Alaska Habitat Management Guide

Guidelines for the Protection of Wildlife and Their Habitat and on Human Use of Fish and Wildlife

Produced by
State of Alaska Department of Fish and Game
Division of Habitat

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Many individuals have been involved in the production of this volume. All products were reviewed first by project staff and distributed for a series of technical reviews. The names of reviewers and other contributors are compiled in appendix A.

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The process of developing the initial plan and procedures for this project involved a number of individuals who are not otherwise listed as authors and contributors. These include many of the staff within the Division of Habitat, as well as planners and research and management coordinators of other divisions. This group also includes all project team members and all ADF&G regional supervisors. Special mention should be made of the support from Alvin G. Ott, Lance Trasky, Richard Reed, and Carl Yanagawa, Regional Supervisors of the Division of Habitat for the Interior-Arctic, Southwest, Southeast, and Southcentral regions, respectively. We would also like to acknowledge the many contributions of John A. Clark, who was Director of the Division of Habitat until his death in 1985.

General Introduction

Overview of the Habitat Management Guides Project

Background

Alaska is an immense and bountiful frontier, and until just recently it was all but inconceivable that we would ever need to worry about its capacity to sustain the wealth of fish and wildlife resources for which it is renowned. But the impetus of progress has not abated, and the pressure to develop our lands and waters intensifies daily. Every year more lands in Alaska are being proposed for uses other than as wildlife habitat, especially around cities, towns, and villages. These proposed uses include logging, mining, hydroelectric projects, agriculture, settlement, geothermal development, and oil and gas leases, among others. As the number of proposals and plans for development continues to increase, so does the need to carefully and efficiently evaluate their possible effects upon species and habitats and to recommend viable managerial options to guarantee that our valuable fish and wildlife resources and habitats are adequately protected and maintained. By using appropriate planning and managerial techniques most of the potential for damage and loss of access for human use can be avoided.

One of the responsibilities of the Alaska Department of Fish and Game (ADF&G) is to assist land managers by recommending to them the best ways and means, based upon the best available data, for protecting local fish, wildlife, and habitats against adverse effects and impacts. Because many proposals and plans for development and land uses require a rapid response from the department, there may not be enough time for staff to actually study the specific area in which the proposed development is to occur. However, the department still needs to accumulate and assess a wide variety of information in order to prepare recommendations for managing habitat. Therefore, the department initiated the Alaska Habitat Management Guides (AHMG) project to prepare reports of the kinds of information upon which its recommendations must be founded in order to responsibly and rapidly address land and water use proposals made by land managers. These guides are a major undertaking and will be of inestimable value to the state in its efforts to avoid or mitigate adverse impacts to Alaska's great wealth of fish and wildlife.

Purpose

The Alaska Habitat Management Guides present the best available information on selected fish and wildlife species: mapping and discussing their geographical distribution; assessing their relative abundance; describing their life functions and habitat requirements; identifying the human uses made of them, including harvest patterns of rural communities; and describing their role in the state's economy. This last kind of information, because of the variety of values humans place upon fish and wildlife, is not easily derived. There are, however, several methods to estimate some of the economic values associated with these resources, and such estimates have become particularly important in land use planning because many potentially conflicting uses must be evaluated in economic terms.

