406 is adjacent to the 2.3 million acre Misty Fjords National Monument. This undeveloped area, along with areas like WAA 405, should serve as a supply source for WAA 406 as long as connectivity corridors are maintained consistent with TLMP (1997). Alternatives 2 and 3 harvest timber in identified connecting corridors. Alternatives 4, 5, and 6 maintain connectivity

Roads

Road construction associated with logging activities has increased road densities. Approximately 158 miles of road exist in the Sea Level Project Area within 146 square miles of land (GIS database). Total road density in the Project Area under existing conditions is approximately 1.08 miles of road per square mile. Some of the roads have been blocked with physical barriers (tank traps or grown over with trees). Assuming all these road blocks are effective, the result is about 142 miles of open, usable road in the Project Area. The resulting open road density is 0.97 miles of road per square mile.

None of the roads are connected to the Ketchikan road system. The road system in the Project Area receives very little use by trappers and hunters. Most new roads and some existing roads would be closed following project completion.

Table Wildlife-12
Road Density for the Sea Level Project Area, by Alternative

	Alternative					
	1	2	3	4	5	6
Total Road (miles per square mile)	1.08	1.48	1.35	1.26	1.24	1.16
Open Road (miles per square mile)	0.97	0.71	0.69	0.68	0.66	0.66

Source: Burns 1997. Data derived from GIS database.

Table Wildlife-12 shows the resulting open road densities for the Project Area for each alternative. All alternatives in the Sea Level Project maintain road densities below 0.7 miles per square mile (TLMP 1997) except Alternative 2. All road systems are not currently connected to the Ketchikan road system which will also limit adverse effects.

However, if road use increases in the future, it may become necessary to close roads to protect wolves form over harvest. Current and proposed road blocks will stop car and truck traffic on the roads, but off-road vehicles may still use some of the roads.

<u>Summary</u>

Based on the above analysis, direct effects from the Sea Level Project are not expected to threaten wolf populations. The TLMP viable population strategy will be maintained through implementation of all alternatives. This strategy will maintain viable populations of wolves throughout the Project Area.

Most effects on wolves in the Project Area are from past activities. Cumulative effects show reductions in the habitat capability model, and the amount of high value deer habitat. Deer density in WAA 406 is 13 deer per square mile, below the 18 deer per square mile recommended by Person et al. (1996) for having a high probability of maintaining viable wolf populations. This suggests that cumulative impacts of past activities and the Sea Level Timber Sale may affect wolves. However, the Sea Level Project will follow the TLMP strategy for maintaining viable wildlife populations. Old-growth reserves and roadless areas in adjacent Misty Fjords National Monument will serve to maintain wolf population viability. Furthermore, many of the roads potentially connected to the Ketchikan road system will be closed. Open road density will be below 0.7 miles of road per square mile (TLMP 1997) for all alternatives except Alternative 2. With these strategies and conditions, the Sea Level Project is not expected to threaten wolf population viability and stability.

Mountain Goat

Mountain goats are concentrated north of the Project Area, near Mount Reid. A few may come south of Swan Lake and reach the north end of the Project Area.

The alternatives in the Sea Level Project mostly avoid areas adjacent to goat habitat. Goats occur only at the north end of the Project Area, near Swan Lake. Alternatives 2 and 5 come the closest to goat populations by including Units 83, 88, 89, and 90. These units are not near the alpine areas where goats would be expected. Based on these conditions, none of the alternatives are expected to significantly affect mountain goat habitat.

Another concern for impacts to mountain goats is hunting pressure from increased access by new road construction. Hunted populations are sensitive to over harvest and human disturbance. Currently, the population on Mount Reid receives limited harvest pressure.

The mainline road along north of Shoal Cove will remain open following project completion. Road access to goat hunting areas will remain at the current condition. Hunters and hikers may still access the high elevation goat habitat by foot, however, the main concentration of goats is still not accessible by road. Based on this information, and the fact that the road system will not be connected to the Ketchikan road system, road effects are expected to be minimal.

Endemic Terrestrial Small Mammals

There is not a high likelyhood that endemic taxa will be affected by the Sea Level Project. MacDonald and Cook (1994) concluded that red-backed voles were ubiquitous with generalized habitat requirements. Also, most of Revillagigedo Island will remain as habitat in old growth habitat reserves, beach and estuary buffers, primitive recreation areas, and Misty Fjords National Monument wilderness. Population viability will be maintained through these designations and other Standards and Guidelines in the Forest Plan. The Sea Levell Project meets the TLMP objective of maintaining habitat to support viable populations of endemic terrestrial mammals.

Comparison of Alternatives: Summary

Table Wildlife-13 summarizes the habitat capability for each MIS in 1997 and 1999. It also includes the percent change from 1997 to 1999.

Table Wildlife-13
Summary of Habitat Capability in the Year 1999 and Percent Change from 1997

		Alt. 1		Alt. 2		Alt. 3		Alt. 4		Alt. 5		Alt. 6	
Species	1997	1999	% Chg	1999	% Chg	1999	% Chg	1999	% Chg	1999	% Chg	1999	% Chg
Sitka black-tailed deer*	2,411.0	2,411.0	0	2,311.0	-4.1	2,350.0	-2.5	2,366.0	-1.9	2,380.0	-1.3	2,400.0	-0.5
black bear**	172.4	172.4	0	171.5	-0.5	171.9	-0.3	172.0	-0.2	172.1	-0.2	172.3	-0.1
marten*	160.0	160.0	0	154.0	-4.2	156.0	-2.5	157.0	-1.9	158.0	-1.3	159.0	-0.6
gray wolf	7.0	7.0	0	6.7	-3.7	6.9	-2.1	6.9	-1.5	6.9	-0.5	7.0	-0.1

Source : Burns 1997. Data derived from GIS data base and interagency habitat capability models.
* Does not incorporate Patch-size Effectiveness calculations (see the Old Growth and Biodiversity section of Chapter 3).
** Does not incorporate road density effects.

Cumulative Effects:

This portion of the analysis (reasonably foreseeable) will focus on effects to the year 2007, which is halfway through the first rotation and the first decade of Forest Plan implementation. Year 2095 is shown to show the effects of the Forest Plan through one rotation (100 years). This analysis displays effects on a WAA basis to show cumulative effects on a larger scale.

Habitat capability was not calculated for State and private lands. This will represent a maximum potential impact, because even if these lands are harvested, they would be providing at least some minimal habitat capability.

Alternative 2 is used to display the reasonably foreseeable future actions, because this is the maximum amount that could be harvested and still meet the requirements of the Forest Plan. Volume not harvested in other action alternatives could be harvested as part of another project by the year 2007.

Table Wildlife-14 shows the cumulative effects on habitat capability for MIS of the reasonably foreseeable actions from 1954 through 2007 and 2095, using Alternative 2 as being equal to the total effects of the reasonably foreseeable actions of all the other alternatives.

Table Wildlife-14 also displays the impacts of harvesting the scheduled acres of the suitable-available forest lands in the next 100-year planning period and assumes all harvested stands are in the closed canopy, second-growth condition.

Table Wildlife-14
Total Cumulative Changes Caused by This and Future Timber Sales, in Habitat Capability for MIS to the Year 2095

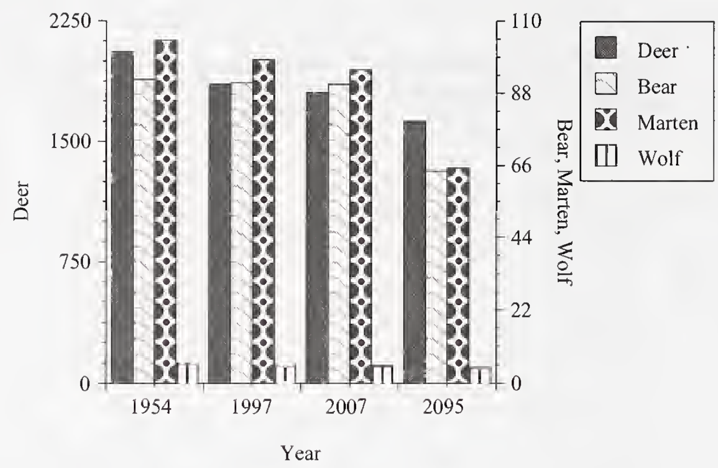
Species	Habitat Capability 1954	Habitat Capability 1997	Habitat Capability 2007 1/	Percent Reduction From 1954	Habitat Capability 2095 2/	Percent Reduction From 1954
WAA 405						
Sitka black-tailed deer 3/	2,056	1,850	1,801	-12	1,623	-21
black bear	92	91	91	-1	64	-30
marten 3/	104	98	95	-9	65	-37
gray wolf	5.9	5.3	5.2	-12	4.7	-21
WAA 406						
Sitka black-tailed deer 3/	3,183	2,691	2,640	-17	2,292	-28
black bear	211	209	209	-1	155	-27
marten 3/	190	174	170	-11	120	-37
gray wolf	9.3	7.8	7.7	-17	6.7	-27

Source: Burns 1996. Data derived from GIS data base and interagency habitat capability models.
1/ Based on Alternative 2, because Alternative 2 is the maximum harvest amount.
2/ Assumes harvest of all suitable-available forest lands identified by the TLMP Final EIS (1997), within the Project Area.
3/ Numbers do not incorporate Patch-size Effectiveness calculations.

Wolf habitat capability changes roughly proportional to deer habitat capability over time. This is to be expected since deer are the main prey item for wolves. Marten show the most change of the four species, followed by bear, then wolves and deer. This is data is illustrated visually in Figures Wildlife-8 and Wildlife-9.

Figure Wildlife-8

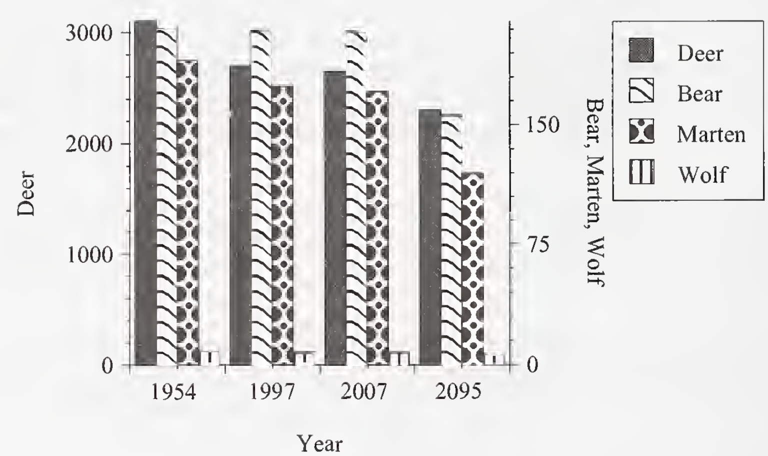
Reasonably Foreseeable and Cumulative Changes in Habitat Capability for Deer, Bear, Marten and Wolf in WAA 405, 1954-2095



Source: Table Wildlife-14. Burns 1997.

Figure Wildlife-9

Reasonably Foreseeable and Cumulative Changes in Habitat Capability for Deer, Bear, Marten and Wolf in WAA 406, 1954-2095



Source: Table Wildlife-14. Burns 1997.

Shelter Cove Road Connection

A road connection between Ketchikan and Shelter Cove is being considered as a separate project. This would allow easy access to the Shelter Cove area by Ketchikan residents. This could affect game species such as deer, bear, marten and wolves.

Hunters from Ketchikan could have a significant impact to these game populations in the Shelter Cove area if a road connection were to occur. We are unable to quantify the effects this would have on game populations. Cumulative effects could be substantial in the Shelter Cove area.

Effects of road densities were discussed earlier in this section as they apply to bear, marten and wolves. These effects would occur in the Shelter Cove portion of the Project Area. Based on these discussions, bear habitat capability in the Shelter Cove area could be reduced an additional 20 percent below predicted levels. Marten habitat capability in the Shelter Cove area could be reduced by 90 percent, as shown in Table Wildlife-10, if trapping levels increase.

To mitigate some of the effects, all existing roads except the mainline roads in the Shelter Cove area would be blocked to car and trucks following project completion. All newly constructed roads would also be blocked to car and truck traffic. Road blocks would consist of physical barriers (tank traps, boulders, etc.) or gated access for administrative purposes, depending on expected future use of the road. Assuming these planned road blocks are successful, they will keep the open-road-density for all alternatives, except Alternative 2, below the 0.7 miles of road per square mile threshold suggested in the TLMP for wolves.

Cultural Resources

Key Terms

Cultural resources—all evidence of past human-related activity, dating from the earliest beginnings to the fairly recent past.
Sensitivity Zone—defined as "high" or "low," based on the probability that they might contain cultural resources.
SHPO—State Historic Preservation Officer.

Affected Environment

Introduction

Cultural resources include all evidence of past human-related activity, dating from the earliest beginnings to the fairly recent past.

The oldest sites located in Southeast Alaska to date are approximately 10,000 years old and are characterized by microblades (small stone blades with sharp cutting edges) and microblade cores (the prepared stone from which blades are removed) (Davis et al. 1989, Davis 1990). These types of tools are thought to be associated with cultures which adapted to a marine resource economy and which were present approximately 10,000 to 5,000 years ago. This technology seems to have been replaced by a ground and polished slate tool industry (Davis et al. 1989, Davis 1990).

The Sea Level Project Area has a unique cultural history, which includes the potential for occupation dating from the Paleomarine-Early Prehistoric Maritime period (10,000 B.C. - 4500 B.C.) through the Northwest Coast Developmental Phase - Late Prehistoric Maritime (4500 B.C. - A.D. 1700) to the protohistoric-historic Tlingit. Prehistorically, extensive use of the rugged terrain in the Project Area is indicated. A number of fish traps, both stone and wood-stake fish weirs, middens, and rock art sites have been identified. Historically, the various traders, miners, fishermen, loggers, subsistence users, and the USDA Forest Service (from 1907 to the present) have had an effect on the area. Historic sites include mines, cabin sites, a fox farm and culturally modified trees.

Many of these cultural remains provide the only record of former human occupation, work areas, and life-styles. Some of these sites may represent cultural traditions associated with early human migration into Alaska, and others may be significant for European exploration and historic economic development. Additionally, some areas may have traditional or spiritual significance for contemporary Native Alaskans. The recovery of information from these sites and objects is important in reconstructing previous human behavior and adaptation in response to environmental or social change and represent an important part of our local, regional, and national cultural heritage.

Ethnohistory

The Sea Level Project Area is included in the traditional homeland of the Tlingit. Immediately prior to the time of European settlement, the Project Area was occupied by two Southern Tlingit groups, the Sanyakwan (also referred to as Saxman or Cape Fox Tribe) and the Tantakwan (also referred to as Tongass or Ketchikan Tribe). The northern half of Revillagigedo (Revilla) Island was also apparently occupied at one time by the Xetlkwan (Foam House People or the Stikine Tribe) who more recently reside in the Wrangell area.

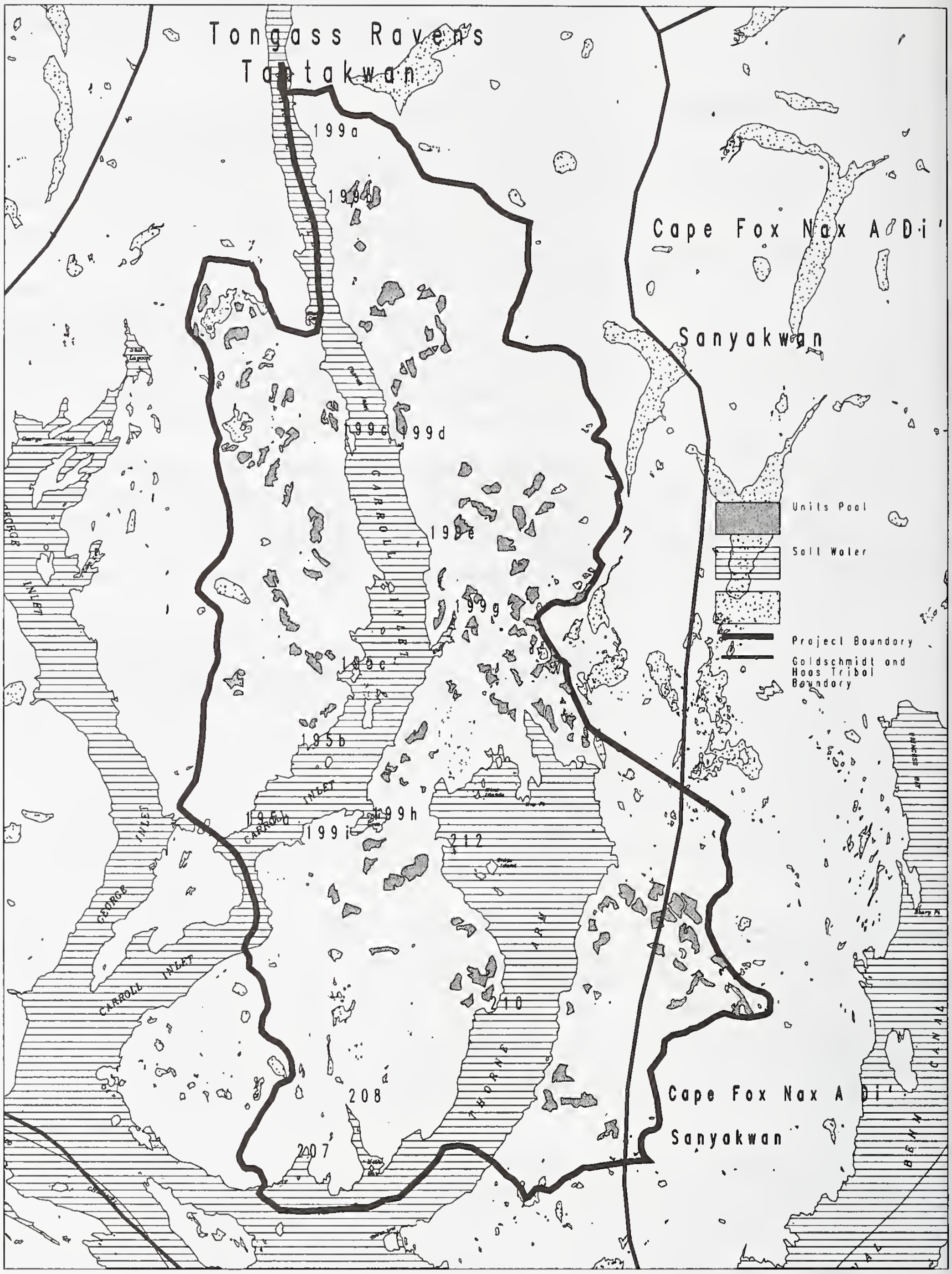
The Stikine are said to have originally settled at the mouth of the Chickamin River. Both the Cape Fox and Tongass tribes have origin stories which suggest population movement from the mainland through the mouth of the Unuk River (on the mainland northeast of Revilla Island), but have had separate histories since that time. The original territory of the Cape Fox Tribe (from north to south) included the southwest portion of the Cleveland Peninsula, the southern half of Revilla Island, and the west coast of the mainland south to the Portland Canal area (Goldschmidt and Haas 1946: 134).

Although the Cape Fox Tribe remained in place on Revilla Island, the Tongass Tribe has a long history of migration. Originally centered on one-third of southern Prince of Wales Island, the Tongass Tribe, as a result of Kaigani Haida encroachment which began around 1720, migrated east. The resulting displacement and competition for resources eventually led to major conflicts between the Tongass and both the Cape Fox and Stikine Tribes in the early part of the nineteenth century. As a result, the Stikine abandoned the area and moved to Wrangell, their territory absorbed by the Cape Fox; the Tongass in the end effectively displaced the Cape Fox from their southern territory and the southwest coast of Revilla Island. By the end of the nineteenth century, however, due to increased Euro-American influence in the area, both groups consolidated and established separate settlements on the southwest coast of Revilla Island — the Tongass at the present day city of Ketchikan, the Cape Fox at Saxman (Arndt, Sackett and Ketz 1987: 85-162).

The historic period in Alaska began with the second Kamchatka Expedition of Vitus Bering in 1741 and developed through various stages of contact with European people and goods. Historic explorations in the Project Area occurred in 1792, with the Jacinto Caamano expedition, and in 1793, when George Vancouver's long boats explored Behm Canal from Port Protection where the British ships Discovery and Chatham were anchored (Mobley 1989; p9).

Figure Cultural-1 displays the areas of the Tongass, Cape Fox, and Stikine tribes in and around the Project Area as depicted by G.T. Emmons in 1888.

Figure Cultural-1
Sea Level Project Area Primary Native Cultures and Tlingit Place Names



Cultural Resources Inventory

In accordance with the National Historic Preservation Act of 1966, as amended, the National Environmental Policy Act (NEPA) of 1969, and a series of implementing regulations and policy direction, the Ketchikan Administrative Area of the Tongass National Forest is undertaking a program to identify, evaluate, preserve, and protect cultural resources as a nonrenewable national heritage. The purpose of the cultural resource investigations is to identify any possible impacts that the proposed activities would have on recorded cultural resources in the area that may be eligible for inclusion in the National Register of Historic Places.

Under a programmatic agreement (PA) with the Advisory Council on Historic Preservation and the Alaska State Historic Preservation Officer (SHPO), the USDA Forest Service, Region 10 has established guidelines that define high and low "sensitivity zones," based on the probability that they might contain cultural resources. Through a review and analysis of existing data, areas of high sensitivity for locating various historic or prehistoric site types have been determined. All areas between zero and 100 feet above sea level, in proximity to known site locations at any elevation, lakes and streams containing salmon species within 100 feet above sea level, areas of limestone or volcanic materials where caves or rock shelters are likely, passes and portages, known previous land use patterns, fossil beaches, mineralized zones where mining activity has occurred, and myth or legend sites are designated high sensitivity zones and require a search of existing data and field investigation. Low sensitivity zones include all other areas over 100 feet above sea level, muskegs, and areas where, because of specific environmental conditions, the probability of the occurrence of cultural resources is so low it is essentially zero.

The analysis process for the cultural resource inventory began with a search of the existing literature to identify any previous work, known cultural sites, and mining properties located within the Project Area and in or near proposed harvest units or road right-of-way. A number of sources were consulted, including the Alaska Heritage Resources Survey (AHRS), the National Register of Historic Places (NRHP), the Forest Service site and survey files, and the Tongass National Forest Cultural Resource Overview (Arndt, Sackett, and Ketz 1987). A literature overview that included ethnohistoric information pertinent to Southeast Alaska Natives and other ethnic groups who have prehistoric or historic ties to the lands within the National Forest was supplemented by public comment and any additional reports submitted to the Forest Service that might pertain to the area presently under consideration. The literature search resulted in the identification of 13 previously documented cultural resources sites.

Archaeological Investigations

Systematic archaeological investigations have been conducted in the Project Area with the majority of the documentation contained in unpublished field notes on file. The following is a summary of investigations performed in the immediate vicinity of the Project Area and the subsequent findings.

- 1978: a pedestrian reconnaissance of Shelter Cove documented one site, KET-015, located within the Project Area.
- 1990: a pedestrian reconnaissance of Shelter Cove located no additional cultural resources.
- 1992: a pedestrian reconnaissance of two timber harvest units for the Shelter Cove Independent Sale which are located within the Project Area located no cultural resources.
- 1994: an intensive pedestrian survey of 17 miles of shoreline in Carroll Inlet.
- 1995: an intensive pedestrian survey of 24 miles of shoreline and 12 harvest units in Thorne Arm.

Table Cultural-1 displays known sites by site type, AHRS site number, relative elevation above sea level, and whether the site is historic or prehistoric.

Table Cultural-1
Sites and Mines Identified within the Project Area

Site Type	AHRS	Elevation	Date
Cabin	KET-011	<100	Historic
Rock Art	KET-019	<100	Prehistoric
Mine	KET-028	<100	Historic
Fish trap	KET-074	<100	Prehistoric
Rock art	KET-075	<100	Prehistoric
Fish trap	KET-079	<100	Prehistoric
Fish trap	KET-091	<100	Prehistoric
Fish trap	KET-107	<100	Prehistoric
Cabin	KET-108	<100	Historic
Canoe run	KET-300	<100	Prehistoric
Rock shelter	KET-302	>300	Prehistoric
Fish camp	KET-306	<100	Historic
Fish traps	KET-349	<100	Prehistoric
Rock art	KET-418	<100	Prehistoric
Midden	KET-422	<100	Prehistoric
Midden	KET-423	<100	Prehistoric
Midden	KET-424	<100	Prehistoric
Midden	KET-426	<100	Prehistoric
Fish trap	KET-427	<100	Prehistoric
Fish trap	KET-428	<100	Prehistoric
Fish trap	KET-436	<100	Prehistoric
Fox Farm	KET-437	<100	Historic
Canoe run	KET-438	<100	Prehistoric
Cabin	KET-439	<100	Historic
Mine	KET-440	>200	Historic
Cabin	KET-441	<200	Historic
Mine	KET-442	<100	Historic
Cabin	KET-443	<100	Historic
Cabin	KET-445	<100	Historic

Note: Total Number of Sites: 29.

Traditional use areas indicated by Tlingit place names (Waterman 1922) along the Project Area's coastline have been identified. While place names do not always indicate the location of archaeological or historical resources (cultural resources), the place names suggest use and familiarity with geographic location and association with legends. All of these associations have varying degrees of potential for locating cultural resources. Tlingit place names in the Project Area as identified by Waterman are shown in Table Cultural-2 and are located in the Figure Cultural-1.

Table Cultural-2
Tlingit Place Names for the Sea Level Project Area

No.	Waterman Name	Location	Waterman comment
199a	Gil'i Shaakhu	Shoal Cove, Carroll Inlet	Little Mountain Cliff
199b	T'ahèeni	North of Licking Creek	King Salmon Stream
199c	Tsàa Eeji	Rock opposite Marble Creek	Seal Creek
199d	Yakw Tak' x' àas	Creek at Shoal Camp	Falls alongside Canoe
199e	Se Yadi	Shoal Cove	Baby of Yakw tExtEx'a'
199g	Gut'te	Near Shoal Cove	Rock
195c	Tat tóok Xh'ay èc Héen	Bay West of Osten Island	Stream Below Entrance
195b	Ch'èixh' Nòowk'u	Bay near Hume Island	Thimbleberry, small for
199h	Dèishu Ghèeyak'w	End of Tramway Cove	Cove at end of portage
195a	S'in[y]axéen	Carroll Inlet, opposite side	Celery tree
199i	Ooxjàa Héen	Gnat Cove, Spit Point	Wind Stream
212	Tàakw.àank'i	Near Snipe Island	Little Winter Village
210	Naandaat	Eve Point	Floating fort
208	Kalsakhsk'i	Moth Cove	Yew wood Bay
207	Shàaw Datéen	Cena Cove, west of Thorne	Gumboots

Source: Waterman 1922.
Note: Assistance in modern spelling from Tongass Tribe and Esther Shea, July 1993.

Survey Strategy in the Sea Level Project Area

The Sea Level Inventory strategy involved sampling of the Project Area based on surveys that included all of the proposed project activity areas within the high sensitivity zone, additional areas where traditional subsistence activities and/or other cultural activities/sites were likely to occur, and a sample of timber harvest units in the low sensitivity zone. Specific areas included: inter-tidal areas, beach fringes, riparian zones, resource procurement areas, uplifted fossil beaches, passes or portages, myth and legend sites, karst topography and mineralized zones. A variety of other characteristics were also considered in designing where the surveys were to be conducted, such as eustacy (changes in sea level) and isostasy (rebounding of the earth's crust since deglaciation), and landform configurations. Due to elevation and sea level changes after deglaciation, the location of the earliest areas of human activity may be further inland and at higher elevations than subsequent human activity areas. The environmental characteristics that invited human use and habitation in prehistoric and historic times are often the same factors which invite use today.

Survey consisted of systematic pedestrian inspection of an area, subsurface examination through inspection of root wads, cut banks, or other natural exposures, and intensive soil probe testing. An inventory was prepared of culturally modified trees in the survey areas. This strategy resulted in maximum survey coverage in the areas of highest sensitivity for cultural resources.

There are no proposed timber harvest units located within the high sensitivity zone under any of the action alternatives.

Results of Cultural Survey

Intensive cultural resource survey in the Project Area in 1994 and 1995 included approximately 1,425 acres. These surveys identified and documented 16 previously undiscovered cultural resource sites in addition to 13 cultural resource sites previously documented. The results of the survey of Waterman Native Place Name locations (see Table Cultural-2, earlier in this section) indicates that many of these sites were probably locational names only. At a number of these identified locations, previous disturbance was noted that would in effect have eliminated intact cultural resource remains had they existed. The results of these investigations have been formalized in clearance report documentation and forwarded to the SHPO for review as required by the National Historic Preservation Act and 36 CFR 800. Additional intensive survey efforts, documentation, and SHPO review will be required should proposed activity areas be changed through project redesign, the acquisition of additional pertinent information, or as a result of SHPO comment prior to project implementation.

The information gathered from the data search and literature overview and intensive archaeological investigations provided information about resource distribution, sensitivity to damage, and management of the resource. This work provided sufficient information with which to make informed decisions about the potential effects to significant cultural resource sites within the Project Area.

Specific locational information is protected to prevent vandalism or unauthorized use of these sites.

Effects of the Alternatives

Direct and Indirect Effects

Types of Potential Impacts

The preservation and protection of cultural resources are closely associated with the location of the resources, the nature of the management activity, and the environmental characteristics where management activities occur. Impacts to the resource may occur from natural forces, from public access, or from project-related activities. Erosion and other environmental effects may also lead to deterioration of cultural resource sites.

Timber harvest activities include the construction and reconstruction of roads, which can lead to an increase in opportunities for public use of cultural resources in the Project Area. Such increased use may enhance understanding of the past—capturing knowledge and information that can disappear over time due to natural decay—and may provide opportunities for interpretation and education. However, public use can destroy cultural resource sites through inadvertent damage caused by compaction or other ground disturbing activities. Vandalism—including relic collecting, defacement, and theft—results in the loss of information and the destruction of the resource. Protection of significant cultural resource sites from inappropriate public use includes the establishment of public education programs, maintaining confidentiality about specific site locations, monitoring, and directing the public away from the most vulnerable sites.

Specific Sea Level Potential Impacts

Alternatives 1 through 6 will result in no effects on cultural resources from the proposed activities, because of avoidance and the continued use of management recommendations.

Cultural resource sites associated with proposed activities have been evaluated for significance through established criteria in 36 CFR 800. Cultural resource sites KET-437, KET-439, KET-440, KET-441, KET-442, KET-443, and KET-445 have been determined to be "Not Eligible" for the National Register of Historic Places, in consultation with the SHPO. KET-015 is located in close proximity to the LTF at Shelter Cove. Current restrictions on the operation of the LTF to avoid the site area and monitoring of the site will continue. No timber harvest or road construction is planned within the proximity of any of the significant sites under any of the proposed alternatives. SHPO has concurred that there will be no effect to significant cultural resources from activities proposed for the Sea Level EIS.

Table Cultural-3 depicts the proposed harvest activity by alternative within the tribal areas as described by G.T. Emmons. Table Cultural-4 depicts prior harvest activity within the tribal areas.

Table Cultural-3
Proposed Harvest Activity within Tribal Areas, as Described by Emmons (Acres)

	Alternative				
Tlingit Tribal Group	**2**	**3**	**4**	**5**	**6**
Sanyakwaan	533	92	0	0	0
Tantakwaan	3,640	2,339	1,762	1,262	479

Source: Autrey 1997.

Table Cultural-4
Prior Harvest Activity within Tribal Areas, as Described by Emmons

Tlingit Tribal Group	Percent of Base	Acres
Sanyakwaan	4.69	0
Tantakwaan	95.31	13,670

Source: Autrey 1997.

Cumulative Effects

Impacts from natural decay, landscape changes, private developments, and timber management activities collectively result in the loss of the cultural resources in Southeast Alaska. Development activities of all kinds pose particular threats to cultural resources as such activities tend to be located in the same areas that cultural resources are found, such as sheltered coastal settings.

It is impossible to determine the exact nature of resources that may have been previously disturbed in the Project Area. Intensive cultural resource investigations and mitigation measures have been implemented only since the 1980s. Current research and survey designs are based upon the results of previous work and modern methodology and technology. When combined with various mitigation measures, they will preserve significant sites and provide data that will guide future research and resource management.

Land Adjustments, Uses and Permits

Key Terms

Alaska Native Claims Settlement Act (ANCSA)—provides for the settlement of certain land claims of Alaska natives.
Encumbrance—a claim, lien, charge, or liability attached to and binding real property.
Native selection—application by Native corporations to the USDI Bureau of Land Management for conveyance of a portion of lands withdrawn under ANCSA in fulfillment of Native entitlements established under ANCSA.
Special use permits—permits and granting of easements (excluding road permits and highway easements) authorizing the occupancy and use of land.
State selection—application by Alaska Department of Natural Resources to the USDI Bureau of Land Management for conveyance of a portion of the 400,000-acre State entitlement from vacant and unappropriated National Forest System lands in Alaska, under the Alaska Statehood Act.

Affected Environment

Land Status

Prior to 1971, the Tongass National Forest, Ketchikan Administrative Area land ownership pattern had not changed significantly, with only minor changes taking place as National Forest System lands were transferred to private home sites, canneries, and townsites. Beginning in the early 1970s, land ownership changes were made as a result of legislation, including the Alaska Native Claims Settlement Act (ANCSA) and the Alaska National Interests Land Conservation Act (ANILCA). Within the Sea Level Project Area there are lands being used under special use permits.

State Selections

The State of Alaska, under the Statehood Act of 1959, is entitled to select up to 400,000 acres from the National Forests in Alaska. As of November, 1997, 100 percent of the entitlement in the Project Area has been conveyed. Most of the remaining acres have been selected and are in the process of being conveyed by the Bureau of Land Management. Because the State of Alaska was granted the opportunity to select more lands than they were entitled to receive conveyance, some of these lands may become available for National Forest management in the future.

Private Land

There is 3,182 acres of private land within the Project Area.

Native Selections

Native selections are authorized under 14(h)(8) of ANCSA. On a large portion of the Project Area, approximately 15,200 acres, subsurface (mineral) rights have been encumbered by Sealaska Native Corporation selection. Title to these subsurface rights have not yet been conveyed, and constitutes an over-selection by Sealaska Corporation.

Special Use Permits

A special use permit has been issued by the Forest Service for specific exclusive uses in the North Saddle Lakes watershed on National Forest System lands. These lands, totalling 920 acres, are under special use permit to the Alaska Energy Authority (AEA) and include those facilities operated by the Ketchikan Public Utilities for the power transmission line from the

Swan Lake hydropower site. The U.S. Coast Guard operates a LORAN site at Shoal Cove on National Forest System lands under a Memorandum of Understanding (MOU) with the Forest.

Table Land Adjustments-1 summarizes the special use permit sites in the Sea Level Project Area.

Table Land Adjustments-1
Summary of Special Use Permit Sites

Name of Permittee	Special Use
AEA*	Power transmission line, 920 acres
U.S. Coast Guard	LORAN site, 55 acres

*Alaska Energy Authority

Mining Claims

There are no known mining claims for locatable minerals within the Sea Level Project Area. For further information see Geology, Minerals and Cave Resources section of this chapter.

Effects of the Alternatives

Alternatives 2, 3, 4, 5 and 6 will not directly affect the status of existing special use permits or mining claims. Alternatives 2, 3, 4, 5 and 6 may require the issuance of new special use permits for logging camp and log sort-yard developments at the Shelter Cove, Shoal Cove and Elf Point LTFs. Alternatives 2, 3, 4, 5 and 6 include timber harvests and road construction on lands encumbered by Sealaska Native Corporation subsurface rights selections. Alternative 2 includes 18 MMBF of timber harvested on about 421 acres of encumbered Forest land. Alternatives 3, 4 and 5 would harvest 6 MMBF of timber on about 328 acres of encumbered land. Alternative 6 harvests 6 MMBF of timber from 290 acres of encumbered National Forest system lands.

Permits and Easements

Alternatives 2, 3, 4 and 5 propose locating timber harvest units or constructing roads near the Misty Fiords National Monument boundary, which would require updated land line surveys. Future conveyance of the Native selections in the Project Area will require the Forest Service to reserve a transportation right-of-way along the existing and proposed road alignments on the selected lands.

Marine Environment, Log Transfer Sites and Related Facilities

Key Terms

A-frame LTF—log transfer facility system which consists of a stationary mast with a falling boom for lifting logs from trucks to water. This system is generally located on a shot-rock embankment with a vertical bulkhead to access deep water, accommodating operations at all tidal periods.
Embankment—rock fill material ranging in size from 1 cubic meter on down to 1cubic millimeter.
Log transfer facility (LTF)—a facility that is used for transferring commercially harvested logs to and from a vessel or log raft.
Marine benthic habitat—the area occupied by the aggregate of organisms living at or on the bottom of ocean water.
Specified roads—constructed to remain a part of the permanent transportation system.

Affected Environment

Marine Environment

Southeast Alaska's coastline consists of approximately 30,000 miles of tidal shoreline; roughly 60 percent of the total Alaskan coast. Within this region a great diversity of habitats comprise Southeast Alaska's complex estuary and tidal environments.

The intertidal and subtidal marine environments are subject to effects from log transfer and storage facilities; those are the points of concentrated activity associated with the marine transportation of logs. The preferred sites for log transfer facilities (LTFs), log storage areas, camp settlements, and anchorages are deep bays or along straits or channels. These areas are preferred because the deeper water and stronger currents flush out bark and debris that may enter the water, therefore less impact to effects on marine life. Other marine areas are not addressed here because they are not expected to be affected by activities associated with the timber harvest of this project.

The shallow marine waters and associated mud flats and estuaries found in the protected coves and bays provide habitat for some important species such as Dungeness crab and juvenile salmon. They are part of a complex and dynamic ecosystem that also includes shrimp, flatfish, marine worms, echinoderms, sponges, sea anemones, shellfish, plankton, marine algae, and other organisms.

Log Transfer Facilities (LTFs)

The transportation of harvested timber on the Project Area requires that the logs must be trucked or flown to the ocean, transferred to the water (or barges) at a LTF and towed to a sort yard for sorting. They are then moved to processing sites such as the saw mill at Ward Cove or the sawmill at Metlakatla.

There are three existing LTFs within the Project Area that were constructed between 1960 and 1990. Log Transfer Facility from the 1960s were modified to meet the current State and Federal permit requirements as part of other activities requiring National Environmental Policy Act (NEPA) documentation. All LTFs are owned by the Forest Service and are permitted. There are no new sites proposed for this project; only the existing sites will be utilized.

Table Marine-1 displays the existing LTF locations and the decade of construction.

Table Marine-1
Existing LTFs Associated with the Project Area

					Decade of Construction		
Location	**Number**	**Latitude**	**Longitude**	**Active**	**1960s**	**1980s**	**1990s**
Shelter Cove	1	55 33 25 N	131 21 00 W	Yes			x
Shoal Cove	2	55 27 25 N	131 17 20 W	Yes	x		
Elf Point	3	55 19 10 N	131 13 30 W	Yes		x	

Source: Oien 1998.

Log Transfer Methods

Two log transfer methods are considered in this analysis: (1) A-Frame type entry device with rafting facilities (see Key Terms) and (2) a dry land to barge transfer facility.

A-frame

A modified version of this method uses a stationary A-frame boom with sloping guide rails placed on the bulkhead to guide the logs to deep water at lower tidal levels. Both A-frame systems allow controlled entry of logs into the water.

Land-to-Barge

The land-to-barge transfer system requires a deep water bulkhead for the barge mooring facility. A minimum of 25 feet of water at low tide is required for barge operations. Logs are loaded directly onto the barge by use of a loader. Barges can also load logs floating in the water with on-board cranes. Most of the sites in the Project Area will be handling small volumes of timber. Because of high operating costs and the impacts of rebuilding the existing LTFs to accept barges, land-to-barge operations were not considered in the analysis of existing LTF's.

Each LTF requires a log transfer area, operations area, a small airplane and boat dock, an equipment off-loading ramp, and a log raft storage area. The existing sortyard areas at the Shelter Cove and Elf Point LTFs must be expanded in order to accommodate multiple operators that may be using the facility. These facilities are generally located within close proximity to the LTF in order to reduce costs and retain impacts to a localized area.

Logging Camps

The Sea Level Project Area has suitable upland areas for land camps. These areas have been established for a number of years and may be used again for this project. The area also contains some protected bays and coves, suitable for float camps.

Float Camps

The number and locations of float camp sites will depend upon the number of logging and road construction contractors engaged in implementing the project. Historical sites are expected to be used. Additionally, camp configuration and type (such as barge or log floats) will influence the location. The operator shall obtain required state and federal permits for camps. A need for sites other than those presently permitted is not expected.

Land Camps
Some previously used land-based camp sites are expected to be utilized. As with float camps, camp configuration will influence the location.

The contractor/operator will be responsible for obtaining appropriate permits for camps in areas other than those already permitted. Solid waste disposal will not be allowed on National Forest land.

Effects of the Alternatives

Log Transfer Facilities

The number of existing LTFs required to harvest the timber scheduled in the action alternatives varies. Table Marine-2 displays the LTFs required for each alternative. No new LTF's are proposed for this project.

Table Marine-2
LTFs Required for the Alternatives

	Alternative				
	2	3	4	5	6
LTFs	3	3	3	2	1

Source: Oien 1998.

LTFs comply with the Alaska Timber Task Force Siting Guidelines and section 404(B)(1) of the Clean Water Act to mitigate the effects of LTFs on other resources and ecosystems.

Selection Rationale
An inactive LTF at Snipe Point was considered for use on the Project Area. It was dropped from consideration because the cost of reconstruction was higher than the cost of hauling timber to the existing LTF at Shoal Cove.

Types
Log Transfer Facilities can be either low-angle ramps or bulkhead type structures used for transferring logs from trucks to saltwater.

The existing permitted facilities considered in this analysis are bulkhead facilities with a lift-off system and/or barge system. The lift-off system may be either a single or double A-frame. Bulkhead construction ranges in direct impact to the intertidal area from 0.1 acres to 0.25 acres.

Table Marine-3 displays the reconstruction costs associated with each LTF; however it should be noted that these sites were reconstructed during previous silvicultural activities and site development cost is for anticipated maintenance.

Another form of log transfer from land to water is aerial transport of logs from the harvest area directly to water or a barge. This method eliminates the need for truck haul and road development. However, this system is economically prohibitive except in specific situations. None of the alternatives propose helicopter to barge-water operations.

Table Marine-3
Reconstruction Costs Associated with Proposed LTFs

LTF	Number	Transfer Method	Transfer Equipment Cost*	Site Development Cost
Shelter Cove	1	A-Frame	200,000	10,000
Shoal Cove	2	A-Frame	200,000	10,000
Elf Point	3	Barge	0	80,000

Source: Oien 1998.
* Transfer equipment costs are not included in cost of transportation system development costs.

Marine Benthic Habitat

During the transfer of logs from land to water, bark is sloughed off and may be deposited on the ocean bottom; bark also is continually sloughed off, while the logs are in rafts, by agitation from wind and waves. If the bark accumulates on the bottom, it can diminish habitat for bottom-dwelling crustaceans and molluscs, as well as hamper underwater vegetation used as food and rearing sites for fish and other organisms. All LTFs in the Project Area have been designed to maximize the flushing of suspended bark away from the LTF area to the open sea before it can accumulate on the bottom. In 1985, it was determined that discharge of bark into the water at an LTF was a discharge requiring a National Pollution Discharge Elimination System (NPDES) permit.

Marine benthic habitat impacts are expected to be as follows:

Structural Embankment:	estimated 0.23 acres affected per site
Site Bark Deposition:	1.0 acre zone of deposition per site
Raft Storage Bark Deposition:	unknown

Impacts are displayed in Table Marine-4.

Table Marine-4
Estimated Marine Benthic Impacts (Acres)

	Alternative					
	1	2	3	4	5	6
Effected by Structural Embankment	0	1.38	1.38	1.38	0.92	0.46
Effected by Bark	0	2.00	2.00	2.00	2.00	2.00

Source: Oien 1998.

Structural Embankment

All LTF types occupy approximately the same amount of bottom area but in different configurations. For instance, the low-angle ramp system with a 10 percent grade extends approximately 250 feet out into the water on a moderately sloped beach. This system is thus long and narrow. The barge and A-frame systems use more shoreline and do not protrude out into the water as much as the low angle ramp system.

Site Bark Deposition

Two publications describe some of the general effects of LTFs and log storage on the marine benthic habitat. Sedell and Duval (1985) summarize the information available on the effects log transport and storage have on marine resources and fisheries. Faris and Vaughn (1985) examined log transportation and log storage in Southeast Alaska.

Shultz and Berg (1976) examined 32 existing LTF sites and found that 19 had bark accumulation, 8 had no bark accumulation, and 5 had traces of bark. The extent of bark accumulation ranged from 0 to 9 acres for 31 of the 32 sites. The 32nd site had an accumulation of 182 acres that could not solely be attributed to log transfer activities. Faris and Vaughn (1985) reexamined the original data from Shultz and Berg (1976) and found that the average accumulation size was 1.96 acres for all sites excluding the 182-acre site. They speculate that bark and debris accumulation may be decreasing over time due to currents. No estimate was made on the length of time before bark accumulation was completely eliminated.

Faris and Vaughn (1985) also examined the extent of total damage to the marine benthic habitat in Southeast Alaska. Their results indicate that from the 90 currently permitted sites, a total of 176 acres would be affected (using the 1.96 acre average). This is .02 percent of the total estuarine area that is less than 60 feet deep in all of Southeast Alaska. Moreover, when they examined all of the potential area of bark and debris accumulation from all permitted and proposed sites in Southeast Alaska, including all sites considered in the KPC Long-term Sale 1989-1994 EIS, they found that a total of 317 acres would be affected. This is 0.09 percent of the total estuarine area that is less than 60 feet deep. This result corresponds with the conclusions of Sedell and Duval (1985) that the evidence of damage on important marine populations (bivalves, crabs and salmonids) was inconclusive because of the small area of impact. This evidence resulted in development of the current siting guidelines (e.g., avoiding crab habitat, shallow areas at the heads of bay, etc.) and suggests impacts would be minimal.

The major effect of bark and debris accumulation is on little neck clams and bay mussels which are eliminated when as little as 4 to 5 inches (10-13 cm) of bark accumulates (Freese and O'Clair 1987). Furthermore, Conlan and Ellis (1979) reported molluscs and several polychaetes were eliminated by bark debris thicker than 2.5 cm, and that effects of bark may last several decades. From this evidence, it can be assumed that other plants and animals which live in and on the bottom would probably be at similar risk.

Concentrations of chemical leachates from bark have been shown to be toxic to salmon fry, crabs, and clams. However, these toxic substances can settle in saltwater therefore do not appear to be a major problem in open water where good circulation exists (Sedell and Duval 1985). The Alaska Timber Task Force Siting Guidelines for LTFs attempts to mitigate the potential effects of bark dispersal and toxicity by: (1) locating LTFs in areas having the least productive inter-tidal and sub-tidal zones, (2) avoiding sensitive habitats, (3) avoiding shallow water, and (4) providing that LTFs should be located along or adjacent to straits, channels, or deep bays where currents are strong enough to disperse sunken or floating wood debris. Currently, all active LTFs receive a yearly underwater diving and sampling transect as required by the Environmental Protection Agency.

Certain dissolved substances (hydrogen sulfide and ammonia) recently have been shown to occur in open spaces between pieces of bark accumulated on the bottom (O'Clair and Freese

1988). O'Clair and Freese also note that it is not clear whether other toxic substances not measured in the study occur within bark accumulations. These substances do not enter the water above the bark. However, if Dungeness crabs burrow into the bark deposit, it has been demonstrated that their reproductive ability, eating habits, and overall survival can be affected. It should be noted that this type of effect has been demonstrated in only one bark accumulation field (Rowan Bay LTF, Kuiu Island, Southeast Alaska) and that, in general, Dungeness crabs were not found in bark accumulations at a number of other LTF locations. It is not known whether these effects would occur for other burrowing crab species. Since king crabs do not burrow, it is not clear whether this species is affected by bark and debris accumulation at LTF sites.