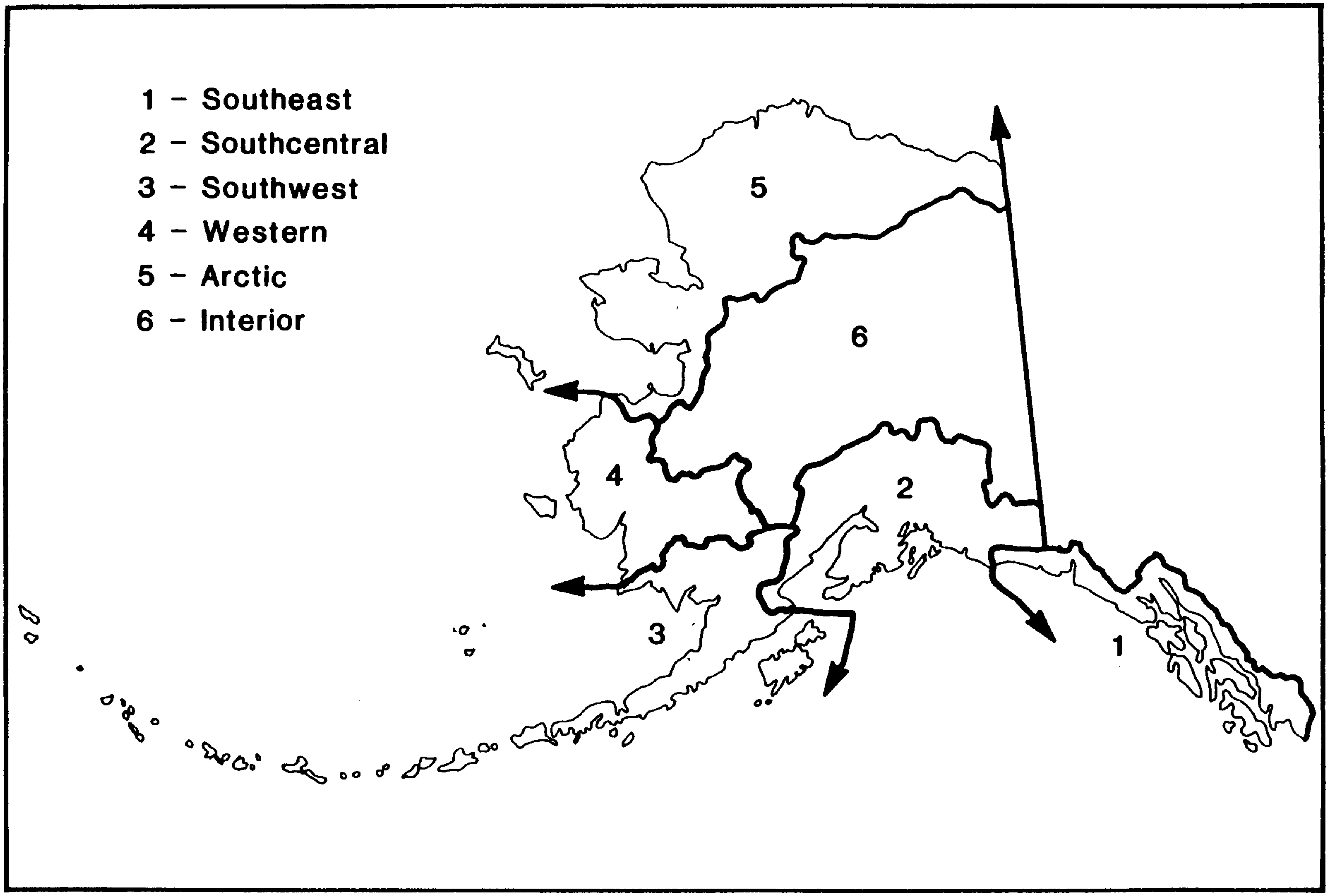
Essential to assessing what might happen to fish and wildlife if their habitats are altered is information about what effects or impacts are typically associated with particular kinds of development activities. The habitat management guides therefore also provide summaries of these known effects. This information, in conjunction with compiled life history information, will allow those concerned to estimate how sensitive a given species might be to a specific proposed activity - whether or not, and to what degree the fish and wildlife are liable to be impacted. The guidance offered (a compilation of existing options for habitat management) is not site-specific. Rather, it is general information available to those who seek to avoid adverse impacts without placing undue restraints upon other land and water uses.

The completed guides coverage of fish and wildlife resources encompasses the Fish and Game Resource Management Regions established by the Joint Board of Fisheries and Game (map 1). These regions provide the most inclusive and consistent format for presenting information about fish and wildlife resources and relating it to management activities and data collections efforts within the department.

Applications

The choice of the term "guides" rather than "plans" for the reports is consistent with the largely advisory role of the department with respect to land management issues. The guides will provide the department was well as other state, federal, and private land managers with information necessary for the development of land and water use plans. Thus, the guides themselves are not land management plans and do not provide for the allocation or enhancement of fish and wildlife. Information included in a guide will be used by the department's staff in their involvement in the land use planning endeavors of various land managers. For specific land use planning efforts, the department joins with other agencies to recommend particular uses of Alaska's lands and waters, as for example in plans by the Department of Natural Resources (Susitna Area Plan, Tanana Basin Area Plan, Southeast Tidelands Area Plan). The public, by means of the public review that is an integral part of land management agencies' planning processes, then has an opportunity to evaluate any recommendations made by the ADF&G that are incorporated by the land-managing agency.