Raft Storage Bark Deposition

The other potential effects associated with LTFs are from log rafts and log storage in saltwater. The area under a log raft may be affected by bark accumulations with effects similar to but not as concentrated as those discussed for LTFs. In addition, if the raft is stored in a bay or cove for a long period of time, marine algae may be affected by shading. Occasionally, rafts stored in shallow depths may ground on the bottom. This would cause mechanical disruption or compaction of inter- and subtidal bottom habitats. This would be a short-duration effect because recolonization would begin shortly after the raft refloated, unless the site were repeatedly used and log rafts frequently grounded. Proposed and existing log storage areas in the Project Area are deep enough and are not expected to ground.

Barge LTFs

Barge LTFs probably would have less effect on the marine environment than rafting LTFs, although no studies are available for comparison. The rock bulkhead associated with the facility would be longer and slightly wider at the seaward end. The additional length and width would impact less intertidal area than a rafting LTF bulkhead. The longer length and wider seaward end in deeper water would require dredging and filling in the subtidal area. Bark and debris would accumulate only in a small area around the extreme seaward end of the facility.

Helicopter to Log Boom or Barge LTF

Helicopter to a log boom or barge LTF would probably have less effect on the marine environment. Helicopter to log boom would have more impact than to a barge. However, the log boom can also be located in deep water to avoid bark deposition and embankment in the higher-value shallow areas. Helicopter to barge would minimize bark deposition and eliminate embankment in the marine environment.

Fisheries

The effects of LTFs on fisheries resources have not been quantified. It is unlikely that any effects on returning anadromous fish would occur unless a LTF and raft storage area caused blockage of a stream entrance. Juvenile pink and chum salmon that spend several months, immediately after out-migration, in protected bays and coves would be more likely to be affected by log-transfer activities. These small fish are highly mobile as they feed on marine invertebrates. Some of their preferred food items live on the bottom surface. Bark accumulation and the area under the embankment of a standard bulkhead eliminates a small portion of the habitat of those food items but is unlikely to cause measurable adverse consequences.

It has been hypothesized that the breakwater usually associated with a LTF structure, regardless of whether a raft or barge, can cause greater mortality of pink and chum juveniles because they are forced to move into deeper water where more predators consume them. It is not known whether this is a major source of mortality in addition to the naturally low survival rate attributed to early marine life stage of juvenile pink and chum salmon. Because barge LTFs require longer breakwaters, the probability of this effect may be increased.

There is no formal documentation that LTF structures or activities associated with their use, conflict with commercial fishing near the facility. If a facility were located in a small bay or cove, it is possible that there could be some difficulty maneuvering around log rafts or moored barges to get to favored fishing sites. No adverse consequences on commercial fishing or subsistence uses or marine resources are anticipated as the result of LTF location.

Camps associated with a LTF site can cause additional use of fisheries and marine sources. There is no data currently available on the amount of additional use occurring at various camp locations in the study area. The competition for resources at or near logging camp locations would probably increase. There is currently little or no information to indicate that resource allocation problems have occurred as the result of a logging camp. The Board of Fisheries and Game (Alaska Department of Fish and Game) can control the amount of harvest by setting bag limits, shortening season lengths, or by instituting a complete closure of a fishery. If resource problems arise because of increased resource pressure due to a logging camp, the Forest Service would aid the Alaska Department of Fish and Game in attempting to resolve the problem. However, it is unlikely that utilization would progress far enough to cause adverse consequences on the fisheries or marine resources.

Wildlife

From a wildlife perspective, there are two types of effects associated with a LTF and camp. First, there is the potential loss of habitat due to clearing for the camp, sort yard, and associated facilities. The amount of habitat lost is relatively minor. Whenever possible, camps and sort yard facilities are located away from the highest quality habitat. The differences between a slide facility and barge facility are inconsequential. The objectives are to avoid eagle nest sites and estuarine habitat. The second type of effect is, disturbance as a result of increased human activity associated with the camp. The overall effects of disturbance of wildlife-use patterns are generally minor. Most wildlife species adapt to increased human activity but will be effected by increased hunting, and increased bear-human encounters.

An increase in the number of people in an area would generally increase the harvest levels however they can be monitored and regulated. The influx of additional people into an area appears to have a greater potential to affect the existing users of the area than wildlife populations.

For additional information on the effects of the proposed alternatives on existing users, see the ANILCA, Section 810, Subsistence Evaluation and Finding in the Subsistence section of this chapter.

Visual Resources

The large size, linear bold shape, and saltwater location of LTFs generally dominate the landscape when viewed within the foreground distance (less than ¼ mile). Their relatively low profile, however, helps mitigate the negative visual impacts when viewed from the middleground (¼ mile to 5 miles). Because the sort yards and land camps are located on level or gently sloping grounds, as opposed to steeper hillslopes, there is less visual impact from a saltwater viewpoint.

There are no new sort yard areas or camp areas considered in any of the alternatives for this Project Area. It is expected that most camps will be floating. Accordingly, upland development will consist of structures such as maintenance shops and fuel storage tanks. These facilities will have minimal permanent visual resource impact.

Long-term Productivity

The short-term effects of developing LTFs in the intertidal area can be compared to the value of long-term accessibility for timber management in the area. Without a way of transferring logs into saltwater, the long-term opportunity to manage the uplands for commercial timber is lost. If LTFs were not approved by permitting agencies, the volume accessible by those facilities would not be available to meet Forest Plan direction.

It is assumed that other resources would have similar management opportunities with or without access to the uplands from saltwater (by an LTF). Table Marine-5 compares the number of acres potentially affected by each LTF to the number of acres of suitable timber harvest for each location.

Short-term use of 4.14 acres of estuarine habitat, all of which occurs in large estuaries, would provide access to 91,000 acres of land suitable for timber production. This roughly equates to 88 million board feet to be available to meet goals set by the Ketchikan Area timber sale program.

Table Marine-5
Comparison of Short-term Impact on the Estuarine System to Long-term Harvest (Year 2000 to 2004)

LTF	Value Comparison Units Served by LTF	Estimated Acres of Impact on the Estuarine System	Acres of Potential Harvest
Shelter Cove	737	1.38	38,000
Shoal Cove	746	1.38	37,400
Elf Point	744, 737	1.38	16,400
Total	**N/A**	**4.14**	**91,000**

Source: Oien 1998.

Other Environmental Considerations

Probable Adverse Environmental Effects that Cannot be Avoided

Implementation of any action alternative would result in some adverse environmental effects that cannot be effectively mitigated or avoided if the proposed action is to take place. The interdisciplinary procedure used to identify specific harvest units and roads was designed to eliminate or lessen the significant adverse consequences. In addition, the application of standards and guidelines, BMPs, mitigation measures, and a monitoring plan are intended to further limit the extent, severity, and duration of these effects. The specific environmental effects of the alternatives were discussed earlier in this chapter, and mitigation measures are described in Chapter 2. Although the formulation of alternatives included avoidance of potentially adverse environmental effects, some adverse impacts to the environment which cannot be completely mitigated may occur.

Although standards and guidelines, BMPs, and monitoring plans are designed to prevent significant adverse effects to soil and water, the potential for adverse impacts does exist. Sediment production would occur as long as roads are being built and timber is harvested. Sediment would be produced by surface erosion, channel erosion, and mass movement.

Disturbance, displacement, or loss of fish and wildlife may occur as a consequence of habitat loss and increased human activity in the Project Area. New road construction and the human activities associated with new access to areas previously unroaded would result in impacts to fish and wildlife. Improved access into areas that previously had limited roads would have similar effects.

Ground-disturbing activities could temporarily increase sediment loads in some streams. This could displace fish, reduce anadromous and resident fish reproductive success, and alter aquatic invertebrate populations. The portion of a stream bed occupied by a culvert or other crossing structure would be lost as fish habitat.

Both the amount and distribution of mature and old-growth stands would be reduced through implementation of any action alternative. The rate and severity of adverse impacts varies by alternative. Because some wildlife species rely on habitat conditions provided by old-growth stands, the reduction in the populations of some wildlife species can be expected. As old-growth and mature timber stands are converted to young even-aged stands, the capability of the Project Area to provide optimal habitat for old-growth dependent species would be reduced.

Timber harvest and road construction in areas that are currently unroaded would alter natural characteristics of these areas. This would modify the recreational experiences that are offered by these areas. Both Primitive and Semi-Primitive recreation opportunities will be lost by these actions. In addition, these development activities would result in a loss of opportunity to consider these areas in future revisions of the Forest Plan for designation as wilderness, as roadless areas, research natural areas, or for other purposes requiring natural characteristics.

The natural landscape would appear visually altered by timber harvest, roads, and structures particularly where logging activity is visible from travel routes and use areas. These adverse effects would eventually be mitigated by natural regrowth of vegetation. Other impacts on the natural appearance of the landscape include roads and structures which are highly visible despite efforts to blend them with landforms and mitigate the effect by landscaping.

The intensity and duration of these effects depends on the alternative and the mitigation measures applied to protect the resources. Most unavoidable effects are expected to be short term (usually less than 2 to 5 years). In all cases, the effects would be managed to comply with established legal limits, such as maximum time for regeneration. To reduce these effects, monitoring procedures and mitigation measures have been planned for those areas which may be affected. Specific mitigation measures are documented in the unit and road cards.

Some adverse effects are of a transitory type. For example, air quality may diminish on a recurring, though temporary, basis due to road construction, timber harvest, timber hauling and recreation traffic on untreated roads, and due to the operation of internal combustion engines. Where they occur, these activities may have localized temporary adverse effects on air quality.

Relationship Between Short-term Uses and Long-term Productivity

All alternatives would come under the mandate of the Multiple Use and Sustained Yield Act of 1960, which requires the Forest Service to manage Forest System lands for multiple uses (including timber, recreation, fish and wildlife, range, and watershed). All renewable resources are to be managed in such a way that they are available for future generations. The harvesting and use of standing timber can be considered a short-term use of a renewable resource. As a renewable resource, trees can be reestablished and grown again if the productivity of the land is not impaired.

Maintaining the productivity of the land is a complex, long-term objective. All alternatives protect the long-term productivity of the Project Area through the use of specific standards and guidelines, mitigative measures, and BMPs. Long-term productivity could change as a result of various management activities proposed in the alternatives. Timber management activities would have direct, indirect, and cumulative effects on the economic, social, and biological environment.

Soil and water are two key factors in ecosystem productivity, and these resources would be protected in all alternatives to avoid damage that could take many decades to rectify. Sustained yield of timber, wildlife habitat, and other renewable resources all rely on maintaining long-term soil productivity. Quality and quantity of water from the Project Area may fluctuate as a result of short-term uses, but no long-term effects to the water resource are expected to occur as a result of timber management activities.

All alternatives would provide the fish and wildlife habitat necessary to contribute to the maintenance of viable, well-distributed populations of existing native and desired non-native vertebrate species. The abundance and diversity of wildlife species depends on the quality, quantity, and distribution of habitat, whether used for breeding, feeding, or resting. Management Indicator Species (MIS) are used to represent the habitat requirements of all fish and wildlife species found in the Project Area. By managing habitats and populations of indicator species, the other species associated with the same habitat would also benefit. The alternatives provide standards, guidelines, and mitigation measures for maintaining long-term habitat and species productivity. The alternatives vary in the risk presented to both wildlife habitat and habitat capability.

Timber rotations are normally over a 100-year or longer rotation, depending upon site quality. To ensure adequate production of timber, harvest has been scheduled to allow the earliest cut stands to mature into merchantable timber before the planned harvest of original stands is complete. When the first rotation is complete, mature timber stands would be harvested again on a new rotation. Management of the timber resource on these rotations could affect long-term productivity, depending on the intensity of silvicultural practices. Projected timber rotation lengths are not anticipated to affect long-term productivity. Mitigation measures are planned under all the alternatives to ensure future availability of other renewable resources as well.

Opportunities for dispersed recreation use, including hiking, camping, and fishing, would be maintained and increased for future generations. The setting in which these activities occur varies by alternative, but the long-term potential for the Project Area to provide a spectrum of recreation opportunities would be maintained in all alternatives.

Irreversible Commitments of Resources

Irreversible commitments are decisions affecting non-renewable resources such as soils, wetlands, unroaded areas, and cultural resources. Such commitments are considered irreversible because the resource has deteriorated to the point that renewal can occur only over a long period of time or at a great expense or because the resource has been destroyed or removed.

The construction of arterial and collector roads, to provide access to the Forest, is an irreversible action because of the time it takes for a constructed road to revert to natural conditions. Irreversible actions also include the associated rock quarries which are developed in conjunction with these roads. Alternative 1 will have no new road construction, while Alternatives 2, 3, 4, 5, and 6 would construct roads and quarries to harvest units as described under the Transportation section of this Chapter. This will require that up to 30 acres of ground be irreversibly committed to rock quarries and up to 0.72 million cubic yards of rock fill to be placed for road construction and reconstruction.

There are three roadless areas as identified in the TLMP Final EIS (1997) that may be affected by the Sea Level project. A decision to develop these roadless areas would mean that their primitive character in terms of opportunities for solitude, remoteness, and development of wilderness skills would be foregone. Alternative 1 would have no new roads constructed or units harvested, while Alternatives 2 through 6 would construct roads and harvest timber as described in the Roadless Areas section of this chapter. Implementation of an action alternative would result in an irreversible loss of portions of these roadless areas.

Old-growth habitat lost due to clear-cut logging can be considered an irreversible effect since it is not expected to regain old-growth characteristics for at least 150 years. Alternative 1 would not harvest any old growth, while Alternatives 2 through 6 would harvest old-growth timber as described in the Silviculture, Timber, Wildlife, and Biodiversity sections of this chapter.

Loss of soil due to erosion and mass failures are irreversible commitments of resources. However, due to the incorporation of BMPs, Forest Plan Standards and Guidelines, and mitigation measures specified in this document, it is not anticipated that there would be any significant soil loss under any alternative.

Loss of cultural resource sites resulting from accidental damage or vandalism would be an irreversible commitment of resources. The standards and guidelines, survey methodology prior to activities, and mitigation measures specified in this document provide reasonable assurance that there would be no irreversible loss of cultural resources.

Irretrievable Commitments

Irretrievable commitment of natural resources means loss of production or use of resources due to management decisions made in the alternative. This represents opportunities foregone for the period of time that the resource cannot be used.

Foregoing timber harvest opportunities at this time in certain areas due to resource concerns or economics may represent an irretrievable commitment of resources because that volume cannot be harvested. The commitment is irretrievable rather than irreversible, because future entries could harvest those areas if they are still classified as part of the suitable timber base.

The reduction in the visual quality of an area due to timber harvesting will be an irretrievable commitment of resources. The commitment is irretrievable since viewsheds will typically heal from a visual quality standpoint after about 40 years. After this time, the second-growth trees will have the color and height needed so as not to be evident to the casual observer.

Alternative 1 will have no irretrievable commitment of visual quality. Alternatives 2 through 6 will irretrievably commit visual resources due to timber harvesting activities.

Possible Conflicts with Plans and Policies of Other Jurisdictions

The regulations for implementing NEPA require a determination of possible conflicts between the proposed action and the objectives of Federal, State, and local land-use plans, policies, and controls for the area. The major land-use regulations of concern are the Coastal Zone Management Act (CZMA), Section 810 of ANILCA, and the State of Alaska's Forest Practices Act. A discussion of each of these determinations is presented below.

Coastal Zone Management Act of 1976 (CZMA)

The CZMA was passed by Congress in 1976 and amended in 1990. This law requires Federal agencies conducting activities or undertaking development affecting the coastal zone to ensure that the activities or developments are consistent with approved state coastal management programs to the maximum extent practicable. The State of Alaska passed the Alaska Coastal Management Act in 1977, to establish a program that meets the requirements of the CZMA. It contains the standards and criteria for a determination of consistency for activities within the coastal zone.

The Forest Service has evaluated the alternatives to ensure that the activities and developments affecting the coastal zone are consistent with approved coastal management programs to the maximum extent practicable. The standards and guidelines for timber management activities in the Sea Level Project Area meet or exceed those indicated in the Alaska Forest Practices Act and the Alaska Coastal Management Program (ACMP).

Evaluation of the proposed activities against standards and guidelines for activities within the coastal zone results in a finding that these activities are consistent with the ACMP to the greatest extent practicable. In accordance with the Memorandum of Understanding and Alaska statutes, the State of Alaska Office of Governmental Coordination will perform a preliminary consistency review of this EIS.

Alaska National Interest Lands Conservation Act of 1980 (ANILCA)

Under Section 810 of ANILCA, agencies are required to evaluate the effects of proposed actions on subsistence uses of Federal land and determine if the proposed action may significantly restrict subsistence opportunities. Refer to the Subsistence section of this chapter for the evaluation of impacts to subsistence use as a result of the alternatives.

State of Alaska's Forest Practices Act of 1990

On May 11, 1990, the governor approved the legislature's major revision of the State's Forest Practices Act (FPA). The revised act significantly increases the State's role in providing protection and management for important forest resources on State and private lands. The revised FPA will also affect National Forest management through its relationship to the ACMP and the Federal CZMA (see above discussion).

For National Forest timber operations, such as proposed for the Sea Level project, the effect of the revised FPA is essentially two-fold. First, it clarifies that the revised FPA regulations are the standard which must be used for evaluating timber harvest activities on Federal lands for purposes of determining consistency to the maximum extent practicable with the Alaska Coastal Zone Management Program. Secondly, it calls for minimum 100-foot buffers on all anadromous and high value resident fish streams and recognizes that consistency to the maximum extent possible for purposes of the ACMP is attainable in Federal timber harvest activities using specific methodologies which may differ from those required by the revised FPA or its implementing regulations.

The Forest Service has evaluated the alternatives to ensure that the activities and developments affecting the coastal zone are consistent with approved coastal management programs to the maximum extent practicable. The layout of all proposed harvest units comply with the TTRA requirements for stream buffers which exceed the stream buffer requirements in the Alaska FPA.

The Forest Service has evaluated all Project Alternatives (including the ROD) prior to completion of the Final EIS and the ROD issuance to ensure that the activities and developments specifically covered by the FPA are consistent with its provisions to the maximum extent possible.

Energy Requirements and Conservation Potential of Alternatives

The implementation of the proposed actions in the Project Area will require the expenditure of energy (e.g., fuel consumption). The amount of energy used varies by alternative based on timber volume harvested and miles of road constructed or reconstructed. The direct effect of the alternatives on energy requirements would be attributed to timber harvest, road construction and reconstruction, and travel necessary to prepare and administer the timber sale. Indirect energy requirements include processing wood products and the transport of the products to secondary processors and consumers. It has been determined that estimating indirect energy requirements used by secondary processors and consumers are unattainable as well as beyond the scope of this document. They are therefore not displayed.

Fuel Consumption

Fuel consumption requirements were estimated as follows:

Timber Sale Preparation and Administration, 1.56 gallons/MBF

Cable Logging, 2 gallons/MBF

Helicopter Logging, 8 gallons/MBF

Load, Haul, Dump and Tow, 8 gallons/MBF

Road Construction, 4,000 gallons/mile

Road Maintenance, 20 gallons/mile

The estimated total fuel consumption required for each alternative is displayed in Table Other-1.

Table Other-1
Estimated Direct Fuel Consumption by Alternative

	Alternative					
	1	2	3	4	5	6
Thousands of gallons	0	1,091	575	426	323	138
Average gallons/MBF	0	65	59	63	62	58

Source: Babik 1998
Note: The estimated fuel consumption for timber harvest activities is based on consumption per MBF of sawlog volume.

Conservation Potential

To conserve fuel and/or minimize harvesting costs, the Forest Service has undertaken studies and allowed experimentation with new harvesting equipment and techniques. Shovel yarding is estimated to use 2.7 gallons of fuel per MBF, which is almost a gallon more per MBF than for cable yarding; however, savings are realized in labor costs. Labor cost per MBF is based on a crew size of 1-2 people for shovel yarding compared to an average of four people for cable yarding.

The use of low tire pressure equipment or central tire inflation (CTI) during road construction and logging has also shown to decrease costs during studies nationwide and on the Stikine Area of the Tongass National Forest. Studies on Mitkof Island indicate that 10 to 14 percent less rock was needed during road construction, resulting in cost savings of approximately $450,000. It is predicted that costs for rock replacement/road maintenance, log truck fuel, and tire repair and replacement will be decreased. Cost savings have proven to be substantial enough that the Forest Service provides a contract clause allowing a reduction in rock replacement deposits when low tire pressure equipment is used.

The use of cable yarding equipment fitted with mechanical or hydraulic interlocking drums provides the ability to decrease yarding expense as the throttle and brake do not have to be ridden simultaneously to provide suspension for a turn of logs.

Natural or Depletable Resource Requirements and Conservation Potential

All alternatives considered in detail are designed to conform to applicable laws and regulations pertaining to natural or depletable resources, including minerals and energy resources. Regulation of mineral and energy activities on the National Forest, under the U.S. Mining Laws Act of 1872, and the Mineral Leasing Act of 1920, is shared with the Bureau of Land Management (BLM). The demand for access to National Forest system lands for the purpose of mineral and energy exploration and development is expected to increase over time.

The action alternatives propose road construction that will increase opportunities for access to the National Forest within the Project Area. This increased access may result in increased activity with regard to both known and potential mineral or energy resource occurrences. The actual potential for increased mineral or energy resource activity in the Project Area is not known, nor can an accurate estimate be made.

Urban Quality, Historic and Cultural Resources

The Project Area contains no urban areas. Therefore, the only applicable concern under this topic is with historic and cultural resources. The goal of the Forest Service's Cultural Resource Management Program is to preserve significant cultural resources in their field setting and ensure they remain available in the future for research, social/cultural purposes, recreation, and education. The direct, indirect, and cumulative effects of the alternatives on cultural resources have been evaluated. The result of this evaluation is the determination that there are adequate standards, guidelines, and procedures to protect cultural resources and to meet the goals of the Cultural Resource Management Program. Cultural resources are discussed further in the Cultural section of this chapter.

Consumers, Civil Rights, Minorities, and Women

All Forest Service actions have the potential to produce some form of impact, positive and/or negative, on the civil rights of individuals or groups, including minorities and women. The need to conduct an analysis of this potential impact is required by Forest Service Manual and Forest Service Handbook direction. The purpose of the impact analysis is to determine the scope, intensity, duration, and direction of impacts resulting from a proposed action. For environmental or natural resource actions, such as proposed for the Project Area, the civil rights impact analysis is an integral part of the procedures and variables associated with the social impact analysis. This analysis is discussed in the Socio-economic section of this chapter.

The effect of the alternatives on consumers is reflected in the discussion of the various goods and services supplied as a result of the proposed actions. This analysis occurs throughout the chapter as an integral part of the analysis of the effects on other components of the environment.

Prime Farmland, Rangeland, and Forest Land

All alternatives are in keeping with the intent of Secretary of Agriculture Memorandum 1827 for prime land. The Project Area does not contain any prime farmlands or rangelands. Prime forest land does not apply to lands within the National Forest System. In all alternatives, lands administered by the Forest Service would be managed with a sensitivity to the effects on adjacent lands.

Recreation

Key Terms

Developed recreation—occurs where more facilities and amenities are incorporated into a site to accommodate intensive recreation activities in a defined area.
Dispersed recreation—requires few improvements or specific developed sites and may occur over a wide area; for example activities related to roads, trails, and undeveloped waterways and beaches.
Recreation Opportunity Spectrum (ROS)—A system for planning and managing recreation settings. There are seven classes which are defined by how they satisfy certain recreation experience needs.

> **Primitive (P)**—An unmodified environment of fairly large size. Interaction between users is very low and evidence of other users is minimal. The area is essentially free from evidence of human-induced restrictions and controls. Motorized use is not present except for infrequent boats and planes.
> **Semi-Primitive Non-Motorized (SPNM)**—A natural or natural appearing environment of moderate to large size. Concentrations of users is low, but there is often evidence of other users. No roads are present in the area.
> **Semi-Primitive Motorized (SPM)**—A natural or natural-appearing environment of moderate to large size. Interaction between users is low, but there is often evidence of other users. Local roads used for other resource management activities may be present. Along saltwater shorelines there may be extensive motorized boat traffic.
> **Roaded Natural (RN)**—A natural-appearing environment with moderate evidence of the sights and sounds of humans. Such evidence usually harmonizes with the natural environment. Interaction between users may be moderate to high with evidence of other users prevalent. Motorized use is allowed.
> **Roaded Modified (RM)**—A natural environment that has been substantially modified, particularly by vegetative manipulation. There is strong evidence of roads and/or highways. Frequency of contact is low to moderate.

Recreation place—an identified geographic area having one or more physical characteristics that are particularly attractive to people engaging in recreation activities; can contain from zero to several recreation sites.
Recreation site—a specific location where recreational activities occur and/or a recreational facility is located; there can be several sites within a recreation place.
Roadless area—An area of undeveloped public land within which there are no improved roads maintained for travel by means of motorized vehicles intended for highway use (TLMP).

Affected Environment

Current Use

Most of the recreation and tourism use in the Project Area takes place in the saltwater bays and coves within and adjacent to the Project Area. The Area receives relatively significant local use for recreation activities. Near the Project Area, saltwater areas are used by several sport-fishing charter boats and outfitter guides. Portions of the Project Area provide settings for recreational activities and are inventoried as recreation places.

Recreation activities in or near the Project Area include fresh and saltwater sport fishing, hunting, camping, hiking, beachcombing, wildlife and scenic viewing, and boating (kayak, canoe, or motorboat). Flightseeing trips from nearby Ketchikan to Misty Fiords National Monument Wilderness (MFNMW), recreation cabins, and the Swan Lake power plant are common. Within the Project Area there is one Forest Service recreation cabin. It is located on the north shore of Thorne Arm at the mouth of Fish Creek. The Low Lake Trail follows Fish Creek to low lake. The Gokachin Lake Trail follows Granite Creek to Starr Lake. Both trails provide access to the boundary of MFNMW. Outside the project area, in MFNMW, two Forest Service cabins can be found on the shoreline of Ella Lake and one privately owned cabin is located on the east shore of Mirror Lake.

As there is no road connection from the Project Area to Ketchikan, access is achieved by personal or commercial boat and aircraft. Past timber harvest and small networks of associated road are frequent on the Project Area. Recreationists who reach these areas (15 to 30 miles from Ketchikan) enjoy viewing wildlife, scenery, and hunting big game and waterfowl. Both freshwater and saltwater fishing are popular in the immediate vicinity.

Recreation Demand

Information about public demand for various recreation opportunities within the Project Area come from four sources:

- the Alaska Public Survey of 1980,
- an Alaska Department of Fish and Game (ADF&G) survey in 1989,
- businesses and groups that discuss nonconsumptive uses of wildlife (i.e. wildlife viewing, photography), and
- the Ketchikan Community Survey of 1990.

The natural setting and remoteness associated with marine and freshwater recreation places were rated as ''very important'' by 80 to 90 percent of the recreation users of the Tongass National Forest. When users were asked about their sensitivity to change, natural-appearing settings and solitude were the most important attributes indicated that they did not want to see modified. A sizeable number of Alaska residents indicated that they would stop going to their favorite places if development-related activities occurred on the site (Alaska Public Survey 1979).

The ADF&G survey related to wildlife viewing also indicated that people engaged in wildlife viewing were concerned that various development activities such as logging, remote homesites, and small aircraft use could adversely effect the quality of their wildlife viewing experience.

Southeast Alaska residents place a high value on opportunities for remote, uncrowded outdoor recreation. At the same time, community access is important to those wanting to do more hunting, fishing, and beachcombing. In particular, Ketchikan residents want to see an expansion of the usable road system on Revillagigeda (Revilla) Island primarily for the purpose of roaded recreation opportunities (Ketchikan Community Survey 1990). Development of new hiking trails and bicycle paths are the most desired opportunities.

Recreation Opportunity Spectrum

The process used to classify recreation opportunities on National Forest System lands is the Recreation Opportunity Spectrum (ROS). The ROS process is a method used to inventory an area's potential recreational opportunities. This system can be used to evaluate the changes that can occur in a given area as a result of different land-use management activities.

The ROS system portrays a range of recreation activities, settings, and experiences from primitive to urban. Criteria defining the various ROS settings are based on a variety of factors including: remoteness, landscape character, facilities present, amount of human modification to the natural landscape, and the opportunity for solitude. Of the six ROS classes, four are present within the Project Area (see Figure Recreation-1, Existing ROS Inventory Map). A summary of the existing acreages by ROS class and the percent of the Project Area is displayed in Table Recreation-1.

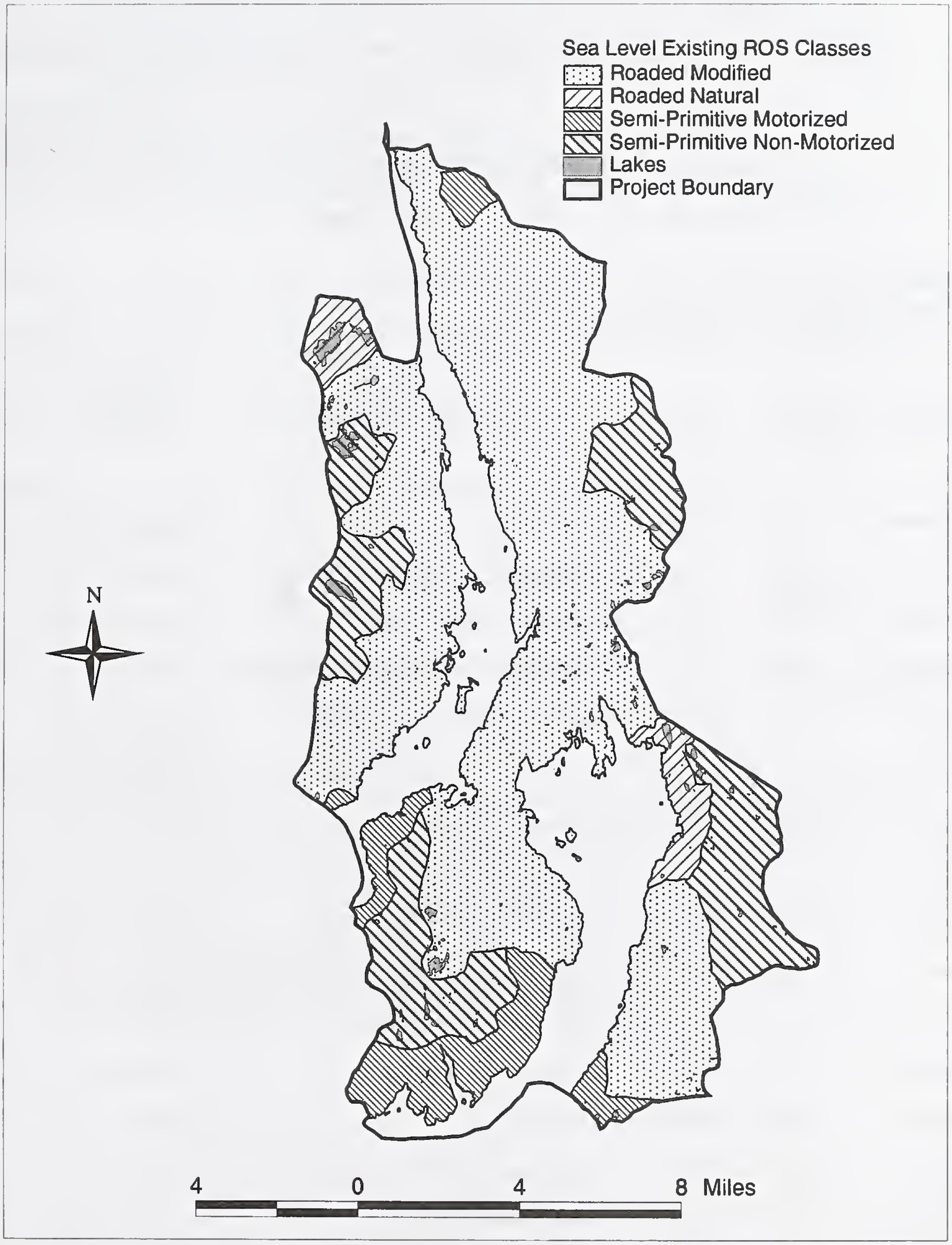
Table Recreation-1
Existing ROS Classes

ROS Class	Acres	Percent of Project Area
SPNM	20,964	22.15
SPM	8,407	8.87
RN	4,056	4.29
RM	61,231	64.69
Project Area Total	**94,658**	**100**

Source: GIS, Benson 1998.

Approximately 94,658 acres of the Project Area are included within 4 ROS settings: Semi-Primitive Non-Motorized (SPNM), Semi-Primitive Motorized (SPM), Roaded Modified (RM) and Roaded Natural (RN). Roaded Modified occurs where roaded timber harvest has occurred in the past such as along low-lying shorelines (Shelter Cove) and stream valleys (Saddle Lakes, Licking and Granite Creeks). A network of roads access these areas but are not linked to any road system from Ketchikan nor are they linked to each other. Most of the Semi-Primitive Non-Motorized and Motorized ROS classes are located on the southern shorelines and inland creek valleys on both sides of Thorne Arm and of a small portion inside Carroll Inlet.

Figure Recreation-1
Existing ROS Class Inventory Map



Recreation Places

A recreation place is identified as a geographic area having one or more physical characteristics attractive to people engaging in recreation activities; can contain from zero to several recreation sites. These places may be beaches, waterfalls, streams, lakes, scenic features, bays, anchorages, existing and potential recreation sites, and trails. Each recreation place has some activity associated with it such as hiking, camping, hunting, or viewing scenery or wildlife. These recreation places define the inventoried recreation areas which are important for existing and potential recreation uses. See the Scenic Resources section in this chapter for further discussion on the scenic features or attributes of the Project Area.

There are 17 recreation places inventoried within the Project Area. Table Recreation-2 displays the recreation places including the number of acres, the ROS class, the existing and potential recreation sites and activities, and the current Tongass Land Management Plan TLMP (1997) Land-Use Designations. Figure Recreation-2 shows the location of each recreation place and whether it is existing or potential.

Table Recreation-2
Recreation Places Within the Sea Level Project Area

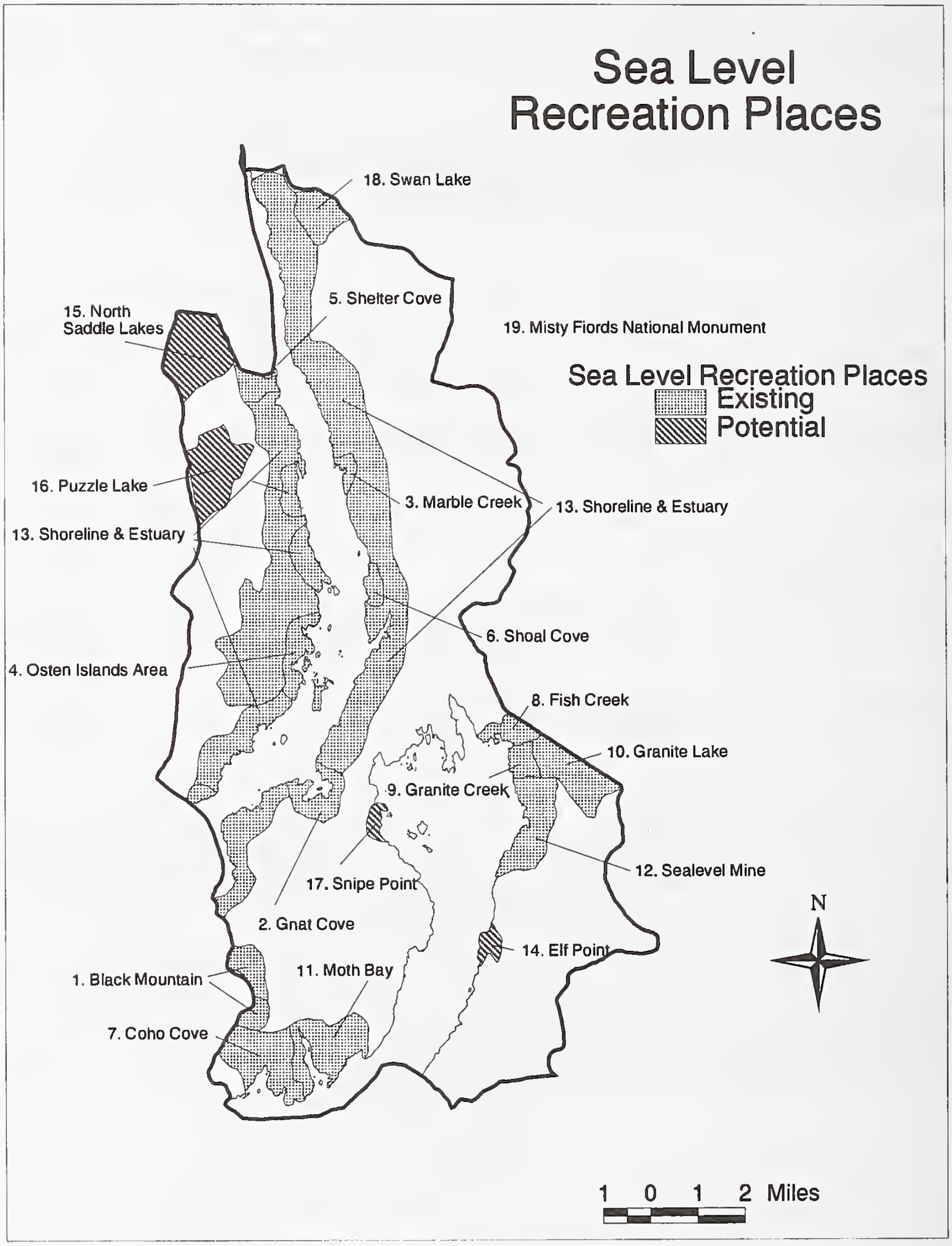
Recreation Place	Acres	ROS*	Recreation Activities	Recreation Sites**	TLMP LUDs***
Carroll Inlet					
1. Black Mountain	394	SPNM	hiking, hunting	hiking trail (E)	SM
2. Gnat Cove	745	RM	beachcombing, boating, saltwater fishing	anchorage (E)	ML
3. Marble Creek	209	RM	dispersed camping, hunting	anchorage (E)	ML
4. Osten Island Area	707	RM	beachcombing, boating, saltwater fishing	anchorage (P)	SM/ML
5. Shelter Cove	31	RM	boating, saltwater fishing, hiking,	boat dock (P) boat launch (P) anchorage (E)	ML
6. Shoal Cove	265	RM	boating, hiking, hunting	boat dock (E)	ML
Thorne Arm					
7. Coho Cove	1,614	SPM	boating, hunting, saltwater fishing	anchorage (P)	SM
8. Fish Creek	470	RN	cabin use, hiking, boating, stream fishing, hunting, canoe/kayaking, saltwater fishing, scenic & wildlife viewing	cabin (E) anchorage (E) hiking trail (E)	SM
9. Granite Creek	370	RN	boating, hiking, hunting	hiking trail (E)	ML
10. Granite Lake	1,323	SPNM	hiking, hunting	hiking trail (E)	ML
11. Moth Bay	1,576	SPM	boating, hunting, saltwater fishing	anchorage (E)	SM
12. Sea Level Mine	1,425	RM	boating, hunting, fishing	anchorage (E)	ML

Table Recreation-2 (cont.)
Recreation Places Within the Sea Level Project Area

Recreation Place	Acres	ROS*	Recreation Activities	Recreation Sites**		TLMP LUDs***
Common To Project Area						
13. Shoreline and Estuary	17,476	RM	boating, saltwater fishing, scenic & wildlife viewing	boat dock anchorage	(P) (P)	ML
Potential						
14. Elf Point[1]	272	RM	boating, hiking, hunting, saltwater fishing	boat dock	(P)	TM
15. North Saddle Lakes[2]	1,796	RN	canoe/kayaking, developed camping, lake fishing, picnicking	campground picnic site	(P) (P)	SV
16. Puzzle Lake[3]	1,569	SPNM	developed camping, lake fishing	campground picnic site	(P) (P)	TM
17. Snipe Point[4]	214	RM	boating, hiking, hunting, saltwater fishing	boat dock	(P)	ML
Adjacent to Project Area						
18. Swan Lake[5]	N/A	RM	lake fishing boating, picnicking	anchorage boat dock	(E) (P)	ML
19. MFNMW[6]	N/A	SPNM and SPM	cabin use, camping, fishing	cabin hiking trails	(E) (E)	W

Source:
1 Elf Point: is located in the southwestern portion of the Project Area on the western shore of Thorne Arm. This is the existing Elf Point LTF site.
2 North Saddle Lakes: is located in the northeastern corner of the Project Area between Shelter Cove on Carroll Inlet and Upper George Inlet.
3 Puzzle Lake: is located in the northeastern corner of the Project Area, south of the North Saddle Lakes and east of Shelter Cove.
4 Snipe Point: is located in the southern portion of the Project Area on the east shore of Thorne Arm. This is the existing Snipe Point LTF site.
5 Swan Lake: is located on Carroll Inlet's east shore just north of the Project Area and is the site of the local power generation source for Ketchikan. The powerline crosses Carroll Inlet then travels south past Shelter Cove to beyond George Inlet.
6 MFNMW: is located immediately adjacent to the Project Area on its eastern boundary. Access from the Project Area is limited due to extremely rugged alpine ridges forming a boundary between the two areas. Mount Reid, the highest point on Revilla Island at 4,592 feet, is located on the Sea Level creek watershed boundary.
* SPNM = Semi-Primitive Non-Motorized, SPM = Semi-Primitive Motorized, RN = Roaded Natural, RM = Roaded Modified
** (E) = Existing Recreation Site, (P) = Potential Recreation Site, (N/A) = Not Available
*** ML = Modified Landscape, SM = Semi-remote Recreation, SV = Scenic Viewshed, TM = Timber Production, W = Wilderness

Figure Recreation-2
Recreation Places—Existing and Potential



Direct and Indirect Effects of the Alternatives

Use and Demand

Future recreation use and demand in the Project Area is expected to change with implementation of any of the alternatives. Existing recreation activities and patterns are associated with a combination of natural and roaded settings. The action alternatives generally would add to existing road networks and increase recreation access.

As recreation settings change, recreationists will have several options. Some will find the conversion of areas to roaded settings unacceptable and will either cease their activity or be displaced to other areas such as the Naha River, Cleveland Peninsula or MFNMW. Some recreationists will adapt to the changes in the settings and continue to pursue traditional activities in the Project Area. Other recreationists will be attracted to opportunities within the roaded settings. Consequently, the use patterns are expected to change slightly.

Impacts of Alternatives on ROS

The proposed harvest in the action alternatives occurs in areas classified as RM (due to harvest within the past 30 years) or in SPNM areas immediately adjacent to RM areas. With the action alternatives, these SPNM areas will change to RM.

Misty Fiords National Monument Wilderness will not be physically impacted by any of the proposed alternatives of this EIS.

Table Recreation-3 displays the acres in each ROS class, by alternative, for the Project Area and the percent the acreage changed from the current condition.

Table Recreation-3
ROS Class Distribution by Alternative and Percent Change

	Roaded Modified		Roaded Natural		Semi-Primitive Motorized		Semi-Primitive Non-Motorized	
Alternative	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
1	61,232		4,057		8,407		20,964	
2	70,653	15.39	2,657	-34.5	8,407	0	12,942	-38.26
3	68,123	11.25	3,370	-16.93	8,407	0	14,760	-29.59
4	64,570	5.45	3,403	-16.13	8,407	0	18,280	-12.80
5	63,389	3.52	4,057	0	8,407	0	18,807	-10.29
6	63,389	3.52	4,057	0	8,407	0	18,807	-10.29

Source: GIS, Benson 1998.

In the action alternatives, RN acres would decrease the most in Alternative 2 and less so Alternatives 3 and 4. Roaded Modified acres would increase the most in Alternative 2 and the least in Alternative 6. Semi-Primitive Motorized acres would not be affected by any of the alternatives. Semi-Primitive Non-Motorized acres would decrease the most in Alternatives 2 and 3, and would be reduced approximately the same amount for Alternatives 4, 5 and 6.

Alternatives

All of the action alternatives would result in changes in the amount of nonroaded and roaded ROS settings found in the Project Area. Under Alternatives 2 through 6, there would be an increase in roaded ROS settings. As a result, there would be more accessible recreational activities such as camping, freshwater angling, wildlife viewing, and hunting. Conversely, there would be a reduction in areas with attributes associated with nonroaded settings. The effects of each alternative on ROS settings is discussed below.

The primary change from the existing condition, as a result of implementing action on all alternatives would be a reduction in the Semi-Primitive ROS settings and an increase in the RM settings. The areas impacted by the alternatives have been identified under Forest Plan as TM (Timber Production) lands with a Roaded Natural desired future setting.

Alternative 1

Alternative 1, the existing condition or no-action alternative, is the baseline for comparing the effects of the action alternatives on recreation. The existing condition is described in the preceding Affected Environment section.

Alternative 2

Alternative 2 proposes harvesting 106 units and constructing 58.80 miles of road. This alternative would reduce the SPNM acres by 38.26 percent and the RN acres by 34.5 percent. The reduction of SPNM and RN means an increase of the RM acres by 15.39 percent. The areas most impacted by this alternative would be the SPNM and RN areas around North Saddle, Puzzle and Buckhorn Lakes in the northwest portion of the Project Area, and along Sea Level Creek in the southeastern portion of the Project Area bordering MFNMW.

Under this alternative there would be helicopter logging near the boundary of MFNMW boundary in the southeastern portion of the project area (Elf Point). Units 138, 140 and 145 are closest to the Monument boundary and have the potential for the greatest impacts due to aircraft noise. Currently this area receives very little use and impacts would be minimal. This alternative also proposes 4 units with new road construction along the Monument boundary (units 45, 46, 56 and 59) east of Shoal Cove. There are concerns that logging activity in these areas will increase access into Third Lake and Big Lake within MFNMW and that noise from the logging and road building activities maybe heard along the Low Lake Trail and Big Lake.

If the road system is linked to Ketchikan, under this alternative recreation opportunities in the Puzzle Lake area would increase. The locality of the units near both North Saddle and Puzzle Lake may impact the visual qualities associated with a campground and picnic site that may be developed in the future.

Alternative 3

Alternative 3 proposes harvesting 64 units and constructing 39.05 miles of road. This alternative would reduce the SPNM acres by 29.59 percent and the RN acres by 16.93 percent. These reductions mean an increase of the RM acres by 11.25 percent. Overall the impacts of this alternative are less than those of Alternative 2.

This alternative proposes 1 new unit (Unit 56) that borders the boundary of MFNMW. As stated under the analysis of Alternative 2, there are some concerns that units along the boundary in this area may impact people recreating along the Low Lake Trail and Big Lake.

The North Saddle Lakes would remain RN and the Puzzle Lake area would remain SPNM, retaining their attractiveness as potential recreation areas. Under this alternative there would be a reduction in the SPNM and RN areas impacted along Sea Level Creek.

Alternative 4

Alternative 4 would result in effects similar to Alternative 3. This alternative proposes 46 harvest units and 26.02 miles of new road. This alternative would reduce the SPNM acres by 12.80 percent and the RN acres by 16.13 percent. This reduction means an increase of the RM acres by 5.45 percent. However, under this alternative the SPNM area along Sea Level Creek is only slightly modified from its current condition.

This alternative proposes 1 new unit (Unit 56) that borders the boundary of MFNMW. As stated under the analysis of Alternative 2, there are some concerns that units along the boundary in this area may impact people recreating along the Low Lake Trail and Big Lake.

Alternative 5 and 6

Alternatives 5 and 6 propose harvest in the existing RM areas and they would reduce the amount of SPNM acres in the Puzzle and Buckhorn Lakes area by 10.29 percent. Alternative 5 proposes 32 units on both the Shoal Cove and Shelter Coves sides of Carroll Inlet with 22.36 miles of new road. Alternative 6 proposes 14 units on the Shelter Cove side of Carroll Inlet with 10.70 miles of new road.

Impact of Alternatives on Recreation Places and Sites

Because data on the number of recreationists who use remote areas, such as the Project Area, is very limited, it is difficult to estimate how the alternatives would affect users of any specific recreation place. Because of noise, visual impacts, and the resulting change in the recreational setting, many existing recreation activities are incompatible with an active logging operation. Recent analysis by the Forest Service has concluded that approximately 50 percent of the current activities occurring in recreation places rely on the natural appearance of the area (Forest Service 1990b). If a recreation place is entered for timber harvest, those activities that are incompatible will cease until the area returns to a natural setting.

The impacts to the recreation places and sites are based on the existing use that occurs and the potential for an area to be developed. A description of the existing recreation places that may be impacted and potential recreation places and sites are described in the following discussion.

Existing

An indirect effect of the action alternatives may be increased recreational and subsistence use in the vicinity of the logging camps and roads. This increased use would be predominately hunting, fishing, and gathering of forest products.