The guides have been designed to provide users with interrelated subject areas that can be applied to specific questions regarding habitat management. Each type of data will be presented in a separate volume, as indicated in figure 1. Material from the AHMG database can be used, for



Map 1. The six regions of the Alaska Habitat Management Guides.

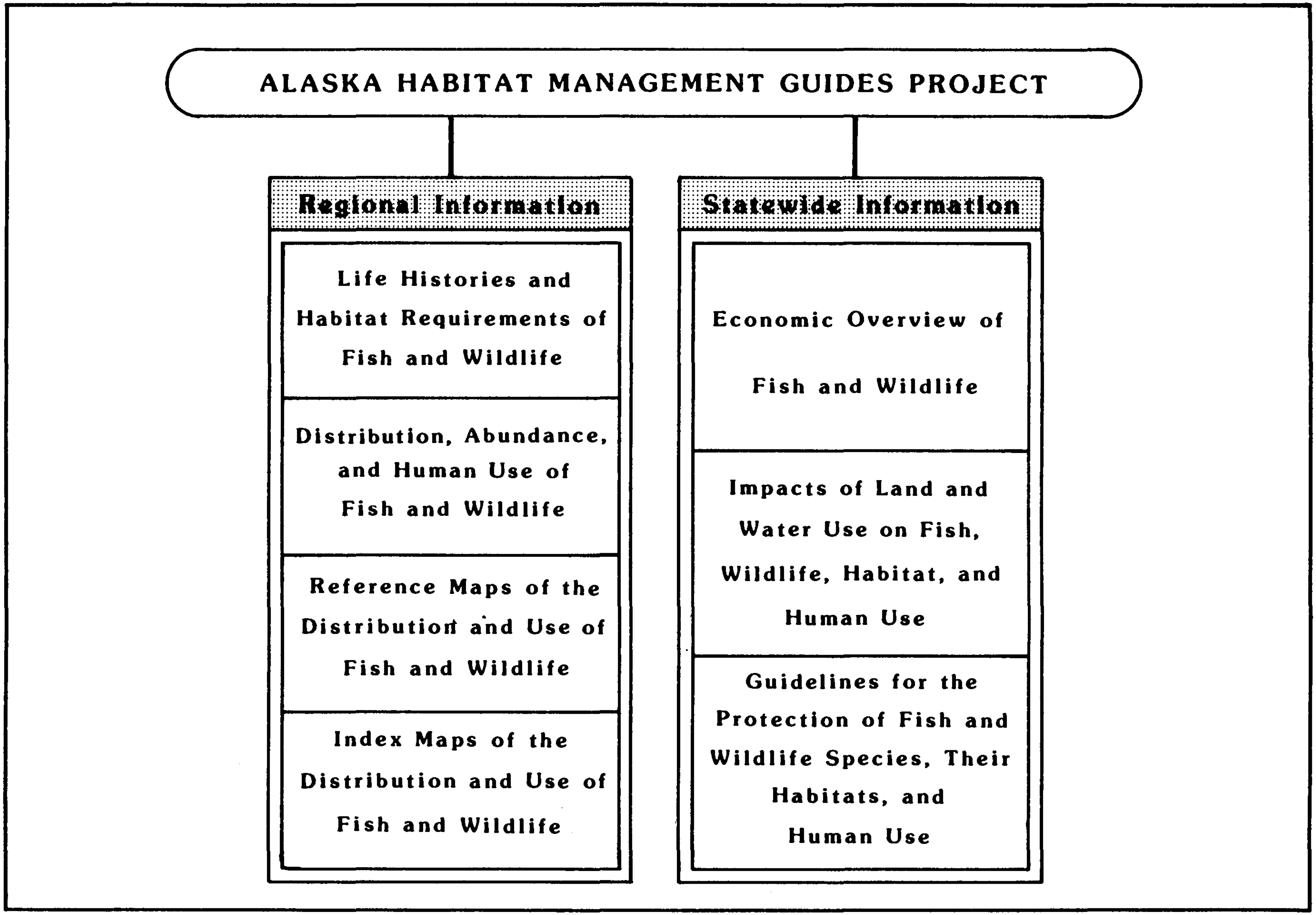


Figure 1. Types of narratives and maps produced by the Alaska Habitat Management Guides Project.