Throughout the Project Area, after harvest, people may use the road systems for recreation. These users may place increased pressure on the fish and wildlife resources. However, this use may diminish over time as alder slowly closes the roads to foot and all terrain vehicle traffic. Some of the roads will be closed after harvest is complete.

Fish Creek

Fish Creek Cabin

This recreation place is located at the northeastern end of Thorne Arm. Fish Creek is easily accessible from Ketchikan, Saxman and Metlakatla making it a popular place for both local and nonlocal visitors. There is a recreation cabin, two trails (Gokachin and Low Lake), and a mooring buoy available for public use. The cabin has beach access, fishing opportunities for both freshwater and saltwater fishing, and access to both trails. Both of the trails provide lake and stream fishing, hunting, scenic and wildlife viewing and access into MFNMW. The mooring buoy is located near the cabin site to provide safe moorage. In the immediate area there are opportunities for saltwater fishing, boating, and beachcombing. Alternatives 2 and 3 propose units directly across from the cabin site on the hillside which is visible from the cabin approximately 5 miles away. Noise associated with logging activities may be heard at the cabin. This may impact visitors coming to this area desiring solitude and scenic landscape. There are existing units in this area that are visible from the cabin. See the Scenic Resources section in this chapter for analysis of this area. Visible harvest along the travel route to this popular recreation site may impact the anticipated experience of those travelling to the site by boat or floatplane.

Sealevel Mine

This recreation place is located approximately 1 mile to the south of the Fish Creek Cabin and is approximately 1,425 acres in size. There is a mooring buoy that people use for a variety of activities. Currently this area is used for fishing (saltwater and freshwater), hunting and boating. The abandoned Starr Lake trail is within this recreation place and due to the private land holdings there are no plans to develop this trail in the future. This trail at one time joined with the Gokachin Lake Trail that provides access into MFNMW. There are 3 parcels of private land equalling about 80 acres within the recreation place. This land is associated with the abandoned Sealevel Mine.

Alternatives 2, 3 and 4 propose 2 units (120 and 121) with approximately 2 miles of road through this recreation place. These alternatives would reduce this recreation place by about 25 percent and would affect the experience in this area.

Remaining Places

The remaining recreation places are located within the RM land designation and impacts would not be significant under the proposed alternatives.

The adjacent recreation places and sites in MFNMW will maintain their current settings. Saddle Lakes and the Shelter Cove area will continue to be affected by ongoing timber harvest and road construction activities, though the former to a much lesser degree. The other recreation places within the Project Area which are now RM will continue to move toward the RN setting as second growth continues to mature.

Potential

Saddle Lakes

This recreation place is located on the northeastern end of the Project Area and is currently used primarily by people working out of Shelter Cove. With the proposal to link the existing road system to Ketchikan, this area could be developed into a destination recreation site. Alternative 2 proposes to place 1 unit within ¼ of a mile of the lake, which could impact the visual qualities of that area.

Puzzle Lake

This recreation place is located south of the North Saddle Lakes. Currently this area has limited access, but it could be developed to provide camping, picnicking, hiking, and hunting. No plans have been developed at this time. Along with Saddle Lakes, it has the potential to be a destination recreation area if the road system is linked with Ketchikan. This recreation place has been classified as SPNM because of its limited access. Alternative 2 proposes several units in this area that will change the current classification from SPNM to RM and a future desired condition of RN. Under this alternative an access route is proposed that will almost reach the lake. This alternative may reduce the desire to place recreation facilities in this area because of reduced scenic quality. Further plans could be developed to extend the road to the lake. See the Scenic Resources section for a detailed visual analysis of this area.

Snipe Point and Elf Point

Both of these sites are existing log transfer facilities (LTF) that, if developed with a boat dock or mooring buoy, could provide opportunities for hiking and hunting. No plans have been created for developing these areas.

Cumulative Effects

By the year 2095, the recreation settings in the Project Area will move toward an emphasis of Roaded Modified and Roaded Natural ROS classes. Existing recreation place settings will reflect this change, and new recreation opportunities associated with roads will likely be present. A connected road network to the City of Ketchikan from the Project Area may occur within 10 years.

In the event of the Shelter Cove Road Connection, access to this area would increase substantially. This road connection may shift the current recreation use patterns from the Ketchikan Area towards the center of the island. The opportunities for developed and dispersed camping, picnicking, hunting, hiking, boating, fishing, wildlife and scenic viewing, and winter recreation may make this a very popular recreation destination. There will be greater potential for:

- sites at both North Saddle Lakes and Puzzle Lake
- a boat launching facility and dock at Shelter Cove, and
- dispersed opportunities in Carroll Inlet.

With increased roaded access, recreation users having expectations for natural appearing settings will either adapt to the changing conditions, use other areas on the Forest, or will no longer recreate on the Forest. Displacement to other natural areas may result in increased use and social encounters, and a reduction in the opportunities for solitude in those places. These changes are consistent with the analysis and projections in the TLMP Final EIS (1997).

Wild and Scenic Rivers: Affected Environment

Rivers eligible for inclusion in the Wild and Scenic River System on the Tongass National Forest were evaluated in the TLMP Final EIS (1997) as to their suitability for the National Wild and Scenic Rivers System. To be eligible, a river must be free-flowing, and contain at least one outstandingly remarkable value. There are no rivers within this project currently designated under either the Tongass or National Wild and Scenic River System but the following have been recommended for inclusion.

Designation

Suitable

The Gokachin, Mirror, Fish, and Low Creeks were determined to be suitable for designation as a Wild River (TLMP ROD, 1997). The system is outstandingly remarkable and has regional significance for its fishery, wildlife, recreation, scenic, and historical/cultural values. The Cultural/Historical values in the river system are significant. Several prehistoric use sites are located along Fish Creek and the entire area is rich in mining history. A detailed analysis of this area can be found in the TLMP, Appendix E.

Figure Recreation-3 displays the location of this Wild River section. The river system consists of a stream, river, or lake itself and a ¼ mile study area measured from its high water mark, on each side of the water course (total minimum width of ½ mile); this area is called a corridor.

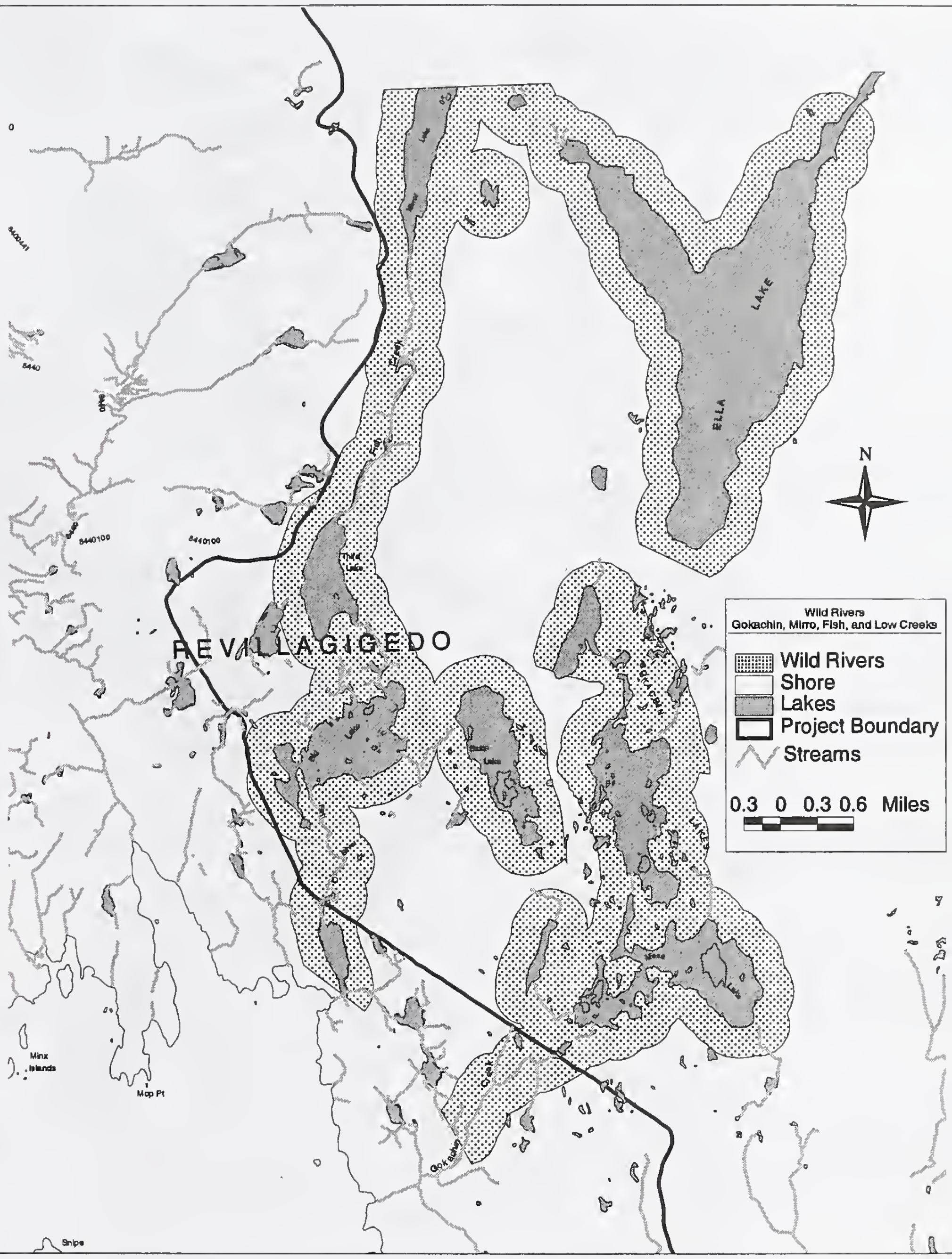
Unsuitable

Sea Level, Painted, Marble, Licking, Calamity, Buckhorn and Gunsite Creeks were determined not to contain outstandingly remarkable values representative of the geographic province (TLMP Final EIS 1997). Therefore, they are not recommended for designation in the Wild and Scenic River system. This evaluation was reflected in the TLMP Final EIS ROD (1997).

Wild and Scenic Rivers: Effects of the Alternatives

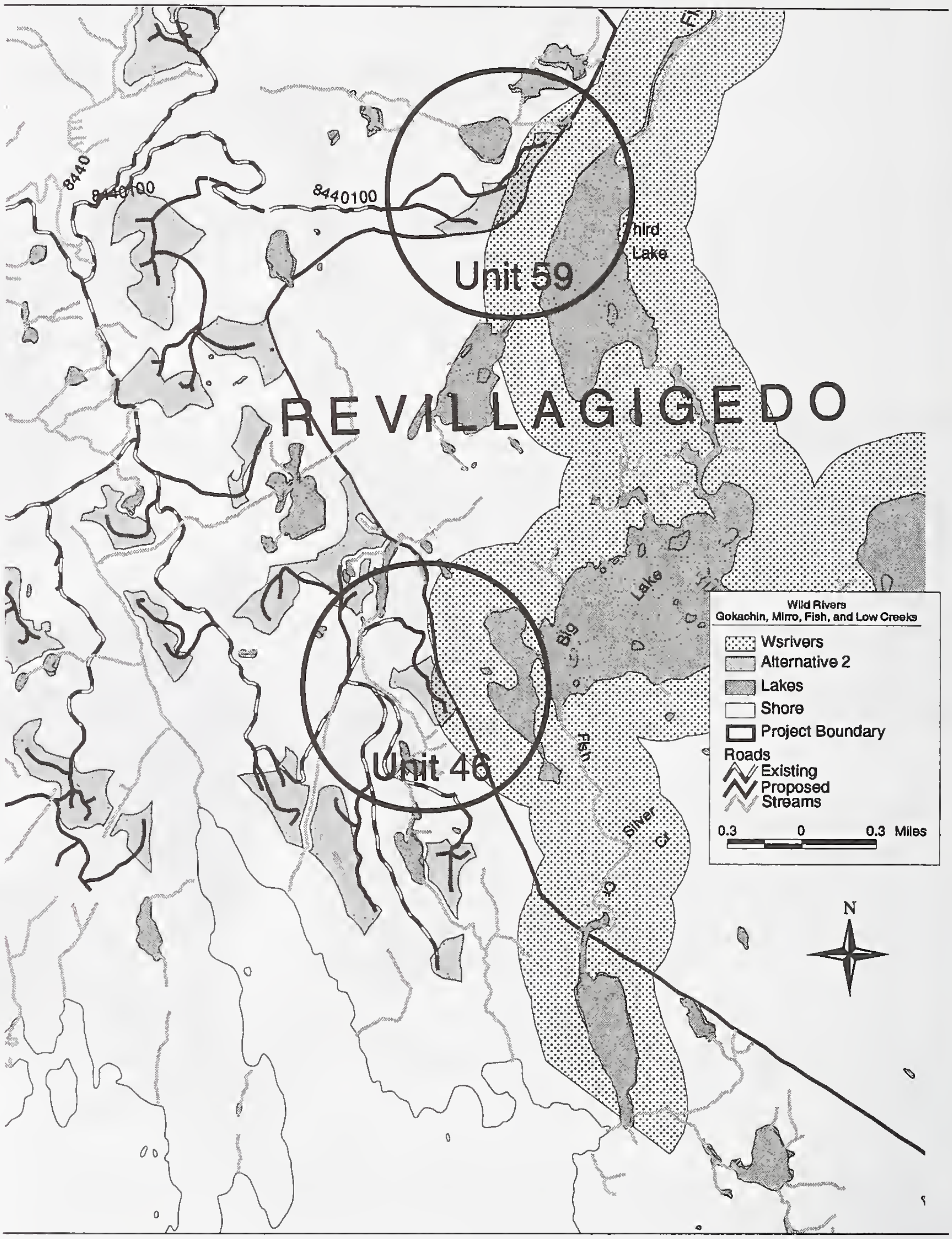
When the TLMP ROD recommended the Gokachin, Mirror, Fish and Low Creek system for inclusion in the National Wild and Scenic River System, the ½ mile corridor was imposed. If Congress designates this as a Wild River, a management plan will be written to regulate activities within that corridor. Alternative 2 proposes 2 units (46 and 59) which are adjacent to the corridor (see Figure Recreation-4). The portions of these units which fall within the corridor are unavailable for harvest.

Figure Recreation-3
Recommended For Wild and Scenic River System —Gokachin, Mirror, Fish, and Low Creeks



Source: Benson 1998.

Figure Recreation-4
Alternative 2 - Portions of Harvest Units Within Wild and Scenic River Corridor



Source: Benson, 1998.

Roadless Areas: Affected Environment

Roadless Areas are defined as areas in a National Forest or Grassland that meet minimum wilderness criteria, as defined by the 1964 Wilderness Act and its implementing regulations. To qualify, an area must contain at least 5,000 acres of undeveloped land which does not contain improved roads, maintained for travel by passenger-type vehicles. However, areas less than 5,000 acres may qualify if they are

- a self-contained ecosystem such as an island,
- contiguous to existing Wilderness, or
- ecologically isolated by topography and manageable in a natural condition.

Once an area is roaded it is generally no longer available for Wilderness designation. These Roadless Areas have been defined by the TLMP (1997) in Appendix C and not by the Roadless Area Review and Evaluation II (RARE II) process.

The Sea Level Project Area includes portions of the North Revilla Roadless Area No. 526, the Carroll Roadless Area No. 535, and the South Revilla Roadless Area No. 523 as identified in the TLMP Final EIS (1997). The following analysis evaluates the direct and indirect effects the alternatives may have on the roadless character and wilderness attributes of these three Areas.

North Revilla Roadless Area No. 526

The North Revilla Roadless Area totals 217,818 acres 9,816 (4.5 percent) of which are within the Project Area. This roadless acreage includes all of the unroaded portions of the upper Marble Creek, Calamity Creek and Licking Creek watersheds. The majority of these three creek drainages have been roaded and harvested through past activities. The remaining unroaded portions of these creek drainages consist of steep and rugged terrain. Both the Marble Creek and Calamity Creek portions of this roadless area border MFNMW and make up the southern section of the greater North Revilla Roadless Area. There are no unique values to this area.

Carroll Roadless Area No. 535

The Carroll Roadless Area is 11,671 acres, 7,892 (67.6 percent) of which are within the Project Area. This area, characterized by rugged terrain, steep mountain slopes and lakes, is located on the peninsula separating George Inlet and Carroll Inlet along the southwestern border of the project area.

The area has been modified by human activity because of its close proximity to Ketchikan. There are opportunities for solitude within certain parts of the area, but aircraft noise can be heard virtually everywhere. Owing to the extensive road networks from previous timber harvest, there are many semi-primitive attractions available. Because of these factors, Roadless Area No. 535 does not meet the Wilderness criteria.

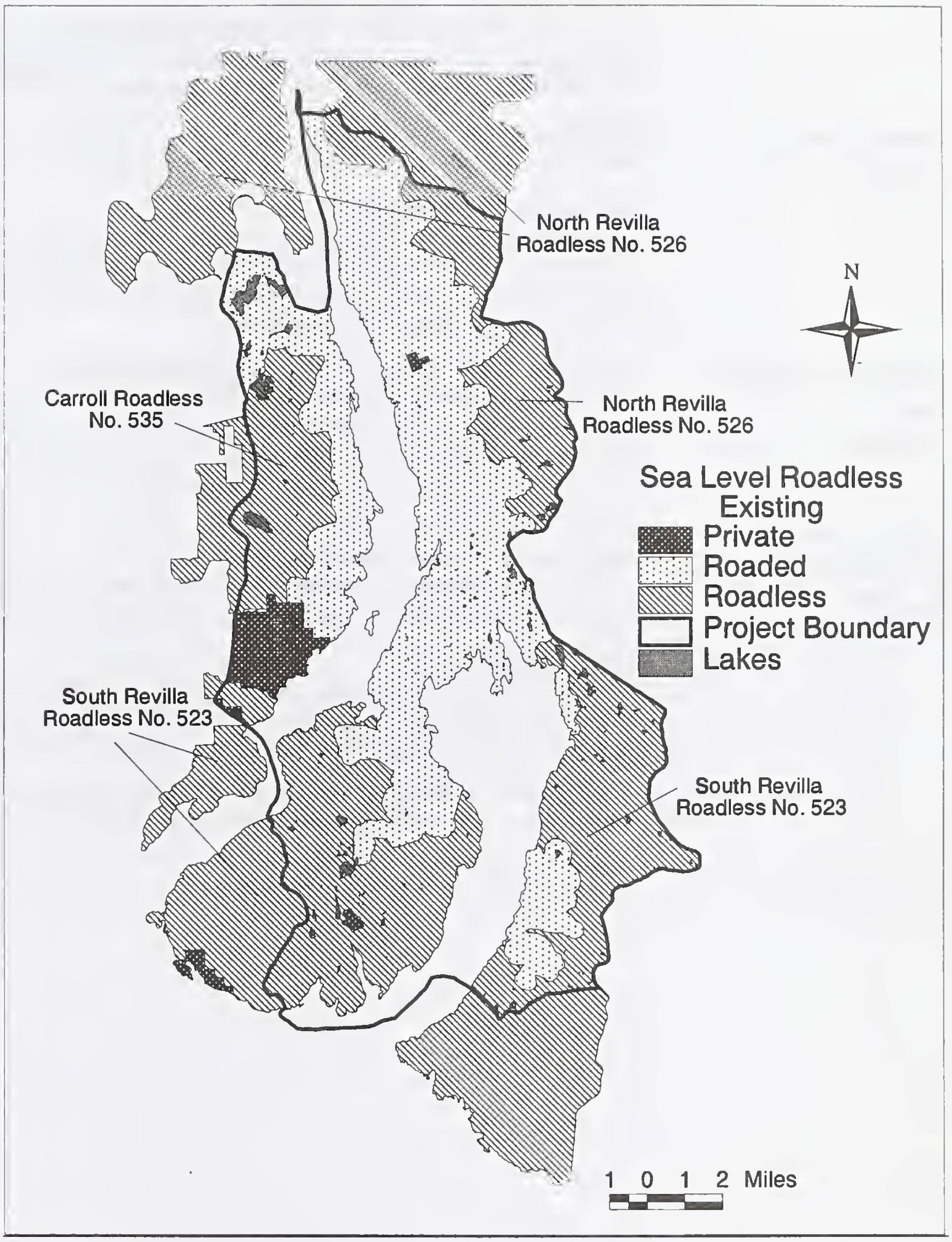
South Revilla Roadless Area No. 523

The South Revilla Roadless Area is 52,209 acres, 29,880 (57.2 percent) of which are within the Project Area. This area is located in the southern portion of the Project Area from the boundary of MFNMW to the east shore of Thorne Arm; it covers the Black Mountain and California Head areas in the south to southwest. It is characterized by a combination of steep mountain slopes and gentle terrain.

There has been some modification to the area by logging in the Elf Point and Snipe Point areas and through use by residents of Ketchikan, Saxman and Metlakatla. There is opportunity for solitude within certain parts of the area, but aircraft and boat noise can be heard virtually everywhere. Owing to the road network from the previous timber harvest, there are many semi-primitive opportunities available. Because of these factors, Roadless Area No. 523 does not meet the criteria for consideration for Wilderness.

Figure Recreation-5 displays the existing roadless areas within the Project Area and the adjoining portions outside the Project boundary.

Figure Recreation-5
Sea Level Roadless Areas



Source: Benson, 1998.

Roadless Areas: Effects of the Alternatives

In all action alternatives, timber harvest and road construction would directly and indirectly affect the roadless character and roadless attributes of the Project Area to varying degrees. The following discussion summarizes how the alternatives differ as to their effects.

North Revilla Roadless Area No. 526

Calamity Creek Drainage

The Calamity Creek drainage will not be affected by any of the action alternatives.

Marble Creek Drainage

The Marble Creek drainage, which is already roaded by past harvest in its lower portion, will be affected by Alternatives 2 through 5 which propose additional harvest units in the roadless area. Alternative 2 would reduce the roadless area the most and Alternatives 3, 4, and 5 would reduce the roadless area the least.

Carroll Roadless Area No. 535

Gunsight Creek Drainage (Puzzle Lake) and Buckhorn Creek Drainages

All action alternatives propose additional timber harvest and roads in this area, with Alternative 2 having the greatest impact and Alternative 6 having the least. Extensive harvest and road construction have occurred in the past. This area has high potential for development of roaded recreation which is a priority objective for Ketchikan area residents.

South Revilla Roadless Area No. 523

Sea Level Creek Drainage

Alternatives 2, 3, and 4 propose additional timber harvest and roads in this area. Alternative 2 has the greatest impact (by splitting the roadless area in half), and Alternative 4 has the least. Existing roads in the Elf Point area would extend into the Sea Level Creek drainage.

Black Mountain

Alternative 2 proposes additional timber harvest and roads in this area. Existing harvest and roads in the Snipe Point area would be extended into the harvest areas. There are five units proposed in this area, two along the shoreline and three inland.

Table Recreation-4 displays the number of roadless acres and the percentage remaining in each roadless area after implementation of each alternative.

Table Recreation-4
Remaining Acres of Roadless Areas within the Project Area by Alternative

	South Revilla		North Revilla		Carroll		Total	
Alternative	Acres	Percent Change	Acres	Percent Change	Acres	Percent Change	Acres	Percent Change
Existing Condition	29,880		9,816		7,892		**47,588**	
2	22,787	-23.7	8,838	-10.0	3,243	-58.9	**34,868**	**-26.7**
3	26,996	-9.7	9,592	-2.3	5,305	-32.8	**41,893**	**-12.0**
4	28,175	-5.7	9,592	-2.3	5,305	-32.8	**43,072**	**-9.5**
5	29,880	0.0	9,592	-2.3	5,305	-32.8	**44,776**	**-5.9**
6	29,880	0.0	9,816	0.0	5,305	-32.8	**45,001**	**-5.4**

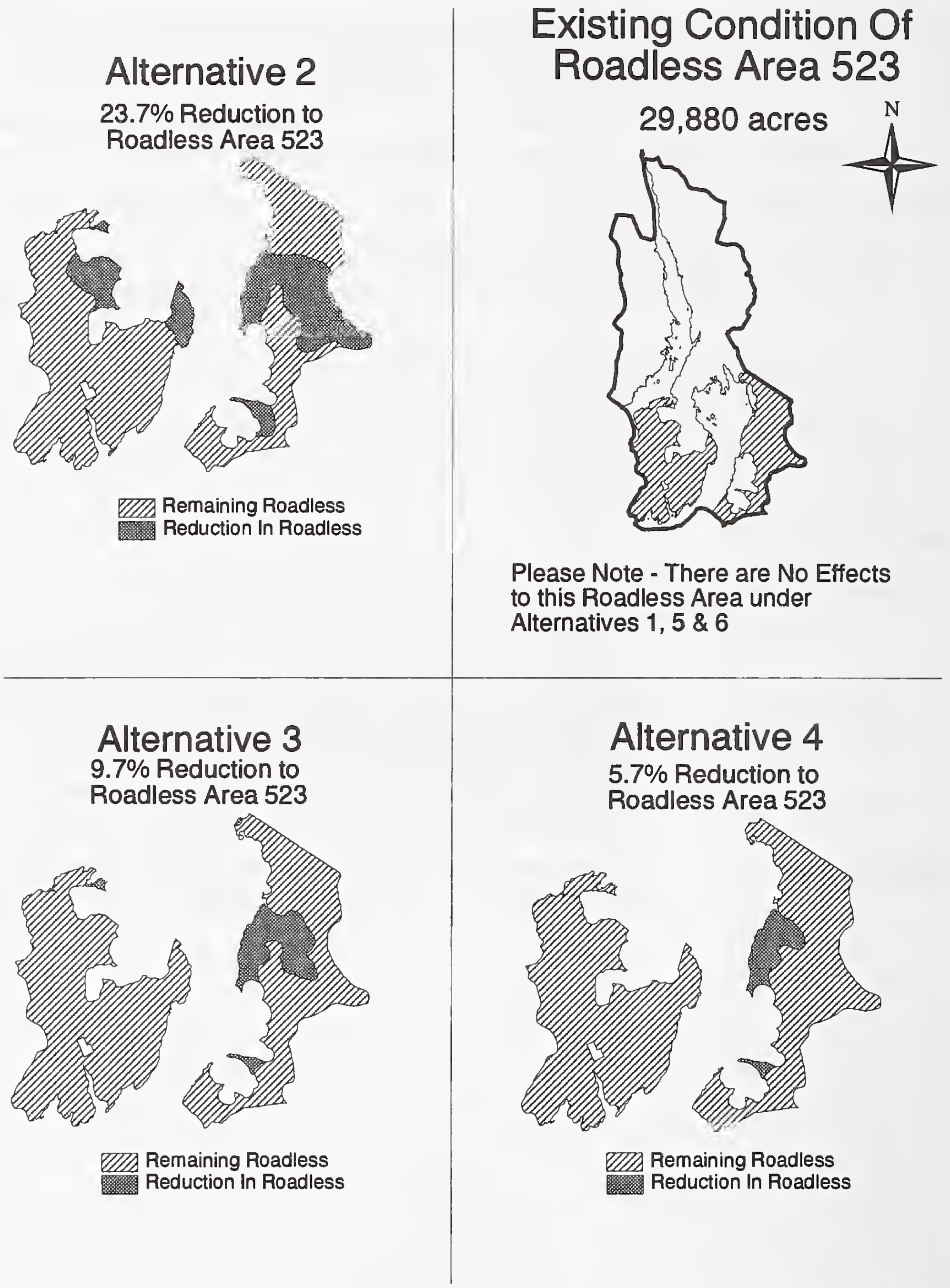
Source: GIS, Benson 1998.

Reductions range from 12,720 acres in Alternative 2 to 2,811 acres in Alternative 6. Some of these reductions are in drainages which have already been logged and roaded. Alternative 2 has the greatest impact breaking large sections of roadless area into segments, reducing the potential for Wilderness designation in Roadless Area No. 523 and No. 535. The TLMP's Land Use Designation for these areas is Timber Production (TM) and Modified Landscape (ML); therefore, the impacts on the roadless areas are consistent with the desired future condition in the Forest Plan. The following figures (Recreation-6 through Recreation-8) display the effects of the action alternatives on the roadless areas within the Project Area.

Cumulative

By the year 2095, there will be few roadless areas remaining in the Project Area except for the upper parts of the drainages and ridges that cannot be logged due to physical limitations.

Figure Recreation-6
Changes to South Revilla Roadless Area 523



Source: Benson, 1998.

Figure Recreation-7
Changes to North Revilla Roadless Area 526

Alternative 2

10% Reduction to
Roadless Area 526

Remaining Roadless
Reduction In Roadless

Existing Condition Of Roadless Area 526

9,816 acres

Please Note - There are No Effects to this Roadless Area under Alternatives 1 & 6

Alternative 3 thru 5

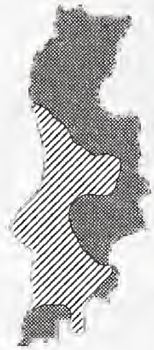
2.3% Reduction to
Roadless Area 526

Remaining Roadless
Reduction In Roadless

Figure Recreation-8
Changes to Carroll Roadless Area 535

Alternative 2

58.9% Reduction to
Roadless Area 535



Remaining Roadless
Reduction In Roadless

Alternative 3 thru 6

32.8% Reduction to
Roadless Area 535

Remaining Roadless
Reduction In Roadless

Existing Condition Of Roadless Area 535

7,892 acres

Please Note - There are No Effects to this Roadless Area under Alternative 1

Roads and Facilities

Key Terms

Access management—acquiring rights and developing and maintaining facilities needed by people to get to and move through public lands.
Arterial roads—usually developed and operated for long-term land and silvicultural purposes and constant service.
Collector roads—collect traffic from Forest Local roads; usually connect to a Forest Arterial road or public highway.
Local roads—provide access for a specific resource use activity such as a timber sale or recreational site; other minor uses may be served.
Log transfer facility (LTF)—a facility that is used for transferring commercially harvested logs to and from a vessel or log raft, or the formation of a log raft.
Main trunk roads—primary roads that are used repeatedly for forest access over long periods of time.
Modular bridge—a portable bridge constructed of components that can be readily assembled and disassembled for movement from one site to another.
Pre-haul maintenance—work performed prior to use of a road for timber harvest activities; includes blading, shaping, and brush removal.
Specified roads—constructed to remain on the permanent transportation system.
Temporary roads—short-term roads built for limited resource activity or other project needs.
Traffic service levels—traffic characteristics and operating conditions that are used in setting road maintenance levels.

Affected Environment

There are approximately 321 miles of Forest Service roads on Revillagigedo (Revilla) Island, 158 miles of which are within the Project Area. Most of the roads do not connect to other existing road systems on Revilla Island and so are not maintained for passenger vehicles. These single-lane, rough-rock roads are primarily designed for heavy, off-highway logging trucks to implement silvicultural activities on the National Forest.

The transportation system can be broken into four categories: (1) state and municipal roads (all state and municipal roads are outside the Project Area), (2) private roads (no private roads exist within the Sea Level Project Area), (3) Forest Service roads, and (4) log transfer facilities (LTFs). The Project Area contains no public transportation facilities such as state highways, ferry dock, or airports.

Forest Transportation System

Forest roads are designed to varying standards depending on use. The forest transportation system includes three classes of roads: arterial, collector, and local. Arterial and collector roads are usually maintained for use by passenger vehicles and are designed with more emphasis on mobility than are local roads. Arterial and collector roads are generally mainline roads requiring higher standards and heavier investment to provide prolonged use. These roads can be built to lower standards initially and upgraded as use intensifies. Thus, the logging operator may construct arterial and collector roads to low or medium standards depending on use. Most local roads are not designed or maintained to accommodate passenger vehicles. Local roads are generally single purpose roads resulting in lower design standards and usually cost less than arterial and collector roads.

Construction of roads for timber harvest activity varies from year to year on Revilla Island. From 1990 to present, approximately 86 miles of local roads have been constructed on Revilla Island. These roads were constructed under the Shelter Cove Final Environmental Impact Statement (EIS) Record of Decision (ROD), the North Revilla Final EIS ROD and the Upper Carroll Final EIS ROD.

Traffic service levels portray the expected traffic characteristics for forest roads in the Project Area (see Appendix E). There are approximately 8.6 miles of traffic service level C roads within the Project Area, the remaining miles are traffic service level D. All new road proposed for each alternative will be constructed as traffic service level D.

Maintenance Levels

Maintenance levels are based on the anticipated use of the roads. Because roads in the Project Area are isolated, resource management for intermittent off-road vehicular and foot traffic is expected.

Maintenance levels for the Project Area are as follows:

- Maintenance Level 1 (traffic service level D)—Roads are closed or blocked by bridge removal, vegetative encroachment, or other closure methods and are monitored for resource protection.
- Maintenance Level 2 (traffic service level C)—Roads are maintained for high clearance vehicles and monitored for resource protection.

During resource management activities the roads will be maintained commensurate with the activity. After completion of the management activity these roads will revert back to the above mentioned maintenance levels.

Pre-haul and post-haul maintenance consists of ditch cleaning, road-side brush removal, roadbed surface blading, and installation of minor pipes.

Road Design

Road design patterns are similar from one alternative to another due to the location of the resource being used, terrain characteristics, and development costs. Roads are located to minimize disturbance on the land, yet provide access to resources. Thus, road locations generally follow routes of favorable terrain where practical.

Construction and Reconstruction of Roads

Road reconstruction consists of complete roadbed repairs, major culvert or bridge replacement (major drainage structures), roadbed realignment, and/or resurfacing.

All three classes of road would be constructed as part of the proposed alternative, each class having different projected uses and construction standards.

Construction and Reconstruction of Major Drainage Structures

Since the 1960s, timber harvest activities have occurred in the Project Area. Until 1980, many of the drainage structures of the Forest transportation system were constructed from native materials which had a safe working life of 8 to 12 years. Most of the drainage structures built with native materials have since then been replaced. The existing road system drainage structures were surveyed for fish passage in 1997. Those structures not providing fish passage where required are to be replaced with adequate structures during reconstruction. On both new and existing roads, modular bridges and permanent culverts will be used.

In situations where roads cross Class III streams, temporary log stringer bridges may be used and then removed upon completion of use. Temporary log stringer bridges may also be used on specified roads during road construction, prior to installation of the permanent structure, to facilitate timing and scheduling concerns.

Rock Borrow Quarry Location and Status (Disposition)

Generally, rock borrow quarries are located every 1 to 2 miles along roads. The quarry location is determined by quality of the rock sources, haul distances, development costs, frequency of entry, and aesthetic considerations. An allowance for rock quarries is included in the acres shown for right of way (ROW) clearing.

Future rock resource needs in the area will be evaluated. Some rock quarries are small, and used once, while others are expanded during future road building operations (if quality rock is available). Each quarry will be evaluated during the construction stage for availability of quality rock and feasibility of expansion. Rock quarries with expansion potential will be retained, particularly in situations where potential roads and timber harvest may be developed in the future, or where numerous roads radiate out from a point near a centralized quarry. Rock quarries near the ends of the road system will be closed and reclaimed by spreading stockpiled overburden on the floor of the quarry.

Log Transfer Facilities

To date the transportation of harvested timber on Revilla Island has required that the log bundles be removed from the log trucks, placed in the water, and rafted. Due to the isolated nature of the Project Area log transfer facilities (LTFs) will be required. Connecting roads to existing LTFs is considered, where feasible, to minimize impacts to beach and marine zones of building new LTFs. Consolidation would avoid the need to build LTFs on encumbered or state selected lands. Further analysis of LTFs is discussed in the Marine Environment, Log Transfer Sites and Related Facilities section of this chapter.

Effects of the Alternatives

The effects of the transportation system on other resources are considered in the sections in this chapter relating to those resources (geology, floodplains, scenic, aquatic, marine environment, etc.). This section focuses on the effects of each alternative on the transportation system and will be categorized as follows: (1) construction costs, (2) road development, and (3) access management.

Construction Costs

Table Roads-1 displays, by alternative, the miles of road constructed and reconstructed and the transportation development costs.

Table Roads-1
Transportation Development Costs (in MM$*) by Alternative

	Alternative					
	1	2	3	4	5	6
New Construction	0.00	13.20	8.80	5.90	5.00	2.50
Miles of New Construction	0.00	58.80	39.05	26.02	22.36	10.70
Reconstruction	0.00	0.23	0.18	0.20	0.19	0.12
Miles of Reconstruction	0.00	23.10	18.30	19.50	18.80	7.20
Bridge Construction/Reconstruction	0.00	0.50	0.40	0.30	0.30	0.00
Existing LTF Reconstruction						
Shelter Cove	0.10	0.10	0.10	0.10	0.10	0.10
Shoal Cove	0.10	0.10	0.10	0.10	0.10	0.10
Elf Point	0.10	0.80	0.80	0.80	0.80	0.10
Total LTF Reconstruction	0.30	1.00	1.00	1.00	1.00	0.30
Total Construction and Reconstruction Cost	**0.30**	**14.83**	**10.38**	**7.30**	**6.49**	**2.92**

Source: Oien 1998.
* MM$ = million dollars.

Road Development

The position and spatial arrangement of resources and the amount of harvesting that would occur in new undeveloped areas, requires changes in the planned road system. Proposed new roads are needed to harvest the timber volume associated with each alternative. To harvest all suitable and available timber in the Project Area a total of 117.6 miles of new road would be needed. The total miles planned are the roads needed to harvest the remaining timber volume in the rotation associated with each alternative.

Expansion of the road system requires: (1) construction of roads, (2) reconstruction of some existing roads, (3) construction and reconstruction of varying types of major drainage structures, and (4) construction coordination activities with other resource needs.

Table Roads-2
Transportation Systems (Miles)

Alternative	Total Existing Roads	Roads To Be Used For Harvest	Proposed New Roads	Total Transportation System*
2	158	70.30	58.8	**216.8**
3	158	55.40	39.05	**197.05**
4	158	39.07	26.02	**184.02**
5	158	37.64	22.36	**180.36**
6	158	14.34	10.67	**168.67**

Source: Oien 1997
Note: Discrepancies may be found between tables due to rounding.
* Total Transportation System equals the total existing roads plus proposed new roads.

Construction and Reconstruction of Roads

Construction

Alternatives 2 and 3 construct the most miles (58.80 and 39.05 respectively) and have the highest costs, while Alternative 6 constructs the least miles (10.67) and thus has the lowest cost. See Table Roads-1 for a display of the miles of new road and bridge construction and reconstruction costs. The level of local road development is not directly proportional to the level of harvest in each alternative because of differing spatial arrangements of harvest units.

Reconstruction

Reconditioning of existing roads is associated with all action alternatives. Activities range from major realignment and bridge replacement to minor blading and shaping of the existing road.

Pre-haul maintenance is not displayed in Table-1 Roads it is assumed all roads require some minor surface blading and ditch cleaning and brushing prior to commencement of log hauling operations. This is accounted for in the socioeconomic appraisal.

Road Connections to Eliminate LTF sites

Road connections to eliminate LTF's was considered and are feasible but the environmental effects of doing so were greater than the continued operation of the three existing, permitted LTF's scheduled for use.

Coordination with US Fish and Wildlife Service

Eagle Nest Trees

Road construction is not anticipated to be within 330 feet of any inventoried eagle nest trees in the Project Area.

In accordance with an agreement between the U.S. Forest Service and the U.S. Fish and Wildlife Service (USFWS), specific criteria concerning road construction within ½ mile of an active eagle's nest is implemented to mitigate disturbance to eagles. There are existing roads and planned roads within the ½ mile zone of known eagle nests on the Project Area. These areas are indicated on the road data cards.

Streams

Road construction involves crossing streams many which are habitat for various fish species. It is necessary to minimize impacts on these streams to protect salmon fry and eggs. Maintaining passage for fish and scheduling construction activities around fish movements (fish timing) are methods used to mitigate impacts of roads on fish populations. Some stream crossings need fish timing restrictions to minimize impacts on fish eggs and fry.

Generally, these restrictions can be accommodated through planning and scheduling of the construction activities. In many cases, additional costs would be incurred to accommodate the timing restrictions. Such costs would include additional equipment mobilization and demobilization, increased construction actions, and increased construction delays. It is estimated that approximately 250 feet of road are involved in crossing a Class I and II stream and buffer; 200 feet for the buffer crossing and 50 feet for the stream channel crossing. The estimated number of crossings with fish timing and/or passage restrictions are displayed in Table Roads-3.

Table Roads-3
Number of Crossings with Fish Timing and/or Passage Restrictions for Proposed Roads.

	Alternative					
	1	**2**	**3**	**4**	**5**	**6**
Both Timing and Passage	0	14	5	3	3	3
Passage	0	6	4	4	3	3
Timing	0	14	7	7	4	4

Source: Tisler 1997.
Note: Associated costs are included in the total road construction and reconstruction costs in Table Roads-2.

Tongass Timber Reform Act (TTRA) Stream Zones

Roads will be located within stream zones (buffers) where it is the environmentally preferred choice and where it is consistent with safety regulations. When these roads are designated on the ground, care will be taken to keep as much of the road as possible outside TTRA stream zones. In most cases, the limiting factor will be the type of terrain adjacent to the various stream zones, which will govern how much of a given road segment can be located outside these zones. Table Roads-4 displays the miles of stream channel and acres of stream zone that may be affected by roads.

Table Roads-4
Planned Road Development in Stream Zones

Alternative	Miles	Acres
1	0.00	0.00
2	2.37	17.22
3	1.00	7.23
4	0.71	5.17
5	0.71	5.17
6	0.62	4.48

Source: Oien 1997.

Wetlands

Peatlands, which includes bogs and fens, are treated differently than other wetlands due to their great expanse on the landscape in Alaska. Experience has shown that roads can be built across peatlands with an overlay-construction technique; appropriate fill material such as rock, logs, wood chunks, wood chips, or geotextiles, is used to construct a stable road base.

As wetlands generally occur on flatter slopes, the width of the affected area is less than the average ROW width. The average ROW width is 75 feet and includes acreage for rock quarry sources, which are not usually in wetlands areas. The ROW width also is the average for all sideslopes from flat ground to full bench (55 percent plus). With wetlands being on the flatter slopes where there is overlay construction, clearing widths will vary from 20 to 30 feet wide depending on slope, horizontal and vertical alinement of the road, and other safety related requirements. Where practicable, standard road construction across peatlands excludes road-side ditches that would disrupt subsurface drainage patterns and create altered wetness conditions. Providing adequate cross drainage is an important consideration for maintaining natural runoff patterns. Wetlands will not be used for disposal of endhaul material. For further information on wetlands, see Floodplains and Wetlands in this chapter 3.

State Land

No road or LTF development will take place within State lands.

Access Management

In all the proposed action alternatives, access to the road system is by boat or float plane, none of the road systems are connected to any community, public road system or ferry terminal. Due to these limits, vehicular use is expected to be negligible except for some use of off-highway vehicles while roads are open.

Options for managing traffic are:

1. Encourage use consistent with the conditions of the road and resource management direction.
2. Accept, but do not encourage, use by vehicles that are not suited for use on a specific road.
3. Discourage all public motor vehicles.
4. Eliminate use by physically blocking the road to all motor vehicle traffic.
5. Prohibit motor vehicle use by an order.

Roads are closed or blocked for numerous reasons including fish and wildlife protection, public safety, other resource protection, and inadequate maintenance funding. It may be necessary to close or block complete roads or portions of roads to use by specific vehicle types. Roads under Forest Service jurisdiction can be closed to motorized vehicles by authority of CFR 36, Ch.11, parts 212.7 and 261. Road closure orders will be posted at the Ketchikan Ranger District office.

New roads proposed for this project will be closed, blocked or obliterated at the termination of silvicultural activities in the area. Some existing roads that are now open will be closed or blocked for a variety of reasons. Cost of maintenance of these roads is the primary reason for closure or blockage.

Road Disposition

Maintenance of the closed or blocked roads will consist of monitoring road and drainage structures for functional and environmental condition. Permanent drainage structures will be installed to meet long-term access objectives; however, maintenance levels fluctuate in response to changing uses. During periods of limited use, maintenance standards are sufficient to provide only for administrative use and resource protection. Post sale road management objectives are to keep the road open for administrative activities and to facilitate maintenance for resource protection. Maintenance Level 1 will be applied to these roads, which will include waterbars to safeguard minor drainage structures. This measure will minimize erosion in the event of structure failure.

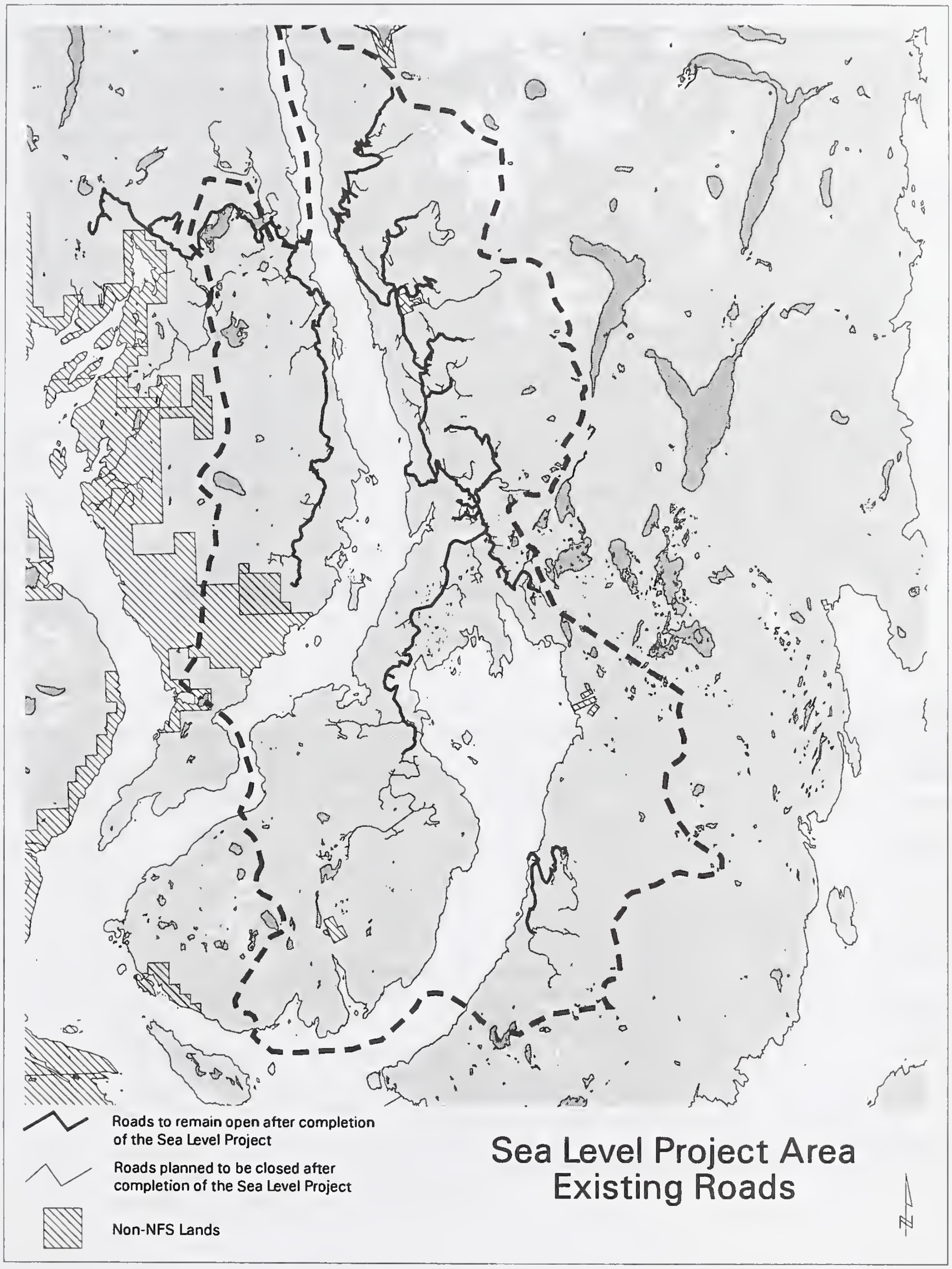
For roads to be closed, bridges will be removed and used in other locations. The roads behind bridges will not be maintained for vehicular traffic; however, drainage structures will be monitored for functional condition. Maintenance Level 1 will be applied to these roads, which will include waterbars to safeguard minor drainage structures. This measure will minimize erosion in the event of structure failure.