example, to correlate information on species' seasonal and geographic habitat use with the written and mapped information on known distribution and abundance. The narratives and maps regarding human uses of fish and wildlife can be compared with abundance and distribution information to obtain an indication of the overall regional patterns of distribution, abundance, and human use for the species of interest. The specific information on habitat requirements also will relate directly to the information on impacts associated with land and water use. This in turn will form the basis for the development of habitat management guidance.

An additional purpose of this project is to identify gaps in the information available on species, human uses, and associated impacts. A particular species, for example, may be known to use certain habitats during certain season; yet information on the timing of these use patterns may be inadequate. In general, there is little documentation of impacts from land and water uses on species' habitats and on the human use of those species or on the economic values associated with the use of fish and wildlife resources.

To maintain their usefulness these habitat management guides are designed to be periodically updated as new research and habitat management options are reported to fill data gaps. Users of these guides are advised to consult with the appropriate species experts and area biologists, however, to check on the availability of more recent information.

Introduction to This Volume

Purpose

A primary purpose of the Alaska Habitat Management Guides is to provide information that is useful in preparing land management recommendations or requirements that will mitigate the impacts of land and water uses and types of development on fish and wildlife species and their habitats, and on human use of those species. Toward that end, this volume contains options that have been developed to maximize the protection of selected wildlife species and their habitat, and human use of fish and wildlife. The basis for the options is found in the department's 1982 "Statement of Policy on Mitigation of Fish and Game Habitat Disruptions." This policy states that "The overall goal of the Department of Fish and Game is to maintain or establish an ecosystem <u>with</u> the project in place that is as nearly desirable as the ecosystem that would have been there in the <u>absence</u> of the project."

It should be emphasized that the managerial alternatives presented here do not exist in isolation from the other products of the Alaska Habitat Management Guides project. On the contrary, these options should be considered in context of the body of information compiled in the volumes of narratives and maps covering the life histories and habitat requirements, distribution, and relative abundance of species, the human uses made of them, and - especially - the survey of documented impacts. These data should be used in conjunction with existing guidelines and the managerial options provided in this volume to generate appropriate recommendations applicable to a specific proposal, such as a land management plan or a permit for a development project. In sum, then, although these alternatives have undergone numerous technical reviews within the department (see appendix A) they are not to be regarded as in themselves statements of department policy. The department may, however, elect to incoproprate one or another of them into specific policy statements in response to a given land use issue.

Approach

Although there are slight differences in the approach between the wildlife and human use portions of this volume, the intent of both remains the same. Recommendations in this volume take two forms--considerations and guidelines. Considerations are concerns that should be kept in mind when one is generating his/her own guidelines using the products mentioned above. These considerations may be general, specific to a particular type of activity, or unique to a particular species or human use. General considerations (see appendix B) can be applied to all species or types of human use--for example, taking into account the intensity and duration of the proposed development. Activity-specific considerations (see appendix C) are relevant to each individual activity that may be involved in a land use or development type--for example, taking into account the charge size, delay, and total amount of each shot in a blasting program. Species-specific considerations apply to each individual featured species--for example, taking into account the importance of mineral licks to Dall sheep nutrition in the spring. Human use considerations are relevant to particular types of human use of fish and wildlife--for example, the location of seasonal hunting or fishing sites. Species considerations are located within each of the species chapters in the wildlife portion of this volume; human use considerations are located in the human use portion of this volume.