Roads to be obliterated shall have the drainage structures removed on all live streams, the road waterbarred and seeded and unstable cutslopes stabilized.

Temporary roads are not retained on the permanent transportation system. These roads will be closed by removing structures, construction of water bars and revegetation of the soil in accordance with National Forest Management Act.

Figure Roads-1 illustrates the roads to remain open with limited maintenance and the roads to be closed. The summary of road management objectives, containing the specific disposition of all existing and proposed roads, including the mileposts of existing roads where closure will be, is in Appendix E.

Figure Roads-1
Road Condition Survey



Road Condition Survey

In 1996-97, Ketchikan Ranger District Fisheries personnel initiated a road condition survey to identify general maintenance concerns for the Shoal Cove road system. The Shoal Cove road system currently has over 70 miles of existing roads. Using a modified version of the Petersburg Ranger District road survey, over 47 miles of existing mainline and lateral roads were surveyed in that area. They were chosen to be surveyed based on the number of streamcrossings and which had high maintenance concerns. Existing roads located in the Shelter Cove and Elf Point area which were not surveyed in 1997 will be inspected in 1998 to identify any critical maintenance concerns.

Objectives

- Identify maintenance concerns that directly affect fish passage and fish habitat.
- Prioritize and identify maintenance levels for each road.
- Identify and update all fish streams that were not previously documented in the Ketchikan Area road logs.

The road condition survey completed in the Shoal Cove Area collected information on a variety of parameters related to roads and their affect on fish passage, habitat and water quality (see Appendix E for survey data). Information collected includes:

- Location and size of all culverts and bridges installed for intermittent and perennial streams. All structures are identified and mapped by milepost (taken off road condition surveys).
- General condition of culverts including: barriers to fish passage, percent damage, percent plugging and diversion potential.
- Record information on potential sediment sources to downstream fish habitat by roads.
- Update of the Aquatic Habitat Management Unit classes for fish passage and water quality crossings for each road (See the Sea Level EIS planning record for the Road Condition Survey Data Dictionary).

Table Roads-5
Road Condition Survey Information (Shoal Cove Mainline Road System including Lateral Roads)

Road Number[1]	Mainline Miles	Lateral Miles	Miles Surveyed[2]	# of Passage Required	# of Passage Failures	Water Quality Crossings	Water Quality Failures[3]
8400000	4.00	4.97	12	8	2	19	1
8430000	13.18	4.96	18	17	6	45	12
8435000	2.79	0.50	1	1	1	8	0
8440000	3.54	2.47	5	2	1	25	2
8444000	4.00	1.55	3	3	0	22	4
8446000	5.00	1.00	0	2	1	0	0

Source: Tisler 1998.
1 Includes mainline roads plus lateral roads within each road segment.
2 Total miles of mainline and lateral roads surveyed.
3 A water quality failures means that heavy equipment will be required for repair/replacement.

Road Management Considerations

A fish stream is defined as any water flow that is accessible to fish and capable of supporting aquatic life. This includes, but is not limited to, all Alaska Department of Fish and Game (ADF&G) designated streams and all their tributaries up to impassable natural barriers. Freshwater systems above blockages may also support resident fish stocks. Evaluation and recommendations will be made by a fisheries biologist during route locations to determine the presence of fish or fish habitat.

Passage Requirements

The objective of providing fish passage is to not interrupt the natural migration of anadromous and resident salmonids. Fish populations depend upon a mixture of habitat types for growth and reproduction. The incorporation of fish passage structures at stream crossings should be based on assessments of the life cycle requirements of fish species, of habitat quality, and the accessibility of sites to fish. Figure Roads-2 displays all the passage requirements.

The choice of crossing location is very important in terms of both sedimentation effects and fish passage. Stream reaches with uniform alignment, good bank stability, and uniform gentle gradients are the easiest to cross and provide for fish passage.

Current Forest Service policy and direction is to provide for the passage of fish at all designated fish streams. Table Roads-8 lists streamcrossings in which fish passage is required for the Shoal Cove existing roads.

Timing Restrictions

The seasonal timing of instream construction operations are most often prescribed as a resource protection requirement for Class I streams. Timing may be recommended on Class II and sometimes Class III streams. Timing recommendations are based on the site-specific and downstream impacts to: spawning, egg presence, fry emergence, and migration of smolts (BMP 14.6). The timing windows are listed in Table Roads-6.

Table Roads-6
Timing Windows for Instream Construction

Species	Timing Window
Pink/Chum	June 1 to August 7
Sockeye	July 18 to August 15
Coho	June 15 to September 1
Steelhead	July 18 to August 15

Source: Tisler 1997.

The window dates represent a period during which instream work can be conducted. For example, if pink salmon are present, all instream work must be done between June 1 and August 7. However, if both pink salmon and steelhead are present, the timing window is shortened to July 18 to August 7.

Timing windows are to be determined from a review of site specific information. Variances from the general windows are allowed on a case by case basis, particularly with implementation of the appropriate mitigation measures as prescribed by fisheries biologists. Table Roads-7 lists the ADF&G catalogued streams that will be subject to timing restrictions and require instream road construction.

Table Roads-7
ADF&G Catalogued Streams That Will Require Instream Road Construction And Maintenance

ADF&G Stream Number	New Construction	Reconstruction	Alternative
101-43-10410	x		2,3
101-43-10150	x		2
101-45-10880	x	x	2,3,4,5
101-43-10560	x		2,3,4
101-45-10880-2003	x	x	2,3,4,5
101-43-10180	x	x	2,3

Source: ADF&G Stream Catalogue and Road Condition Survey 1997.

Additional recommendations for design and maintenance of the road system to maintain riparian and wetland function and fish habitat include:

- Minimize the amount of new road construction through fens. Roads located on fens can impede the natural water movement associated with these areas and generally require a high density of drainage structures. Fens often contain numerous Class I and II channels that provide high value fish habitat and will therefore require special passage and/or timing restrictions. Roads located within fens usually require high maintenance due to beaver activity.
- Avoid crossing active alluvial fan channel areas. Where possible locate crossings at the apex of the fan where the stream is still relatively contained. If the fan must be crossed, extra and oversized drainage structures are recommended.
- Remove all drainage structures in sensitive areas where fish passage, beaver habits, and unstable stream channels are a concern unless routine road drainage maintenance is feasible. Close all temporary roads and use water bars to control road drainage.
- Conduct annual inspections in accordance with criteria set forth in the Soil and Water Conservation Handbook and Monitoring Plan. Identify all existing and potential streamcrossing deficiencies and recommend corrective actions.
- Construction of roads, particularly mid-slope roads, in sediment source areas should be minimized. Roads in these sensitive areas have potential for accelerating large scale mass wasting and have a high likelihood of direct sediment delivery to anadromous and resident fish habitats.
- To ensure proper fish passage for anadromous and resident fish, install over-sized culverts where bridges are not feasible. Over-sized culverts should be buried enough for the stream to regain its natural streambed and to allow natural flows during high water events.

Road Maintenance Strategy

Data collected from the road condition survey will be used in prioritizing road segments that require general maintenance and will help in determining whether a specific road will stay open or closed. Road segments identified as having critical maintenance concerns will be repaired and/or closed during implementation of the Project. Money generated through timber harvest will be used to finance any maintenance concerns identified within the Project Area. Table Roads-8 lists the number of streamcrossings that will be repaired/replaced for each alternative.

Roads segments both outside and inside Project Area, identified as having critical maintenance concerns will be repaired/replaced using funds allocated for Fiscal Year (FY) 1998. Maintenance to be performed in FY98 will include the replacement of corrugated metal pipes currently failing due to structural damage, blockage, and failure to provide fish passage. Road segments having limited resource management activities and identified as having extensive maintenance concerns will be closed by removing all culverts along that road.

Table Roads-8
Streamcrossings (Fish Streams & Water Quality) Scheduled for Repair/Replacement for the Shoal Cove Road System (Mainline & Lateral)

	Alternative					
Road Number	**1**	**2**	**3**	**4**	**5**	**6**
8400000	0	1	2	2	1	0
8430000	0	19	15	0	3	0
8435000	0	1	1	0	0	0
8444000	0	4	0	0	0	0
8446000	0	0	0	0	0	0

Source: Tisler 1997.

Table Roads-9
Streamcrossings for Fish Passage for Existing Roads.

Road Number	Milepost	AHMU Class (TTRA)	Passage/Failure	ADF&G Stream #
8400000	24.25	I	Passage	
8400000	26.18	II	Passage	
8400000	26.81	II	Failure	
8400000	28.59	I	Passage	101-45-10880
8400000	29.61	I	Failure	101-45-10880-2003
8400000	32.89	II	Passage	
8400000	34.78	I	Passage	
8400000	37.16	I	Passage	101-45-10850
8430000	1.49	II	Passage	
8430000	2.67	I	Passage	
8430000	4.08	I	Passage	101-45-10230
8430000	4.20	I	Passage	
8430000	4.27	I	Passage	
8430000	6.46	II	Passage	
8430000	6.84	II	Failure	
8430000	6.92	I	Failure	
8430000	8.18	II	Failure	
8430000	8.49	II	Passage	
8430000	8.51	II	Passage	
8430000	10.46	II	Failure	
8430000	11.15	II	Failure	
8430200	0.17	II	Passage	
8430050	0.11	II	Failure	
8440000	2.15	I	Failure	101-45-10880
8440000	1.90	I	Passage	101-45-10880
8435000	0.03	II	Failure	
8442000	0.46	II	Passage	
8444000	0.03	II	Passage	
8446000	3.00	II	Passage	
8446000	3.09	II	Failure	
8400350	0.35	II	Passage	

Source: Tisler - Road Condition Survey 1997.

Figure Roads-2
Fish Passage Requirements for Sea Level Existing Roads

Source: Tisler GIS 1998.

Scenic Resources

Key Terms

Cumulative Visual Disturbance (CVD)—the sum of all scenic effects created by all landscape alterations that are visible at a given point in time.

Distance Zone

Foreground—the detailed landscape found within 300 feet to ½ mile from an observer.

Middleground—the space between foreground and background in a picture or landscape. The area located from ½ to 4 miles from the viewer; often the most critical zone for scenery management; form, texture, and color remain dominant, and pattern is important.

Background—the distant part of a landscape; from 4 miles to the horizon from the viewer; line, form and pattern are the dominant visual characteristics.

Viewshed—a distinct area of land visible from important travelways (boat route, trail) or use areas (recreation cabin, anchorage).

Visual Condition (VC)—a measure of the magnitude of human-caused deviations in form, line, color, and texture from attributes of the natural or natural-appearing landscape. Visual condition is used to describe an existing situation (EVC) or a desired future condition (FVC). Defined in terms that closely correlate with VQOs listed below.

Level I - Unaltered—areas where only ecological changes have taken place. Corresponds to the preservation VQO.

Level II - Imperceptibly altered—management activities are not visually evident to the casual forest visitor. Corresponds to the retention VQO.

Level III - Slightly altered—management activities may be evident, but must remain visually subordinate to the natural or natural-appearing landscape character. Corresponds to the partial retention VQO.

Level IV - Moderately altered—management activities may dominate the landscape character, but at the same time, appear as a natural occurrence when viewed in the middleground or foreground zone. Corresponds to the modification VQO.

Level V - Heavily altered—management activities may dominate the landscape character, but should appear as a natural occurrence when viewed as background. Corresponds to the maximum modification VQO.

Level VI - Drastically altered—human-caused deviations that glaringly dominate the natural or natural-appearing landscape. An unacceptable visual condition. Does not meet any minimum visual objective.

Visual Quality Objective (VQO)—management direction that sets measurable limits on degrees of human-caused alterations and management activities; is based on a landscape's diversity of natural features and the public's sensitivity for high scenic quality.

Affected Environment

Introduction

An important aspect of Southeast Alaska's natural resource base is its attractive setting. The importance of the scenic character of a landscape area is evident by increased tourism and a heightened awareness of and sensitivity to scenic resource values by Alaska's residents and visitors alike. Because of this public concern, the "visual landscape" has been established as a basic resource of the land, and receives consideration along with the other forest resources.

The Visual Management System (VMS), developed by the Forest Service in 1976 and revised in 1996, inventories these scenic or visual resources and provides measurable standards for their management. The VMS deals with the visible aspects of the land and the design of human activities occurring on it. The VMS provides an overall framework for the orderly inventory, analysis, and management of scenery (Landscape Aesthetics: A Handbook for Scenery Management, 1996). This inventory and analysis system applies to every acre of National Forest System lands and all activities administrated by the Forest Service.

Project Area Scenic Analysis

Landscape Character and Variety

On the Tongass National Forest, landscape character can be described as an overall visual impression of its landscape attributes—the physical appearance of a landscape that gives it an identity and "sense of place" or "lay of the land". Landscape character gives a geographic area its image. These areas or types of landscapes are distinct geographic units of land, each having distinguishing visual characteristics of landform, rock formations, waterforms, and vegetative patterns (USDA Forest Service, 1979b).

A landscape can be described by inventorying its physical features—terrain, geologic, water, and vegetative patterns. The Sea Level Project Area is typical of the Coastal Hill landscape character type. The Project Area consists of a deeply incised island with two major north-to-south waterways—the lower and middle portions of Carroll Inlet and all of Thorne Arm. The western boundary is dominated by a 1,000- to 2,000-foot ridge that separates Carroll Inlet from George Inlet. The eastern boundary matches the Misty Fiords Wilderness Area boundary. The southern boundary is formed by a combination of Revilla Channel (the main cruise and tour ship route along the Inside Passage), and the northern boundary of VCU 760. The northern Project Area boundary matches with the southern boundary of VCU 747 and VCU 745 (State of Alaska - Swan Lake hydroelectric generation facility).

Prominent physical features of the Project Area can be described as follows:

Terrain Features - characterized by moderately diverse rounded to occasionally blocky terrain created from ancient glaciation—rounded, hummocky summits, knobs, and ridges. Generally steep landforms to saltwater and an irregular rounded appearance are characteristic of the terrain (Middle Carroll Inlet and Lower Thorne Arm).

Vegetative Patterns - dense conifer cover is prevalent; however, many small muskeg areas dominate the lowlands (Minx Flats area—between Upper Thorne Arm and Lower Carroll Inlet; adjacent to Fish Creek cabin). Some variation in color and texture can be expected, although this character type is dominated by few major plant cover types.

Project Area Viewsheds

For purposes of assisting in the design of harvest areas and providing a systematic way to analyze and display the impacts of different alternatives, several viewsheds were identified. These viewsheds are discrete areas defined by logical terrain features such as major ridges or other landform features. Computer-generated perspectives from several representative viewpoints were developed within these viewsheds using PC New Perspectives and ArcInfo to help analyze the visual impacts of the various alternatives. The alternative effects analysis is based on the viewsheds (See Figure Scenic-1 for viewshed locations) listed below:

1. Saddle Lakes recreation area
2. Middle Carroll Inlet
3. Lower Carroll Inlet
4. Fish Creek Cabin & anchorage
5. Upper Thorne Arm
6. Lower Thorne Arm

In the following sections, these six viewsheds will be described in terms of their existing visual condition (degree of visual disturbance) and the 1997 Forest Plan visual quality objectives (VQOs). The environmental consequences section will then describe the visual impacts of each alternative on these viewsheds.

1997 Forest Plan Visual Quality Objectives (VQOs)

Visual quality objectives are a set of measurable standards for management of National Forest landscapes. They are: Preservation (P), Retention (R), Partial Retention (PR), Modification (M), and Maximum Modification (MM), and are defined in the Glossary (Chapter 4). Except for Preservation, each describes a different degree of potential, but acceptable, levels of alteration of the natural landscape. Degree of alteration is measured in terms of visual contrast with the surrounding natural landscape. Over time, visually altered forest landscapes return to a natural appearance.

The 1997 TLMP established visual resource management goals to be implemented in each land use designation (LUD) on the Sea Level Project Area (see Table Scenic-1). These goals are referred to as adopted VQOs, and are derived from a combination of two factors:

- whether a landscape area can be seen from a Visual Priority Travel Route and Use Area (VPR) designated in Appendix F of the 1997 TLMP; and
- the distance zone between the area being viewed and the viewer (see Key Terms).

Table Scenic-1
Adopted Visual Quality Objectives, by Distance Zone and Land Use Designation (LUD)

	Adopted VQO by Distance Zones (as seen from a Visual Priority Travel Route and Use Area)			
Project Area Land Use Designations	**Foreground**	**Middleground**	**Background**	**Not seen from Visual Priority Route/Area**
Old-growth Habitat	Retention	Retention	Retention	Retention
Semi-remote Recreation	Partial Retention	Partial Retention	Partial Retention	Partial Retention
Scenic Viewshed	Retention	Partial Retention	Partial Retention	Maximum Modification
Modified Landscape	Partial Retention	Modification	Modification	Maximum Modification
Timber Production	Modification	Maximum Modification	Maximum Modification	Maximum Modification

Source: TLMP 1997.

Visual Priority Travel Routes and Use Areas

The 1997 TLMP identified priority viewpoints from which scenery will be emphasized. These viewpoints are used to assess the existing visual condition of any given project area and to develop project designs that will be consistent with the adopted VQOs for each LUD.

Priority Saltwater Use Areas
Carroll Inlet and Thorne Arm (from Ketchikan, 32 and 37 miles, respectively) are classified as saltwater use areas. These waterways are used extensively by local sport and commercial fishing boats from nearby Ketchikan, Saxman, and Metlakatla.

Priority Inland Recreation Use Areas
The Saddle Lakes area is a future recreation complex near Shelter Cove on Carroll Inlet and is the only inland recreation site in the Project Area; although it is considered a potential or planned use area in TLMP. This area is currently road accessible for ATVs or four-wheel drive vehicles brought in by boat via the Shelter Cove log transfer facility (LTF) on Carroll Inlet. However, due to a potential road connection to the population center of Ketchikan, recreational use is expected to increase in the foreseeable future (within ten years).

Priority Shoreline Recreation Use Areas
The Fish Creek cabin and associated mooring buoy at the mouth of Fish Creek is defined as a priority shoreline recreation use area.

Project Area VQOs

The VQOs for the Sea Level Project Area are consistent with the Forest Plan (TLMP 1997). The visual quality objectives and land-use designations (LUDs) for the six project area viewsheds are listed below.

Saddle Lakes Recreation Area
This area is within the Project Area's only Scenic Viewshed LUD. Its visual management prescription is Retention VQO in the foreground distance zone and Partial Retention VQO in the middleground.

Middle Carroll Inlet (south of Shelter Cove)
This area is a combination of Modified Landscape LUD and Partial Retention VQO in the foreground, Modification VQO in the middleground and Timber Production LUD - Maximum Modification VQO in certain middleground areas.

Lower Carroll Inlet (south of Shoal Cove)
Modified Landscape LUD - Partial Retention VQO in the foreground and Modification VQO in the middleground; Timber Production LUD - Maximum Modification VQO in certain middleground areas. The visible southwest portion of viewshed is private land extensively harvested 8-10 years ago.

Fish Creek Cabin and Anchorage
A unique combination of a Modified Landscape LUD - Partial Retention VQO in the foreground, and Timber Production LUD on the middleground slopes with a Maximum Modification VQO.

Upper Thorne Arm
A combination of two natural setting LUDs: (Old-growth Habitat) - Retention VQO in both foreground and middleground; and (Semi-Remote Recreation) - Partial Retention VQO in both foreground and middleground. It also combines two developmental LUDs (Modified Landscape) - Partial Retention VQO in the foreground and Modification VQO in the middleground; and (Timber Production) - Modification VQO in the foreground and Maximum Modification VQO in the middleground.

Lower Thorne Arm
On the western shoreline, a combination of a natural setting LUD (Old-growth Habitat) - Retention VQO both foreground and middleground; and a developmental LUD (Modified Landscape) - Partial Retention VQO in the foreground and Modification VQO in the middleground.

On eastern shoreline, the developmental LUD of Timber Production - Modification VQO in the foreground and Maximum Modification VQO in the middleground.

Existing Visual Condition of Project Area

Existing Visual Condition (EVC) represents the degree of visual modification or disturbance presently occurring on the ground. Similarly, Future Visual Condition (FVC) represents the visual condition level that would occur at the end of a proposed activity period (including what presently exists). Both are measured in terms of condition types as described in the Key Terms (Levels I - VI) at the beginning of this section. Existing and future visual condition levels may also be described in terms similar to those used to describe VQOs. Additionally, visual modification levels of viewsheds can be described in a similar manner.

An existing visual condition analysis can be used to: (1) compare a viewshed's actual condition (current degree of alteration) with a project's adopted VQOs; (2) assess cumulative visual impacts of alternatives; and (3) determine whether the proposed management activities or facilities will maintain or change the present conditions, lower the scenic quality, or meet/not meet a project's VQOs.

The landscape character and EVC of the Project Area viewsheds are described in the following text.

Saddle Lakes Recreation Area Viewshed

This viewshed has a closed-in bowl character with a mainline road at the base of even steep slopes. All views are foreground with a natural to slightly altered appearance from the road.

Middle Carroll Inlet at Shelter Cove

Closed canyon, steep sided, close-in views

A. Northeast View - Marble Creek - heavily altered appearance
B. Southeast View - Painted Peak - moderately to heavily altered appearance

Lower Carroll Inlet at Shoal Cove

Open terrain, close-in to distant and crossover views (views into other viewsheds)

A. Northeast View - Painted Peak - heavily altered appearance
B. Northwest to West View - moderately to heavily altered
C. Southeast View - Eve Point - moderately altered appearance

Fish Creek Cabin and Anchorage

Open terrain, middle to distant views, crossover views

Southwest View - Eve Point - heavily altered appearance

Upper Thorne Arm

Open terrain, middle to distant views, crossover views

A. North View - Fish Creek Cabin - slightly altered appearance
B. Southeast View - Elf Point - slightly altered appearance

Lower Thorne Arm

Close-in, steep-sided canyon landscape character, close-in views

A. Northwest View - Eve Point - unaltered appearance
B. Southeast View - Elf Point - moderately altered appearance

There are 34,412 viewshed acres (38 percent) within the Project Area, of which 6,038 seen acres (or 18 percent) of the viewsheds have been harvested since the middle 1960s. Although the majority of second-growth is 20 to 40 years old and 25 to 40 feet high, it is still noticeable when viewed as foreground due to variations in topography, harvest unit shape and location, and mature-stand backline edge contrasts. Vegetation texture and color differences account for definitive edge separations as well.

Private Lands

A major factor affecting the visual condition in this Project Area is the extensive timber harvest and road system on private lands on the prominent slopes and ridges at the south end of the peninsula between George Inlet and Carroll Inlet. The scale of this expansive harvest (beginning in the late 1980's and continuing) clearly dominates views from the nearby Lower Carroll Inlet, Upper Thorne Arm, and Fish Creek Cabin viewsheds. The appearance of this easily noticed clearcut may influence a casual forest visitors' impression of existing and proposed harvest on adjacent National Forest System lands. In addition, it is clearly visible from the major cruise ship route in Revilla Channel (south of and adjacent to the Project Area) and from the popular saltwater sport fishing areas near Mountain Point and Herring Bay.

The following map, Figure Scenic-1, Project Area Viewsheds, illustrates the visible terrain in the Project Area.

Figure Scenic-1
Project Area Viewsheds

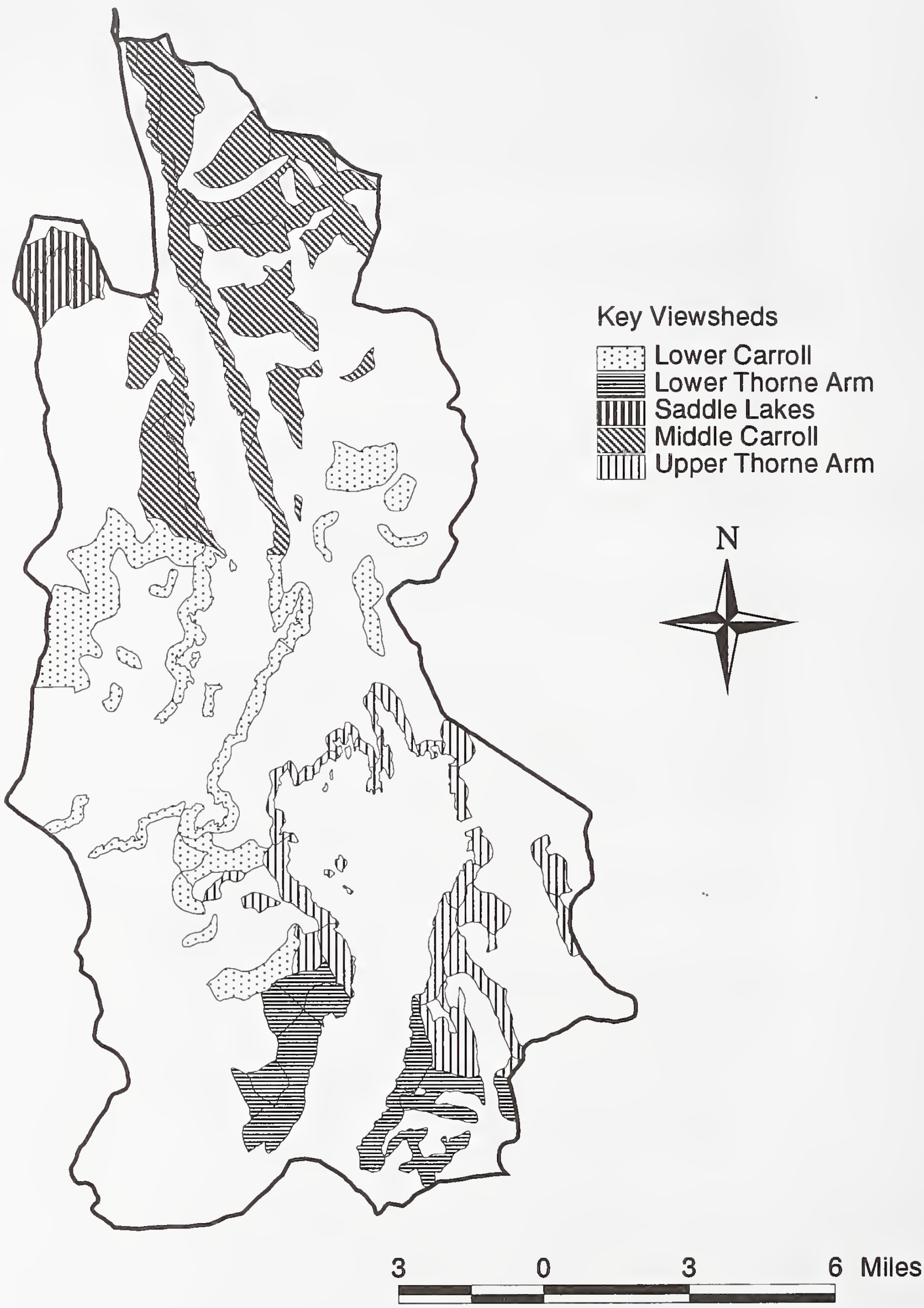
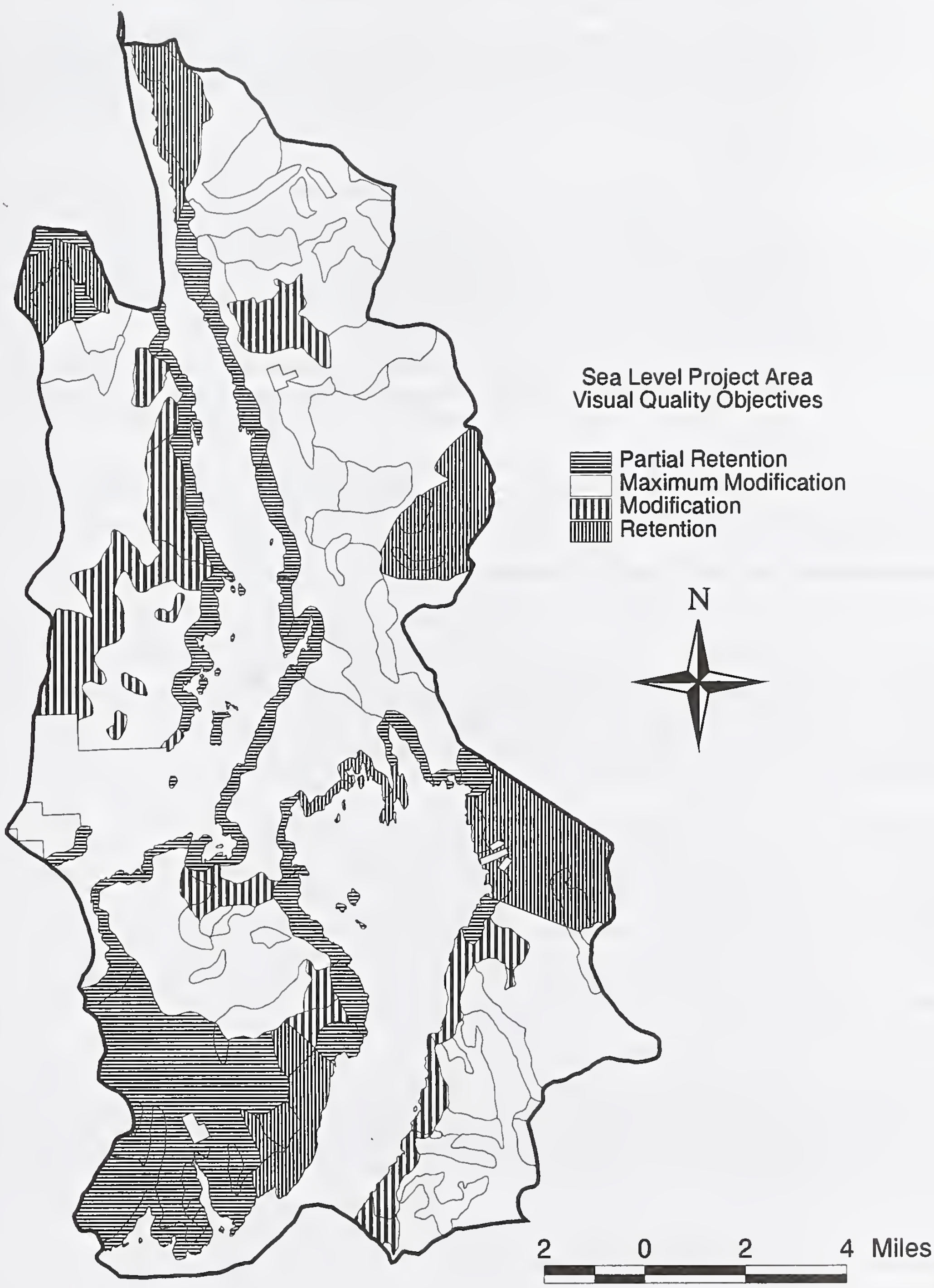


Figure Scenic-2
Sea Level Project Area Visual Quality Objectives



Effects of the Alternatives

Individual Viewsheds

The following discussion will cover the visual impacts of the proposed action alternatives within six viewsheds. The discussion order for the Carroll Inlet area is geographically southward from the Saddle Lakes Recreation Area to Lower Carroll Inlet, then crosses over into Upper Thorne Arm at the Fish Creek cabin site, finally ending at the Lower Thorne Arm viewshed.

Although computer-assisted viewshed analyses were plotted none are displayed in this section due to the majority of harvest being proposed as Individual Tree selection or other partial harvest techniques. The area with the most exposed clearcuts (patch cuts) is the southeastern shoreline of upper Thorne Arm viewshed, north of Elf Point. However, this area meets the Modification and Maximum Modification VQOs for the Timber Production LUD, the most permissive of the Forest Plan land-use designations.

The following table, Scenic-2, displays the visible units and visible acres per action alternative. Alternative 2 proposes the most visible units and acres (51 units or 1,162-acres), while Alternative 6 proposes the least (3 units or 73-acres). The Fish Creek cabin viewshed is not shown.

All proposed units in all of the action alternatives would meet the adopted VQO's.

Table Scenic-2
Visible Harvest Units and Visible Acres per Alternative

	Alt. 2		Alt. 3		Alt. 4		Alt. 5		Alt. 6	
Viewshed Name	**Units**	**Acres**	**Units**	**Acres**	**Units**	**Acres**	**Units**	**Acres**	**Units**	**Acres**
Saddle Lakes	1	49	0	0	0	0	0	0	0	0
Lower Carroll Inlet	20	509	13	290	11	244	10	244	3	73
Lower Thorne Arm	6	133	3	80	3	80	0	0	0	0
Middle Carroll Inlet	12	197	4	75	5	80	3	34	0	0
Upper Thorne Arm	12	274	10	202	6	148	1	14	0	0
Project Area	**51**	**1,162**	**30**	**647**	**25**	**552**	**14**	**292**	**3**	**73**
Average Visible Unit Size	22.8		21.6		22.1		20.9		24.3	

Source: GIS, Angelus 1998.
Note: Visible harvest acres reflects a plan or "birds-eye" view measurement. Actual visible acres are less because they are viewed in the perspective view (i.e., from a boat deck or beach cabin). Terrain features and forested vegetation help block most of the visual impacts of timber harvest and constructed roads. For example, Alternative 2 in the Saddle Lakes viewshed with a Visual quality objective of retention (no alteration to be evident) would normally preclude a harvest unit 49 acres in size, but the proposed location is mitigated by terrain and vegetation screening. Hence it meets the Retention VQO.

Saddle Lakes Recreation Area Viewshed

This 1,600-acre inland use area viewshed has an undisturbed natural appearance from the lake surface except for a 24-foot wide (recreation standard) gravel road skirting the north side of the largest lake and the south shore of the smallest lake. At some point in the future, this road may be joined with a "missing link" road connection to Harriet Hunt Lake. Roaded access may make this road corridor and lake viewshed even more sensitive to effects from future management activities.

Currently, this viewshed meets the adopted VQOs of Retention in the foreground and Partial Retention in the middleground.

Alternative 1 - No Action, and Alternatives 3, 4, 5, and 6

The Existing Visual Condition (EVC) of this viewshed ranges from natural-appearing (Level II) on the slopes and ridge-tops, to slightly altered (Level III) on the lakes' north shoreline. Because this project proposes no visible harvest in any of these alternatives, the Future Visual Condition (FVC) would remain natural-appearing except for continuing change in tree height, color, and texture. Additionally, the road cut slopes would revegetate over time thereby reducing soil color contrasts with the adjacent forest.

Alternative 2

Only one harvest unit is proposed (Unit 203) on the ridge-top south of the largest lake. This unit as proposed (49.4 acres) locates three patch cut openings in nearly unseen portions of the viewshed at the crest of the ridge. Due to this unit's placement on the ridge-top, its exposed ground and slash would not be visible to the casual forest visitor. Unit 203 meets the adopted Retention VQO. The Future Visual Condition (FVC) would remain natural-appearing.

Middle Carroll Inlet Viewshed

This 12,045-acre priority saltwater use area viewshed is the first in the Project Area encountered while boating south from the State of Alaska's Swan Lake hydroelectric facility near the head of Carroll Inlet. It is located nearly 1 mile east of the Saddle Lakes Recreation Area Viewshed. The landscape character consists of an essentially narrow canyon in the north giving away to a more open and wider canyon on the south near Island Point and Shoal Point. This canyon is 1/2 to 1 mile in width with steep slopes rising to 2,500-foot ridgetops.

This viewshed has the most existing visible harvest (2,914 acres or 24 percent) of the Project Area. The eastern foreground and middleground slopes were extensively harvested in the 1970's to early 1990's. The western shore was just harvested in the mid-1990's on very steep slopes in the foreground to near middle ground. This harvest is fully exposed, directly facing any boating recreations or other viewer. Because of these visual impacts, this viewshed's appearance ranges from moderately altered (Level IV) to heavily altered (Level V).

Because of the scale and intensity of visible harvest on the eastern middleground slopes, the EVC of this portion of the viewshed does not meet the adopted VQOs of Modification. The western portion of this viewshed meets the adopted VQO of Partial Retention in the foreground (owing to the height of second-growth forest) and the adopted VQOs of Modification and Maximum Modification on the middleground slopes (different land-use designations). The apparent scale of harvest is not so dominant that additional, but small scale, alterations could still be made in this portion of the viewshed.

Alternative 1 - No Action

The EVC of this viewshed is moderately altered (Level IV) from an existing 2,914 seen acres of timber harvest and a LTF. Left unchanged, the FVC would remain the same except for a change in tree height, color, and texture.

Alternatives 2, 3, 4, and 5

These four action alternatives propose from 3 to 12 harvest units (from 34 to 197 visible acres). This harvest would occur adjacent to existing alterations or on middleground slopes more than 1 mile distant. Most of the proposed harvest units are screened from major impacts by the 1000-foot shoreline vegetative buffer. Although there is an active LTF onshore immediately in the foreground at Shoal Cove, the proposed additional harvest would not add appreciably to visual contrasts. All proposed harvest in all alternatives would meet the adopted VQOs. However, visible foreground rock pits and road cut-and-fill slopes may not meet the VQOs. The FVC would remain the same except for a change in tree height, color, and texture.

Alternative 6

Alternative 6 does not propose visible units within this viewshed. Because of this, the FVC would remain the same except for a change in tree height, color, and texture.

The next two viewsheds are on separate waterways (and different priority use areas), are adjacent to each other, and share many of the same visible ground areas. Some viewed areas are seen as background distance zone or, 4 or more miles from the viewer. Harvest, roads, or another management activity would, at a minimum, need to meet a Modification VQO, but should appear as a natural opening in the landscape setting.

Lower Carroll Inlet Viewshed

This 9,167-acre saltwater use area viewshed is essentially the eastern and western shorelines of Carroll Inlet from near Shoal Cove and Island Point to just south of Hume Island. The landscape character is less confined and more open with crossover views (to other priority routes and use area viewsheds). Visible areas are confined to the immediate foreground shoreline, occasional hummocks and knobs in the middleground, with moderately angled slopes and forested ridge-lines in the far middleground. It is interesting to note that many of the visible areas are actually fully within another viewshed (Upper and Lower Thorne Arm) or outside the Project Area, such as Misty Fiords National Monument, the mountains above Ketchikan, or on Annette Island many miles away.

Currently, this viewshed meets the adopted VQOs of Partial Retention in the foreground and Modification in the middleground.

Alternative 1 - No Action

The existing visual condition of this viewshed ranges from slightly (Level III) to moderately altered (Level IV) from an existing 1,593 seen acres of timber harvest. With no additional harvest, the FVC would remain the same except for natural changes in tree height, color, and texture.

Alternatives 2, 3, 4, 5, and 6

These five action alternatives propose from three to 20 harvest units (from 73 to 509 visible acres). Most of this harvest will occur adjacent to existing alterations or on middleground slopes more than 1 mile distant. Units 240 and 241 (51 total acres), proposed only in Alternative 2, would be most visible to observers looking in a southwest direction from near the entrance of Shoal Cove. Because these two units are located immediately adjacent to the existing large expanse of private land harvest from this viewpoint, these units may not meet the VQO of Modification. Most of the other proposed harvest units in all the action alternatives are screened from view by beach fringe vegetation or would blend in with the already altered landscape. The FVC for all action alternatives, except for Alternative 2 noted above, would remain in a moderately altered (IV) condition.

Fish Creek Cabin and Anchorage Viewshed

Located at the head of Thorne Arm and adjacent to the mouth of Fish Creek, this priority recreation use area viewshed consists of two views from both a Forest Service cabin and a mooring buoy located about 100 yards offshore.

The 1,793-acre cabin viewshed is located at the back of a small cove at the outlet of Fish Creek which flows out of the Misty Fiords National Monument. Fish Creek is a Wild and Scenic Designated River (TLMP 1997). The views are of an immediate foreground beach area and stream outlet, framed by heavy vegetated points of land. The views frame mountainous terrain (clearly showing the effects of extensive previous timber harvest), at least 3 miles distant across the head of Thorne Arm.

The views from the mooring buoy are much more diversified since it is further out in the open saltwater bay. Here the viewshed appears heavily (Level V) to drastically altered (lLevel VI) on the slopes and peaks to the southwest (nearly the same terrain viewed from the cabin site, but because of the wider angle of view exposing a wider water view, the scale of the visible landscape is much greater). Almost all the existing visible clearcuts within this viewshed become visible from the mooring buoy. Nearly all the visible harvest is located within lands designated as Timber Production LUD.

Alternative 1 - No Action

The EVC as seen from the cabin ranges from slightly (Level III) to moderately altered (Level IV) from visible timber harvest. With no additional harvest, the FVC would remain the same except for natural changes in tree height, color, and texture.

Alternatives 4, 5, and 6

There are no visible harvest units seen from the cabin viewpoint in these action alternatives. As such, the FVC of this viewshed would remain the same except for natural changes in tree height, color, and texture.

Alternatives 2 and 3

From the cabin, Alternative 2 proposes Unit 168 with a seven acre patch clearcut and Unit 171 with 33.5 acres harvested by the Individual Tree Mark (ITM) partial harvest method. Alternative 3 proposes just one unit - Unit 171. Most of this harvest will occur adjacent to existing harvest alterations or on middleground slopes more than one mile distant. Looking due south from the mooring buoy, in addition to the above units, portions of Units 113, 118, 119, and 120 (less than 67 total acres) may be visible. Most of the proposed harvest units are screened from direct views of bare ground and logging slash. There may be some visible evidence of roads and rock pits. However, these visible units would meet the adopted VQO of Modification and Maximum Modification. With this harvest, the FVC would change to an acceptable (TLMP) heavily altered visual condition level due to the effects of a first entry into an apparently unharvested viewshed area.

Upper Thorne Arm Viewshed

Located at the head of Thorne Arm (north of a line between Eve Point and Elf Point), this 6,620 acre viewshed encompasses many of the previous viewsheds' views but with many more vantage points. In a northerly direction, the slopes and ridges of the mountains above the other three viewsheds—Saddle Lakes, Middle Carroll Inlet, and Lower Carroll Inlet—can be seen from this saltwater use area. In addition, in an easterly direction the mountains above Ketchikan and Mountain Point are visible as well. These mountains form backdrop for the extensive private land timber harvest and clearly dominate the visual scene. In a westerly direction the mountains within the Misty Fiords National Monument form a permanent scenic background.

Alternatives 1 and 6

No harvest is proposed under these alternatives. The EVC ranges from slightly (Level III) to moderately altered (Level IV) from past timber harvest. With no additional alterations from harvest activities, the FVC would remain the same except for natural changes in tree height, color, and texture.

Alternatives 2, 3, 4, and 5

These action alternatives propose from one to 12 harvest units ranging from 14 acres in Alternative 5 to 274 acres in Alternative 2. As noted in the Fish Creek discussion, some units would be visible although their negative scenic effects would be mitigated by partial harvest methods (ITM and Shelterwood). Most of the proposed harvest units are screened from direct views of bare ground and logging slash. There may be some visible evidence of roads and rock pits. As proposed, all units and roads would meet the adopted TLMP VQOs.

Lower Thorne Arm Viewshed

This saltwater use area viewshed is the first encountered when boating to the Project Area from either Ketchikan or Metlakatla. Its landscape character is of a narrow waterway bordered on both sides by steep mountains rising out of saltwater. Most of the southwestern and western portion of the viewshed is restricted from timber harvest by the Old-growth LUD. To the northeast and east, the land areas are located in the Timber Production LUD, which allows for a higher level of visible harvest. Just 477 acres of existing harvest are visible within this viewshed.

Alternatives 1, 5, and 6

No harvest is proposed under these alternatives. The EVC as seen from the waterway ranges from slightly (Level III) to moderately altered (Level IV) from visible timber harvest and roads. With no additional harvest, the FVC would remain the same except for natural changes in tree height, color, and texture.

Alternatives 2, 3, and 4

These three action alternatives propose entries in this viewshed ranging from three to six units ranging from 80 acres in Alternative 4 to 133 acres in Alternative 2. As noted in the Fish Creek and Upper Thorne Arm viewshed discussions some units would be visible although their negative scenic effects would be mitigated by partial harvest methods (ITM and Shelterwood). Most of the proposed harvest units are screened from direct views of bare ground and logging slash. There may be some visible evidence of roads and rock pits. As proposed, all units and roads would meet the adopted TLMP VQOs.

Cumulative Effects

While individual harvest units may meet the adopted VQOs, when viewed as a group along with previous harvest, they may disturb too much of the natural landscape during one period of time. This could create a significant cumulative effect.

The Cumulative Visual Disturbance (CVD) is a way of determining the level of visual impacts over broader areas by evaluating the percentage of harvested area visible in larger viewsheds. It is a threshold or amount of visible disturbance (such as timber harvest) allowed in any given area in order to meet the intent of the Visual Quality Objective (VQO) for that area. This threshold, or CVD level, ranges from 8 to 35 percent of the area may be in a disturbed visual condition at any one time. If a harvested area is over the prescribed threshold, the CVD guideline is exceeded. The CVD threshold levels for the Sea Level Project Area VQOs are stated in the following text.

- Retention VQO - No more than 8 percent of an area may be in a disturbed condition at any one time.
- Partial Retention VQO - No more than 15 percent of an area may be in a disturbed condition at any one time.

- Modification VQO - No more than 25 percent of an area may be in a disturbed condition at any one time.
- Maximum Modification VQO - No more than 35 percent of an area may be in a disturbed condition at any one time.

An evaluation of the CVD for the Sea Level Project Area shows that no VCU or combination of project area viewsheds exceed the CVD guidelines under the VQO scenario established by the 1997 TLMP.

Alternative 2, which harvests the maximum amount of timber allowed under Forest Plan Standards and Guidelines, is used to project the level of harvest through the end of the rotation. It is assumed that reduced levels of harvest, as part of another alternative, will be harvested in a future entry.

Assuming a continuation of the present harvest level and implementation of Forest Plan resource constraints, timber harvest would continue to occur in the Sea Level Project Area. Over time, as further entries occur, the distribution of additional harvest units would add to visual diversity, thereby increasing the capacity of a viewsheds' ability to absorb future alterations. During this time, the forest would become a mosaic of varying sizes, shapes, heights, and textures reflecting those alterations. This mosaic would achieve the desired future condition of the Forest Plan.

Visual Impacts and Forest Regeneration

The potential for visual impact is greatest right after timber is harvested; stumps and debris, fresh road cuts and fills, and exposed boles and limbs of adjacent stands dominate the visual setting. By the 5th year of regeneration, the new forest is filling out, and low-lying vegetation, young alder and conifer trees begin to cover the stumps and exposed ground. From year 5 to 20, the young trees have become established, reaching a height of approximately 15 feet. After 20 years, the forest visitor would see a stand of spruce and hemlock, with some Alaska-cedar in the foreground. In the middle-ground, the contrast between the new forest and mature forest would be very obvious.

At the end of 50 years, the new forest would reach a height of approximately 50 feet. The canopy would be closing and the new forest would appear very dense. Toward the end of 80 years, the stand would reach 75 percent of its mature height. The canopy would appear full with crowns touching, allowing little sunlight to reach the forest floor and little understory vegetation. At 100 years, little visual difference would be noticed between the 100-year forest and an adjacent mature forest. Timber would reach approximately 100 feet in height and appear as a healthy and full canopy.

Socioeconomic Environment

Key Terms

Direct effects for employment and income—represents the response or change in a given industry due to a change in the final demand for that industry, changes that occur within the industry of interest. An example of direct effects in the wood products industry would be a change in the number of people employed in a sawmill due to an increase in wood available to the sawmill.

Discounted benefits and costs—the sum of all monetary or assigned benefits and costs derived from the Forest over the life of a project in current dollars. This is a measure of all expected costs and benefits of a project, accounting for inflation.

Economic efficiency—a measure of the relationship between discounted costs and discounted benefits, such as present net value or benefit/cost ratio. These measures allow different management alternatives to be compared in terms of long term returns of public benefits.

Indirect effects for employment and income—represents the response by all local industries to a change in activity by a direct purchasing industry, changes in a business which provides goods and services to a directly impacted sector. An example of indirect employment would be changes in the employment at a sawmill servicing business due to changes in the amount of wood available to the sawmill that requires services.

Induced effects for employment and income—represents the response of all local industries to a change in household spending. An example of induced effects in employment would be grocery store employees who sell products to people working in a sawmill or sawmill servicing business.

Pond log value—price of delivered logs at mill minus manufacturing costs.

Present net value (PNV)—the difference between discounted benefits and costs associated with different management alternatives. This is a measure used to compare the economic efficiency of the alternatives.

Primary zone of influence—the area where social, economic, and/or environmental conditions are significantly affected by changes in forest resource management and outputs. Also referred to as the study area.

Public net benefits (PNB)—the sum of the present net value and nonpriced commodities (such as scenic quality and community stability) of each alternative. This is a measure of economic efficiency used to compare alternatives.

Affected Environment

This section provides a baseline for evaluating the economic and social condition of the Sea Level Project Area. Included is a discussion of regional and local employment and income, returns to the federal treasury, payments to the state, economic efficiency, sales below cost, nonmarket values and nonpriced values. The following section is an analysis and comparison of the potential and cumulative effects that could result from implementing a Project alternative.

The primary zone of influence for the purpose of this economic analysis is the region around Ketchikan. This area consists of the Ketchikan Gateway Borough, which includes the city of Ketchikan, Saxman, Ward Cove, and Gravina Island.

Employment and Income

The economy of Southeast Alaska is diverse, but with over 90 percent of the region managed by the Forest Service, much of the economic activity is resource-based. This would include not only resource-use industries such wood products, salmon harvesting and processing, and mining, buy also non-use resource industries including recreation and tourism. A more complete analysis of the regional economic situation is discussed in the TLMP FEIS, Part 2: chapter 3.

The economy within the study area is one of the more diverse in the region. It continues to support a large wood products industry after the closure of the Ketchikan Pulp Company's (KPC) pulp mill in Ward Cove. Recent wood product industry developments include KPC, one of Ketchikan's largest employers, plans to open a veneer mill in addition to the small log sawmill located at Ward Cove and Steve Seley's Lewis Reef project, which will feature a sawmill with several value-added sections including a planing and molding division. Tourism and other service industries have continued to expand as the number of people visiting Southeast Alaska grows. Other industries including transportation, communication, retail and educational services, health and social services, and government are also a significant part of the study area's economy. For a complete analysis of the Ketchikan Gateway Borough economic situation, refer to the TLMP Final EIS (1997).

Industry and individuals throughout Southeast Alaska have an interest in how the Forest will be managed. Within the study area, interest in Forest management includes a mixture of local economic concerns and quality of life/ life-style issues. Many of the area residents derive their incomes from economic activity in their communities, but they also value the recreational and aesthetic opportunities that are present in the vicinity. While the livelihood of some people may depend indirectly upon the forest, others also have an important stake in its management, both for short-term economic considerations and for the maintenance of their current life-styles.

The following sections describe trends and current situations of the three major resource industries related to Forest management, wood products, salmon harvesting and processing, and recreation and tourism. For more information concerning these industries, refer to the TLMP Final EIS (1997).

Wood Products Industry

The activity of the timber industry mirrors that of the Pacific Northwest where a global recession in the wood products industry, depressed output in the early to mid 1980s, followed by a boom and then subsequent declines in timber harvest, in spite of rising prices, due to supply constraints. The variable activity is striking but not all that unusual for an industry, such as the wood products sector, which is prone to "boom and bust" cycles.

Current timber harvest statistics for Southeast Alaska and the Tongass National Forest are provided in *Timber Supply and Demand* 1996 (USFS R10-MB-357). Total Southeast timber harvest levels range from 457 MMBF in 1984 and 1996 to peak levels of just under 1,000 MMBF in 1989 and 1990, with an average over the 1981-96 time period of 671 MMBF.

The vast majority of the region's timber harvest comes from two sources: (1) the Tongass National Forest and (2) Private land. On average, over a ten-year period, 1985 to 1996, these two ownerships accounted for 43 percent and 55 percent respectively, with private harvest exceeding Tongass National Forest harvest by an average of 14 percent. Although private timber harvest has been 50 percent of the region's total harvest, only the Tongass National Forest harvest is available for local mill production. Private lands are not subject to the Federal requirements for primary manufacturing that restricts the export of most logs from the

Tongass National Forest. Because local mills are unable to compete with oversees market for the wood supply from private lands, the harvest from the Tongass National Forest has a significant link to local employment and income in Southeast communities.

On average, over the 1981-96 period, logging employment accounted for about half of total sector direct employment. Pulp production and sawmills accounted for 31 and 17 percent respectively (Timber Supply and Demand 1996, and TLMP 1997). Although with the closure of the KPC pulp mill, it is uncertain as of yet what will happen to future utility logs and sawmill waste, employment will change based on future developments around the pulp resource. Past employment patterns follow the generally familiar depressed levels of the 1980s, followed by a peak in 1990 and subsequent decline, but the variation is somewhat less than in the harvest or production statistics. Delays in employment response to decreased production are common and further declines in employment levels can be expected even if 1996 harvest levels are maintained.

Because most of Alaska's forest products are exported, fluctuations in wood product markets are primarily a function of international markets and do not necessarily reflect domestic markets alone. A constant supply of Tongass National Forest wood is not the only factor controlling timber employment. Other controlling factors include foreign exchange rates, the overall Pacific Rim demand for wood products, and competition among timber suppliers outside the Tongass National Forest. For an in-depth discussion of wood products supply and demand of Southeast Alaska, see the TLMP (1997) Part 2, pg 3-449 to 3-452.

Commercial Fishing Industry

Harvesting and processing of fisheries resources provides a broad base of employment opportunities throughout Southeast Alaska. Many small towns and villages are very economically dependent on fish harvest and processing. The Ketchikan Area supports diverse fish-based employment opportunities for bottom fish, herring, shellfish, salmon, and other specialty products. The fishing industry is highly seasonal. The potential for year-round employment is enhanced with the diversity of harvestable species, harvest methodology (troll, seine, longline, trawl, etc.), and the processing methodology (frozen, canned, and the fresh market). Expansion of the bottom-fish sector provides the greatest opportunity for increased employment and more year-round employment opportunities (Alaska Department of Labor, Research and Analysis 1990).

Recreation and Tourism

During the 1980s, the tourism industry became a major force in the economics of Southeast Alaska. Resident recreation is also increasing as local populations grow with people moving to Southeast to enjoy the life-style not readily found in the lower-48. Both residents and tourist spend their money in the local economy for goods and services that assist their enjoyment of the environment. Increases in resident recreation can be most visibly seen in the increases in hunting and fishing license sales and equipment.

Cruise ships are traveling the Inside Passage, making regular stops at Southeast Alaska ports in record numbers. Newer and larger capacity ships are bringing more and more people to Alaska at an economical price. Smaller ships, tailoring to people interested in a more intimate, eco-tourism experience, have also found a niche in the Southeast tourist industry. These types of innovations are increasing the numbers of visitors and types of activities that make up tourism in Southeast. The visitor season currently runs from May through September. Cruise ship passengers visiting Ketchikan have grown from 85,000 passengers in 1981, to 426,232 passengers in 1996, with State Ferry activity showing similar growth patterns.

Marketing studies by the Alaska Division of Tourism indicate that scenery, forest, mountains, out-of-doors, and wilderness (unspoiled, rugged) were the top interests which appealed to potential nonresident visitors (Bright 1985). Tourism is currently one of the top three industries in Alaska, and though it is dependent on seasonal labor associated with low wages, sector of the industry are establishing themselves as year-round and well-paid.

Sport Fishing

The Southeast Alaska Sport Fishing Economic Study (1991), a research report done for the State of Alaska, contains Ketchikan Area information:

> "In 1988, anglers spent $83.1 million for sport fishing in Southeast Alaska. Resident anglers spent about $40.7 million and nonresident anglers spent about $42.4 million. Ketchikan area resident anglers spent about $6.6 million on sport fishing. For nonresident anglers, sport fishing in the Ketchikan area generated the most spending, comprising about $13.7 million, or 32 percent of all nonresident angler spending."

Of all species sought by residents and nonresidents, king salmon generated the most spending, accounting for $13.3 million, or about 32 percent of all resident angler spending, and $9.6 million, or 23 percent of all nonresident spending. This has important significance for the local sport fishing charter fleet.

It was estimated that in 1988, angler spending generated $1.5 million in local sales tax revenue, $105,000 in lodging tax, $135,000 in state corporate income tax, and $1.2 million in fishing license revenues. For nonresident anglers, fisheries in the Ketchikan Area are the most valued throughout Southeast Alaska, with an annual "willingness-to-pay" value of $7.5 million. The *willingness-to-pay* concept can be described as a value which approximates market price or the amount a consumer is willing to pay for a product.

Sport Hunting

In Southeast Alaska and the Ketchikan area the primary big game species, in terms of number harvested and hunter participation, is the Sitka black-tailed deer. Deer constitute over 90 percent of the total big game harvest in Southeast Alaska (Doerr & Sigman 1986). Estimating value using the willingness-to-pay concept, resident Southeast Alaskans would pay $332 (Swanson, Thomas, and Donnelly 1989). Hunting expenditures were not available for the Ketchikan Area.

Employment and Income for Primary Zone of Influence

Forest Service resource use and management supports employment and income opportunities throughout the Southeast region. It is difficult to determine the exact number of jobs associated with only Forest Service output because other lands and agencies also provide opportunities for local businesses to operate. The following Socioeconomic Table-1 reflects the number of jobs associated with the major resource-related industries within the study area. These figures are inclusive of all resource production within the study area, not just that associated with Forest Service management.

Table Socioeconomic-1
Direct and Indirect Employment for Three Major Industries

Industry	Direct Employment	Indirect Employment	Total Employment
Timber	3,543	2,570	6,113
Commercial Fishing	4,100	2,397	6,497
Recreation and Tourism	3,497	1,193	4,690
Total	**11,140**	**6,160**	**17,300**

Source: USDA Forest Service 1993b.

Returns to the Federal Treasury

Management of the United States National Forest system generates revenue for the Federal Treasury. Revenue returns from the Tongass National Forest fluctuate from year to year. Returns were $45 million in 1987, and $34 million in 1994. Timber sales are the source of about 99 percent of federal receipts for this area; fees from recreation permits, admissions, and user fees make up the other 1 percent.

Payments to State

Revenue from National Forest timber sales are shared with State and local governments. Twenty five percent of the total revenues received by the National Forests are returned to State and local governments to support schools and roads. Payments to the State of Alaska from the Ketchikan Administrative Area (including purchaser road credits) ranged from $3.2 million in 1992, to $8.7 million in 1994 ($388,314 went to the Ketchikan Gateway Borough). Changes in these payments are of considerable interest to local residents.

Economic Efficiency

The National Forest Management Act of 1976 (NFMA) set requirements for economic efficiency of forest management proposals. Although the Forest Service has generally tried to achieve cost-effective management (lowest possible input cost per unit of output), systematic evaluation of all costs and benefits from forest management practices and activities has been undertaken only in recent years.

The harvesting of timber involves large investments. The economic efficiency of these investments is relevant to the choice of different alternatives being considered. This issue is addressed in three ways:

1. The economic efficiency of alternatives will be evaluated. Historic costs for managing, harvesting, and processing timber, and historic prices for various timber and wood products are identified and the present net value (PNV) of each alternative is estimated.
2. Below cost timber sales will be evaluated.
3. Other nonmarket and nonpriced values are evaluated and discussed. Many of these values are nonquantifiable within the scope of this project and, therefore, are assessed in a qualitative way.

For a comprehensive analysis, these factors must be considered along with the timber economics to determine the net benefit to the government from timber harvest.

The measure of economic efficiency applied in formulating and evaluating alternatives is public net benefits (PNB) (see Key Terms) (36 CFR 219.1(a) and 219.12(f)). Examples of nonpriced benefits include scenic quality, wildlife habitat, and community stability. Public net value is a method of adjusting revenues and costs to allow their comparison over time. Values of some nonpriced commodities are inferred from observations such as the number of participants, tolerance of congestion, and expense of participation.

Sales Below Cost

In response to concerns about the costs and revenues from timber sales on National Forest lands, especially sales where costs exceeded revenues, the General Accounting Office (GAO) and the Forest Service, at the direction of Congress, jointly developed the Timber Sale Program Information Reporting System (TSPIRS). TSPIRS reports are designed to describe financial aspects of the forest-wide timber sale program. Managing timber is a long-term commitment of land and resources with a variety of activities occurring each year at various ages in stand rotation. For this reason, many forest management costs, such as roads and reforestation, are pooled and then redistributed over a series of years based on the amount of timber harvested. This is a different approach than is used in the calculation of PNV described above where costs are measured in the year they occur and discounted back to the present.

Large development costs usually accompany new timber sales. These costs in turn translate into revenue for local businesses and employment and income for local people. The TSPIRS reports provide a description of the extent of investments in timber harvesting on the Tongass National Forest. In 1994, on the Tongass National Forest expenses exceed revenues by $300,000. Revenues were over $123 per MBF while total controllable expenses were about $124 per MBF (includes payments to the State of $4.83 per MBF). There was a total net loss of about -$1.10 per MBF (Page 60, 1994 TSPIRS Report).

Nonmarket Values

A discussion of the relationship between an economic benefit to cost analysis and the analysis of unquantified environmental effects, values, and amenities is useful in considering project alternatives. In Forest Service terminology, three types of values are typically considered in economic evaluations: market values, nonmarket values, and nonpriced values. Market values are those established through a market, such as timber. Nonmarket values are those that can be quantified using economic techniques that infer or deduce values which might prevail if a market were present, such as some types of recreation. These first two types are included directly in the benefit to cost analysis. Nonpriced values refer to those for which it is impossible to quantify a value, even with nonmarket economic techniques, such as the value of religious sites or genetic diversity.

Nonmarket values such as recreation, fish, and wildlife are not typically established by a market but are important considerations in making resource management decisions. Wildlife viewing and photography are some of the most popular activities among forest visitors. A survey of businesses which provide products and services for wildlife viewing, wildlife photography, and other nonconsumptive wildlife uses indicated that this use is rapidly increasing in Southeast Alaska (Shea 1990). It is estimated that over 200 businesses in Southeast Alaska provide wildlife viewing recreation services. This business activity is growing as much as 33 percent annually, with client expenditures contributing substantially to the economy (Shea 1990). Nonmarket values can be applied to changes in the levels of some recreation, fishing, and hunting activities associated with the alternatives to estimate the economic value of these changes.

Nonpriced Values

There are many values (nonpriced values) that people hold, for which markets do not exist and to which market values cannot be attached. Among others, these include active-use values (subsistence), the value of the forest as habitat for wildlife, and passive-use values. Passive-use values include existence, option, and other nonuse values (Mitchell and Carson 1989). They represent values of people who may never visit the Project Area, but benefit from the knowledge that the area exists in a certain condition. This value can be intergenerational since timber cuts conducted in the 1990s, will be visible for the next human generation. Recent work in this field was conducted following the Exxon Valdez oil spill in Prince William Sound, Alaska.

Some important nonpriced values are visual quality, diversity and quality of recreation opportunities, old-growth retention, suitable habitat for threatened and endangered species, and cultural resources. Another is the value of retaining old-growth forest and wilderness or semi-wilderness areas.

Quantitative surveys to determine prices for values based on people's willingness-to-pay (such as to avoid habitat degradation) must be conducted on a national or international basis. They are beyond the scope of this project and have not been conducted for the Tongass National Forest as a whole. It should be noted that contingent values can be quite high. Those arrived at for the oil spill study determined that the people of the United States were willing to pay about $3 billion to avoid the oil spill (Carson et al. 1992). It is evident that similar values exist for the Tongass National Forest because of the concern expressed, by the general public and some conservation and preservation organizations, about logging on the Tongass National Forest and the response to those pressures by Congress.

Judgments are necessary in assessing whether the benefits of maintaining nonpriced values equal or exceed the trade-offs of producing priced values. While the quantitative dollar values of nonpriced values cannot be determined, they generally can be examined by association with such quantitative indicators as acres, resource inventories, or timber production related activities and outputs.

Effects of the Alternatives

Employment and Income

Employment and Income Levels

Multipliers generated by a Forest Service input-output economic model were used to estimate employment and income supported by each alternative within the Sea Level Project Area. The multipliers used included direct, indirect, and induced impacts to the economy. In this way, the multiplier traces money as it cycles through the study area. The cycle starts with the direct impacts of the wood products industry, the multiplier accounts for all employment and income associated with additional activity in the wood products sector. Indirect impacts are then accounted for as those businesses that support the wood products industry change their employment and income based on the activity of the wood products sector. Finally, induced impacts are accounted for as businesses that serve the people who are employed within the wood products and supporting industries. These impacts, or ripples, are all accounted for within the study area as a single multiplier. So, the larger the original impact, in this case, a timber sale measured in MMBF, the more money that will ripple through the community, creating a larger total impact. These jobs and income would be in addition to the jobs and income already supported by the community's economy. It is assumed in this analysis that these additional jobs will be within the study area, when in reality it is difficult to predict what business, if any, will take advantage of resource opportunities. Socioeconomic Table-2 displays the results derived from the multiplier analysis for each alternative.

Timber Industry

Each alternative will affect the number and composition of timber-related employment within the communities in the primary zone of influence. The amount of timber offered for sale within the Project Area is not the only factor that affects the number of wood products industry jobs. Other factors may include the supply and demand for wood products and the subsequent number of employment opportunities, worker productivity, interest rates, import and export levels, production and shipping costs, competition, and other landowner harvest levels and policies. Segments of the wood product industry which would likely be affected by the Sea Level Project include sale of logs, cants, dimension lumber, and wood chips.

Table Socioeconomic-2
Projected Wood Product-related Additional Jobs and Income by Alternative*

	Alt. 1		Alt. 2		Alt. 3		Alt. 4		Alt. 5		Alt. 6	
Harvest	**Jobs**	**Income**	**Jobs**	**Income**	**Jobs**	**Income**	**Jobs**	**Income**	**Jobs**	**Income**	**Jobs**	**Income**
Logging	0	0	311	13.20	170	7.20	166	4.97	89	3.77	37	1.54
Construction	0	0	133	5.70	73	3.09	71	2.13	38	1.62	15	0.66
Marine Transport	0	0	6	0.30	3	0.15	3	0.10	2	0.07	1	0.03
Subtotal	0	0	450	19.20	246	10.44	240	7.20	129	5.46	52	2.23
Sawmills	0	0	184	7.75	100	4.26	99	2.95	52	2.24	21	0.92
Total	**0**	**0**	**634**	**26.95**	**346**	**14.70**	**339**	**10.15**	**181**	**7.70**	**74**	**3.15**

Source: Marks 1998.
*Number of jobs and income is calculated by alternative volume estimates only. Calculations include ROW volume
Jobs = Direct Jobs (person years) 1992 IMPLAN MODEL
Income = Direct Income (millions of dollars)1992 IMPLAN MODEL

Alternative 1 proposes no timber harvest and could result in a decline in timber-related employment should the local mills not be able to substitute volume from another source. The effects of Alternative 1 are not predictable and could range from elimination of shifts to a partial or even a full short-term shutdown of a mill in addition to the potential loss of revenue.

Possible long-term ramifications of Alternative 1 could be the destabilization of the wood products industry in the affected community. This assumes that no other replacement timber harvest projects are cleared through the National Environmental Planning Act (NEPA) process for sale beyond 1998.

Employment opportunities closely parallel the level of timber harvest. A larger timber harvest is accompanied by greater local expenditures. Therefore, Alternative 2 produces the highest impacts, since local expenditures associated with its implementation are highest among the alternatives. The annual harvest and annual mill production under Alternative 2 would result in the largest employment gains associated with the harvest; harvest under the scenarios proposed for Alternatives 3 and 4 would sustain a lower level, about half of the regional employment relative to Alternative 2. As employment is reduced, regional income and economic output would fall as well.

Alternatives 5 and 6 maintain an annual harvest, but at a much lower level, with less impact to the wood product industry. It is likely that timber harvest at these level will result in consequences similar to Alternative 1 if the industry does not have enough supply to operate at a profitable margin.

Long-term impacts on timber employment on the Ketchikan Administrative Area are a function of the Forest Plan, and the analysis in the TLMP Final EIS (1997) is incorporated by reference. The primary effect of any of the action alternatives would however be maintenance of current employment levels.

Commercial Salmon Fishing Industry

Current standards and guidelines and management area prescriptions are expected to limit measurable effects on salmon during timber harvest and related activities. There are no substantive changes in commercial salmon habitat capability predicted. The direct and indirect jobs attributable to National Forest System lands for the commercial salmon industry should also remain unchanged for all alternatives. Again, the TLMP Final EIS (1997) can be referred to for further discussion of the impacts to commercial salmon fishing.

Recreation and Tourism

Projections for future employment for Southeast Alaska in the recreation and tourism industries, including employment related to sport hunting and fishing, are a 27 percent increase for recreation and tourism, 36 percent for sport fishing, and 53 percent for hunting related jobs during the 1990s, (TLMP Final EIS 1997). The core community of Ketchikan should, on the average, reflect these increases. Differences between action alternatives should have little overall impact on these projections.

The action alternatives will have no measurable effects on sport fishing jobs. The action alternatives are expected to have no measurable effects on jobs generated by permits for kayak or air charter services due to set standards and guidelines for visual resources. There are no outfitter/guides with current permits or waivers operating within the Sea Level Project Area.

Access to the area by plane will remain unchanged. However, access by foot travel and All Terrain Vehicles (ATV) will increase with implementation of action alternatives. Past experiences in adjacent project areas show an increase in sport fishing and hunting due to having a developed LTF and docking facility with a connecting road system. Even though roads are often closed to vehicle traffic, hunters will often boat to LTFs and gain access to a project area by utilizing the road system. ATVs are often used if main roads remain open.

Returns to the Federal Treasury

A TSPIRS analysis depicting Federal returns for the Sea Level Draft EIS was considered but not performed. TSPIRS was designed to be assessed on an annual basis at the National Forest level for the timber program as a whole, with expenses and costs amortized over the length of the entire rotation (100 years). Furthermore, TSPIRS sums all expenses associated with a timber sale including NEPA prep work, timber inventories, etc. These expenses are then put into a sale or growth activity pool and a percentage is subtracted each year based on how much volume is harvested versus how much remains under contract. Tracking annual project expenses from planning through implementation and final harvest spans several years and is difficult to track on a project-by-project basis (R. Zaborske, Regional Office Direction, 1993). The estimated costs and profits analysis under Economic Efficiency within this section more accurately portrays actual returns to the Federal Treasury.

Payments to the State

Socioeconomic Table-3 displays the estimated volume of timber harvested, anticipated total timber receipts, estimated returns to the State (includes purchaser road credits) and Borough, and total estimated net revenue to the United States Government. These estimated returns could be dispersed over a 3 to 7 year period depending on the rate of timber harvest. The anticipated total timber receipts for all alternatives are displayed for the total Project Area which includes the LTFs located at Shelter Cove, Shoal Cove, and Elf Point.

Table Socioeconomic-3
Estimated Returns to State of Alaska and Ketchikan Gateway Borough

	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6[4]
Estimated Total Volume (MMBF)[1]	0	77	42	29	22	9
Estimated Total Returns to U.S. Treasury ($)[2]	0	5,527,000	1,353,000	993,000	51,260	34,830
Estimated Returns to State ($)[3]	0	5,121,655	2,875,845	1,915,522	1,542,200	8,707
Estimated Returns to KGB ($)	0	6,079	1,488	1,092	56	38

Source: Fletcher 1998.
1 Rounded to the nearest MBF including right-of-way.
2 Based on mid-market rates (does not include possible bid premiums or purchaser road credit values).
3 25% of estimated total anticipated receipts.(includes purchaser road credit value and base rate value)
4 Note:Alt 6 receipts based on base rates only (due to anticipated ineffective purchaser road credits).

Economic Efficiency

Historically, the timber market has been cyclic, with sharp peaks and valleys in pond log values. A modest change of a few dollars per thousand board feet can result in significant shifts in the economic supply of timber. The present net value yardstick reflects historical average conditions for both prices and costs, and may not represent the economic viability of the Project Area in any given year.

Mid-market Analysis

Socioeconomic Table-4 summarizes the differences in approximate net stumpage value between alternatives. The stumpage values represents the economic efficiency of each alternative. Each alternative has a specific management strategy or emphasis which requires certain timber harvest levels that may not be the most economically efficient harvest pattern for the Project Area. The management strategy for Alternative 3 is for maximum economic efficiency. With the relatively low amount of cedar and associated low pond log values, the logging costs are not offset completely. Negative net stumpage values indicate that the direct costs associated with timber harvest exceeded the direct value of the benefits.

Table Socioeconomic-4
Summary of Estimated Costs and Benefits by Alternative (source: Mid-market Analysis)

Economic Appraisal Inputs	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Total Volume (MBF)	0	76,862	42,263	29,523	21,596	8,830
Roads, New and Repair (Miles)	0	82	57.4	31.9	41.2	17.9
Pond Log Value ($/MBF)[1]	0	539.25	542.03	543.91	544.04	594.90
Stump to Truck Costs ($/MBF)[2]	0	152.46	149.68	164.38	150.65	173.13
Transportation Costs ($/MBF)[2]	0	38.60	38.60	38.60	38.75	39.16
Administration Costs ($/MBF)	0	26.26	26.26	26.26	26.26	26.26
Temporary Development Costs ($/MBF)[2]	0	18.60	20.63	16.43	18.32	10.90
Road Development Costs ($/MBF)[2]	0	194.28	241.67	229.95	278.07	329.35
Total Harvest Costs ($/MBF)	0	430.20	476.84	475.62	512.05	578.80
Conversion ($/MBF)[3]	0	109.05	65.19	68.29	31.99	16.10
Profit and Risk Margin ($/MBF)	0	37.27	32.97	34.03	29.66	25.00
Net Stumpage Value ($MBF)4	0	71.78	32.22	34.26	2.33	(8.90)

Source: Fletcher 1998.
1 Pond log values from Table Timber-12.
2 Costs from timber appraisal spreadsheet.
3 Conversion = pond log value - total harvest costs.
4 Net stumpage = negative values indicated with. ( ).

Nontimber Harvest Values

Neither the PNV nor TSPIRS accounting conventions consider nonuse values. Land uses that result in decreased visitations or in a change from higher-valued to lower-valued visitor use will result in a net loss to society. Likewise, any activities which decrease societies willingness-to-pay for the area result in a loss.

It is not possible to quantitatively compare these priced and nonpriced values. The proposed action could result in a loss of nonuse values due to decreases in "nature" tourism and decreases in societal willingness-to-pay for post-logged landscapes. Due to the limited access of the Project Area, this loss is expected to be proportional to the amount of access gained by implementing an action alternative, and is expected to be minimal.

Of the action alternatives, Alternative 2 harvests the most seen acreage and may create the greatest visual impact to the nonconsumptive user. Alternative 6 harvests the least seen acreage and could have the least amount of visual impact, with the no action alternative preserving the highest level of nonuse values

Cumulative Effects

The cumulative effects of each of the alternatives on the economic and social environment are difficult to estimate. There are a wide variety of factors affecting the employment, income, receipts, population, life-style, and community stability of Southeast Alaska. While it is not easy to project the incremental effects of the proposed actions on the Project Area, there are two facets of long-term timber harvest in the Project Area that can be addressed.

First, from the standpoint of employment, personal income, population, community services, and community stability, there is substantial benefit to maintaining long-term timber harvest levels. The receipts generated, including revenue to the U.S. Treasury, payments to the State of Alaska, taxes, and dollars brought into the community, all represent an economic benefit of continued timber harvest activity. The TLMP Final EIS (1997) schedules areas for long-term timber harvest activity. The Sea Level Project Area is one of the areas scheduled to meet these economic and social needs.

The second facet of a long-term timber harvest that can be addressed is the alteration of the natural environment that takes place when roads are constructed and timber is harvested. Some of the economic and social value of Southeast Alaska is dependent on its natural setting. The recreation and tourism industry is based primarily on the natural conditions and scenic quality. As more and more acres of National Forest System lands and other lands are converted from a natural condition to a managed forest, the activities dependent on and the values attributed to the natural state of the forested land will be affected.

The balance necessary to maintain a viable or even robust economic and social environment is set at a National Forest level, not at a project level. Based on regional standards and guidelines, the action alternatives have been constructed to minimize the negative cumulative effects on the economics and community values of the affected communities when considering the total resource. Cumulative effects on employment are best displayed in the TLMP Final EIS (1997). This analysis indicates that for the Ketchikan area as a whole, National Forest System-based timber employment and commercial fishing employment will remain fairly constant, while recreation and tourism employment will increase in the future. Harvesting in the Sea Level Project Area is included as part of the overall harvest level assumed as a basis for this projection.

One consequence of timber harvests at the level projected by the Forest Plan is the degree of continued stability of communities dependent on timber from the Project Area. The analysis conducted for this project suggests that the timber supply in the Project Area could be reduced following the next several entries (see the Silviculture and Timber and Cumulative Effects sections). To the extent that this is correct, timber-dependent communities would suffer losses which would vary by their degree of dependency on the timber industry. This would result in some community residents finding employment in other timber producing geographic areas.

Community Stability

Timber harvest and wood processing is one of a variety of ways of maintaining community stability. Value-added opportunities, such as the further processing of wood products (the manufacture and export of plywood, medium density fiberboard, speciality cedar siding and roof shakes, etc.) is being either considered, planned or to a limited extent, implemented on a trial basis (for example, Lewis Reef Development) to supplement community employment in association with expanding existing natural resource-based industries such as tourism and sport fishing.

The analysis conducted for this project suggests that the timber supply in terms of old-growth timber in the Project Area could be reduced following the next several entries (see the Silviculture and Timber and Cumulative Effects sections). As the mature timber resource base is harvested, and yearly harvests decrease in volume, it is probable that fewer workers would be required for timber harvest and transport to the Sea Level area. This reduction in local work force could result in a decreased population within logging communities currently living in and adjacent to the primary zone of influence of Ketchikan. Alternately, more workers might increase their commuting distances or change employment patterns such as living part time at work camps. Decreasing timber volumes or the halting of harvests from the Project Area in certain years could also result in a reduced labor force at local and regional processing facilities and other support facilities, and could have ripple effects throughout the regional economy.

Mitigation

Mitigation measures could be undertaken to improve net national benefits from the Project Area. This project addresses only timber investment opportunities. Alternatives 2, 3, 4, and 5 show a negative PNV based on the mid-market analysis, while Alternative 6 shows a positive PNV. Other natural resource investment opportunities may offer better investment choices and at the same time contribute to mitigating potential community stability goals.

Monitoring

A monitoring plan has been developed for the Tongass National Forest by the Forest Planning Team and is described in the Forest Plan (1997).

Project-specific monitoring that is unique to the Sea Level Project Area has been identified for several resources. Project-specific monitoring is not identified for socioeconomic resources in the Sea Level Project Area.

Subsistence

Key Terms

Alaska National Interest Lands Conservation Act (ANILCA)—requires evaluations of subsistence impacts before changing the use of certain Federal lands.
Non-rural—generally a community with more than 7,000 people; does not qualify for priority use of subsistence resources.
Rural—any area of Alaska determined by the Federal Subsistence Board to qualify as such; qualifies for priority use of subsistence resources.
Subsistence—customary and traditional uses by rural Alaskans of wild renewable resources.
Wildlife Analysis Area (WAA)—a division of land designated by Alaska Department of Fish and Game (ADF&G) and used by the USDA Forest Service for wildlife analysis.

Affected Environment

Many Southeast Alaskan communities use natural resources as a base or supplement to their livelihoods. Nearly a third of rural households in Southeast Alaska get at least half their meat and fish by hunting and fishing (Holleman and Kruse 1991). Fish and game are widely preferred sources of food among Southeast Alaskan households, regardless of their incomes. Examples of major subsistence resources include deer, salmon, halibut, trout, harbor seal, crab, clams, waterfowl, and berries. Findings from the Tongass Resource Use Cooperative Study (TRUCS) indicate that "members of the highest income group have the highest mean harvest and the lowest mean percent of meat derived from subsistence activities" (Kruse and Muth 1990).

Subsistence activities represent a major focus of life for rural residents. These resource or subsistence gathering activities include hunting for deer, bear, marine mammals, and birds; digging clams; catching fish and shellfish (crabs, shrimp) ; harvesting marine invertebrates; trapping furbearers; collecting firewood; collecting herring eggs; and collecting berries and edible plants and roots. Subsistence goods may be eaten, traded, given away, or made into an item of use or decoration. For example, the fur from the marten or sea otter may be used for regalia costumes which are used in ceremony and dance.

Even for households which can afford to purchase all their own food, the act of gathering subsistence resources is an important cultural aspect reflecting deeply held attitudes, values, and beliefs. Some traditional foods are not available through any other means than subsistence, and often, the occasions for gathering wild foods and edible plants are social events. Historical patterns of movement such as the annual cycle of dispersal into small family groups at summer fishing camps and then to larger gatherings at protected winter villages are also linked to the tradition of subsistence gathering.

Average per capita income may or may not indicate the importance of subsistence to a community. While individuals of low income may have a greater dependence on subsistence gathering, individuals with a higher income may simply be in a position to have a more comfortable life-style because they combine their subsistence activities with their ability to purchase goods. Higher income does not deter an individual from gathering resources and sharing those with friends and family (Kruse and Muth 1990).

Sharing of subsistence resources is important not only between households within communities, but also with extended families and friends in other areas. This includes sharing with those households which are unable to participate in the harvest of resources. And, because some communities have access to resources not found in other communities, sharing of subsistence resources occurs between as well as within communities.

The importance of subsistence is recognized in both State and Federal laws. With the passage of the Alaska National Interest Lands Conservation Act (ANILCA), Congress recognized the importance of subsistence resource gathering to the rural communities of Alaska.

In 1988, a detailed subsistence resource and use inventory of the Tongass National Forest was started as part of the TLMP Revision process. The Tongass Resource Use Cooperative Study (TRUCS) of 1988, was conducted by the University of Alaska's Institute of Social and Economic Research in conjunction with the U.S. Forest Service and the Division of Subsistence of the Alaska Department of Fish and Game (ADF&G) (Kruse and Frazier 1988).

In the TRUCS, researchers went to over 30 communities in Southeast Alaska and conducted interviews with randomly selected households about their 1987 subsistence uses. As part of the interview, household residents were also asked to draw special maps of the areas used for hunting and fishing. As stated by Kruse and Frazier in the TRUCS (1988), it should be noted that all figures used in reporting subsistence are based on a sample of households. Therefore, it is entirely possible that actual amounts harvested were either higher or lower than reported by sample households. A detailed description of the survey is found in the Tongass Resource Use Cooperative Survey Technical Report Number One from the Institute of Social and Economic Research, University of Alaska.

Affected Areas

Based on identified use of the Project Area, the following communities were selected to be analyzed: Metlakatla, Meyers Chuck, Saxman, Wrangell, and Ketchikan. Of these communities, all are designated rural except Ketchikan.

Metlakatla

Metlakatla is 25 nautical miles south of the Sea Level Project Area and on the west side of Annette Island. The 1990 census reported there were 1,407 people living in the community, of which 1,175 or 84 percent were Native. This community was established in 1887 when a band of Tsimshian Natives migrated from northern British Columbia. In 1891, Congress designated Annette Island an Indian reservation, the first in Alaska. The community did not participate in the Alaska Native Claims Settlement Act of 1971 (ANCSA) and does not have a village corporation. Their economy is based on sawmill operations of the Annette Hemlock Mill operated by Ketchikan Pulp Company, Annette Island Packing Company (a community owned cannery), Tamgas Creek Hatchery, and Metlakatla Indian Community Services.

Metlakatla subsistence use is over 71 pounds of edible harvest consumed per person per year. This supplements their relatively low income and traditional cultural life-styles. In the Project Area, Metlakatlans fish for salmon and hunt for deer.

Meyers Chuck

Meyers Chuck is a small fishing village with a seasonal population of 30 to 40 people located about 35 miles from the Project Area along the Clarence Strait on the southwest tip of Cleveland Peninsula. A natural, well protected harbor, Meyers Chuck has been a shelter for passing fishing boats caught in the stormy waters of Clarence Strait Beginning in the late 1800s, the community grew after a cannery was established in Union Bay in 1916. Fishing is still the basic source of income, although declining salmon populations have caused some residents to seek work in Ketchikan or on Prince of Wales Island. A community-sponsored fish hatchery was constructed in 1977, with the hope of improving local fish supplies.

Meyers Chuck residents depend on subsistence activities to supplement the relatively low cash economy. Fish, berries, deer, and other local protein sources are an important element of the local economy. Subsistence use of salmon and deer within the Project Area has been reported by residents of Meyers Chuck. Over 414 pounds of edible harvest are consumed per person per year.

Saxman

Saxman was settled in 1894, by Tlingit Natives from Cape Fox and Tongass Islands. The town was named after a Presbyterian teacher named Samuel Saxman, who along with a Native village elder, were lost at sea looking for a new school site. When established, a few Tlingits from the old village of Kahshakes joined the growing community. Under ANCSA, the Cape Fox Corporation was formed and is the economic base for Saxman. Cape Fox Corporation is counted among one of the major employers in the Ketchikan area, including the Westmark Cape Fox Lodge, Cape Fox Tours, and as owner of 23,000 acres of forested land.

Today, about 266 villagers consume an average of 89 pounds of food per capita per year from subsistence activities. In the Project Area, residents of Saxman travel 30 miles to fish for salmon, hunt for deer and bear, and trap for marten, crab, and shrimp.

Wrangell

Wrangell, located in the east-central portion of Southeast Alaska, is on the northern tip of Wrangell Island about 7 miles from the mouth of the Stikine River and approximately 50 air miles from the Project Area. The 1990 population is reported as 2,479. Wrangell began as an important Tlingit site primarily because of its proximity to the Stikine River. Starting in 1811, the flags of three nations—England, Russia, and the United States—have flown over this community, with Russian and English interests centered on fur trading. When the United States purchased Alaska in 1867, a military post was established. Prospecting for gold along the Stikine River and later in the Cassiar District of northern British Columbia dwindled by 1916, and the economy changed to fishing, crabbing, and shrimping. Today, fishing and fish processing dominate Wrangell's economy. More than 100 residents fish commercially. It is the major source of income for 50 percent of those residents. Tourism is a growing economic influence in the Wrangell area.

Wrangell subsistence use is approximately 164 pounds consumed per person per year. In the Project Area, their reported use is for deer, salmon, crab, shrimp, and halibut.

Ketchikan

Ketchikan is located in southern Southeast Alaska, on the southwest side of Revillagigedo (Revilla) Island on Tongass Narrows opposite Gravina Island. Ketchikan is approximately 30 air/water miles from the Project Area.

The Ketchikan area was a summer fishing camp for the Tlingit Indians. Development began with a saltery at the mouth of Ketchikan Creek. Ketchikan was a boom town in the late 1800s. Since the early 1900s, timber products have been an important economic factor in Ketchikan. Because of its location as a transportation center, fishing center, and focus for the region's timber industry, Ketchikan grew rapidly in the 1950s. In 1954, a world-scale pulp mill was built in Ward Cove, with a computer aided, laser scanning sawmill added to the site in 1989. Besides the pulp and saw mills, Ketchikan has over a dozen large and small fish processing establishments. While mining does occur within the area, it is not currently of any major economic significance.

Ketchikan's 1990 borough population was reported as 13,828. Ketchikan was not included in the TRUCS study, since it is defined as non-rural. Information for this community reflects ADF&G sport fish and game harvest information.

Other Communities and Camps

In addition to communities already discussed, the Shoal Cove and Shelter Cove Camps also use the Project Area for subsistence gathering purposes. Subsistence use by these communities is expected to have minimal impact on the area.

Table Subsistence-1 presents information taken from the 1988 TRUCS report detailing the importance of subsistence use for individual communities using the Project Area. Total harvest figures include additional food items, plants, and berries.

Table Subsistence-1
Per Capita Subsistence Harvest for Rural Communities Which Use the Project Area for Subsistence Gathering Activities

Community	Total Harvest lbs.	Deer Harvest lbs.	Other Mammal lbs.	Salmon Harvest lbs.	Other Fish lbs.	Shellfish Harvest lbs.	Birds/ Eggs lbs.	Misc. Plants lbs.
Metlakatla	71	11	1	20	18	15	2	4
Meyers Chuck	414	22	37	105	176	52	14	8
Saxman	89	17	7	33	19	9	1	3
Wrangell	164	20	24	30	43	41	2	4

Source: TRUCS 1988.

Affected Resources

The Project Area supports a wide variety of resources that contribute to the maintenance of the subsistence life-style. Identified activities include harvest of fish, waterfowl, bear, deer, furbearers, clams, crab, and shrimp; and the gathering of berries and seaweed. In addition, many residents use trees for firewood and lumber, and spruce roots and cedar bark for cultural expression. Of these resources, fish, deer, black bear, furbearers, and waterfowl may be affected by the Sea Level Project and are analyzed in the following discussion.

Fish

Salmon and trout are the principal subsistence fish resources in the affected area. Pacific salmon are harvested in both fresh and saltwater in a variety of ways throughout the year in the Project Area. Pink and chum salmon are the most heavily used subsistence species because of their availability within the Project Area. Sockeye and Chinook salmon are not as common in the Project Area. Traditional harvest sites for salmon within the Project Area include pink and chum salmon at Fish Creek. Some pink, sockeye, and chum salmon are harvested at the mouth of Carroll Creek.

Table Subsistence-2 lists the stream, number of subsistence permits issued, and the number of fish taken by species for subsistence purposes. Neets Bay and at the mouth of Carroll Creek are shown as the principal salmon subsistence use areas in the Project Area.

Table Subsistence-2
Salmon Personal Use Permits and Harvest near the Project Area, 1985-94

Location & Year	Permits Reported	Salmon Taken: Chinook	Sockeye	Pinks	Chums
Carroll Creek—1985	3	0	3	34	2
Carroll Creek—1986	1	0	10	0	0
Fish Creek—1986	1	0	0	50	20

Source: ADF&G commercial and subsistence harvest data

Wildlife

For record keeping purposes, the ADF&G has broken the Game Management Units (GMUs) into smaller areas called minor harvest areas. Minor harvest units are approximately comparable to Wildlife Analysis Areas (WAAs). WAAs and their corresponding Value Comparison Units (VCUs) within the Sea Level Project Area are found in Table Subsistence-3.

Table Subsistence-3
VCUs Within the Sea Level Project Area

WAA	VCUs
405	7542, 7552, 756, 757, 759
406	746, 753

Source: Burns 1995.
Note: Only about 5 percent of WAA 405 and about 24 percent of WAA 406 are within the Sea Level Project Area.

Deer

Harvest of deer on the Project Area is from rural users and non-rural users. Communities whose residents have hunted deer in WAAs 405 and 406 since 1984 include Ketchikan and Juneau. Subsistence users came from: Metlakatla, Meyers Chuck, Saxman, Thorne Bay and Wrangell (ADF&G Harvest Data). Access is limited to boat or float plane.

Hunting effort in WAA 405 and 406 increased during certain years due to the resumption of logging operations in the area. Most of the additional harvest is by logging camp residents at Shoal Cove, Shelter Cove, and Elf Point. Harvest may increase as more logging, road building, and other developments occur in the Sea Level Project Area.

The general hunting season is August through late December. Harvest is concentrated during two time periods: the first few weeks of the season in August, and later in November when the rut occurs. Most of the deer harvest in the Project Area occurs on shorelines or timber harvest access roads.

Locations where communities harvested deer within the Sea Level Project Area during the 1987 to 1996 period are shown below in Table Subsistence-4.

Table Subsistence-4
WAAs within the Project Area Where Subsistence Communities Harvested Deer During 1987-1996

WAA	Metlakatla	Meyers Chuck	Saxman	Wrangell	Swan Lake	Revilla/406	Shoal Cove
405						x	
406			x			x	x

Source: Burns 1997. ADF&G Deer Harvest Data Base.

The average number of deer harvested from 1987 through 1996, by each community for WAAs 405 and 406, is shown in Table Subsistence-5. Ketchikan was included to illustrate the relative impact this community has on the area. An average of one deer per year was taken by hunters from rural communities in WAA 405. An average of three deer per year were taken by hunters from rural communities in WAA 406.

Subsistence hearings held in Ketchikan and Saxman revealed that some Saxman residents do not report their deer harvest to ADF&G, which indicates that the ADF&G harvest data is under-reporting the importance of this area to residents of Saxman. Another problem with the ADF&G harvest data is that some Saxman residents have a Ketchikan mailing address, so some Saxman resident deer harvest is being reported as Ketchikan resident harvest.

Table Subsistence-5
Average Deer Harvest by Community and WAA for the Years 1987-96

Community	WAA 405	WAA 406
Ketchikan	20	89
Metlakatla	0	0
Saxman	0	1
Shoal Cove	0	2
Revilla/406	1	1
Wrangell	0	0
Swan Lake	0	0
Outside Alaska	0	1
Average Deer Harvest	**21**	**94**
Average Non-rural Harvest	**20**	**91**
Average Rural Harvest	**1**	**3**

Source: ADF&G Deer Harvest Data For Southeast Alaska 1987-96.

The percentage of a community's deer harvest occurring within WAAs 405 and 406 is illustrated in Table Subsistence-6.

Table Subsistence-6
Average Deer Harvest by Community 1987-1996 and Percent of Total Harvest that Occurred Within WAAs 405 and 406

Community	Average Deer Harvest Within Project WAAs	Average Deer Harvest All Areas	Percent of Harvest Within Project WAAs
Ketchikan	110	1,628	6.7
Metlakatla	0	39	0.0
Saxman	1	5	25.5
Shoal Cove	2	2	62.5
Revilla/406	1	2	66.7
Wrangell	0	404	0.0
Swan Lake	0	0	0.0
Outside Alaska	1	66	2.0
Total Deer Harvest	**115**	**2,146**	**5.4**
Total Non-rural Harvest	**111**	**1,695**	**6.6**
Total Rural Harvest	**4**	**452**	**0.9**

Source: ADF&G Deer Harvest Data For Southeast Alaska 1987-96.

While Ketchikan accounted for the greatest number of deer harvested within the Project Area WAAs (110), it amounted to 0.1 percent of that community's total deer harvest (1,628). People living at the Shelter Cove and Shoal Cove Bay Logging Camp harvested all their deer from the Project Area WAAs. These logging camps are no longer in the Project Area; however, this level of harvest could be expected when another logging camp is moved in to harvest the proposed timber.

The TRUCS study (1988) produced a map that displayed areas used for subsistence deer hunting by Southeast Alaska subsistence households. This map shows that most of the Project Area has been used by one to five percent of subsistence households, with the exception of along the shoreline in Thorne Arm and Carroll Inlet.

Black Bear

Black bears occur throughout the Project Area and populations are currently stable. The TRUCS effort indicated that some black bear harvest was associated with subsistence use, but that community use varies widely. Bear tagging information from ADF&G indicates hunters were usually from the Ketchikan area; only five bear out of 139 were harvested by residents of rural communities. It is very possible that more bear were harvested by rural residents who had a Ketchikan or Ward Cove mailing address, but lived in Saxman.

Table Subsistence-7 displays the black bear harvest by WAA by year. Table Subsistence-8 displays the black bear harvest in WAAs 405 and 406 broken down by harvest of individuals from rural and non-rural communities.

Table Subsistence-7
Black Bear Harvest from 1986 to 1994 and Population Needed to Support Harvest Compared to Current Habitat Capability

WAA**	1986	1987	1988	1989	1990	1991	1992	1993	1994	Average Harvest Per Year	Population to Support Harvest*
405	2	1	1	2	2	1	0	2	0	1.2	12
406	21	17	2	19	22	11	7	17	12	14.2	142

Source: Burns 1997. Data derived from ADF&G harvest data.
* Population needed to support harvest assumes a 10 percent harvest of the population (pers. comm. D. Larsen, ADF&G Wildlife Biologist).
** Includes entire WAA, including portions outside the Project Area.

Table Subsistence-8
Black Bear Harvest by Rural and Non-rural Communities During 1986-1994

	WAA 405		WAA 406	
Year	Rural Harvest	Nonrural	Rural Harvest	Nonrural
1986	0	2	0	21
1987	0	1	0	17
1988	0	1	0	2
1989	0	2	0	19
1990	0	2	3	19
1991	0	1	0	11
1992	0	0	0	7
1993	0	2	0	17
1994	0	0	2	10
Total	**0**	**11**	**5**	**123**

Source: Burns 1997. ADF&G Black Bear Harvest Data Base.

Furbearers

Furbearer harvest supplements the seasonal income of many area residents. Different levels of trapping intensity exist, from the occasional trapper who targets primarily marten and otter close to shore, to those individuals pursuing all furbearers both near to and far from the road system. Harvest effort usually is concentrated along the saltwater/upland interface. Marten appear to be the most old-growth dependent of the furbearers and are trapped intensively from shore and along the road system. Tables Subsistence-9 and Subsistence-10 show furbearer harvest for 1998 to 1996 for WAA 405 and 406.