As was the case with species and human use considerations, guidelines are presented for wildlife species and for various types of human uses that have been featured in the Alaska Habitat Management Guides. Wildlife guidelines are prepared only for documented impacts--i.e., those that were discussed in the companion volume Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Whereas the wildlife species guidelines rely completely on documented impacts, the human use guidelines rely only partially on documented impacts to human uses. The human use guidelines must rely heavily on information provided by the user groups that will be affected, as well as on information provided by the species volumes. This difference in emphasis has led to the difference in organization between the two portions of this volume. The wildlife guidelines are specific recommendations, whereas the human use guidelines are more a set of procedures to follow to arrive at a decision about whether or not to support a particular project. These differences will be explained further in the respective portions of this volume.

Introduction

Approach

Ideally, guidelines to protect wildlife species and their habitat from impacts of human land uses and developments should incorporate information about the activities that may be involved in the specific proposed land use or development, knowledge of the life history and distribution of wildlife species that may be affected by the land use or development, and an assessment of the impacts of the land use or development activities that is based not only on documentation of past impacts related to those activities but also on the potential for future impacts. Unfortunately, such an all-encompassing approach is seldom possible with the constraints under which the department operates. Therefore, the approach for preparing wildlife guidelines has been to focus on recommendations that apply to species featured in the Alaska Habitat Management Guides (see table 1) and to limit the guidelines to those that pertain to documented impacts that were discussed in the wildlife portion of the companion impacts volume. These recommendations consist of specific considerations and guidelines for each of the species. The species-specific considerations are derived from the life history and distribution and abundance narratives. The guidelines have been prepared solely from those impacts that have been documented in the wildlife portion of the companion impacts volume. With only a few exceptions, the language of the guidelines has been derived from references discussed in the annotated bibliography of that volume and has been selected to reflect the maxiumum protection of wildlife species and their habitat.

A limitation to the approach of preparing guidelines based solely on documented impacts is that in many cases impacts have occurred but have not been documented sufficiently to allow their inclusion in the impacts volume. In other cases, although the specific project may not have caused an impact on one of the featured species (and therefore would not have been included here) such an impact is suspected. In this volume, guidelines have not been prepared for these situations, which are considered potential impacts by our criteria. For example, many of these are noted in tables 2 and 3 as "?". However, the nucleus of guidelines presented here can be used in conjunction with other guidelines used by the department (such as those listed in the Alaska Habitat Management Guide--Southwest Region) and the general (appendix B), activity-specific (appendix C), and species-specific considerations to prepare guidelines tailored to a specific project proposal or planning effort. In this manner, comprehensive guidelines to provide maximum protection to wildlife species and their habitat can be realized.

Organization

Recommendations in this volume are organized by individual species chapters, each of which consists of two parts--species-specific considerations and species guidelines. The guidelines are organized similarly to the widlife impacts volume--i.e., by impacts category (see list in appendix F) under each of the land use or development activities (see appendices E and G) that

Table 1. Featured Species and Regions for Which Impacts Apply

Species	Region				
	South-central	Arctic	Interior	Western	State-wide
Bald Eagle					x
Belukha whale		x		x	
Bowhead whale		x		x	
Brown bear					x
Caribou*					
Dall sheep					x
Ducks					x
Furbearers					x
Geese					x
Harbor seal	x				
Moose					x
Pacific walrus		x		x	
Polar bear		x		x	
Ringed seal		x		x	
Seabirds					x
Sea otter	x				
Sitka black-tailed deer	x				
Steller sea lion	x			x	
Trumpeter swan	x		x		

* Two reports have been prepared in lieu of discussion in this volume. For the complete reference to these reports, see chapter 10.

Table 2. Activities that Cause Impacts to Featured Wildlife Species

Species	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Marine Mammals:																														
Belukha whale	X							X								X										X	X		X	
Bowhead whale	X						X	X												X						X	X		X	
Harbor seal	X			X				X						X		X				X						X	X	X	X	
Pacific walrus	X													X													X	X	X	
Polar bear														X								X			X	X		X		
Ringed seal	X			X										X											X	X	X	X		
Sea otter	X							X								X				X						X			X	
Steller sea lion	X			X												X						X					X		X	
Terrestrial Mammals:																														
Brown bear	X	X			X			X	X			X	X	X							X	X			X		X	X		
Dall sheep	X			X	X			X	X			X	X	X					X		X				X		X	X		X
Furbearers	X	X	X	X	X		X		X	X		X	X	X					X		X	X			X		X	X		X
Moose	X	X		X	X	X	X	X	X	X		X	X	X											X		X	X	X	X
Sitka black-tailed deer	X		X	X	X				X			X	X	X					X								X	X	X	X
Birds																														
Bald Eagle	X			X	X							X	X	X					X	X		X					X	X	X	X
Ducks		X		X	X	X		X		X		X	X	X		X			X	X	X	X			X	X	X	X	X	X
Geese	X			X	X			X		X		X	X	X						X					X		X	X	X	X
Seabirds	X			X									X	X		X			X	X	X	X			X	X	X		X	
Trumpeter swan								X	X			X	X	X					X			X			X		X	X	X	

Table 3. Impacts to Featured Wildlife Species

Species	Aquatic substrate materials	Aquatic vegetation, destruction or change	Attraction to artificial food source	Barriers to movement, physical and behavioral	Collision with vehicles or structures	Entanglement in fishing nets, debris	Entrapment in impoundments or excavations	Harassment, active or passive	Harvest, change in level	Introduced wild/domestic species, competition	Morbidity/mortality by ingestion of petroleum	Parasitism/predation, increased susceptibility	Prey base, alteration of	Shock waves (increase in hydrostatic pressure)	Terrain alteration or destruction	Veg. composition, change to less preferred	Veg. damage/destruction due to air pollution	Veg. damage/destruction due to fire/parasitism	Veg. damage/destruction due to grazing	Veg. damage/destruction due to erosion	Water level or water quality fluctuations/
Marine Mammals:																					
Belukha whale	?	#		X	?	X		X			X			X	#	#	#	#	#	#	#
Bowhead whale	?	#	#		?		#	X		#	X	#		X	#	#	#	#	#	#	#
Harbor seal	?	#				X		X			X			X	#	#	#	#	#	#	#
Pacific walrus	?	#	#					X						X	#	#	#	#	#	#	#
Polar bear	#	#	X			#	#	X	X	#	X				#	#	#	#	#	#	#
Ringed seal	#	#	#		?			X	?		X			X	#	#	#	#	#	#	#
Sea otter	#					X		X			X			X	#	#	#	#	#	#	#
Steller sea lion		#	X			X		X	#		X			X	#	#	#	#	#	#	#
Terrestrial Mammals:																					
Brown bear			X	X	X			X	X	X			X		X	X		X	X	X	
Dall sheep	#	#	X	X	X	X	X	X	X	X		X	#	?	X	X		?	X	X	X
Furbearers	X	X	X	X	X	?	?	X	X	X	X	X	X		X	X		X	X	X	X
Moose	#		X	X	X	X	X	X	X	X		X	#	?	X	X	X	X	X	X	X
Sitka black-tailed deer	#	#	X	X	X	X	X	X	X	X	X	X	#	?		X	X		X	X	X
Birds																					
Bald Eagle	#	#	X	#	X	X		X			X			#					#	X	
Ducks		X	X		X	X	X	X		X	X	X	X		X	X	X	X	X	X	X
Geese			X	X	X	?		X			X	X	#	?	X	X				X	X
Seabirds			X		X	X	#	X		#	X	X		X	X				X		
Trumpeter swan			X		X	#		X			X	X	#								

X - Documented impact
\# - Not relevant to this species
? - Potential impact

are relevant to the particular species. Activities and impacts that affect featured wildlife species are summarized in tables 2 and 3, respectively.

Guidelines for each impact include a general guideline in all cases and, in many cases additional specific guideline(s). General guidelines correspond to the first step of the department's mitigation policy--i.e., avoid the impact. For many projects avoiding the impact is unrealistic; therefore, the second step of the mitigation policy--i.e., minimize the impact--is more useful. In the latter situation, although we recognize that some impact will occur this impact is deemed acceptable if further measures are taken. These measures are presented as specific guidelines.