Table Subsistence-9
WAA 405 Furbearer Harvest from 1988 to 1996

Animal	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total	Average Harvest Per Year	Population Needed to Support Harvest*
Beaver	0	0	0	0	0	0	0	0	0	0	0.0	N/A
Marten	3	0	6	0	0	1	17	0	11	38	4.2	10.6
Otter	8	0	1	0	0	1	0	4	12	26	2.9	14.4
Wolf	2	0	1	3	0	2	0	0	0	8	0.9	4.4

Source: ADF&G Data Base.
* Population needed to support harvest assumes a 40 percent harvest of the marten population and a 20 percent harvest of the otter and wolf populations.

Table Subsistence-10
WAA 406 Furbearer Harvest from 1988 to 1996

Animal	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total	Average Harvest Per Year	Population Needed to Support Harvest *
Beaver	2	2	0	0	3	9	9	28	12	65	7.2	N/A
Marten	68	33	20	73	6	1	4	2	22	229	25.4	63.6
Otter	7	12	13	15	14	23	38	20	18	160	17.8	88.9
Wolf	0	2	1	1	3	1	4	7	3	22	2.4	12.2

Source: ADF&G Data Base.
* Population needed to support harvest assumes a 40 percent harvest of the marten population and a 20 percent harvest of the otter and wolf populations.

All of the marten trapped in WAAs 405 and 406 were trapped by non-rural residents (Table Subsistence-11). Rural residents harvested none of the marten in WAAs 405 and 406 (ADF&G Marten Harvest Database). It should be noted that there are wide yearly variations in harvest levels.

Table Subsistence-11
Marten Harvest by Rural and Non-rural Communities During 1988-96

	WAA 405		WAA 406	
Year	**Rural Harvest**	**Nonrural**	**Rural Harvest**	**Nonrural**
1996	0	11	0	22
1995	0	0	0	2
1994	0	17	0	4
1993	0	1	0	1
1992	0	0	0	6
1991	0	0	0	73
1990	0	6	0	20
1989	0	0	0	33
1988	0	3	0	68
Total	**0**	**38**	**0**	**229**

Source: Burns 1997. ADF&G Marten Harvest Data Base.

Waterfowl
A variety of species of ducks, along with Canada geese, occur in the Project Area, primarily along bays and estuaries. Identified sites with a history of waterfowl use that are within the Project Area include Gnat Cove Estuary and the head of Thorne Arm.

Marine Mammals
Seals are the main subsistence marine mammals in the Project Area. Seals are known to use the rocks in Carroll inlet near Shoal Cove and the rocks near Snipe and Minx Islands in Thorne Arm. Wrangell and Saxman are known to harvest marine mammals in these areas (TRUCS 1988). For more information on subsistence marine mammals, see Appendix B.

810 Evaluation-Effects of the Alternatives

Introduction

Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA) requires a Federal agency having jurisdiction over lands in Alaska to evaluate the potential effects of proposed land-use activities on subsistence uses and needs.

This section evaluates how the proposed action alternatives could affect subsistence resources used by the rural communities found to use the Project Area, including: Metlakatla, Saxman, Meyers Chuck, Wrangell, and the non-rural community of Ketchikan. The subsistence resource categories evaluated are deer, furbearers, waterfowl, black bear, salmon, other finfish, shellfish, other food and cultural resources, and firewood.

Criteria used to evaluate the effects of the proposed alternatives are: (1) changes in abundance or distribution of subsistence resources; (2) changes in access to subsistence resources; and (3) changes in competition from non-rural users for those resources. The evaluation determines whether subsistence uses in the Project Area or portions of the Project Area may be significantly restricted by any of the proposed action alternatives. The evaluation relies heavily upon the use of wildlife habitat capability models as well as upon ADF&G hunter survey data.

Direct, Indirect, and Cumulative Effects on Subsistence Use of Deer

A decrease in deer habitat capability of less than three percent for all alternatives in WAAs 405 and 406 is illustrated in Table Subsistence-12.

Table Subsistence-12
Percent Decrease from Current Deer Habitat Capability by Alternative

	Alternative					
WAA	**1**	**2**	**3**	**4**	**5**	**6**
405	0.0	2.7	1.6	0.9	0.3	0.0
406	0.0	1.9	1.2	1.1	1.0	0.4

Source: Burns 1997.

Based on the outputs of the habitat capability models for deer, only minor changes in current habitat levels would occur in WAAs 405 and 406. Current demand is assumed to be the average deer harvest from 1987-96, for each of the Project Area WAAs. To determine future demand for deer, the current demand was increased by 1.8 percent per year though the year 2010, and 1.5 percent per year from 2010 to the year 2040.

Deer: Reasonably Foreseeable Future Actions

Table Subsistence-13 displays the effects on deer habitat capability of harvesting Sea Level and other planned harvest activities taking place on Revilla Island between now and the year 2007. Table Subsistence-13 also shows the deer habitat capability in 2007 as a percentage of the current habitat capability for all the WAAs on Revilla Island.

Table Subsistence-13

Deer Habitat Capability Reductions on National Forest System Lands, by Reasonably Foreseeable Project and WAA for Revillagigedo Island by 2007

WAA	FS Lands Current Habitat Capability*	Percent Habitat Capability Reduction for Deer on National Forest System Lands			Percent of Current Habitat Capability
		Upper Carroll ROD	Sea Level Alt. 2	Total Reductions	Present at year 2007
404	4,357			0	100
405	1,850		3	3	97
406	2,737	1	2	3	97
407	1,107			0	100
408	274			0	100
509	1,520			0	100
510	2,553			0	100
511	522			0	100
Total	**14,920**	**0.1**	**1**	**1**	**99**

Source: Burns 1997.
* From TLMP 1997.
Note: Habitat capability assumes the harvested units are in the clearcut stage (0-25 years).

Table Subsistence-14
Percent Decrease from 1954 in Habitat Capability Effects for Deer

WAA	Current 1997 Change	Indirect 2007 Change	Cumulative 2095 Change
405	10.0	12.4	21.0
406	15.4	17.0	28.0

Source: Burns 1997.

Assuming that all suitable timber is harvested by the year 2095, there would be a 21 percent reduction in habitat capability in WAA 405 and a 28 percent reduction in WAA 406 (Table Subsistence-14). Using the assumption that there will be a constant increase in demand for deer, at some time in the future demand may exceed the deer habitat capability; however that exact time is difficult to predict given the many variables such as weather, human population increases, road access, and the desire to hunt certain areas.

Effects resulting from changes in access may be the most significant potential effects of the project. If a road network connecting the Project Area to Ketchikan were to develop, the effects on subsistence users may be significant. Ketchikan hunters dominate the harvest within their land use area. At present, Ketchikan's use of the Project Area is limited by the lack of road access. Road access would make it easier for the much larger pool of Ketchikan hunters to use the Project Area.

A road connection is being considered between Ketchikan and Shelter Cove. If this connection is constructed, the additional access for Ketchikan hunters may cause a significant possibility of a significant restriction on subsistence users. All of the roads constructed in the Shelter Cove area for the Sea Level Project would be closed following project completion to mitigate some of the potential impacts of competition. Some existing roads would be closed as well. Still, the mainline roads would provide the opportunity for increased competition from non-rural hunters

Direct, Indirect, and Cumulative Effects on Subsistence Use of Other Resources

Black Bear

The direct effects of the all alternatives on black bear habitat capability is less than one percent. There is no indication from the models that black bear habitat capability will be significantly diminished due to the proposed action as illustrated by Table Subsistence-15.

Table Subsistence-15
Percent Decrease from 1997 Black Bear Capability by Alternative

WAA	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
405	0.0	0.4	0.2	0.1	0.1	0.0
406	0.0	0.2	0.1	0.1	0.1	0.0

Source: Burns 1997.

Table Subsistence-16
Percent Decrease from 1954 in Habitat Capability Effects for Black Bear

WAA	Current 1997 Change	Indirect 2007 Change	Cumulative 2095 Change
405	1.1	1.5	30.2
406	0.9	1.2	26.4

Source: Burns 1997.

Indirect and cumulative effects on bear habitat capability are displayed in Table Subsistence-16, which exhibits the percent change to habitat capability from 1954 conditions. Habitat capability for Alternative 2 in WAAs 405 and 406 are 91 and 209, respectively. These habitat capabilities suggests enough habitat to support current black bear harvest levels (Table Subsistence-7) through 2007.

Assuming that all suitable timber is harvested by the year 2095, there would be a 30.2 percent reduction in habitat capability in WAA 405 and a 26.4 percent reduction in WAA 406. Black bear harvest can be expected to increase through 2095. At some point, demand can be expected to exceed supply.

A road connection is being considered between Ketchikan and Shelter Cove. If this connection is constructed, the additional access for Ketchikan hunters may cause a significant possibility of a significant restriction on subsistence users. Also, habitat capability in the Shelter Cove area could be reduced as much as 20 percent due to road effects. All of the roads constructed in the Shelter Cove area for the Sea Level Project would be closed following project completion to mitigate some of the potential impacts of competition. Some existing roads would be closed as well. Still, the mainline roads would provide the opportunity for increased competition from non-rural hunters.

Based on the possible road connection and future possible timber harvest, cumulative effects may cause a significant possibility of a significant restriction for black bear.

Fish

Salmon are a major subsistence food harvested in Southeast Alaska. The Water Resources, Fisheries, and Riparian sections of this chapter conclude that potential effects of the proposed timber harvest and road construction activities on salmon spawning and rearing habitat would be minimal or eliminated by applying the Forest Service Standards and Guidelines from the TLMP Final EIS (1997), and prescriptions described in detail in the Aquatic Habitat Management Handbook, Tongass Timber Reform Act, and Soil and Water Conservation Handbook. The application of these standards, guidelines, and prescriptions also minimize immediate and foreseeable impacts to other finfish.

Furbearers

The direct effects of the Sea Level Project on furbearers are shown in Table Subsistence-17. Habitat capability estimates were derived from computerized models of management indicator species (MIS) for marten and wolf.

Table Subsistence-17
Percent Change from 1997 Furbearer Habitat Capability by Alternative

WAA	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
405						
Marten	0.0	3.1	1.7	0.8	0.2	0.0
Wolf	0.0	2.1	1.1	0.3	0.0	0.0
406						
Marten	0.0	2.1	1.3	1.3	1.1	0.6
Wolf	0.0	1.4	0.7	0.6	0.5	0.0

Source: Burns 1997.

The habitat capability of the Project Area will remain essentially the same for wolf. Marten will decrease less than 4 percent in WAA 405 and less than 3 percent in WAA 406 for all alternatives. Habitat capability is approximately twice the population needed to sustain current harvest levels for marten. Wolf habitat capability is currently at or below the population needed to support current harvest levels. Therefore, there may be a significant possibility of a significant restriction for wolves due to direct effects.

Table Subsistence-18
Percent Change from 1954 in Habitat Capability Effects on Furbearers

WAA	Current 1997 Change	Indirect 2007 Change	Cumulative 2095 Change
405			
Marten	5.8	8.7	37.4
Wolf	9.7	12.1	20.7
406			
Marten	8.4	10.4	37.1
Wolf	14.8	16.4	27.4

Source: Burns 1997.

Table Subsistence-18 shows a summary of the cumulative effects on marten and wolves. Table Subsistence-18 indicates that if all suitable timber is harvested, by the year 2095, there could be a 20 to 40 percent reduction in habitat capability, from 1954, for marten and wolf. Increased demand for marten and wolves is expected through the year 2095.

A road connection is being considered between Ketchikan and Shelter Cove. If this connection is constructed, the additional access for Ketchikan hunters may cause a significant possibility of a significant restriction on subsistence users. Also, habitat capability in the Shelter Cove area could be reduced as much as 20 percent due to road effects. All of the roads constructed in the Shelter Cove area for the Sea Level Project would be closed following project completion to mitigate some of the potential impacts of competition. Some existing roads would be closed as well. Still, the mainline roads would provide the opportunity for increased competition from non-rural hunters

Based on the possible road connection and future possible timber harvest, cumulative effects may cause a significant possibility of a significant restriction for marten and wolves.

Otter

Forest-wide standards and guidelines in the TLMP (1997) protect most important otter habitats. The Sea Level Project incorporates these standards and guidelines into all alternatives. No harvest is proposed within stream buffers or within 1000 feet of beach and estuary buffers. Effects on otter habitat are expected to be minimal due to the implementation of these standards and guidelines.

Waterfowl

Effects of the proposed action on waterfowl are expected to be minimal because no timber harvest will be permitted within 1,000 feet of estuaries or shorelines. Timber harvest unit locations generally avoid important waterfowl areas, including: estuary grass flats, beach fringe, and borders of inland lakes and streams.

Marine Mammals

Forest-wide Standards and Guidelines in the TLMP (1997) will protect marine mammals in the Project Area. No harvest or road building is proposed near seal haulouts. Logging camps will be located appropriately to avoid conflicts with seal haulouts.

Firewood and Lumber

Current use of both live and dead timber for subsistence is very low throughout the Project Area. No need for wood in the Sea Level Project Area has been expressed. In terms of effects, there may be an immediate, localized, temporary use by logging camps, but indirect and cumulative demand is expected to return to current low use rates.

Other Resources

Other subsistence uses of the natural resources occur. Some examples are cedar bark gathering, berry picking, mushroom gathering, use of native plants for arts and crafts, use of bays and estuaries for shrimp and crab, and collection of other edible plants and animals.

Most of these activities are associated with a particular traditional site. These sites vary in locations and are not accurately mapped. The Sea Level Project could impact these sites if they fall inside proposed units.

ANILCA 810 Findings for Subsistence Use of the Project Area

Abundance and Distribution of Subsistence Resources

The harvest of old-growth habitat may reduce the abundance of deer, black bear, marten, and wolf based on the habitat capability models for these species. Timber harvest proposed by the action alternatives will reduce the deer habitat capability by less than three percent (Table Subsistence-12). Black bear habitat capability will be reduced by less than one percent for all action alternatives (Table Subsistence-15). Marten habitat capability in WAAs 405 and 406 will be reduced by less than four percent (Table Subsistence-17).

The Sea Level Project is not expected to affect distribution of subsistence resources, but abundance may be reduced by the amounts shown earlier in this section. Wolf habitat capability in WAA 406 is currently below the population needed to support current harvest levels. Therefore, direct effects may cause a significant possibility of a significant restriction for subsistence use of wolves based on abundance.

Abundance of deer, bear, wolves and marten may be significantly restricted at some point in the future, based on cumulative impacts.

Access

Access to traditional subsistence-use areas will not be restricted by the proposed project. Traditional subsistence access is by boat to the beaches of the Project Area. The effect on access would probably be minor under all alternatives because no beach fringe will be harvested in the Project Area and less than one percent of the marine and estuarine habitat will be affected by logging activities.

New and rebuilt roads will provide access to areas that were not previously used for subsistence harvesting resources. Miles of road proposed for construction can be found in the Roads and Facilities section. In most of the Project Area, mechanized use of the road system will be limited because access to the roads will be by boat or plane.

Road management prescriptions developed for Project Area roads take subsistence users' needs into consideration. All new roads except 3 (Alternative 4) to 6 (Alternative 2) miles at Elf Point will be blocked to cars and trucks following project completion. Some existing roads will be blocked as well for maintenance cost reasons. Existing roads are currently not connected to the Ketchikan road system. Most road use is by off-road vehicles. Off road vehicles would still be able to use many of the blocked roads. Therefore, there would not be significant restriction to subsistence users due to restricted access.

A possible road connection between Ketchikan and Shelter Cove has been proposed. Access would be improved under this project for Ketchikan and Saxman residents. The road connection would not restrict subsistence user access.

Competition

Competition for subsistence resources in the Project Area is a scoping issue. Subsistence users are concerned with competition from residents of Ketchikan. Since Ketchikan residents are considered non-rural, this competition can be regulated if it starts to restrict non-rural residents' ability to obtain subsistence resources. In the Wildlife section, the cumulative analysis discussed a potential road connection between the Shelter Cove area and the Ketchikan road system. If such a connection is made, it would significantly increase the amount of rural and non-rural use of the area and could increase the amount of competition to the point that there would be a significant restriction in subsistence use of deer, bear, wolves and marten in the Project Area.

The Federal Subsistence Board may use its authority to regulate non-rural harvest of deer and has authority to prioritize the harvest of deer among rural residents when necessary to protect the resource. The current deer population level does not require restrictions on non-rural users.

There is no evidence to indicate that availability of salmon, finfish, shellfish, or other food resources to subsistence users would be affected by sport or non-rural harvest. Any increase in competition from non-rural Alaskan residents and nonresidents would not be substantial because of the availability of resources in the immediate vicinity and in the surrounding areas.

Summary

The above analysis indicates that the direct effects of Alternatives 2 through 6 will not represent a significant possibility of restrictions on subsistence use of deer, black bear, marten or otter in the Project Area. Direct effects may cause a significant possibility of a significant restriction for wolves. This is based on a comparison between harvest levels and habitat capability in WAAs 405 and 406.

Cumulative impacts show a significant possibility of a significant restriction on deer, bear, marten, and wolves. Cumulative impacts include future reductions of habitat capability for deer and marten, past reductions in habitat capability, and the potential road connection between Shelter Cove and Ketchikan. This, combined with the possibility that Saxman residents' use of the area is under-reported for the Project Area, suggests there may be a possibility of significant restriction of subsistence use of deer, bear, marten and wolf at some point in the future.

EIS Conclusions

Section 810 (a)(3) of ANILCA requires that when a significant restriction may occur, determinations must be made with regard to whether:

- such a significant restriction of subsistence uses is necessary and consistent with sound management principles for the utilization of public lands;
- the proposed activity will involve the minimum amount of public lands necessary to accomplish the purposes of such use and occupancy, or other disposition; and
- the steps to be taken to minimize adverse impacts upon subsistence uses and resources resulting from such actions.

Necessary and Consistent with Sound Management of Public Lands

The alternatives proposed in the Sea Level Draft EIS have been examined to determine whether they are necessary and consistent with sound management of public lands. In this regard, the National Forest Management Act of 1976, the ANILCA, the Alaska Regional Guide, the TLMP Final EIS (1997), the Alaska State Forest Practices Act, and the Alaska Coastal Zone Management Program have been considered.

The ANILCA placed an emphasis on the maintenance of subsistence resources and life-styles. However, the Act also required the Forest Service to manage the forest for multiple use. The TTRA removed the 4.5 MMBF requirement from ANILCA, but directed the Forest Service "to the extent consistent with providing for the multiple use and sustained yield of all renewable forest resources, [to] seek to provide a supply of timber from the Tongass National Forest which (1) meets the annual market demand for timber from such forest, and (2) meets the market demand from such forest for each forest for each planning cycle," and left the volume requirements and contract area of the KPC contract in place.

The alternatives presented here encompass six different approaches that would produce the resources that would meet the purpose and need of this project. All of the action alternatives involve some potential to affect subsistence uses. Therefore, based on the analysis of the information presented in this document on the proposed alternatives, these actions are necessary and consistent with the sound management of public lands.

Amount of Public Land Necessary to Accomplish the Purpose of the Proposed Action

Appendix A addresses the availability of other lands suitable for timber harvest. Much of the Tongass National Forest is used by one or more rural communities for subsistence purposes for deer hunting. The areas of most subsistence use are the areas adjacent to existing road systems, the beaches, and the areas in close proximity to communities. Within the Project Area, the extent and location of the subsistence use areas precludes complete avoidance. Areas other than subsistence use areas that could be harvested may be limited by other resource concerns such as: soil and water protection, high value wildlife habitat, economics, visuals, or unit and road design. Effort was taken to protect the highest value subsistence areas such as the beach fringe, estuaries, and riparian areas.

The impact of viable timber harvest projects always includes alteration of old-growth habitat, which in turn always reduces projected habitat capability for old-growth dependent species. It is not possible to lessen harvest in one area and concentrate it in another without affecting one or more rural communities' important subsistence use areas. In addition, harvestable populations of game species could not be maintained in a natural distribution across the Forest if harvest were concentrated in specific areas. A well distributed population of species is also required by the Forest Service regulations implementing the National Forest Management Act (NFMA).

Reasonable Steps to Minimize Adverse Impacts Upon Subsistence Uses and Resources

Reasonable steps to minimize impacts on subsistence have been incorporated into development of the alternatives and project design criteria. Project design criteria called for locating roads and units outside of important subsistence use areas such as the beach fringe, estuary fringe, and riparian areas adjacent to salmon streams. During development of alternatives, an effort was made to minimize activities that could adversely affect important subsistence use areas.

Hearings

On the basis of findings of this analysis and under the provisions of the ANILCA, subsistence hearings will be held to gather input from subsistence users. Letters will be sent to the Federal Subsistence Board, ADF&G, Regional Fish and Game Advisory Councils, local Fish and Game Advisory Committees, and to the Post Offices in Metlakatla, Meyers Chuck, Ketchikan, Saxman, and Thorne Bay to inform people of where hearings will be held. Announcements will also be made in the Ketchikan Daily News announcing the dates of the Subsistence Hearings.

Testimony received, both verbal and written, will be analyzed and incorporated into the Final EIS.

Draft EIS Conclusions

The Record of Decision (ROD) for the Final EIS for the Sea Level Project will include a final finding about the significant restriction on subsistence uses that may result from implementation of the Selected Alternative. Below is a summary of the Draft EIS evaluation and findings.

1. Hunting and trapping harvest levels of wolf currently are at or exceed habitat capability. Direct effects of the Sea Level Project, including the No-Action Alternative, may present a significant possibility of a significant restriction of subsistence uses of wolf.
2. The direct effects from the action alternatives in the Sea Level Project do not present a significant possibility of a significant restriction of subsistence uses of deer, black

bear, marten, otter, marine mammals, waterfowl, salmon, other finfish, shellfish, and other foods.

3. The potential foreseeable and cumulative effects from implementing the Forest Plan (1997) through the entire rotation period, including the no-action and action alternatives in the Sea Level Project Area, may present a significant possibility of a significant restriction of subsistence uses of deer, bear, marten, and wolf. Due to the possibility that Saxman residents' use of the Project Area is under-reported in the data, there is a possibility that at some point in the future it may be necessary to restrict the non-rural harvest of deer, marten, bear and wolf and give rural residents priority.

Table Subsistence-19 displays the summary comparison for subsistence use within the Project Area.

Table Subsistence-19
Summary Comparison of Alternatives

Activity/Resource	Units	Alternatives					
		1	2	3	4	5	6
Subsistence - WAAs 405 and 406							
High & Moderate Use Subsistence (TRUCS)	Acres harvested	0.0	0.0	0.0	0.0	0.0	0.0
Deer Habitat Capability	Percent of 1954 Habitat Capability	87	85	86	86	86	87
Deer Population Needed to Support Current Harvest	Percent of 1954 Habitat Capability	22.0	22.0	22.0	22.0	22.0	22.0
Significant Possibility of a Significant Restriction							
Direct Effects:							
Deer	Response	No	No	No	No	No	No
Bear	Response	No	No	No	No	No	No
Furbearers	Response	May	May	May	May	May	May
Salmon	Response	No	No	No	No	No	No
Other Finfish	Response	No	No	No	No	No	No
Waterfowl	Response	No	No	No	No	No	No
Marine Mammals	Response	No	No	No	No	No	No
Indirect & Cumulative Effects of Implementing the Forest Plan Over the Entire Rotation:							
Deer	Response	May	May	May	May	May	May
Bear	Response	May	May	May	May	May	May
Furbearers	Response	May	May	May	May	May	May
Salmon	Response	No	No	No	No	No	No
Other Finfish	Response	No	No	No	No	No	No
Waterfowl	Response	No	No	No	No	No	No
Marine Mammals	Response	No	No	No	No	No	No

Source: Burns 1996.

Chapter 4

Lists

List of Preparers

The following is a list of contributors to the Sea Level Environmental Impact Statement. Other Forest Service employees contributed to the completion of this document through their assistance in support functions. Their help is greatly appreciated.

Members of the Interdisciplinary Team

Pete Griffin, Team Leader
Education
B.S. Biology, Lake Superior State University, 1974
Forest Service: 24 years
Environmental Coordinator, Tongass NF, Ketchikan Area, 5 years
Assistant Ranger Recreation, Chippewa NF, Walker RD, 5 years
Shared Service Wildlife Biologist, Huron-Manistee NF, 4 years
Biological Technician (Fish/WL), Huorn-Manistee NF, Cadillac RD 5 years
Biological Technician (Soils/Watershed), Huron-Manistee NF, 4 years
Other Relevant Experience:
Michigan Chapter of The Wildlife Society, Secretary-Treasurer, Board of Directors, 4 years
Fish/Wildlife Project Coordinator, Huron-Manistee NF, Sprinkler Lake YCC Camp, 1 season
Biological Aid (Fisheries), Huron-Manistee NF, 1 season

Bill Nightingale, Initial Team Leader
Education
B.S., Forestry, University of Minnesota, 1978
Certified silviculturist 1983 - 1993
Forest Service: 20 years
Planning Forester, Tongass NF, Ketchikan Area, 7 years
Forest Silviculturist, Tongass, Ketchikan Area, 2 years
Presale Forester/Silviculturist, Bighorn NF, 2 years
Silviculturist, Black Hills NF, 3 years
Presale/Fire/Zone Scaler-Technician and Forester, White River NF, Rifle RD, 4 years
Forest Technician, Bitterroot NF, Sula RD, 1 season
Engineering Technician, Kootenai NF, Rexford RD, 2 seasons
Other Relevant Experience
Forest Technician, BLM - Craig, Colorado, 1 season
Forest Technician, Minnesota DNR, Effie, MN, 1 season
Forestry Aid, City of St. Louis Park, MN, 1 season

William E. Angelus, Landscape Architect
Education
B.L.A., University of Florida, 1974
Registered Landscape Architect since 1976
Forest Service: 6 years
Landscape Architect, Tongass NF, Ketchikan Area, 6 years
Other Relevant Experience
Regional Planning Firm, Florida, 2 years
Florida Department of Transportation, 1 year
Landscape Architectural Design firms, New Mexico and California, 8 years

4 Lists

Neil R. Babik, Soil Scientist
Education
B.S., Forestry, University of Wisconsin-Stevens Point, 1975
Forest Service: 18 years
Soil Scientist, Tongass NF, Ketchikan RD, 7 years
Soil Scientist, Targhee NF, St. Anthony, Idaho, 3 years
Soil Scientist, Kisatchie NF, Pineville, Louisiana, 3 years
Soil Scientist, Tongass NF, Petersburg RD, 5 years
Other Relevant Experience
Soil Conservation Service, Hawaii, No. Carolina, Wisconsin, 6 years

Kerry A. Burns, Wildlife Biologist
Education
B.S., Wildlife Biology, Colorado State University, 1982
Forest Service: 12 years
Wildlife Biologist, Tongass NF, Ketchikan RD, 7 years
Range Technician/Wildlife Biologist, Shoshone NF, Greybull RD, 1 year
Forestry Technician, Pike/San Isabel NF, Leadville RD, 9 seasons
Forestry Aid, Pike/San Isabel NF, 2 seasons

Ricardo Sainz, Fisheries Biologist
Education
B.S., Biology, Northern Arizona University, 1991
Forest Service: 7 years
Fisheries Biologist, Tongass NF, Ketchikan Ranger District, 7 years
Fisheries Biologist, Cooperative Education Student, Misty Fjords National Monument 1 year.

James Llanos, GIS Manager and Native Liaison
Education
Systems and Procedures, Development and Design, National Career Institute, San Francisco, California, 1967-69.
Forest Service: 6 years
Systems Analyst, Tongass NF, Ketchikan Area, 6 years
GIS Technician, Tongass NF, Ketchikan Area, 2 years
Other Relevant Experience
Administrative Officer, Union Bank, 10 years
Research and Development, Federal Home Loan Bank Assn., San Francisco, California, 3 years
Independent Managerial & Systems Consultant, 5 years
Commercial SE Alaska Fisherman, 5 years
Resident Alaskan, 34 years

Craig Trulock, Forester - Silviculturist
Education
B.S., Forest Resources, University of Montana, 1991
Certified Silviculturist 1997
Forest Service: 7 years
Silvicultural Forester, Tongass NF, Ketchikan Ranger District, 2 years
Presale Forester, Tongass NF, Ketchikan Ranger District, 3 years
Forestry Technician, Tongass NF, Ketchikan Ranger District, 1 year
Forestry Technician, Clearwater NF, Pierce RD, 1 year
Forestry Technician, Targhee NF, Island Park RD, 1 season
Forestry Technician, Kootenai NF, Libby RD, 1 season
Other Relevant Experience:
Horticulture Worker, Northwest College, 1 season
Horticulture Worker, Red Arrow Campground, 2 seasons

Thomas V. Marks, Forester
Education
A.S., Forest Technician Certificate, Sierra College, 1976
Professional Forestry Training Program, California Polytechnic University, 1989
Forest Service: 20 years
Planning Forester, Tongass NF, Ketchikan Area, Ketchikan RD, 2 years
Sales Preparation Forester, Tongass NF, Ketchikan Area, Ketchikan RD, 7 years
Timber Sale Layout Technician/NEPA, Klamath NF, Goosenest RD, 4 years
Marking Crew Foreman, Klamath NF, Goosenest RD, 5 years
Silviculture Foreman, Klamath NF, Goosenest RD, 2 years
Forest Technician Marking Crew Foreman, Tahoe NF, Sierraville RD, 4 Seasons
Other Relevant Experience
Forest Engineering Institute, Oregon State University, 1992
Certified Tree Measurement Specialist, 1983
Advanced Cruiser/District Check Cruiser since 1984

Jack Oien, Transportation Planner
Forest Service: 22 years
Transportation Planner, Tongass NF, Ketchikan Area, 4 years
Project Engineer, Tongass NF, Ketchikan Area, 5 years
Transportation Planner, Mt. Baker Snoqualmie N.F, 2 years
Project Engineer, Tongass NF, Ketchikan Area, 4 years
Construction Inspector, Lolo N.F., 7 years

Additional Support

Lynn Atkins - Writer/Editor

John Autrey - Archaeologist

Dennis Benson - Recreation, Road Cards

Julie Benson - Writer/Editor

Colleen Bentley-Grundy - Silviculture

Dave Fletcher - Timber

Devin Fox - Timber

Alan Grundy - Timber

Pete Klein - GIS

Melinda Kuharich - GIS

Ralph Lively - Unit cards, Field surveys

Fred Norman - Road Layout

Todd Tisler - Stream Survey, Road Cards & Roads and Facilities Section

4 Lists

Glossary

Access
The opportunity to approach, enter, and make use of public lands.

Access Management
Acquiring rights and developing and maintaining facilities needed by people to get to and move through public lands (physical attributes).

Active Channel
Unstable portion of a stream where stream channels are frequently changing course.

Adfluvial Fish
Species of populations of fish that do not go to sea, but live in lakes, and enter streams to spawn.

Aelvin
Young salmon that are still attached to the yolk sac, which provides nourishment.

Aerial Harvest Systems
Harvesting methods in which the cut logs are moved from the stump to the loading area or log deck without touching the ground, for example helicopter logging.

Aggradation
The process of building up a land surface by deposition.

Alaska National Interest Lands Conservation Act (ANILCA)
Passed by Congress in 1980, this legislation designated 14 National Forest wilderness areas in Southeast Alaska. The Alaska National Interest Lands Conservation Act of December 2, 1980. Public Law 96-487, 96th Congress, 94 Stat. 2371-2551. In Section 810 requires evaluations of subsistence impacts before changing the use of these lands.

Alaska Native Claims Settlement Act (ANCSA)
Public Law 92-203, 92nd Congress, 85 Stat. 2371-2551. Approved December 18, 1971, ANCSA provides for the settlement of certain land claims of Alaska natives and for other purposes.

Allowable Sale Quantity (ASQ)
ASQ refers to the maximum quantity of timber that may be sold each decade from the Tongass National Forest. This quantity, expressed as a board foot measure, is calculated per timber utilization standards specified in the Alaska Regional Guide, the number and type of acres available for timber management, and the intensity of timber management. The ASQ was calculated at 2.67 billion board feet per decade for the Tongass National Forest.

Alluvial Fan
A cone-shaped deposit of organic and mineral material made by a stream where it runs out onto a level plain or meets a slower stream.

Alluvium
Material deposited by rivers or streams, including the sediment laid down in river beds, flood plains and at the foot of mountain slopes and estuaries.

Alpine
Parts of mountains above tree growth and/or the organisms living there.

Alternative
One of several options proposed for decision making.

Anadromous Fish
Anadromous fish (such as salmon, steelhead, and sea run cutthroat trout) spend part of their lives in freshwater and part of their lives in saltwater.

Anadromous Species
One whose individuals are born in freshwater but migrate to and feed in the sea before returning to freshwater to breed.

Background
The distant part of a landscape. The seen or viewed area located from three or five miles to infinity from the viewer. (See "Foreground" and "Middleground".)

Beach Fringe Use Area
Non-forested wildlife use areas that occur from the intertidal zone inland 500 feet and islands of less than 50 acres. Forested wildlife use areas that occur from the intertidal zone inland 600 feet and islands of less than 50 acres.

Bedload
Sand, silt, and gravel, or soil and rock debris rolled along the bottom of a stream by the moving water.

Benthic
Refers to the substrate and organisms in and on the bottom of a body of water.

Best Management Practice (BMP)
Practices used for the protection of water quality. BMPs are designed to prevent or reduce the amount of pollution from nonpoint sources or other adverse water quality impacts while meeting other goals and objectives. BMPs are standards to be achieved, not detailed or site specific prescriptions or solutions.

Biological Diversity (Biodiversity)
The variety of life in all its forms and at all levels. This includes the various kinds and combinations of: genes; species of plants, animals, and microorganisms; populations; communities; and ecosystems. It also includes the physical and ecological processes that allow all levels to interact and survive. The most familiar level of biological diversity is the species level, which is the number and abundance of plants, animals, and microorganisms.

Blowdown
See windthrow.

Board Foot (BF)
A unit of wood 12" X 12" X 1". One acre of commercial timber in Southeast Alaska on the average yields 28,000-34,000 board feet per acre (ranging from 8,000-90,000 board feet per acre). One million board feet (MMBF) yields approximately enough timber to build 120 houses.

Braided Streams or Channels
A stream flowing in several dividing and reuniting channels resembling the strands of a braid, the cause of division being the obstruction by sediment deposited by the stream.

Cant
A log partly or wholly cut and destined for further processing.

Channel Migration
Movement of a stream or river channel within a floodplain area usually over an extended period of time.

Clearcut
Harvesting method in which all trees are cleared in one cut. It prepares the area for a new even-aged stand. The area harvested may be a patch, strip, or stand large enough to be mapped or recorded as a separate age class.

Climax
A community of plants and animals which is relatively stable over time and which represents the late stages of succession under current climate and soil conditions.

Commercial Forest Land (CFL)
Productive Forest land that is producing or capable of producing crops of industrial wood and is not withdrawn from timber utilization by statute or administrative regulation. This includes areas suitable for management and generally capable of producing in excess of 20 cubic feet per acre of annual growth or in excess of 8,000 board feet net volume per acre. It includes accessible and inaccessible areas.

Normal CFL: Timber that can be economically harvested with locally available logging systems. Composed of two categories:

Standard: Timber that can be economically harvested with locally available logging systems, such as highlead or short-span skyline.

Special: Timber that is in areas where special consideration is needed to protect other resources but can be harvested with locally available logging systems.

Non-standard CFL: Timber that cannot be harvested with locally available logging systems and would require the use of other logging systems such as helicopter or long-span skyline.

Commercial Thinning
Thinning a stand where the trees to be removed are large enough to sell.

Confluence
The point where two streams meet.

Corridor
Connective links of certain types of vegetation between patches of suitable habitat which are necessary for certain species to facilitate movement of individuals between patches of suitable habitat. Also refers to transportation or utility rights-of-way.

Cover
Refers to trees, shrubs, or other landscape features that allow an animal to partly or fully conceal itself.

Critical Habitat
Specific terrain within the geographical area occupied by threatened or endangered species. Physical and biological features that are essential to conservation of the species and which may require special management considerations or protection are found in these areas.

Crown
The tree canopy. The upper part of a tree or woody plant that carries the main branch system and foliage.

Cruise
Refers to the general activity of determining timber volumes and quality as opposed to a specific method.

Cull Logs
Trees that do not meet certain quality specifications.

Culmination Mean Annual Increment (CMAI)
The point at which a tree (or stand) achieves its highest average growth, based on expected growth according to the management intensities and utilization standards assumed in the Forest Plan.

Cultural Resources
Historic or prehistoric objects, sites, buildings, structures, and their remains, resulting from past human activities.

Cumulative Effects
The impacts on the environment resulting from additional incremental impacts of past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions occurring over time.

Cutover
Areas harvested recently.

Diameter Breast Height (DBH)
Diameter breast height is the diameter of a tree measured 4 feet 6 inches from the root collar on the uphill side of the tree.

Debris Avalanche
The sudden movement downslope of the soil mantle; it occurs on steep slopes and is caused by the complete saturation of the soil from prolonged heavy rains. Also known as a debris slide.

Debris Flow
A general term for all types of rapid movement of debris downslope.

Debris Torrents
Landslides that occur as a result of debris; avalanche materials which either dam a channel temporarily or accumulate behind temporary obstructions such as logs and forest debris.

Deer Winter Range
Locations that provide food and shelter for Sitka black-tail deer under moderately severe to severe winter conditions.

Degradation
The general lowering of the surface of the land by erosive processes, especially by the removal of material through erosion and transportation by flowing water.

Detritis
Material, produced by the disintegration and weathering of rocks, that has been moved from its site of origin.

Developed Recreation
Recreation that requires facilities that, in turn, result in concentrated use of an area. Facilities in these areas might include roads, parking lots, picnic tables, toilets, drinking water, and buildings.

Direct Employment
The jobs that are immediately associated with timber harvest and processing, including, for example, logging, sawmills, and pulpmills.

Discount Rate
The rate used to adjust future benefits or costs to their present value.

Dispersion
To disperse the effects of timber harvest by distributing harvest units more or less uniformly throughout a drainage so that increased runoff and sediment from disturbed sites will be buffered by lower levels of runoff and sediment production from surrounding undisturbed lands.

Dissected Landforms
A physical, recognizable form or feature of the earth's surface such as a mountain, hill, or valley having a characteristic shape, that in part is the result of several shallow or deeply incised drainage channels.

Dissolved Oxygen
The amount of free (not chemically combined) oxygen in water.

Distance Zone
Areas of landscapes denoted by specified distances from the observer (foreground, middleground, or background). Used as a frame of reference in which to discuss landscape characteristics of management activities.

Diversity
The distribution and abundance of different plant and animal communities and species within an area.

Draft Environmental Impact Statement (Draft EIS)
A statement of environmental effects for a major Federal action which is released to the public and other agencies for comment and review prior to a final management decision. Required by Section 102 of the National Environmental Policy Act (NEPA).

Eagle Nest Tree Buffer Zone
A 330-foot radius around eagle nest trees established in an Agreement between the U.S. Fish and Wildlife Service and the Forest Service.

Ecosystem
A community of organisms and its physical setting. An ecosystem, whether a fallen log or an entire watershed, includes resident organisms, non-living components such as soil nutrients, inputs such as rainfall, and outputs such as organisms that disperse to other ecosystems.

Ecotone
A transition or junction zone between two or more naturally occurring diverse plant communities (ecosystems).

Ecotype
A species of plant or animal that displays different genetic or physiological adaptations. For example, the brown bear in Southeast Alaska is the same species as the grizzly bear in interior Alaska, but the brown bear is generally larger than the grizzly.

Effects
Effects, impacts, and consequences as used in this environmental impact statement are synonymous. Effects may be ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historical, cultural, economic, or social, and may be direct, indirect, or cumulative.

Direct Effects: Results of an action occurring when and where the action takes place.

Indirect Effects: Results of an action occurring at a location other than where the action takes place and/or later in time, but in the reasonably foreseeable future.

Cumulative Effects: See Cumulative Effects.

Encumbrance
A claim, lien, charge, or liability attached to and binding real property.

Endangered Species
Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act. See also, threatened species, sensitive species.

Erosion
The wearing away of the land surface by running water, wind, ice, gravity, or other geological activities.

Escapement
Adult anadromous fish that escape from all causes of mortality (natural or human-caused) to return to streams to spawn.

Estuarine Buffer
A 1,000-foot wide zone around an estuary.

Estuary
For the purpose of this EIS process, estuary refers to the relatively flat, intertidal, and upland areas generally found at the heads of bays and mouths of streams. They are predominately mud and grass flats and are unforested except for scattered spruce or cottonwood.

Even-Aged Management
The application of a combination of actions that result in the creation of stands in which trees of essentially the same age grow together. The difference in age between trees in forming the main canopy level of a stand usually does not exceed 20 percent of that age of the stand at harvest rotation age. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.

Executive Order
An order or regulation issued by the President or some administrative authority under his or her direction.

Existing Visual Condition
The level of visual quality or condition presently occurring on the ground. The six existing visual condition categories are:

Type I: Natural Condition. Areas in which only ecological change has taken place. Corresponds to the Preservation VQO.

Type II: Natural appearing. Areas in which changes in the landscape are not noticed by the average forest visitor unless pointed out. Corresponds to the Retention VQO.

Type III: Slightly altered. Areas in which changes in the landscape are noticed, but do not attract attention. Corresponds to the Partial Retention VQO.

Type IV: Moderately altered. Areas in which changes in the landscape are easily noticed and may attract attention. Corresponds to the Modification VQO.

Type V: Heavily altered. Areas in which changes in the landscape obviously appear to be major disturbances and stand out as a dominating impression of the landscape. Corresponds to the Maximum Modification VQO.

Type VI: Drastically altered. Areas in which changes in the landscape are in glaring contrast to a natural appearance. Not a VQO.

Final Environmental Impact Statement (Final EIS)
The final version of the statement of environmental effects required for major federal actions under Section 102 of the National Environmental Policy Act. It is a revision of the draft environmental impact statement (Draft EIS) to include public and agency responses to the draft. The decision maker chooses which alternative to select from the Final EIS, and subsequently issues a Record of Decision (ROD).

Fiscal Year (FY)
October 1 through September 30, e.g. October 1, 1997 - September 30, 1998 = FY98.

Floodplain
That portion of a river valley, adjacent to the river channel, which is covered with water when the river overflows its banks at flood stages.

Fluvial
Of or pertaining to streams and rivers.

Foreground
The stand of trees immediately adjacent to a scenic area, recreation facility, or forest highway; area located less than 1/4 mile from the viewer. See also, Background and Middleground.

Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA)
Amended in 1976 by the National Forest Management Act. See RPA Assessment and Program.

Forest or Forest Land
National Forest System lands currently supporting or capable of supporting forests at a density of 10 percent crown closure or more. Includes all areas with forest cover, including old growth and second growth, and both commercial and non-commercial forest land.

4 Lists

Forested Wetland
A wetland whose vegetation is characterized by an overstory of trees that are 20 feet or taller.

FORPLAN
The forest planning model. A linear programming software package used to analyze planning decisions regarding land use patterns, capital investment, and timber harvest scheduling.

FSH
Forest Service Handbook.

FSM
Forest Service Manual.

Geographic Information System (GIS)
An information processing technology to input, store, manipulate, analyze, and display spatial and attribute data to support the decision-making process. It is a system of computer maps with corresponding site specific information that can be electronically combined to provide reports and maps.

Geomorphology
The study of the forms of the land surface and the processes producing them. Also the study of the underlying rocks or parent materials and the landforms present which were formed in geological time.

Glide or Placid Streams
Grouping of channel types (L1 and L2) that have fairly consistent physical characteristics occurring on lowland landforms and are mostly associated with bogs, marshes, or lakes.

Groundwater
Water within the earth that supplies wells and springs.

Guideline
A preferred or advisable course of action or level of attainment designed to promote achievement of goals and objectives.

Habitat
The sum total of environmental conditions of a specific place occupied by an organism, population, or community of plants and animals.

Habitat Capability
The number of healthy animals that a habitat can sustain. Used in wildlife models to calculate rough population estimates for Management Indicator Species.

Habitat Improvement
Management of wildlife and fish habitat to increase their capability.

Hard Snags/Soft Snags
Hard snags are dead trees which have little decay and are generally still hard wood. Soft snags are dead trees which have a considerable amount of decay and are generally soft, broken wood.

Haul out
An area of large, smooth rocks used by seals and sea lions for resting and pupping.

Humus
Soil component of organic origin that is fairly resistant to bacterial decay.

Hydrophyte
Plants typically found in wet habitats.

IMPLAN
IMpact analysis for PLANning. A computer-based system used by the Forest Service for measuring economic input. The system includes a data base for all counties in the United States and a set of computer programs to retrieve data and perform the computational tasks.

Indirect Employment
The jobs in service industries that are associated with timber harvest including, for example, suppliers of logging and milling equipment.

Inoperable Timber
Timber that cannot be harvested by any proven method because of potential resource damage, extremely adverse economic considerations, or physical limitations.

Interdisciplinary Team (IDT)
A group of people with different backgrounds assembled to research, analyze, and write a project Environmental Impact Statement.

Invertebrates
Animals without a backbone.

Irretrievable Commitments
Losses of production or use of renewable natural resources for a period of time. For example, timber production from an area is irretrievably lost during the time an area is allocated to a no-harvest prescription; if the allocation is changed to allow timber harvest, timber production can be resumed. The production lost is irretrievable, but the action is not irreversible.

Irreversible Commitments
Decisions causing changes which cannot be reversed. For example, if a tree is cut, that action cannot be reversed. The tree cannot be "uncut." This term often applies to the extraction of nonrenewable resources such as minerals.

Issue
A point, matter, or section of public discussion or interest to be addressed or decided.

Knutsen-Vandenburg Fund (KV)
The portion of timber sale receipts collected and used for reforestation and other renewable resource projects on the sale area.

Land Use Designation (LUD)
The method of classifying land uses presented in the Tongass Land Management Plan (TLMP). Land uses and activities are grouped to define a compatible combination of management activities. The TLMP describes 19 land use designations, each with its own desired future condition, goals, and objectives to be achieved through implementation of the Forest Plan.

Landslides
The moderately rapid to rapid down slope movement of soil and rock materials that may or may not be water-saturated.

Large Woody Debris (LWD)
Any large piece of relatively stable woody material having a diameter of at least four inches and a length greater than three feet that intrudes into the stream channel. Also called Large Organic Debris (LOD).

Log Transfer Facility (LTF)
A facility that is used for transferring commercially harvested logs to and from a vessel or log raft, or the formation of a log raft. It is wholly or partially constructed in waters of the United States and location and construction are regulated by the 1987 Amendments to the Clean Water Act.

Logging Systems
Highlead: A cable yarding system, using a two-drum yarder, in which lead blocks are hung on a spar or tower to provide lift to the front end of the logs. Grabinski is a modified highlead cable system.

Aerial Logging Systems: Systems where the cut logs are moved from the stump to the loading area or log deck without touching the ground.

Live skyline/gravity carriage return: A two-drum, live skyline yarding system in which the carriage moves down the skyline by gravity; thus, is restricted to uphill yarding; the skyline is lowered to attach logs then raised and pulled to the landing by the mainline.

Live skyline/haulback required: A live skyline yarding system composed of skyline, mainline, and haulback; the carriage is pulled to the woods by the haulback; the skyline is lowered to permit the chokers to be attached to the carriage, and the turn is brought to the landing by the mainline.

Running skyline: A yarding system with three suspended moving lines, generally referred to as the main, haulback, and slack-pulling, that when properly tensioned will provide lift, travel, and control to the carriage; normally indicates a gantry type tower and a three-drum yarder.

Standing skyline: Used wherever yarding distances or span distances exceed the capability of live skyline equipment.

Multispan skyline: European equipment is commonly associated with this.

Tractor: Used to describe the full range of surface skidding equipment, designed to operate on level to downhill settings.

Shovel: A system of short-distance logging in which logs are moved from the stump to the landing by repeated swinging with a swing-boom log loader; the loader is walked off the haul road and out into the harvest unit; logs are moved and decked progressively closer to the haul road with each pass of the loader; when logs are finally decked at roadside, the same loader, or a different loader, loads out trucks. On gentle ground, logs are either heeled and swung or dragged by the boom as it rotates; larger log length and tree length logs are usually dragged to maintain machine stability. Soils should be moderate to well drained and side slopes must be less than 20 percent; passes or stripes should be kept to a maximum of four.