Marine Mammals

1. Belukha Whale

Table 1. Impacts Associated With Each Activity - Belukha whale

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change																														
Attraction to artificial food source	?		?	?			?	?		?				?					?	?	?	?			?	?	?	?	?	
Barriers to movement, physical and behavioral	?		?				?	?		?					?		?		?	?	?	?			?	?	?	?	X	
Collision with vehicles or structures			?				?	?		?					?		?		?	?					?	?		?	?	
Entanglement in fishing nets, debris							?	?		?					?	X	?		?			?				?			?	
Entrapment in impoundments or excavations	?		?				?										?													
Harassment, active or passive	X		?				?	X		?				?	?		?		?	?	?	?			?	?	X	?	X	
Harvest, change in level			?				?	?		?				?			?								?	?	?	?	?	
Introduced wild/domestic species, competition																														
Morbidity/mortality by ingestion of petroleum			?	?			?	?												?					?	X		?	?	
Parasitism/predation, increased susceptibility	?		?	?			?	?		?				?			?		?	?	?	?			?	?	?	?	?	
Prey base, alteration of	?		?	?			?	?		?				?			?		?	?	?	?			?	?	?	?	?	
Shock waves (increase in hydrostatic pressure)	X																													
Terrain alteration or destruction	?		?	?			?	?		?																				
Veg. composition, change to less preferred																														
Veg. damage/destruction due to air pollution																														
Veg. damage/destruction due to fire/parasitism																														
Veg. damage/destruction due to grazing																														
Veg. damage/destruction due to erosion																														
Water level or water quality fluctuations																														

X - Documented impact (see text).
? - Potential impact.

1. BELUKHA WHALE - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Will the proposed project affect nearshore belukha calving or feeding concentration areas? (Note: See the belukha distribution maps in the Alaska Habitat Management Guides for the Southwest, Arctic, and Western regions, respectively, for locations of such areas in those regions.)

2. Will the proposed project result in the potential for oil spills in areas where ice cover is partial or complete, and belukhas spend the winter or migrate through?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the species or its habitat use.

Belukhas prey on a number of marine fish and marine life stages of anadromous fish. Impacts and guidelines for those prey species that are also featured in the Alaska Habitat Management Guides have been prepared in the companion fish impacts and guidelines volumes. Guidelines have not been prepared for prey species not featured in the regional guides project unless a reference specifically documented an impact on the prey species and referred to the secondary impact on belukhas.

1. Blasting. Belukhas have been killed or injured when under water during the detonation of a blast. Two references have provided formulae that predict when blasting may cause either death or injury to seals and other marine mammals. (Note: Although these references do not meet the criteria for documentation in the strictest sense, they are included here because they provide sufficient information to determine when shock waves that are in the water column and that exceed a specified criterion will result in death or injury to whales.)

   a. Harassment, active or passive.

      General guideline. Avoid blasting near belukhas when such blasting may result in active or passive harassment (derived from Goertner 1982, Hill 1978).

   b. Shock waves, increase in hydrostatic pressure.

      (1) General guideline. Avoid blasting when belukhas are in the water and the impulse level generated by the blast will exceed 0.39 bar-m sec (derived from Goertner 1982 and Hill 1978).

      (2) Specific guideline. Minimize the impact of shock waves on belukhas by ensuring that the impulse level generated by the blast does not exceed 0.69 bar-m sec (derived from Hill 1978).

2. Drilling. Playback of recordings of offshore drilling rig noise caused temporary and minor overt harassment of belukhas in a river system.

   Harassment, active or passive

      General guideline. Avoid offshore drilling in belukha concentration areas when harassment could result (derived from Stewart et al. 1983).

3. Netting. Entanglement of belukhas, especially calves, has increased as the amount of commercial fishing time for king and red salmon has increased.

<u>Entanglement in nets, debris</u>

General guideline. Avoid methods of netting, such as setnets, in belukha concentration areas (derived from Frost et al. 1984). (<u>Note</u>: In many regions belukhas are concentrated in nearshore areas during the same period that commercial fish species such as salmon and herring are also present and are being fished, therefore another form of prevention should be attempted, such as nonlethal scaring devices [e.g., killer whale recordings]. However, if such means are not available, proposed changes in fishing regulations must be promulgated by the Alaska Board of Fisheries.)

4. <u>Transport of oil/gas/water - water</u>. Crude oil and gasoline have temporarily damaged skin of cetaceans related to belukhas.