Helicopter: Flight path cannot exceed 40 percent downhill or 30 percent uphill; landings must be selected so there is adequate room for the operation and so that the helicopter can make an upwind approach to the drop zone.

A-Frame: Beach fringe timber which is logged with a float mounted yarder typically rigged in a highlead configuration for direct A-frame yarding.

Cold-deck and swing: Planned to access areas not suitable for skyline operations.

MBF
Thousand board feet net sawlog and utility volume.

MMBF
Million board feet net sawlog and utility volume.

MMCF
Million cubic feet net sawlog and utility volume.

Management Indicator Species (MIS)
Species selected in a planning process that are used to project the effects of planned management activities on wildlife and fish that are socially or economically important.

Management Prescription
Management practices and intensity selected and scheduled for application in a land use designation to attain multiple-use and other goals and objectives.

Management Requirement
Standards for resource protection, vegetation manipulation, silvicultural practices, even-aged management, riparian areas, soil and water and diversity, to be met in accomplishing National Forest System goals and objectives. (see 36 CFR 219.17)

Mass Failure
The downslope movement of a block or mass of soil. This usually occurs under conditions of high-soil moisture and does not include individual soil particles displaced as surface erosion.

Mean Annual Increment (MAI)
The total volume of a stand divided by its age.

Memorandum of Understanding (MOU)
A legal agreement between the Forest Service and others agencies resulting from consultation between agencies that states specific measures the agencies will follow to accomplish a large or complex project.

Microclimate
The temperature, moisture, wind, pressure, and evaporation (climate) of a very small area that differs from the general climate of the larger surrounding area.

Middleground
The visible terrain beyond the foreground where individual trees are still visible but do not stand out distinctly for the landscape; area located from 1/4 to 5 miles from the viewer. See also, Foreground and Background.

Mineral Soils
Soils consisting predominately of mineral material.

Mining Claims
A geographic area of the public lands held under the general mining laws in which the right of exclusive possession is vested in the locator of a valuable mineral deposit.

Mitigation
Measures designed to minimize environmental impacts or to make impacts less severe.

Mixed Conifer
In Southeast Alaska, mixed conifer stands usually consist of western hemlock, mountain hemlock, Alaska yellowcedar, Western redcedar, and Sitka spruce species. Shorepine may occasionally be present depending on individual sites.

Model
A representation of reality used to describe, analyze, or understand a particular concept. A model may be a relatively simple qualitative description of a system or organization, or a highly abstract set of mathematical equations. A model has limits to its effectiveness, and is used as one of several tools to analyze a problem.

Monitoring
A process of collecting information and observing results of management activities to provide a basis for the periodic evaluation of the project and its effects.

Multiple-aged Stands
An intermediate form of stand structure between even and uneven-aged stands. These stands generally have two or three distinct tree canopy levels occurring within a single stand.

Multiple Use
The management of all the various renewable resources of the National Forest System to be used in the combination that will best met the needs of the American people.

Muskeg
In Southeast Alaska a type of bog that has developed over thousands of years in depressions or flat areas on gentle to steep slopes. Also called peatlands.

National Environmental Policy Act (NEPA) of 1969
An Act to declare a national policy which will encourage productive and enjoyable harmony between humankind and the environment, to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the

health and welfare of humanity, to enrich the understanding of the ecological systems and natural resources important to the Nation, and to establish a Council on Environmental Quality.

National Forest Management Act (NFMA)
A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act requiring the preparation Forest Plans.

National Wild and Scenic River System
Rivers with outstanding scenic, recreational, geological, fish and wildlife, historic, cultural, or other similar values designated by Congress under the Wild and Scenic Rivers Act for preservation of their free-flowing condition.

Native Allotment
A tract of nonmineral land, not to exceed 160 acres, on which an Alaska Native (who was 21 year of age or head of a household) established continuous use and occupancy prior to the creation of the National Forests (authorized under the Native Allotment Act of May 17, 1906).

Native Selection
Application by Native corporations and individuals to a portion of the USDI Bureau of Land Management for conveyance of lands withdrawn in fulfillment of Native entitlements established under ANSCA.

Net Sawlog Volume
Tree or log volume suitable in size and quality to be processed into lumber. In Southeast Alaska, depending on the market, the volume may be processed as pulp or lumber.

No-action Alternative
The most likely condition expected to exist in the future if current management direction were to continue unchanged.

Noncommercial Forest Land
Land with more than 10 percent cover of commercial tree species but not qualifying as Commercial Forest land.

Nonforest Land
Land that has never supported forests and lands formerly forested but now developed for such nonforest uses as crops, improved pasture, etc.

Notice of Intent (NOI)
A notice printed in the Federal Register announcing that an Environmental Impact Statement will be prepared. The NOI must describe the proposed action and possible alternatives, describe the agency's proposed scoping process, and provide a contact person for further information.

Objectives
The precise steps to be taken and the resources to be used in achieving goals.

Old Growth
Ecosystems distinguished by old trees and related structural attributes. Old-growth forests are characterized by larger tree size, higher accumulations of large dead woody material, multiple canopy layers, different species composition, and different ecosystem function. The structure and function of an old-growth ecosystem will be influenced by its stand size and landscape position and context. For the displays in this project, it is those areas typed as low, medium, and high volume strata.

Organic Soils
Soils that contain a high percentage (generally greater than 20 to 30 percent) of organic matter throughout the soil depth.

Parent Material
The unconsolidated and partially weathered material (or the C Horizon) from which upper layers of soil developed.

Partial Cut
Method of harvesting trees where any number of live stems are left standing in any of various spatial patterns. Not clearcutting. Can include seed tree, shelterwood, or other methods.

Patch
A non-linear surface area differing in appearance from its surroundings.

Payments to States
A fund consisting of approximately 25 percent of the gross annual timber receipts received by the National Forests in that state. This is returned to the State for use on roads and schools.

Peak flow
The highest discharge of water recorded over a specified period of time at a given stream location. Often thought of in terms of spring snowmelt, summer, fall, or winter rainy season flows. Also called maximum flow.

pH
The degree of soil acidity or alkalinity.

Planning Area
The area of the National Forest System covered by a decision document.

Planning Record
A system that records decisions and activities that result from the process of developing a forest management project.

Plant Association
Climax plant community type.

Plant Community
Group of plants living in the same environment.

Population Viability
Ability of a population to survive.

Potential Yield
The maximum, perpetual, sustained-yield harvest attainable through intensive forestry on regulated areas considering the productivity of the land, conventional logging technology, standard cultural treatments, and interrelationships with other resource uses and the environment.

Present Net Value (PNV)
The difference between the benefits and costs associated with the alternatives.

Primary Succession
Vegetation development is initiated on newly formed soils or upon surfaces exposed for the first time (as by landslides) which have, as consequence, never borne vegetation before.

Process Group
A combination of similar stream channel types based on major differences in landform, gradient, and channel shapes.

Public Participation
Meetings, conferences, seminars, workshops, tours, written comments, responses to survey questionnaires, and similar activities designed and held to obtain comments from the public about Forest Service activities.

Receipts
Those priced benefits for which money will actually be paid to the Forest Service: recreation fees, timber harvest, mineral leases, and special use fees.

Record of Decision
A document separate from but associated with an Environmental Impact Statement which states the decision, identifies all alternatives, and states which practicable means to avoid environmental harm have been adopted.

Recreation Opportunity Spectrum (ROS)
A system for planning and managing recreation resources that categorizes recreation opportunities into seven classes. Each class is defined in terms of the degree to it satisfies certain recreation experience needs based on the extent to which the natural environment has been modified, the type of facilities provided, the degree of outdoor skills needed to enjoy the area and the relative density of recreation use. The seven classes are:

Primitive
An unmodified environment generally greater than 5,000 acres in size and located generally at least 3 miles from all roads and other motorized travel routes. A very low interaction between users (generally less than 3 group encounters per day) results in a very high probability of experiencing solitude, freedom, closeness to nature, tranquillity, self-reliance, challenge, and risk. Evidence of other users is low. Restrictions and controls are not evident after entering the land unit. Motorized use is rare.

Semi-Primitive Non-motorized
A natural or natural-appearing environment generally greater than 2,500 acres in size and generally located at least ½ mile (greater or less depending on terrain and vegetation, but no less than ¼ mile) but not further than 3 miles from all roads and other motorized travel routes. Concentration of users is low (generally less than 10 group encounters per day), but there is often evidence of other users. There is a high probability of experiencing solitude, freedom, closeness of nature, tranquillity, self-reliance, challenge, and risk. There is a minimum of subtle on-site controls. No roads are present in the area.

Semi-Primitive Motorized
A natural or natural-appearing environment generally greater than 2,500 acres in size and generally located within ½ mile of primitive roads and other motorized travel routes used by motor vehicles; but not closer that ½ mile (greater or less depending on terrain and vegetation, but no less than ¼ mile) from better-than-primitive roads and other motored travel routes. Concentration of users is low (generally less than 10 group encounters per day), but here is often evidence of other users. There is a moderate probability of experiencing solitude, closeness to nature, and tranquillity along with a high degree of self-reliance, challenge, and risk in using motorized equipment. Local roads may be present, or along saltwater shorelines there may be extensive boat traffic.

Roaded Natural
Resource modification and utilization are evident, in a predominantly naturally-appearing environment generally occurring within ½ mile (greater or less depending on terrain and vegetation, but no less than ¼ mile) from better-than-primitive roads and other motorized travel routes. Interactions between users may be moderate to high (generally less than 20 group encounters per day), with evidence of other users prevalent. There is an opportunity to affiliate with other users in developed sites but with some chance for privacy. Self-reliance on outdoor skills is only of moderate importance with little opportunity for challenge and risk. Motorized use is allowed.

Roaded Modified
Vegetative and landform alterations typically dominate the landscape. There is little on-site control of users except for gated roads. There is moderate evidence of other users on roads (generally less than 20 group encounters per day), and little evidence of others or interactions at campsites. There is opportunity to get away from others but with easy access. Some self-reliance is required in building campsites and use of motorized equipment. A feeling of independence and freedom exists with little challenge and risk. Recreation users will likely encounter timber management activities.

Rural
The natural environment is substantially modified by land use activities. Opportunity to observe and affiliate with other users is important as is convenience of facilities. There is little opportunity for challenge and risk and self-reliance on outdoor skills is of little importance. Recreation facilities designed for group use are compatible. Users may have more that 20 group encounters per day.

Urban
Urbanized environment with dominant structures, traffic lights and paved streets. May have natural appearing backdrop. Recreation places may be city parks and large resorts. Opportunity to observe and affiliate with other users is very important as is convenience of facilities and recreation opportunities. Interaction between large numbers of users is high. Outdoor skills, risk, and challenge are unimportant except for competitive sports. Intensive on-site controls are numerous. Identified geographical areas having one or more physical characteristics that are particularly attractive to people engaging in recreation activities. They may be beaches, streamside or roadside areas, trail corridors, hunting areas of the immediate area surrounding a lake, cabin site, or campground.

Recreation Places.
Identified geographical areas having one or more physical characteristics that are particularly attractive to people engaging in recreation activities. They may be beaches, streamside or roadside areas, trail corridors, hunting areas of the immediate area surrounding a lake, cabin site, or campground.

Reforestation
The natural or artificial restocking of an area with trees.

Regeneration
The process of establishing a new crop of trees on previously harvested land.

Regional Forester
The Forest Service official responsible for administering a single region.

Regional Guide
The guide developed to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974 as amended. It guides natural resource management activities and establishes management standards and guidelines for the National Forest System lands within a given region.

Rehabilitation
Actions taken to protect or enhance site productivity, water quality, or other values for a short period of time.

Resident Fish
Fish that are not anadromous and that reside in freshwater on a permanent basis. Resident fish include nonanadromous Dolly Varden char and cutthroat trout.

Resource values
The tangible and intangible worth of forest resources.

Responsible Official
The Forest Service line officer who has the authority to make a specific decision.

Restoration
The long-term placement of land back into its natural condition or state of productivity.

Revegetation
The re-establishment and development of a plant cover. This may take place naturally through the reproductive processes of the existing flora or artificially through the direct action of reforestation or reseeding.

Roads
Arterial: Roads usually developed and operated for long-term land and resource management purposes to constant service.

Collector: Collects traffic from Forest local roads; usually connects to a Forest arterial or public highway.

Local: Provides access for a specific resource use activity such as a timber sale or recreational site, although other minor uses may be served.

Preplanned: Roads planned in a prior EIS.

Temporary: For National Forest timber sales, temporary roads are constructed to harvest timber on a one-time basis. These logging roads are not considered part of the permanent Forest transportation network and have stream crossing structures removed, erosion measures put into place, and the road closed to vehicular traffic after harvest is completed.

Roadless Area
An area of undeveloped public land within which there are no improved roads maintained for travel by means of motorized vehicles intended for highway use.

Rotation
The planned number of years between the time that a stand of trees is regenerated and its next cutting at a specified stage of maturity.

Rotation Age
The age of a stand when harvested at the end of a rotation.

Salvage Sale
A timber sale to use dead and down timber and scattered poor-risk trees that would not be marketable if left in the stand until the next scheduled harvest.

Sawlog
That portion of a tree that is suitable in size and quality for the production of dimension lumber collectively known as sawtimber.

Scheduled Lands
Land suitable and scheduled for timber production and which are in the land base for the calculation of the allowable sale quantity and long-term sustained yield timber capacity.

Scheduled Timber Harvests
Timber harvests done as part of meeting the allowable sale quality.

Scoping Process
Early and open activities used to determine the scope and significance of a proposed action, what level of analysis is required, what data is needed, and what level of public participation is appropriate. Scoping focuses on the issues surrounding the proposed action, and the range of actions, alternatives, and impacts to considered in an EA or an EIS.

Scrub-Shrub Wetland
Wetlands dominated by woody vegetation less than 20 feet tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. In Southeast Alaska this includes forested lands where trees are stunted because of poor soil drainage.

Second Growth
Forest growth that has become established following some disturbance such as cutting, serious fire, or insect attack; even-aged stands that will grow back on a site after removal of the previous timber stand.

Secondary Stream Production
Results from consumption by animals of materials produced in primary production in streams; this includes production of macroinvertebrates and some fish species.

Secondary Succession
The process of re-establishing vegetation after normal succession is disrupted by fire, cultivation, lumbering, windthrow, or any similar disturbance.

Sediment
Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface.

Seed Tree
Small number of seed-bearing trees left singly or in small groups after timber harvest to provide seed for regeneration of the site.

Selective Cutting
The annual or periodic removal of trees (particularly the mature), individually or in small groups from an uneven-aged forest to achieve the balance among diameter classes needed for sustained yields, and in order to realize the yield, and establish a new crop of irregular constitution. Note: The improvement of the Forest is a primary consideration.

Sensitive Species
Plant and animal species which are susceptible or vulnerable to activity impacts or habitat alterations. Those species that have appeared in the Federal Register as proposed for classification or are under consideration for official listing as endangered or threatened species, that are on a non-official State list, or that are recognized by the Regional Forester as needing special management to prevent placement on Federal or state lists.

Sensitivity Level
A map inventory that measures peoples' concern for the scenic quality of the National Forests. In 1980, the Tongass National Forest assigned sensitivity levels to land areas viewed from anchorages, plane and boat routes, roads, trails public-use areas, and recreation cabins.

Level I: Includes all seen areas from primary travel routes, use areas, and water bodies where at least three-fourths of the Forest visitors have a major concern for scenic quality.

Level II: Includes all seen areas from primary travel routes, use areas, and water bodies where at least one-fourth of the Forest visitors have a major concern for scenic quality.

Level III: Includes all seen areas form secondary travel routes, use areas, and water bodies where less than one-fourth of the Forest visitors have a major concern for scenic quality.

Seral
Early stage of succession.

Shelterwood Cutting
A harvest method in which most of the trees are removed in an initial entry and some trees are left to naturally reseed the area and provide protection to new seedlings that establish on the site. A second entry is conducted later to remove the remaining trees.

Silviculture
The science of controlling the establishment, composition, and growth of forests.

Single-tree selection
A cutting method to develop and maintain uneven-aged stands by removal of selected trees from specified age classes over the entire stand area in order to meet a predetermined goal of age distribution and species in the remaining stand.

Site Index
A measure of the relative productive capacity of an area for growing wood. Measurement of site index is based on height of the dominant trees in a stand at a given age.

Site Preparation
Manipulation of the vegetation or soil of an area prior to planting or seeding. The manipulation follows harvest, wildfire, or construction in order to encourage the growth of favored species. Site preparation may include the application of herbicides, burning, or cutting of living vegetation that competes with the favored species; tilling the soil; or burning of organic debris (usually logging slash) that makes planting or seeding difficult.

Site Productivity
Production capability of specific areas of land.

Slope Distance
Distance measured along the contour of the ground.

Smolt
Young silvery-colored salmon or trout which move from freshwater streams to saltwater.

Snag
A standing dead tree, usually greater than 5 feet tall and 6 inches in diameter at breast height.

Soil Productivity
The capacity of a soil, in its normal environment, to produce a specific plant or sequence of plants under a specific system of management.

Soil Quality Standards
Standards that are a combination of (1) "threshold" values for severity of soil property alteration, or significant change in soil properties conditions, and (2) areal extent of disturbance.

Split Yarding
The process of separating the direction of timber harvest yarding into opposite directions.

Stand (Tree Stand)
Group of trees occupying a specific area and sufficiently uniform in composition, age arrangement, and condition as to be distinguishable from the forest in adjoining areas.

Standard
A course of action or level of attainment required by the forest plan to promote achievement of goals and objectives.

State Historic Preservation Officer (SHPO)
State-appointed official who administers Federal and State programs for cultural resources.

State Selection
Application by Alaska Department of Natural Resources to the USDI Bureau of Land Management for conveyance of a portion of the 400,000 acre State entitlement from vacant and unappropriated National Forest System lands in Alaska, under the Alaska Statehood Act of 1959 (Public Law 85-508, 72 Stat. 340).

Stocking
The degree of occupancy of land by trees as measured by basal area or number of trees and as compared to a stocking standard; that is, the basal area or number of trees required to fully use the growth potential of the land.

Stream Classes
A means to categorize stream channels based on their fish production values. There are four stream classes on thc Tongass National Forest. They are:

Class I: Streams with anadromous or adfluvial fish habitat; or high quality resident fish waters listed in Appendix 68.1, Region 10 Aquatic Habitat Management Handbook (FSH 2609.24), June 1986; or habitat above fish migration barriers known to provide reasonable enhancement opportunities for anadromous fish.

Class II: Streams with resident fish populations and generally steep (6-15 percent) gradient (can also include streams from 0-6 percent gradient) where no anadromous fish occur, and otherwise not meeting class I criteria. These populations have limited fisheries values and generally occur upstream of migration barriers have other habitat features that preclude anadromous fish use.

Class III: Perennial and intermittent streams with no fish populations, but which have sufficient flow or transport sufficient sediment and debris to have an immediate influence on downstream water quality or fish habitat capability. These streams generally have bankfull widths greater than 5 feet and are highly incised into the surrounding hillslope.

Class IV: Other intermittent, ephemeral, and small perennial channels with insufficient flow or sediment transport capabilities to have an immediate influence on downstream water quality or fish habitat capability. These streams generally are shallowly incised into the surrounding hillslope.

Nonstreams: Rills and other watercourses, generally intermittent and less than one foot in bankfull width, with little or no incisement into the surrounding hillslope, and with little or no evidence of scour.

Stream Order
First order streams are the smallest unbranched tributaries; second order streams are initiated by the point where two first order streams meet; third order streams are initiated by the point where two second order streams meet, and so on.

Structural Diversity
The diversity of forest structure, both vertically and horizontally, which provides for a variety of forest habitats such as logs and multi-layered forest canopy for plants and animals.

Stumpage
The value of timber as it stands uncut in terms of dollar value per thousand board feet.

Subsistence
Section 803 of the Alaska National Interest Lands Conservation Act defines subsistence as, "the customary and traditional uses by rural Alaska residents of wild renewable resources for direct, personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade."

Subsistence Use Area
Important subsistence use areas include the "most reliable" and "most often hunted" categories from the Tongass Resource Use Cooperative Survey (TRUCS) and from subsistence survey data from ADF&G, the University of Alaska, and the Forest Service, Region 10. Important use areas include both intensive and extensive use areas for subsistence harvest of deer, furbearers, and salmon.

Substrate
The type of material in the bed (bottom) of rivers and streams.

Succession
The ecological progression of community change over time, characterized by displacements of species leading towards a stable climax community.

Suitable
Commercial forest land identified as having both the biological capability and availability to produce industrial wood products.

Suitable Forest land
Forest land for which technology is available that will ensure timber production without irreversible resource damage to soils, productivity, or watershed conditions, and for which there is reasonable assurance that such lands can be adequately restocked, and for which there is management direction that indicated that timber production is an appropriate use of that area.

Suspended Sediment
The very fine soil particles which remain in suspension in water for a considerable period of time without contact with the stream or river channel bottom.

Swale
A slight, marshy depression in generally level land. A depression in glacial ground moraine.

Tentatively Suitable Forest Land
Forest land that is producing or is capable of producing crops of industrial wood and: (a) has not been withdrawn by Congress, the Secretary of Agriculture of the Chief of the Forest Service; (b) existing technology and knowledge is available to ensure timber production without irreversible damage to soils productivity, or watershed conditions; (c) existing technology and knowledge, as reflected in current research and experience, provides reasonable assurance that it is possible to restock adequately within 5 years after final harvest; and (d) adequate information is available to project responses to timber management activities.

Terrestrial Ecosystems
Plant communities that are not dependent on a perpetual source of water to grow.

Thinning
The practice of removing some of the trees in a stand so that the remaining trees will grow faster due to reduced competition for nutrients, water, and sunlight. Thinning may also be done to change the characteristics of a stand for wildlife or other purposes. Thinning may be done at two different stages.

Threatened Species
Plant or animal species which is likely to become endangered throughout all or a significant portion of its range within the foreseeable future, as defined in the Endangered Species Act of 1973, and which has been designated in the Federal Register by the Secretary of the Interior as a threatened species. (See also, endangered species, sensitive species.)

Threshold
The point or level of activity beyond which an undesirable set of responses begins to take place within a given resource system.

Tiering
Eliminating repetitive discussions of the same issue by incorporating by reference. The general discussion in an environmental impact statement of broader scope; e.g., this document is tiered to the Tongass Land Management Plan.

Timber Appraisal
Establishing the fair market value of timber by taking the selling value minus manufacturing costs, the cost of getting logs from the stump to the manufacturer, and an allowance for profit and risk.

Timber Classification
Forested land is classified under each of the land management alternatives according to how it relates to be management of the timber resource. The following are definitions of timber classifications used for this purpose.

Nonforest: Land that has never supported forests and land formerly forested where use for timber production is precluded by development or other uses.

Forest: Land at least 10 percent stocked (based on crown cover) by forest trees of any size, or formerly having had such tree cover and not currently developed for nonforest use.

Suitable: Land to be managed for timber production on a regulated basis.

Unsuitable: Forest land withdrawn from timber utilization by statute or administrative regulation (for example, wilderness), or identified as inappropriate for timber production in the Forest planning process.

Commercial forest: Forest land tentatively suitable for the production of continuous crops of timber and that has not been withdrawn.

Timber Dispersion
When an opening created from a final timber harvest is no longer considered an opening for the purpose of scheduling adjacent timber harvest.

Timber Harvest Unit
A "Timber Harvest Unit" is a portion of a timber sale within which the Forest Service specifies for harvest all or part of the timber to meet the requirements of a timber sale contract.

Timber Stand Improvement (TSI)
All noncommercial intermediate cutting and other treatments to improve composition, condition, and volume growth of a timber stand.

Tongass Land Management Plan (TLMP)
The 10-year land allocation plan for the Tongass National Forest that directs and coordinates planning, the daily uses, and the activities carried out within the forest.

Tongass Resource Use Cooperative Survey (TRUCS)
A study on subsistence uses which was used for evaluating the effects of the proposed action in this EIS.

Turbidity
An indicator of the amount of sediment suspended in water.

Understory
The trees and shrubs in a forest growing under the canopy or overstory.

Uneven-Aged Management
Forest management techniques which simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes. Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes.

Unscheduled Lands
Lands suitable but not scheduled for timber production and which are not in the land base for the calculation of the allowable sale quantity nor long-term sustained yield timber capacity.

Unsuitable
Forest land withdrawn from timber utilization by statute or administrative regulation; for example, wilderness, or identified as not appropriate for timber production in the forest planning process.

Utility Logs
Those logs that do not meet sawlog grade but are suitable for production of firm useable pulp chips.

VAC
See Visual Absorption Capability.

Value Comparison Unit (VCU)
Areas which generally encompass a drainage basin containing one or more large stream systems; boundaries usually follow easily recognizable watershed divides. Established to provide a common set of areas where resource inventories could be conducted and resource interpretations made.

Viable Population
The number of individuals of a species required to ensure the long-term existence of the species in natural, self-sustaining populations adequately distributed throughout their region.

Viewshed
An expansive landscape or panoramic vista seen from a road, marine water way, or specific viewpoint.

Visual Quality Objectives (VQO)
Measurable standards reflecting five different degrees of landscape alteration based upon a landscape's diversity of natural features and the public's concern for high scenic quality. The five categories of VQOs are:

Preservation: Permits ecological changes only. Applies to wilderness areas and other special classified areas. Management activities are generally not allowed in this setting.

Retention: Provides for management activities that are not visually evident to the casual Forest visitor.

Partial Retention: Management activities remain visually subordinate to the natural landscape.

Modification: Management activities may visually dominate the characteristics landscape. However, activities must borrow from naturally established form-line color and texture so that the visual characteristics resemble natural occurrences within the surrounding area when viewed in the middleground distance.

Maximum Modification: Management activities may dominate the landscape but should appear as a natural occurrence when viewed as background.

V-Notches
A deeply incised valley along some waterways that would look like a "V" from a cross-section. These abrupt changes in terrain features are often used as harvest unit or yarding boundaries.

Volume
Stand volume based on standing net board feet per acre by Scribner Rule.

Volume Strata (i.e. Class)
Divisions of old-growth timber volume derived from the interpreted timber type data layer (TIMTYP) and the common land unit data layer (CLU). Three volume strata (low, medium, and high) are recognized in the 1997 TLMP for each administrative Area. For the Ketchikan Area, average MBF/acre for the three strata are as follows:

Low: 13.9 MBF

Medium: 23.3 MBF

High: 29.9 MBF

Watershed
The area that contributes water to a drainage or stream. Portion of the forest in which all surface water drains to a common point. Watersheds can range from a few tens of acres that drain a single small intermittent stream to many thousands of acres for a stream that drains hundreds of connected intermittent and perennial streams.

Wetland
Areas that are inundated by surface or groundwater frequently enough to support vegetation that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include: swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mudflats, and natural ponds. See the TLMP 1997 pg. 4-111 for detailed discussion on wetland type definitions.

Wilderness
Areas designated by congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped federal land retaining its primeval character and influence without permanent improvements or humans habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature, with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or a primitive and unconfined type of recreation; areas of at least 5,000 acres are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features of scientific, educational, scenic, or historical value as well as ecologic and geologic interest. In Alaska, Wilderness has been designated by ANILCA and TTRA.

Wildlife Analysis Area (WAA)
A division of land used by the Alaska Department of Fish and Game for wildlife analysis.

Wildlife Habitat
The locality where a species may be found and where the essentials for its development and sustained existence are obtained.

Windfirm
Trees that have been exposed to the wind throughout their life and have developed a strong root system or trees that are protected from the wind by terrain features.

Windthrow
The act of trees being uprooted by the wind. In Southeast Alaska, Sitka spruce and hemlock trees are shallow rooted and susceptible to windthrow. There generally are three types of windthrow:

Endemic: where individual trees are blown over;

Catastrophic: where a major windstorm can destroy hundreds of acres; and

Management Related: where the clearing of trees in an area make the adjacent standing trees vulnerable to windthrow.

Winter Range
An area, usually at lower elevation, used by big game during the winter months; usually smaller and better-defined than summer ranges.

Withdrawal
The withholding of an area of Federal land from settlement, sale, location, or entry under some or all of the general land laws for the purpose of limiting activities under those laws in order to maintain other public values in the area.

Yarding
Hauling timber from the stump to a collection point.

4 Lists

Literature Cited

ADEC. See Alaska Department of Environmental Conservation.

ADF&G. See Alaska Department of Fish and Game.

Agler, B.A., S.J. Kendall, P.E. Seiser, and J.R. Lindell. 1995. Estimates of marine bird and sea otter abundance in Southeast Alaska during summer 1994. USFWS, Anchorage and Juneau, Alaska.

Airola, D.A. and R.H. Barrett. 1985. Foraging and habitat relationships of insect-gleaning birds in a Sierra Nevada mixed-conifer forest. Condor 87:205-216.

Alaska Climate Center. 1986. Technical Note No.3.

Alaska Department of Environmental Conservation (ADEC). 1993. Air Quality Control Standards and Limitations 18 AAC 50, as amended through: April 7, 1993.

Alaska Department of Environmental Conservation (ADEC). 1989. Water Quality Standards Regulations 18 AAC 70, 18-2052 (Revised November 1989).

Alaska Department of Fish and Game, Division of Subsistence (ADF&G). 1991. Seven criteria worksheets for findings on customary and traditional uses of fish and shellfish in Southeast Alaska. For use by the Alaska Board of Fisheries, January 1991. ADF&G: Douglas.

Alaska Department of Fish and Game (ADF&G). 1991. Sport fishing guide, Prince of Wales Island Area. Alaska Department of Fish and Game Division of Sport Fish, Ketchikan, Alaska.

Alaska Department of Fish and Game (ADF&G). 1993. Deer harvest data for Southeast Alaska 1987-91. Compiled by Thomas Thornton, Division of Subsistence

Alaska Department of Labor. Research and analysis, Alaska industry/occupation outlook to 1994, food processing profile, Juneau, Alaska.

Alaska Department of Labor. Research and analysis, Alaska industry/occupation outlook to 1995, food processing profile, Juneau, Alaska.

Alaska Heritage Resource Survey. Undated. Alaska Heritage Resource Survey records. On file, Alaska State Office of History and Archaeology, Anchorage, Alaska.

Alaska National Interest Lands Conservation Act (ANILCA). 1980. Public Law 96-487, U.S. Congress, 96th Congress, 16 USC 3101, 94 Stat. 2371-2551.

Alaska Native Claims Settlement Act (ANCSA). 1971. Public Law 92-203, U.S. Congress, 92nd Congress, 85 Stat. 688-716.

Alaska Public Survey. See Alves 1980.

Alaska Regional Guide. See USDA Forest Service 1983.

Alaska Statehood Act of 1959. Public Law 85-508, 72 Stat. 340.

Alaska State Historic Preservation Office. 1990.

Alves, W. 1980. Residents and Resources: Findings of the Alaska Public survey on the importance of Natural Resources to the Quality of Life in Southeast Alaska. A Report for the USDA Forest Service, Region 10. Institute of Social and Economic Research, University of Alaska, Anchorage.

Ambrose, R.E., R.J. Ritchie, C.M. White, P.F. Schempf, T. Swem, R. Kittrick. 1988. Changes in the status of peregrine falcon populations in Alaska. Ch. 11 in Peregrine Falcon Populations - Their Management and Recovery, edited by T.J. Cade, J.H. Enderson, C.G. Thelander, and C.M. White. The Peregrine Fund, Inc., Boise, Idaho. 1988.

Apfelbaum, S. and A. Haney. 1977. Nesting and foraging activity of the brown creeper in northeast Minnesota. Loon 49:78--80.

Anderson, C.M. and P.M. DeBruyn. 1979. Behavior and Ecology of Peregrine Falcons Wintering Upon the Skagit Flats, Washington. Washington Dept. of Game. PF-79-1. 53pp.

Anderson, C.M., P.M. DeBruyn, T. Ulm, and B. Gossoin. 1980. Behavior and Ecology of Peregrine Falcons Wintering Upon the Skagit Flats, Washington: A Report on the 1980 Field Season. Wash. Dept. of Game. 54pp.

Argus, G. W. 1965. An Endemic Subspecies of *Salix Reticulata L.* From the Queen Charlotte Islands, British Columbia. Canadian Journal of Botany. Vol. 43, 1021 - 1024.

Arndt, K.L., R.H. Sackett, and J.A. Ketz. 1987. A cultural resource overview of the Tongass National Forest, Alaska. On file at USDA FS Region 10 Office, Juneau, Alaska.

Autrey, J.T. 1990. Analysis of the management situation: Tongass National Forest Land and Resource Management Plan Revision, Draft (Cultural Resource Section). Document on file, Tongass National Forest, Ketchikan Area, Ketchikan, AK.

Babik, N.R. 1995. Field guide to the ecological classification and inventory system Ketchikan Ranger District and Misty Fiords National Monument. Unpublished resource inventory report. USDA Forest Service, Tongass National Forest, Ketchikan Area, Ketchikan, Alaska.

Barker, John. 1985. Timber management opportunities in visually important areas. Pan Sylvan, Ketchikan, AK.

Bartos, L.R. 1989. A new look at low flows after logging. USDA Forest Service, Tongass National Forest, Ketchikan Area, Ketchikan, AK.

Beak. 1989. Fishery surveys of fifty-one stream sites in logged or unlogged drainages on Prince of Wales Island, Alaska: Initial Site/Survey Report. Beak Consultants Incorporated, Portland, OR.

Beck, R.W. and Associates, Inc. in association with Dames and Moore Power Technologies, Inc. 1992. Lake Tyee to Swan Lake transmission intertie. A draft feasibility study submitted to the Alaska Energy Authority.

Bellrose, F.C. 1980. Ducks, geese and swans of North America. Wildlife Management Institute, Illinois Natural History Survey. Stackpole Books.

Bent, A.C. 1942. Life Histories of North American flycatchers, larks, swallows, and their allies. U.S. Government Printing Office, Smithsonian Institution, U.S. National Museum Bulletin #179.

Berg, H.C., R. Elliott, and R. Koch. 1988. Geologic map of the Ketchikan and Prince Rupert quadrangles, southeastern Alaska. U.S. Geological Survey, Miscellaneous Investigations Series, Map I-1807, 27 pp.

Beschita, R.L. and W.S. Platts. 1986. Morphological features of small streams: Significance and function. Water Resources Bulletin 22(3):369-380.

Bjornn, T., S. Kirking, and W. Meehan. 1991. Relation of cover alterations to the summer standing crop of young salmonids in small Southeast Alaska streams. In Transactions of the American Fisheries Society 120:562-570.

Bormann, F.H. and G.E. Likens. 1979. Pattern and Process in a Forested Ecosystem. New York, Springer-Verlag.

Bright, L. 1985. Patterns of tourism in Southeast Alaska: An analysis of the impacts of wilderness designations on the tourism industry. Research paper submitted to the School of Agriculture and Land Resources Management, University of Alaska, Fairbanks, Alaska.

Brown, E.R., Ed. 1985. Management of wildlife and fish habitats in forests of western Oregon and Washington. Part 1—Chapter narratives. USDA Forest Service Pacific Northwest Region, in Cooperation with USDI Bureau of Land Management. Pub.No. R6-F&WL-192-1985.

Brown, G.W., G.W. Swank, and J. Rothacher. 1971. Water temperature in the Steamboat drainage. Forest Service Research Paper PNW-119. Pacific Northwest Forest and Range Experiment Station, Portland, OR.

Bryant, M.D. 1983. The role and management of wood debris in west coast salmonid nursery streams. North American Journal of Fisheries Management 3:322-330.

Bryant, M.D. 1985. Changes 30 years after logging in large woody debris, and its use by salmonids. In, North American Riparian Conference (1st:1985: Tucson, AZ), Riparian Ecosystems and Their Management: Reconciling Conflicting Issues. R. Johnson et al., technical coordinators: USDA Forest Service Technical Report-RM 120.

Bryant, M.D. and B. Frenette. 1992. Assessment of the resident cutthroat trout, Dolly Varden char, and introduced anadromous salmonids in Margaret Lake, Southeast Alaska, Progress Report 1992. USDA-PNW Research Station, Juneau, AK.

Bugert, R., T. Bjornn, and W. Meehan. Summer habitat use by young salmonids and their response to cover and predators in small Southeast Alaska streams. In Transactions of the American Fisheries Society 120:474-485.

Capp, J., B. Vaught, J. Christner, J. McKibben, F. Sampson, and C. Iverson. 1991. Committee report, steering committee for viable population review. USDA Forest Service, unpublished report. Juneau, AK.

CEQ. See Council on Environmental Quality.

Chamberlin, T.W. 1982. Timber harvest. Part 3 of influence of forest and rangeland management on anadromous fish habitat in western North America. W.R. Meehan, technical ed. General Tech. Rep. PNW-136. Pacific Northwest Range and Experiment Sta., USDA Forest Service, Portland, OR.

Chamberlin, T.W., R.D. Harr, and F.H. Everett. 1991. Timber harvesting, silviculture, and watershed processes. American Fisheries Society Special Publication 19:181-205.

Chatwin, S. C., D. E. Howes, J. W. Schwab, and D. N. Swanston. 1994. A guide for management of landslide-prone terrain in the Pacific Northwest. Second Edition. Land Management Handbook, ISSN 0229-1622; No. 18. Research Branch, Ministry of Forests, Victoria, British Columbia.

Christner, J. and R.D. Harr. 1982. Peak streams from the transient snow zone, western Cascades, Oregon. Presented at the Western Snow Conference, April 20, 1982. Reno, NV.

Clean Air Act, as amended (42 U.S.C. 7401 et seq).

Clean Water Amendments ("Federal Water Pollution Control Act Amendments of 1972"). 1972. Public Law 92-500, 86 Stat 816, as amended; 33U.S.C. 1251, et seq. 18 October.

Code of Federal Regulations.

CFR. 36. 800

CFR. 40. 230.41(a)(1)

Coastal Zone Management Act of 1972. Public Law 94-370, 90 Stat. 1013; U.S.C. 1982 Title 16, Sec. 1451 et seq. 27 October.

Corps of Engineers (COE). See U.S. Army Corps of Engineers.

Council on Environmental Quality (CEQ), Executive Office of the President. 1986. Regulations for implementing the procedural provisions of the National Environmental Policy Act. 40 CFR Parts 1500-1508.

Cowardin, L.M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. FWS/OBS -79/31. Washington, D.C.: U.S. Fish and Wildlife Service, Biological Services Program.

Crocker-Bedford, D.C. 1991. Unpublished report to Forest Supervisor, D. Rittenhouse. Ketchikan Area, Tongass National Forest.

Davis, S.D. 1990. A chronology of Southeast Alaska. In, Handbook of North American Indians, Vol. 7. Smithsonian Institution, Washington, DC.

Davis, S.D., J.M. Erlandson, R.G. Holloway, R.R. Lightfoot, M.L. Moss, and D.N. Swanston. 1989. The Hidden Falls Site, Baranof Island, Alaska. Alaska Anthropological Assn. Monograph Series, Brockport, NY.

DeGraff, R.M., V. Scott, R.H. Hamre, L. Ernest, and S.H. Anderson. 1991. Forest and Rangeland Birds of the United States. USDA Forest Service Handbook #688.

Della Sala, D.A., K. Engel, D.P. Volson, R.L. Fairbanks, W.B. McComb, J. Hagar, and K. Radeke. 1994. Final Report 1993: Evolution of young-growth treatments for wildlife. USDA Forest Service, Region 10, Juneau, Alaska.

DeMeo, T.D. 1992. Forest plant association management guide: Ketchikan Area, Tongass National Forest. USDA Forest Service, Ketchikan, AK.

DeMeo, T.D. and W.D. Loggy. 1989. Development of wetlands mapping procedures for forest planning in Southeast Alaska. In, Proceedings of Watershed '89: A Conference on the Stewardship of Soil, Air, and Water Resources, March 1989. USDA Forest Service, Alaska Region publication R10-MB-77.

Doerr, J.G. and M.J. Sigman. 1986. Human use of Pacific herring, shellfish, and selected wildlife species in Southeast Alaska with an overview on access for noncommercial harvests of fish and wildlife. Technical Report 86-5, ADF&G, Division of Habitat. Juneau.

Doyle, A.T., W. Bruce Dinneford, M.D. Kirchhoff, L.C. Shea, L.H. Suring, D.A. Williamson. 1988. Habitat capability model for Vancouver Canada goose in Southeast Alaska: Nesting and brooding habitats. USDA Forest Service. Draft.

Endangered Species Act of 1973. Public Law 93-205 (87 stat. 884), as amended; 16 U.S.C. 1531-1536, 1538-1540. 28 December.

Environmental Protection Agency (EPA). See U.S. Environmental Protection Agency.

Faris, T.L. and K.D. Vaughan. 1985. Log transfer and storage facilities in Southeast Alaska: A review. General Technical Report PNW-174. USDA, Forest Service, Pacific Northwest Forest and Range Experiment Station.

Fish and Wildlife Service. See U.S. Dept. of the Interior, Fish and Wildlife Service.

Forest Service. (See USDA, Forest Service).

Ford, E.W., W.A. Farr, and C. Lu-Ping. 1988. Preliminary analysis of four soil variables and their relation to site index of Sitka spruce in Southeast Alaska. In, Proceedings of the Alaska Forest Soil Productivity Workshop. C.W. Slaughter and T. Gasbarro, eds. Gen. Tech. Rep. PNW-GTR-219. USDA Forest Service, Pacific Northwest Research Sta. and University of Alaska Fairbanks, School of Agriculture and Land Resource Management.

Forman, T.T. and M. Godron. 1986. Landscape Ecology. New York: John Wiley and Sons.

Foster Wheeler Environmental Corporation, with Grotefendt, R.A. 1996. Estimation of timber volume in Southeast Alaska using low-altitude fixed base aerial photography.

Foster Wheeler Environmental Corporation, with Harza Northwest. 1995. Evaluation of photo-point inventory methods for the estimation of timber volume and proportionality in Southeast Alaska.

Franklin, J.F. 1990. Old growth and the new forestry. In, Proceedings of the New Perspectives Workshop: Petersburg, Alaska, July 17-19, 1990, Copenhagen, M.J., ed. USDA Forest Service, Region 10, Juneau, AK.

Franklin, J.F., and R.T.T. Forman. 1987. Creating landscape patterns by forest cutting: ecological consequences and principles. Landscape Ecology 1:5-18.

Fredricksen, R.L. 1971. Comparative chemical quality—natural and disturbed streams following logging and slash burning. In, Symposium on Forest Land Use and the Stream Environment, J.T. Krygier and J.D. Hall, eds. Oregon State University, Corvallis, OR.

Freese, J.L. 1987. Factors affecting benthic depositions of bark debris at 13 log transfer facilities in Southeast Alaska: A report. Juneau, AK: National Marine Fisheries Service (NMFS).

Freese and O'Clair. 1987. Reduced Survival and Condition of the Bivalves *Protothaca staminea* and *Mytilus edulis* Buried by Decomposing Bark J.Lincoln Freese and Charles E. O'Clair National Marine Fisheries Service

FSH. See USDA Forest Service Handbooks.

FSM. See USDA Forest Service Manuals.

Fuller, T.K. 1989. Population dynamics of the wolves in North-Central Minnesota. Wildlife Monograph 105.

Furniss, M.J., T.D. Roelofs, and C.S. Yee. 1991. Road construction and maintenance. American Fisheries Society Special Publication 19:297-327.

Gabrielson, I.N. and F.C. Lincoln. 1959. The Birds of Alaska. The Stackpole Co., Harrisburg, PA, and the Wildlife Management Institute, Washington, D.C.

Gasaway, W.C., R.O. Stephenson, J.L. Davis, P.E.K. Shepard, and O.E. Burris. 1983. Interrelationships of Wolves, Prey, and Man in Interior Alaska. Wildlife Monograph 84.

Geier, T. W. and W. D. Loggy. 1995 A proposed geomorphic risk assessment of potential fish habitat impacts from forest management. In Proceedings: American Water Resources Association, Alaska Section. Publication #WRC-117, Water Research Center, Institute of Northern Engineering, University of Alaska, Fairbanks, Alaska.

Gibbons, D.R. 1989. Adult salmon pre-spawning mortalities—A status report. Attachment to memo dated 12/27/89 to Rick Harris. (Status report of the Alaska Cooperative Forestry/Fisheries Working Group - draft.) USDA Forest Service. Alaska Region. 11 pp.

Godfrey, W.E. 1979. The Birds of Canada. National Museum of Natural Sciences, Ottawa, Canada.

Goldman, E.A. 1937. The Wolves of North America. Journal of Mammalogy.

Goldschmidt, W.R. and T.H. Haas. 1946. Possessory rights of the Natives of southeastern Alaska. A report to the Commissioner of Indian Affairs.

Gregory, S.V., G.A. Lambati, D.C. Erman, K.V. Koski, M.C. Murphy, and J.R. Sedell. 1981. Influences of forest practices on aquatic production. In, Proceedings of Symposium on Streamside Management—Forestry and Fish Interaction, C. Salo and T. Cundy, eds. University of Washington, Seattle.

Grubb, T.C., Jr. 1975. Weather-dependent foraging behavior of some birds wintering in a deciduous woodland. Condor 77:175--182.

Hanley, T.A., C.T. Robbins, and D.E. Spalinger. 1989. Forest habitats and the nutritional ecology of Sitka black-tailed deer: A research synthesis with implications for forest management. USDA Forest Service Gen. Tech. Rep. PNW-GTR-230.

Hanley, T.A. and C.L. Rose. 1987. Influence of overstory on snow depth and density in hemlock-spruce stands: Implications for management of deer habitat in southeastern Alaska. USDA Forest Service. Res. Note PNW-RN-459, 11pp.

Hanlon v. Barton. 1988. Memorandum and Order in the case of Hanlon v. Barton, No. J88-025 (District of Alaska). Signed 14 November 1988 by J.A. von der Heydt.

Hansen, A.J., T.A. Spies, F.J. Swanson, and J.L. Ohmann. 1991. Lessons from natural forests. BioScience 41:382--392.

Hanson, H.A. 1962. Canada Geese of Coastal Alaska. Transactions North Wildlife and Natural Resources Conference, 27:301-320.

Harmon, M.E. 1986. Logs as sites of tree regeneration in *Picea sitchensis-Tsuga heterophylla* forests of coastal Washington and Oregon. PhD. thesis, Oregon State University, Corvallis.

Harmon, M.E. and J.F. Franklin. 1989. Tree seedlings on logs in *Picea-Tsuga* forests of Oregon and Washington. Ecology 70(1):48-59.

Harr, R.D. 1976. Forest practices and streamflow in western Oregon. Forest Service Pacific Northwest Range and Experiment Sta. General Tech. Rep. No. PNW-49.

Harr, R.D. 1981. Some characteristics and consequences of snowmelt during rainfall in western Oregon. Journal of Hydrology 53:277-304.

Harr, R.D. 1983. Potential for augmenting water yield through forest practices in western Washington and western Oregon. Water Resources Bulletin 19(3).

Harris, A.S. 1989. Wind in the Forests of Southeast Alaska and Guides for Reducing Damage. USDA Forest Service GTR, Pacific Northwest Res. Sta., PNW-GTR-244.

Harris, A.S. and W.A. Farr. 1974. Forest ecology and timber management. In, The Forest Ecosystem of Southeast Alaska. Technical Report PNW-25. Portland: USDA Forest Service. Pacific Northwest Forest and Range Experiment Station.

Harris, L.D. 1984. The fragmented forest: Island biogeography theory and the preservation of biotic diversity. University of Chicago Press, Chicago.

Harris, L.D. 1985. Conservation corridors: A highway system for wildlife. Environmental Info. Center, Florida Conservation Found., Winter Park, Florida. ENFO Rept. 855.

Hass, G.R., and J.D. McPhail. 1991. Systematics and distribution of Dolly Varden (*Salvelinus malma*) and Bull Trout (*Salvelinus confluentis*) in North America. Canadian Journal of Fisheries and Aquatic Sciences. Vol. 48, No. 11. pp. 2191-2211.

Heifetz, J., M.L. Murphy, and K.V. Koski. 1986. Effects of logging on winter habitat of juvenile salmonids in Alaskan streams. North American Journal of Fisheries Management 6(1):52-58.

Hodges, J.I., Jr. and F.C. Robards. 1982. Observations of 3,850 bald eagle nests in Southeast Alaska. In, Proceedings of a Symposium and Workshop on Raptor Management and Biology in Alaska and Western Canada, 17-20 February 1981. Anchorage, Alaska, W.N. Ladd and P.F. Schempf, eds., pp.37-54. USDI Fish and Wildlife Service, Alaska Reg. Rep. Proc-82. Anchorage.

Hogan, D.L. and D.J. Wilford. 1989. A sediment transfer hazard classification system: Linking erosion to fish habitat. In, Proceedings of Watershed '89: A Conference on the Stewardship of Soil, Air, and Water Resources, March 1989. USDA Forest Service, Alaska Region, Juneau, AK, R10-MB-77.

Holleman, M. and J. Kruse. 1991. Hunting and fishing in Southeast Alaska. Alaska Review of Social and Economic Conditions, Institute of Social and Economic Research, University of Alaska Anchorage.

Holmberg, N.D. 1992. Letter from U.S. Fish and Wildlife Service concerning Section 7 consultation with the U.S. Forest Service, March 5, 1992.

Holtby, L.B. and J.C. Scrivener. 1989. Observed and simulated effects of climatic variability, clear-cut logging and fishing on the numbers of chum salmon (*Oncorhynchus keta*) and coho salmon (*Oncorhynchus kitsutch*) returning to Carnation Creek, British Columbia. In, Proceedings of the National Workshop on Effects of Habitat Alteration on Salmonid Stocks, C.D. Levings, L.B. Holtby, and M.A. Henderson, eds., pp. 62-81. Can. Spec. Publ. Fish. Aquat. Sci. 105.

Hopwood, D. 1991. Principles and practices of new forestry: A guide for British Columbians. BC Ministry of For. Land Manage. Rep. 71.

Hughes, J.H. 1985. Characteristics of standing dead trees in old-growth forests on Admiralty Island, Alaska. M.S. Thesis, Washington State University, Pullman. 103 pp.

Hughes, R.M. and R.F. Noss. 1992. Biological diversity and biological integrity: Current concerns for lakes and streams. Fisheries 17 (3):11-19.

Hunter, M.J. 1990. Wildlife, forests, and forestry: Principles of managing forests for biological diversity. Englewood Cliffs, NJ: Prentice Hall.

Interagency Task Group Meeting Records, July 18, Sept. 1 and 18, 1988.

Irland Group. 1991. Assessment of adequacy of timber supply and analysis of potential effects of eliminating the long-term timber sale contract areas, pursuant to Sec. 301(e), Tongass Timber Reform Act of 1990. The Irland Group, December, 1991.

Irvine, J., and N. Johnston. 1992. Coho salmon (*Onocorhynchus kisutch*) use of lakes and streams in the Keogh River drainage, British Columbia. In Northwest Science 66(1):15-25, February 1992.

Jensen, W.F., T.K. Fuller, and W.L. Robinson. 1986. Wolf, Canis lupus, distribution on the Ontario-Michigan border near Saulk St. Marie. Canadian Field Naturalist.

Keith, L.B. 1983. Population Dynamics of Wolves. Pages 66-77 in L.N. Carbyn (ed.), Wolves of Canada and Alaska. Canadian Wildlife Service, #45.

Kessler, W.B. 1979. Bird population responses to clearcutting in the Tongass National Forest of Southeast Alaska. USDA Forest Service, Alaska Region, Report 71.

Ketchikan Pulp and Paper Company (KPC). 1951, amended 1991. Contract No. A10fs-1042, 7/26/51, as amended.

Ketchikan Pulp Company, Alaska Department of Environmental Conservation information request work plan. ENSR Consulting and Engineering. Remond, Washington. February, 1995.

Ketchikan Pulp Company, Mixing zone request and environmental analysis for outfall extension into Tongass Narrows. ENSR Consulting and Engineering. Remond, Washington. August, 1995.

Ketchikan Pulp Company, Study of solids deposition. Document Number 4025-042-500. ENSR Consulting and Engineering. Remond, Washington. April, 1996.

Ketchikan Visitors Bureau. Cruise Ship Calendar 1992, Ketchikan, Alaska.

Kiester, A.R. and C. Eckhardt. 1994. Review of wildlife management and conservation biology on the Tongass National Forest: A synthesis with recommendations. Pacific Northwest Research Station, Corvallis, OR.

Kirchhoff, M.D. and J.W. Schoen. 1987. Forest cover and snow: Implications for deer habitat in Southeast Alaska. Journal of Wildlife Management. 51(1):28-33.

Knutson-Vandenberg Act. 1930. Ch. 416, Stat 527, as amended; 16 U.S.C. 576-5766.

Konopacky. 1991. Water temperature studies in streams on Prince of Wales Island, Alaska, during summer-fall 1990. Konopacky Environmental, Meridian, ID.

Kruse, J. 1992. Institute of Social and Economic Research (ISER), University of Alaska, Anchorage.

Kruse, J. and R. Frazier. 1988. Report to the community of [ ]:Tongass Resource Use Cooperative Survey (TRUCS). A report series prepared for 31 communities in Southeast Alaska. Institute of Social and Economic Research, University of Alaska Anchorage in Cooperation with USDA Forest Service and Alaska Department of Fish and Game, Division of Subsistence.

Kruse, J. and R. Muth. 1990. Subsistence use of renewable resources by rural residents of Southeast Alaska. A final report prepared for the USDA Forest Service. Institute of Social and Economic Research, University of Alaska Anchorage.

Landwehr, D. 1992. Landslide frequency occurrence in the 1989-94 Ketchikan Pulp Company Long-Term Timber Sale Area. Interim report. USDA Forest Service, Tongass National Forest, Ketchikan Area, Ketchikan, Alaska.

Landwehr, D. 1992. Soil disturbance on the 89-94 KPC Long-term Sale Area. Unpublished interim monitoring report. USDA Forest Service, Tongass National Forest, Ketchikan Area, Ketchikan, Alaska.

Larsen, D.N. 1983. Habitats, movements, and foods of river otter in coastal Southeastern Alaska. University of Alaska. MS Thesis.

Lawrence, W. 1979. Pacific working group: Habitat management and land use Practices. In, The Black Bear in Modern North America, D. Burk, ed., pp. 196-201. Boon and Crockett Club. Amwell Press, Clinton, N.Y.

Lebeda, C.S. and J.T. Ratti. 1983. Reproductive biology of Vancouver Canada geese on Admiralty Island, Alaska. Journal of Wildlife Management. 47:297-306.

Leopold, A. 1933. Game management. Scribner, New York. 481 pp.

Lindell, J. 1996. Letter from U.S. Fish and Wildlife Service concerning Section 7 consultation with Forest Service, April 9, 1996.

Lindzey, C.S. and E.C. Meslow. 1977. Home range and habitat use by black bears in southwestern Washington. Journal of Wildlife Management. 41:413-425.

Loggy, W.D. 1974. Landslide inventory of the Harris River drainage. Unpublished report. USDA Forest Service, Tongass National Forest, Ketchikan Area, Ketchikan, Alaska.

Longhurst, W.M. and W.L. Robinette. 1981. Effects of clearcutting and timber management on Sitka black-tailed deer. Wildlife and Fisheries Habitat Management Notes. USDA Forest Service. Alaska Region Admin. Doc. No. 103.

Long-Term Contract. See Ketchikan Pulp and Paper Co.

LTS EIS. 1989-94 Long-Term Sale Contract EIS. See USDA Forest Service 1989.

Madej, M.A. 1982. Sediment transport and channel changes in an aggrading stream in the Puget Lowland, Washington. In, Sediment Budgets and Routing in Forest Drainage Basins. General Technical Report PNW 141.

Marshall, D.B. 1988. Status of the marbled murrelet in North America, with special emphasis on populations in California, Oregon, and Washington. U.S. Fish and Wildlife Service, Biological Report 88(30).

Marston, R. A., 1978. Morphometric Indices of Streamflow and Sediment Yield from Mountain Watersheds in Western Oregon. USDA Forest Service, Pacific Northwest Region, Corvallis, OR.

MacDonald, S.O. and J.A. Cook. 1994 The Mammals of Southeast Alaska: A Distribution and Taxonomic Update. University of Alaska Museum, Fairbanks. Ref. R-632.

McDowell, D.E. and S. Eppenbach. 1985. Alaska tourism handbook: A guide to community tourism development. State of Alaska Division of Tourism, Juneau, Alaska.

McNeil, W. 1964. Redd superimposition and egg capacity of pink salmon spawning beds. In, Journal of Fisheries Research Board of Canada, 21(6), 1964.

Mech, L.D. and P.H. Karns. 1977. Role of the wolf in a deer decline in the Superior National Forest. USDA Forest Service Research Paper NC-52, North Central Forest Experiment Station, St.Paul, Minnesota.

Mech, L.D., S.H. Fritts, G.L. Radde, and W.J. Paul. 1988. Wolf distribution and road density in Minnesota. Wildlife Society Bulletin #16.

Meehan, W.R., W.A. Farr, D.M. Bishop, and J.H. Patric. 1969. Some effects of clearcutting on salmon habitat of two Southeast Alaska streams. USDA Forest Service Res. Paper PNW-82. Pacific Northwest Forest and Range Experiment Sta., Portland OR.

Melquist, W.E., and M.G. Hornocker. 1983. Ecology of river otters in west central Idaho. Wildlife Monograph #83.

Merrian, H.E. 1970. Deer fluctuations in Alaska. Paper presented at the 1970 Ann. Meeting NW Sec. Wildl. Soc., Spokane WA.

Mitchell, R.C. and R.T. Carson. 1989. Using Surveys to Value Public Goods: the Contingent Valuation Method. Resources for the Future, Washington, D.C.

Mobley, C.M. 1989. An archaeological survey on the Cleveland Peninsula, Southeastern Alaska, including six timber harvest units. Report to USDA Forest Service, Ketchikan Area, Fairbanks, AK.

Mondafferi, R.D. 1982. Black bear movements and home range study. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest., Final Rep. Proj. W-17-10, W-17-21, W-21-1, and W-21-2., Job 17.2R.

Montgomery, D. R. et. al., 1995. Watershed Analysis as a Framework for Implementing Ecosystem Management. Water Resources Bulleti, American Water Resources Association, Vol. 31, No. 3.

Moore, K. 1977. Factors contributing to blowdown in streamside leave strips on Vancouver Island. Province of British Columbia, Ministry of Forest, Information Division, Victoria, B.C.

Morgan, S.O. 1990. Wolf. Juneau, AK: Alaska Department of Fish and Game; annual report of survey inventory activities, federal aid in wildlife restoration project: W-23-2; study 14.0. 158 p.

Morrison, M.L., K.A. With, I.C. Timossi, W.M. Block, and K.A. Milne. 1987. Foraging behavior of bark-foraging birds in the Sierra Nevada. Condor 89:201--204.

Murphy, M.L., J.M. Lorenz, J. Heifetz, J.F. Thedinga, K.V. Koski, and S.W. Johnson. 1987. The relationship between stream classification, fish, and habitat in Southeast Alaska. Wildlife and Fisheries Habitat Management Notes, TNF, R10-MB10. USDA Forest Service. 63pp.

Nagorsen, D.W., and R.M. Brigham. 1993. Bats: Royal British Columbia Museum Handbook. University of British Columbia Press, Victoria. 164 p.

National Environmental Policy Act (NEPA) of 1969, as amended. Public Law 91-90, 42 USC 4321-4347, January 1, 1970, as amended by Public Law 94-52, July 3, 1975, and Public Law 94-83, August 9, 1975.

National Forest Management Act (NFMA). 1976. Public Law 94-588, 90 Stat. 2949, as amended; 16 U.S.C. 36 CFR 219.

National Historic Preservation Act (NHPA). 1966.

Nelson, M.E. and L.D. Mech. 1981. Deer Social Organization and Wolf Predation in Northeastern Minnesota. Wildlife Monograph #77.

Nickelson, T., J. Rodgers, S. Johnson, and M. Solazzi. 1992a. Seasonal changes in habitat use by juvenile coho salmon (*Oncorhynchus kisutch*) in Oregon coastal streams. In Canada Journal of Fishery and Aquatic Sciences, Vol. 49, 1992.

Nickelson, T., J. Rodgers, S. Johnson, and M. Solazzi. 1992b. Effectiveness of selected stream improvement techniques to create suitable summer and winter rearing habitat for juvenile coho salmon (*Oncorhynchus kisutch*) in Oregon coastal streams. In Canada Journal of Fishery and Aquatic Sciences, Vol. 49, 1992.

Noble, R.E., P. Harrington. 1977. Snag characteristics in old-growth forests on Prince of Wales Island in Alaska. Wildlife and Fisheries Habitat Notes. USDA Forest Service. Alaska Region Report number 125.

Noss, R.F. 1983. A Regional Landscape Approach to Maintain Diversity. BioScience Vol. 33, pp 700-702.

Noss, R.F. and L.D. Harris. 1986. Nodes, Networks, and MUMS: Preserving Diversity at all Scales. Environmental Management.

O'Clair and Freese(1988) Reproductive Condition of Dungeness Crab, *Cancer magister*, at or near Log Transfer Facilities in Southeastern Alaska Charles E. O'Clair and J.Lincoln Freese National Marine Fisheries Service

Packard, J.P. and L.D. Mech. 1980. Population regulation in wolves. Pages 135-150 in M.N. Cohen, R.S. Malpass and H.G. Klein (eds.), Biosocial Mechanisms of Population Regulation. Yale Univ. Press, New Haven, Conn.

Palmer, R. 1975. Handbook of North American Birds, Volume 3. Yale Univ. Press. London, England.

Parker, D. I. 1996. Forest Ecology and Distribution of Bats in Alaska. Thesis. University of Alaska-Fairbanks.

Patric, J.H. 1966. Rainfall interception by mature coniferous forests of Southeast Alaska. Journal of Soil and Water Conservation 21(6):229-231.

Paustian, S.J. 1987. Monitoring non-point source discharge of sediment from timber harvesting activities in two Southeast Alaska watersheds. In. Proceedings of Water Quality in the Great Land: Alaska's Challenge, pp. 153-167. Water Research Center. Institute of Northern Engineering, University of Alaska, Fairbanks, AK.

Pearson, T.G. 1923. Brown Creeper. Bird-Lore 23:60-63.

Pedersen. S. 1982. Geographical variation in Alaskan wolves. Pages 345-361 in Harrington, F.H. and P.C. Paquet (eds.). Wolves of the World: Perspectives of Behavior, Ecology, and Conservation. Noyes Publications, Park Ridge, NJ.

Pella, J.J. and R.T. Myren. 1974. Caveats concerning evaluation of effects of logging on salmon production in southeastern Alaska from biological information. Northwest Science 48 (2):132-144.

Pennoyer, S. 1992. Letter concerning Section 7 consultation, National Marine Fisheries Service, Feb. 6, 1992.

Pennoyer, Steven. 1996. Letter of concurrence that the North Revilla Project will not likely affect endangered or threatened species. National Marine Fisheries Service, August 2, 1996.

Pentec Environmental, Inc. 1991. The cause of adult salmon pre-spawner mortality in Southeast Alaska. A report, submitted to Alaska Working Group in Cooperative Forestry/Fisheries Research. Project No. 009-002, dated May 20, 199'

Person, D. 1993. Ecology of the Alexander Archipelago Wolf and Response to Change. Progress Report No.2. November 22, 1993.

Person, D. K., M. Kirchhoff, V. Van Ballenberge, G. C. Iverson, and E. Grossman. 1996. The Alexander Archipelago Wolf: A Conservation Assessment. USDA Forest Service, Pacific Northwest Research Station. Gen. Tech. Rep. PNW-GTR-384. 42 pp.

Peterson, R.T. 1990. A Field Guide to Western Birds. Houghton Mifflin Co., Boston, MA.

Pierce, R.S., C.W. Martin, C.C. Reeves, C.F. Likens, and F.H. Bormann. 1972. Nutrient loss from clearcutting in New Hampshire. In, Proceedings of a Symposium on Watersheds in Transition. S.C. Csallany, T.G. McLaughlin, and W.D. Striffler, eds. American Water Resources Assn. and Colorado State University.

Pojar, Jim and Andy MacKinnon. 1994. Plants of the Pacific Northwest Coast Washington, Oregon, British Columbia and Alaska. B. C. Ministry of Forests and Lone Pine Publishing. Vancouver, British Columbia. 527 pp.

Ralph, C.J., G.L. Hunt Jr., M.G. Raphael and J.F. Piatt. 1995. Ecology and Conservation of the Marbled Murrelet in North America: An Overview. USDA Forest Service Pacific SW Research Station. General Technical Report PSW-GTR-152.

Ratti, J.T. and D.E. Timm. 1979. Migratory behavior of Vancouver Canada geese: Recovery rate bias. In, Biology and Management of Pacific Flyway geese. R.L. Jarvis and J.T. Bartonek, eds., pp.208-212. Oregon State University Bookstores, Inc. Corvallis.

Reid, L.M. and T. Dunne. 1984. Sediment production from forest road surfaces. Water Resources Research 20(11):1753-1761.

Reilly, G.M., Jr. 1968. The Audubon Illustrated Handbook of American Birds. McGraw-Hill Co., New York, N.Y.

Reiser, D.W. and T.C. Bjornn. 1979. Habitat Requirements of Anadromous Salmonids. Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America. General Technical Report PNW-96. Portland, OR: USDA, Forest Service, Pacific Northwest Forest and Range Experiment Station.

Resources Planning Act (RPA). See USDA Forest Service 1974.

Rice, R.M., F.B. Tilley, and P.A. Datzman. 1979. A watershed's response to logging and roads: South Fork of Casper Creek, California, 1967-1976. USDA Forest Service, Berkeley, CA, Research Paper PSW-146.

Rivers and Harbors Act of 1899. 33 U.S.C. 403.

Robbins, C.S., B. Brunn, and H.S. Zim. 1983. A Field Guide to Identification of Birds of North America. Golden Press, New York, NY.

Rogers, G. 1960. Alaska in transition. Johns Hopkins Press, Baltimore, MD.

Rosenberg, K.V., and M.G. Raphael. 1986. Effects of forest fragmentation on vertebrates in douglas-fir forests. In, Wildlife 2000: Modeling Habitat Relationships of Terrestrial Vertebrates, J. Verner, M.L. Morrison, and C.J. Ralph, eds., pp.263-272. Univ. Wisc. Press., Madison.

Rothacher, J. 1965. Streamflow from small watersheds on the western slope of the Cascade Range of Oregon. Water Resource Research 1(1).

Rothacher, J. 1970. Increases in water yield following clear-cut harvest in the Pacific Northwest. Water Resource Research 6(2):653-658.

Rothacher, J., C.T. Dryness, and R.L. Fredricksen. 1967. Hydrologic and related characteristics of three small watersheds in the Oregon Cascades. Forest Service Pacific Northwest Range and Experiment Sta., Portland, OR.

Ruth, R.H. and A.S. Harris. 1979. Management of western hemlock-Sitka spruce forests for timber production. General Technical Report PNW-88. USDA, Forest Service, Pacific Northwest Forest and Range Experiment Station.

Salo, E. 1966. Study of the effects of logging on pink salmon in Alaska. In Proceedings, Society of American Foresters, Contribution No. 264.

Salo, E. 1972. Effects of logging on salmon stream studies sponsored by the Alaska Loggers Association. Unpublished lecture.

Schempf, P.F. 1981. Unpublished survey information. US Fish and Wildlife Service.

Schempf, P.F. 1982. Unpublished survey information. US Fish and Wildlife Service.

Schoen, J.W. and M.D. Kirchhoff. 1990. Seasonal habitat use by Sitka black-tailed deer on Admiralty Island, Alaska. Journal of Wildlife Management. 54(3):371-378.

Schoen, J.W., M.D. Kirchhoff, and J.H. Hughes. 1988. Wildlife and old-growth forests in Southeast Alaska. Natural Areas Journal 8:138-145.

Schoen, J.W., M.D. Kirchhoff, and M.H. Thomas. 1985. Seasonal distribution and habitat use by Sitka black-tailed deer in Southeastern Alaska. Fed. Aid in Wildl.Res.Final Rep. Prog. W-17-11, W-21-2, W22-2, W22-3, and W22-4. Job 2.6R, Alaska Dept. of Fish and Game, Juneau.

Sedell and Duval(1985) Water Transportation and Storage of Logs general Technical Report PNW-186 August 1985

Shea, L. 1990. Impacts of development on the nonhunting, wildlife oriented businesses of Southeast Alaska. ADF&G, Habitat Division.

Sheridan, W.L., J.E. Weisgerber, and C.N. Wilson. 1965. The effects of logging in twelve salmon streams in Southeast Alaska, USDA Forest Service, Region 10, Juneau, 59p.

Sheridan, W.L. and W.J. McNeil. 1982. Pink salmon escapements in some logged and unlogged streams in Southeast Alaska, Juneau, AK: USDA, Forest Service, Alaska Region.

Sheridan, W.L. et al. 1984. Sediment content of streambed gravels in some pink salmon spawning streams in Alaska in fish and wildlife relationships in old-growth forests. In, Proceedings of a Symposium, Juneau, Alaska, 12-15 April 1982, W.R. Meehan, T.R. Merrell, and T.A. Hanley, eds., pp.153-165.

SHPO. (See Alaska State Historic Preservation Office.)

Shultz and Berg(1976) Some Effects of Log Dumping on Estuaries by Robert D.Schultz and Ronald J. Berg June 1976 National Marine fisheries Service

Sidle, W.D. and L.H. Suring. 1986. Wildlife and fisheries habitat management notes: Management indicator species for the National Forest lands in Alaska. USDA Forest Service. Alaska Region Tech. Pub. R10-TP-2.

Sidle, W.D. 1985. Wildlife and fisheries habitat management notes: Habitat management for forest birds in Southeast Alaska. USDA Forest Service, Alaska Region, Admin. Doc. No. 146. 21 p.

Simon, T.L. 1980. An ecological study of the marten in the Tahoe National Forest, California. M.S. Thesis. California State University, Sacramento.

Simons, D. B., R. M. Li, N. Duong, N. Douwen, V.M. Ponce, E.V. Richardson, K. Schneider, S. A. Schumm and R. K. Simons. 1980. Watershed and stream Mechanics. USDA Soil Conservation Service, Washington, DC.

Smith, C.A., R.E. Wood, L. Beier, and K.P. Bovee. 1986. Wolf-Deer-Habitat Relationships in Southeast Alaska. Progress Report. Federal Aid in Wildlife Restoration Project W-22-4, Job 14.13. Alaska Department of Fish and Game, Juneau, Alaska.

Smythe, C.W. 1988. Harvest and use of fish and wildlife resources by residents of Petersburg, Alaska. Chilkat Institute, Juneau, Alaska, and Division of Subsistence, Alaska Department of Fish and Game, Juneau, Alaska.

Stebbins, R.C. 1985. Western Amphibians and Reptiles. Houghton Mifflin Co., Boston, MA.

Stednick, J.D., T.W. Lewis, and D.J. Hoffman. 1978. Suspended sediment production from bridge/culvert placement and/or removal. Forest Service, Chatham Area, Sitka, AK. Unpublished report.

Stednick, J.D., L.N. Tripp, and R.J. McDonald. 1982. Slash burning on soil and water chemistry in Southeast Alaska. Journal of Soil and Water Conservation, March-April, 1982.

Stephens, F.R., C.R. Gass, R.F. Billings. 1968. Soils and site index in Southeast Alaska. Rep. No. 2 of the Soil-Site Index, Administrative Study. USDA Forest Service, Alaska Region.

Stephens, F. R., C. R. Gass, R. F. Billings, and D. E. Paulson. 1969. Soils and associated ecosystems of the Tongass. Internal report. USDA Forest Service, Alaska Region.

Strickland, M.A., C.W. Douglas, M. Novak, and N.P. Hunziger. 1982. Marten (Martes americana). In, Wild Mammals of North America, J.A. Chapman and G.A. Feldhamer, eds., pp.599--612. The John Hopkins University Press. Baltimore, MD.

Suring, L.H., E.J. Degayner, R.W. Flynn, M.D. Kirchhoff, J.R. Martin, J.W. Schoen, L.C. Shea. 1992. Habitat capability model for Sitka black-tailed deer in Southeast Alaska: Winter habitat. USDA Forest Service, Tongass National Forest.

Suring, L.H., E.J. Degayner, and R.W. Flynn. 1988a. Habitat capability model for marten in Southeast Alaska: Winter habitat. USDA Forest Service, Tongass National Forest. Draft.

Suring, L.H., E.J. Degayner, R.W. Flynn, T. McCarth, M.L. Orme, R.E. Wood, and E.L. Young. 1988b. Habitat capability model for black bear in Southeast Alaska. USDA Forest Service, Tongass National Forest. Draft.

Suring, L.H., E.J. Degayner, and P.F. Schempf. 1988c. Habitat capability model for bald eagles in Southeast Alaska: Nesting habitat. USDA Forest Service, Tongass National Forest. Draft.

Suring, L.H., A.T. Doyle, R.W. Flynn, D.N. Larsen, M.L. Orme, and R.E. Wood. 1988d. Habitat capability model for river otter in Southeast Alaska: Spring habitat. USDA Forest Service, Tongass National Forest. Draft.

Suring, L.H., R.W. Flynn, J.H. Hughes, M.L. Orme, and D.A. Williamson. 1988e. Habitat capability model for hairy woodpeckers in Southeast Alaska: Winter habitat. USDA Forest Service, Tongass National Forest. Draft.

Suring, L.H., R.W. Flynn, J.W. Schoen, and L.C. Shea. 1993f. Habitat capability model for mountain goats in Southeast Alaska: Winter habitat. Version 4.1. USDA Forest Service, Tongass National Forest. Draft.

Suring, L.H., D.C. Crocker-Bedford, R.W. Flynn, C.S. Hale, G.C. Iverson, M.D. Kirchhoff, T.E. Schenck, L.C. She[illegible] K. Titus. 1993. Report of an Interagency Committee: A proposed strategy for maintaining well-distributed, viable populations of wildlife associated with old-growth forests in Southeast Alaska. Review Draft. Juneau, AK. 96 p.

Swanson, F. J., L. E. Benda, S. H. Duncan, G. E. Grant, W. F. Megahan, L. M. Reid and R. R. Ziemer, 1987. Mass failures and other Processes of Sediment Production in Pacific Northwest Forest Landscapes. In Streamside Management: Forestry and Fishery Interactions, Salo, E. O. And T. W. Cundy (Editors). Institute of Forest Resources, University of Washington, Seattle WA, pp. 9-38.

Swanson, C.S., M. Thomas, and D. M. Donelly. 1989. Economic Value of Big Game Hunting in Southeast Alaska, USDA Forest Service Resource Bulletin. RM-16.

Swanston. D.N. 1974. Soil mass movement. The Forest Ecosystem of Southeast Alaska. USDA Forest Service Research Paper. PNW-17.

Swanston, D.N. 1989. A preliminary analysis of landslide response to timber management in Southeast Alaska: An extended abstract. Proceedings of Watershed '89: A Conference on the Stewardship of Soil, Air, and Water Resources. R10-MB-77. Juneau, AK, USDA, Forest Service, Pacific Northwest Research Station, Forest Sciences Laboratory.

Swanston, D.N. and D.A. Marion. 1991. Landslide Response to timber harvest in Southeast Alaska. Proceeding of the Fifth Federal Interagency Sedimentation Conference. Eds. Drs. Shou-Shan Fan and Yung-Huang Kuo. Vol. 2.

Taylor, R.F. 1934. Yield of second-growth western hemlock-Sitka spruce stands in Southeastern Alaska. Technical Bulletin No 412. USDA, Forest Service. Washington: GPO.

Taylor, T.F. 1979. Species list of Alaskan birds, mammals, freshwater and anadromous fish, amphibians, reptiles, and commercially important invertebrates. USDA Forest Service, Alaska Region Report No 82.

Tenakee v. Courtright. 1987. Memorandum of Order in case of Tenakee v. Courtright, No. J86-024 (District of Alaska). Signed 26 June 1987 by J.A. von der Heydt.

Theil, R.P. 1985. Relationship between road densities and wolf habitat suitability in Wisconsin. American Wildlife Naturalist #133.

Thomas, J.W. 1979. Wildlife habitats in managed forests in the Blue Mountains of Oregon and Washington. USDA Forest Service, Agriculture Handbook No. 553. September 1979.

TLMP (1979a, as amended). See USDA Forest Service 1979a.

TLMP (1986). See USDA Forest Service 1986.

TLMP (1991a). See USDA Forest Service 1991a.

TLMP RSDEIS (1996a). See USDA Forest Service 1996.

TLMP (1997). See USDA Forest Service 1997.

Tongass Resource Cooperative Use Survey (TRUCS). (See Kruse and Frazier 1988; Kruse, Frazier and Fahlman 1988.)

Tongass Timber Reform Act (TTRA). 1990. Public Law 101-626.23 October.

Tyler, R., and D. Gibbons. 1973. Observations of the effects of logging on salmon producing tributaries of the Staney Creek watershed and the Thorne River watershed and of logging on the Sitka District. Unpublished, Alaska Loggers Association, FRI-UW-7307.

Uberuaga. 1984. Effectiveness of buffer zones in protecting fish habitat on small streams during clear-cut logging in southeastern Alaska. Unpublished, NMFS Northwest and Alaska Fisheries Center, Auke Bay Laboratory.

University of Alaska-Fairbanks. 1986. Alaska climate summaries. Alaska Climate Center Technical Note Number 3. 59 pp.

U.S. Army Corps of Engineers.1987. Corps of Engineers Wetlands Delineation Manual. Technical report Y-87-1, Vicksburg, MS: Department of the Army. Waterways Experiment Station. Washington, D.C. 100 pp.

USDA Forest Service. 1973. National Forest Landscape Management: Volume 1. Agriculture Handbook 434. U.S. Govt. Printing Office. Washington, D.C.

_. 1974a. Forest and Rangeland Renewable Resources Planning Act.

_. 1974b. Cable Logging Systems. Corvallis, Oregon.

_. 1974c. National Forest Landscape Management: Volume 2. Chapter 1 - The Visual Management System. Agriculture Handbook 462. Washington, D.C.

_. 1977a. Southeast Alaska Area Guide. USDA Forest Service, Alaska Region. Juneau, AK.

_. 1979a. Tongass Land Management Plan and Final EIS. Series Number 10-57. USDA Forest Service, Alaska Region, Juneau, AK.

_. 1979b. Visual Character Types. USDA Forest Service, Alaska Region Series No. R-10-63. USDA Forest Service, Alaska Region, Juneau, AK.

_. 1982. National Forest System Land and Resource Management Planning. USDA Forest Service. Federal Register 47:43026-43092.

_. 1983. Alaska Regional Guide. Alaska Region Rep. No. 126. USDA Forest Service, Alaska Region, Juneau, AK.

_. 1984. Ketchikan Pulp Company Long-Term Sale Area, Final Environmental Impact Statement for the 1984-89 Operating Period. USDA Forest Service, Alaska Region, Juneau, Alaska.

_. 1985. Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington. Part 1-Chapter Narratives. USDA Forest Service, Pacific NW Reg., Pub. R6-F&WL-192-1985.

_. 1986. Tongass Land Management Plan. Amended 1985-86. USDA Forest Service, Alaska Region. Administrative Document No. 147.

_. 1989. Ketchikan Pulp Company Long-Term Sale Area, Final Environmental Impact Statement for the 1989-94 Operating Period. R10-MB-66a et al. USDA Forest Service, Alaska Region, Juneau, Alaska.

_. 1990a. Tongass Land Management Plan Revision Draft Environmental Impact Statement. USDA Forest Service. Tongass National Forest, R10-MB-96 and R10-MB-97 (Appendices).

_. 1990c. Timber Supply and Demand, Alaska National Interest Lands Conservation Act Section 706(A), Report No. 10. R10-MB-156 USDA Forest Service, Alaska Region, Juneau Alaska.

_. 1991a. Tongass Land Management Plan Revision, Supplement to the Draft Environmental Impact Statement. USDA Forest Service, Tongass National Forest, R10-MB-149 (Supplement to the Draft EIS), R10-MB-146 (Supplement to Draft EIS, Proposed Revised Forest Plan), R10-MB-145 (Supplement to DEIS, Appendix Volume 1), and R10-MB-144 (Supplement to DEIS, Appendix Volume 2). Alaska Region, Juneau, Alaska.

_. 1991b. Shelter Cove Final Environmental Impact Statement. USDA Forest Service, Tongass National Forest, Ketchikan Area, Ketchikan, Alaska.

_. 1991c. Technical Report #91-01, USDA Forest Service R10 publication.

_. 1991e. Archaeological Survey of Proposed Timber Harvest Units and Access Roads Near Shelter Cove, Revillagigedo Island, Southeast Alaska. CRM Report 1991-05-17. Ketchikan Area, Tongass National Forest, Ketchikan, Alaska.

_. 1992a. Soil Quality Standards. Forest Service Manual 2500, Watershed and air management. R10 Supplement No. 2500-92-1, pg. code 2554.

_. 1992e. Ketchikan Area summary of potential fisheries habitat improvement projects. Unpublished report.

_. 1992f. Evaluation of the Irland Group Report, Pertaining to Sec. 301(3), Tongass Timber Reform Act of 1990. US Forest Service Alaska Region.

_. 1992h. Channel type User Guide, Tongass National Forest, Southeast Alaska. USDA Forest Service, Tongass National Forest, R10-TP-26. Alaska Region, Juneau, Alaska.

_. 1992i. Archaeological Clearance for the 8400 Salvage Timber Sale near Shoal Cove on Carroll Inlet, Revillagigedo Island, Alaska. CRM Report 1992-05-01. Ketchikan Area, Tongass National Forest, Ketchikan, Alaska.

_. 1992j. Archaeological Clearance Report for Changes in Units, Roads, and Bridge Locations for the Shelter Cove Independent Timber Sale, Revillagigedo Island, Southeast Alaska. CRM Report 1992-05-13. Ketchikan Area, Tongass National Forest, Ketchikan, Alaska.

_. 1993a. The Reserve Tree Selection Guidelines Booklet. USDA Forest Service, Alaska Region, R10-MB-215.

_. 1993b. Landscape Aesthetics: A Handbook for Scenery Management. Agriculture Handbook 701. U.S. Govt. Printing Office. Washington, D.C.

_. 1993c. Archaeological Clearance Report for Timber Harvest Units and Roads Surveyed in 1992 for the Shelter Cove Independent Sale on Revillagigedo Island, Southeast Alaska. CRM Report 1993-05-08, addendum 1. Ketchikan Area, Tongass National Forest, Ketchikan, Alaska.

_. 1994a. Alternatives to using the Timber Type Map for determining proportionality under the Tongass Timber Reform Act. USDA Forest Service, Alaska Region.

_. 1994b. A working guide to the sensitive plants of the Alaska Region. USDA Forest Service, Alaska Region, Juneau, AK.

_. 1994c. Classification and correlation of the soils of the Ketchikan Area. Unpublished report. USDA Forest Service, Tongass National Forest, Ketchikan Area, Ketchikan, Alaska.

USDA Forest Service. 1995a. TSPIRS Report #2: Economic Account, Ketchikan Area Tongass National Forest, Fiscal Year 1994.

_. 1995b. Report to Congress: Anadromous fish habitat assessment. USDA Forest Service, R10-MB-279. Pacific Northwest Research Station, Alaska Region.

_. 1995c. An Archaeological Clearance Report for the Upper Carroll Environmental Impact Statement, Revillagigedo Island, Southeast Alaska. CRM Report 1995-05-02. Ketchikan Area, Tongass National Forest, Ketchikan, Alaska.

_. 1995d. A Report on Archaeological Surveys Conducted in 1995 under the Sea Level Environmental Impact Statement for the Ketchikan Pulp Company Long Term Sale on Revillagigedo Island, Southeast Alaska. CRM Report 1995-05-05 Addendum 1. Ketchikan Area, Tongass National Forest, Ketchikan, Alaska.

_. 1995e. A Report on Archaeological Surveys Conducted in 1994 under the Sea Level Environmental Impact Statement for the Ketchikan Pulp Company Long Term Sale on Revillagigedo Island, Southeast Alaska. CRM Report 1995-05-05. Ketchikan Area, Tongass National Forest, Ketchikan, Alaska.

_. 1995f. A Hierarchical Framework of Aquatic Ecological Units in North America (Nearctic Zone). USDA Forest Service, Alaska Region, General Technical report NC-176, Juneau, AK.

_. 1995g. Impact Analysis for Planning (IMPLAN) Database. Alaska Region.

_. 1996a. Tongass Land Management Plan Revision, Revised Supplement to the Draft Environmental Impact Statement, USDA Forest Service, Tongass National Forest, R10-MB-314a. Alaska Region, Juneau, Alaska.

_. 1997a. Draft Stream Survey Protocol for the Tongass National Forest. Compiled by Kathy Coghill, FSL, Juneau.

_. 1997b (Draft). A Proposal for a Two-Tiered Sediment Risk Assessment for Potential Fish Habitat Impacts from Forest Management in Southeast Alaska. Geier, T. W. 1997. Tongass National Forest, Ketchikan Area, Ketchikan, Alaska.

_. 1997c. Watershed Analysis Handbook, Draft Version 2, July 1997. Alaska Region.

_. 1997d. Tongass Land Management Plan, USDA Forest Service, Tongass National Forest, R10-MB-338dd. Alaska Region, Juneau, Alaska.

_. 1997e. Brand X Timber Sale Environmental Assessment. USDA Forest Service, Tongass National Forest, Ketchikan Area, Ketchikan Ranger District, Ketchikan, Alaska.

_. 1998 (Final). A Proposed Two-Tiered Sediment Risk Assessment for Potential Fish Habitat Impacts from Forest Management in Southeast Alaska. Geier, T. W. 1998. Tongass National Forest, Ketchikan Area, Ketchikan, Alaska

USDA Forest Service Manuals

FSM Title 2400, Timber Management

FSM Title 2500, Watershed and Air Management, Chapter 2554 "Soil Quality Monitoring"

USDA Forest Service Handbooks

FSH 2409.17. Silvicultural Practices Handbook, Chapter 9

FSH 2409.18. Timber Sale Preparation Handbook and R10 Supplement 6

FSH 2409.18-92-5. Region 10 Supplement to Timber Sale Preparation Handbook. Proportionality Analysis.

FSH 2509.18. Soil Management Handbook and R10 Supplement 7

FSH 2509.22. Soil and Water Conservation Handbook (1993)

FSH 2609.24. Aquatic Habitat Management Handbook (1986)

FSH 2554. R-10 Supplement, 2500-92-1

USDA Forest Service and Alaska Department of Environmental Conservation. 1992g. Memorandum of Agreement between the USDA Forest Service and the Alaska Dept. of Environmental Conservation.

USDA Forest Service and USDI Fish and Wildlife Service. 1990e. Interagency Agreement, FS Agreement # 89-010/FWS Agreement # 14-16-000-90-8745, May 15, 1990.

U.S. Department of Commerce. Bureau of the Çensus. 1991. Alaska population by sex, race, and Hispanic origin: 1990 Census. Prepared by Alaska Department of Labor.

U.S. Office of the Federal Register National Archives and Records Administration. 1997. 36 Code of Federal Regulations. Parks, Forests and Public Property, Parts 200 to 299.

U.S. Office of the President. 1977. Executive Order 11988. Floodplain Management.

U.S. Office of the President. Executive Order 11990. Wetlands. 42 USC 4321 et seq.

Vahle, J.R. and D.R. Patton. 1983. Red Squirrel Cover Requirements in Arizona Mixed Conifer Forests. Journal of Forestry (January):14-15.

Van Ballenberghe, V. and T.A. Hanley. 1984. Predation on deer in relation to old-growth forest management in southeastern Alaska. In, Fish and Wildlife Relationships in Old-growth Forests: Proceedings of a Symposium, W.R. Meehan, T.R.Merrell, and T.A. Hanley, eds., pps. 290-296. Am. Inst. Fish Res. Biol., Reintjes Publ., Morehead City, N.C.

Van Ballenberghe, V., A.W. Erickson, and D. Byman. 1975. Ecology of the Timber Wolf in Northeastern Minnesota. Wildlife Monograph #43.

Van Zyll de Jong, C.G. 1985. Handbook of Canadian Mammals, volume 2: bats. National Museum of Natural Science, National Museum of Canada, Ottowa. 212 p.

Van Zyll de Jong, C.G., and D,W. Nogorsen. 1994. A review of the distribution and taxonomy of *Myotis keenii* and *Myotis evotis* in British Columbia and the adjacent United States. Canadian Journal of Zoology 72:1069-1078.

Wagner, W. H. 1993. Flora of North America, Volume 2. Flora of North America Editorial Committee. Oxford University Press.

Walter, Rhoda A. 1982. A stream ecosystem in the old-growth forest in Southeastern Alaska, Part II: Structure and dynamics of the periphon community. In, Symposium Proceedings of Fish and Wildlife Relationships in Old-growth Forests, W.R. Meehan, T.R. Merrell, and T.A. Hanley, eds., pps. 56-69. American Institute of Fish Resources Biology.

Waters, Dana L. 1992. Habitat associations, phenology, and biogeography of amphibians in the Stikine River Basin and Southeast Alaska. Report of the 1991 pilot project. US Fish and Wildlife Service and California Cooperative Fisheries Research Unit, Humboldt State University, Arcata, CA.

Webber, D.F. 1986. Foraging site selection of the brown creeper (*Certhia americana*) in relation to temperature in Central Iowa. Proc. Acad. Sci. 93:22-23.

Wilson, M.F. 1970. Foraging behavior of some winter birds of deciduous woods. Condor 72:169--174.

Wilson and Golnick. 1995. Alternatives to using the timber type map for determining proportionality under the Tongass Timber Reform Act.

Wood, R. 1990. Annual survey and inventory report—wolf. Federal aid in wildlife restoration. Alaska Department of Fish and Game, Juneau, AK.

Yeo J.J. and J.M. Peek. 1992. Habitat selection by female Sitka black-tailed deer in logged forests of Southeast Alaska. Journal of Wildlife Management. 56(2): 253-261.

Zaborske, R. 1993. Memo concerning project analysis of economics based on TSPIRS data.

Zimmerman, S.T. 1996. Letter concerning Section 7 consultation, National Marine Fisheries Service, May 10, 1996.

Distribution List

The distribution list includes Agencies, Organizations and individuals to whom complete and summary copies of this Draft Environmental Impact Statement were sent.

Complete Copy of EIS

Individuals

Margaret Clabby, Ketchikan, AK
Harold and Ellen Cowan, Ward Cove, AK
Raymond D. Cowan, Ketchikan, AK
Barny Freedman, Thorne Bay, AK
Lawrence A. Hilley, Ketchikan, AK
Eric Hummel, Ketchikan, AK
Dave Naslund, Salt Lake City, UT
Bill Nightingale, Cook, MN
Fred Norman, Ketchikan, AK
Ronald Paden, Twain Haute, CA
Pat Roppel, Wrangell, AK
Dennis Wolfe, Ward Cove, AK

Agencies and Organizations

Alaska Department of Environmental Conservation, Ketchikan, AK
Alaska Department of Environmental Conservation, Juneau, AK
Alaska Department of Fish & Game, Douglas, AK
Alaska Department of Fish & Game, Ketchikan, AK
Alaska Power & Telephone Company, Port Townsend, WA
Ballard and Associates, Ketchikan, AK
Citizens' Advisory Commission on Federal Areas, Fairbanks, AK
City of Saxman, Ketchikan, AK
EPA EIS Review Coordinator, Seattle, WA
Federal Aviation Administration, Renton, Washington, DC
Federal Highway Administration, Portland, OR
FERC, Environmental Compliance Branch, Washington, DC
First Bank, Ketchikan, AK
General Services Administration, Washington, DC
Glacier Grotto, Ketchikan, AK
Greater Ketchikan Chamber of Commerce, Ketchikan, AK
Hyder Public Library, Hyder, AK
Institute for Policy Research, Evanston, IL
Interstate Commerce Commission, Washington, DC
Ketchikan Public Library, Ketchikan, AK
Klawock Public Library, Klawock, AK
Koncor Forest Products Company, Anchorage, AK
KRBD Radio, Ketchikan, AK
Metlakatla Community School Library, Metlakatla, AK
National Marine Fisheries Service, Juneau, AK
NOAA Ecology and Conservation, Washington, DC
Revilla High School, Ketchikan, AK
Robertson, Monagle & Eastaugh, Juneau, AK
Rural Development Administration, Kalamath Falls, OR
Sierra Club Legal Defense Fund,Incorporated, Juneau, AK
Society of American Foresters, Ketchikan, AK

Southeast Alaska Conservation Council, Juneau, AK
State of Alaska, Juneau, AK
Thorne Bay Community Library, Thorne Bay, AK
University of Alaska - Southeast, Ketchikan, AK
US Army Engineer District, Anchorage, AK
US Army Engineering Division, Portland, OR
US Coast Guard, Loran Station, Shoal Cove, Ketchikan, AK
US Coast Guard, Environmental Impact Branch, Washington, DC
US Department of Energy, Washington, DC
US Department of Housing and Urban Development, Seattle, WA
US Department of Transportation, Washington, DC
US Environmental Protection Agency, Seattle, WA
US Environmental Protection Agency, Office of Environment Review, Washington, DC
US Naval Observation OP-963, Naval Oceanography Division, Washington, DC
US Navy, Environmental Protection Division, Washington, DC
USDA Forest Service, Fred Norbury, Juneau, AK
USDA Forest Service, Winnie Weber, Juneau, AK
USDA Forest Service, Washington, DC
USDA, National Agricultural Library, Beltsville, MD
USDA Soil Conservation Service, Washington, DC
USDI Fish & Wildlife Service, Anchorage, AK
USDI Fish & Wildlife Service, Ketchikan, AK
USDI Fish & Wildlife Service, Juneau, AK
USDI Office of Environmental Policy, Washington, DC
USDI Office of Environmental Affairs, Washington, DC
Wrangell Public Library, Wrangell, AK

Summary of EIS

Individuals
David Faast, Ketchikan, AK
John Geddie, Albuquerque, NM
William S. Haag, Kodiak, AK
Hank Hays, Bainbridge Island, WA
Wayne D. Hendrickson, Ketchikan, AK
Elzie Isley, Ketchikan, AK
Thomas F. Martinez Jr., Ketchikan, AK
Dixie Sanders, Lyons, OR
Charles W. Stout, Ward Cove, AK
Frank Talerico, Ketchikan, AK
Len Tiemersma, Ketchikan, AK

Agencies and Organizations
AK Dept. of Fish & Game, Tenakee Springs, AK
Alaska Woods Service Company, Ketchikan, AK
AMHT Trust Land Office, Anchorage, AK
Cape Fox Corporation, Ketchikan, AK
Craig Public Library, Craig, AK
Edna Bay School, Edna Bay, AK
Forestry Library, University of Minnesota, St. Paul, MN
Hollis Public School, Hollis, AK
Howard Valentine School, Coffman Cove, AK
Hunger Mountain Logging, Ward Cove, AK
J.R. Gildersleeve School, Ketchikan, AK
Kasaan School, Ketchikan, AK

Ketchikan Outdoor Recreation and Trails Coalition, Ketchikan, AK
Naukati School, Ketchikan, AK
Petersburg Public Library, Petersburg, AK
Polk Inlet School, Ketchikan, AK
Port Alexander School, Port Alexander, AK
Port Protection School, Ketchikan, AK
Schoenbar Junior High School, Ketchikan, AK
Shuham & Milner PC, CPA's, Ketchikan, AK
State of Alaska, Juneau, AK
Tenakee Springs, Tenakee Springs, AK
Thorne Bay School, Thorne Bay, AK
Tongass Forest Enterprises, Ketchikan, AK
USDA Forest Service PNW Research Station, Juneau, AK
USDA Forest Service, Regional Forester, Juneau, AK
USDA Forest Service - Chugach NF,
USDA Forest Service - Ketchikan Ranger District, Jimmy DeHerrera, Ketchikan, AK
USDA Forest Service - Tongass NF, Stikine Area, Petersburg, AK
USDA Forest Service - Tongass NF, Chatham Area, Sitka, AK
USDA Forest Service - Tongass NF, Chatham Area, Sitka Ranger District, Sitka, AK
USDA Forest Service - Tongass NF, Craig Ranger District, Craig, AK
USDA Forest Service - Tongass NF, Thorne Bay Ranger District, Thorne Bay, AK
Wrangell Advisory Committee, Wrangell, AK

Index

☆ U.S. GOVERNMENT PRINTING OFFICE: 1998 689-113 / 41961 REGION NO. 10

in, sex, religion, age,
uire alternative means
voice or TDD).

ice) or