<u>Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals</u>

(1) General guideline. Avoid marine transportation corridors near belukha concentration areas (e.g., calving, feeding, Arctic migration, or wintering) when petroleum or petroleum products are being shipped along such corridors (derived from Geraci and St. Aubin 1982).

(2) Specific guideline. Minimize oil contamination of belukhas by ensuring that adequate spill containment procedures and materials are available to prevent a petroleum or petroleum products spill from affecting belukha concentration areas (derived from Geraci and St. Aubin 1982).

5. <u>Transport of personnel/equipment/material - air</u>. One reference documented a group of belukhas moving to deep water after a small aircraft flew over them at 300 m (1,000 ft) asl.

<u>Harassment, active or passive</u>

General guideline. Avoid low-level aircraft flights over belukha concentration areas (derived from Burns and Seaman 1985, Calkins 1983).

6. <u>Transport of personnel/equipment/material - water</u>. Belukha have temporarily avoided some areas when boat traffic increased, and have permanently abandoned use of other areas after intensive, long-term boat traffic especially when such traffic has been associated with hunting belukhas.

a. Barriers to movement, physical and behavioral

General guideline. Avoid barge and other shipping traffic within 4 km (2.4 mi) of belukha concentration areas (e.g., calving, feeding, migration, and wintering areas) (derived from Fraker 1977).

b. Harassment, active or passive

General guideline. Avoid boat traffic in belukha concentration areas (e.g., calving, feeding, and migration areas) when harassment could result (derived from, e.g., Burns and Seaman 1985, Calkins 1983).

2. Bowhead Whale

Table 1. Impacts Associated With Each Activity - Bowhead whale

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change																														
Attraction to artificial food source																														
Barriers to movement, physical and behavioral										?																				
Collision with vehicles or structures																														
Entanglement in fishing nets, debris																?														
Entrapment in impoundments or excavations																														
Harassment, active or passive	X						X	X		?				?			?			?							X		X	
Harvest, change in level																?														
Introduced wild/domestic species, competition																														
Morbidity/mortality by ingestion of petroleum				?				X												X	?	?				X				
Parasitism/predation, increased susceptibility																														
Prey base, alteration of																														
Shock waves (increase in hydrostatic pressure)	X																													
Terrain alteration or destruction																														
Veg. composition, change to less preferred																														
Veg. damage/destruction due to air pollution																														
Veg. damage/destruction due to fire/parasitism																														
Veg. damage/destruction due to grazing																														
Veg. damage/destruction due to erosion																														
Water level or water quality fluctuations																														

X - Documented impact (see text).
? - Potential impact.

2. BOWHEAD WHALE - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Will the proposed project or activity affect the presence, distribution, or use of seasonal feeding areas used by bowheads? (Note: See distribution and abundance section of the Alaska Habitat Management Guides for the Arctic and Western regions.)

2. Will the proposed project or activity interfere with the movement of bowheads between areas of important habitat (e.g., spring migration in ice leads or fall movement to feeding areas)? (Note: See the distribution and abundance section of the Alaska Habitat Management Guides for the Arctic and Western regions.)

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

1. Blasting. Several references documented behavioral responses of bowheads to noise from seismic exploration with air guns and sleeve exploders. These responses were varied, inconsistent, and generally not dramatic.

Two references provided formulae for predicting when blasting would injure or kill cetaceans, including bowhead whales. (Note: Although these references do not meet the criteria for documentation in the strictest sense, they are included here because they provide sufficient information to determine that shock waves in the water column that exceed the specified threshold will result in death or injury to a number of marine mammal species, including bowhead whales.)

a. Harassment

(1) General guideline. Avoid seismic and high explosive blasting in bowhead habitat when whales are likely to be present (derived from Hill 1978, Goertner 1982, Richardson et al. 1985b).

(2) Specific guidelines:

- Minimize harassment of bowhead whales by using formulae in Hill (1978) and Goertner (1982) to determine safe distances and conditions for blasting with high explosives.

- Minimize harassment from noise of seismic explorations by avoiding operation of seismic equipment within 7.5 km (4.5 mi) of bowhead whales (Ljungblad et al. 1985, Richardson et al. 1985b).

b. Shock waves

(1) General guideline. Avoid high explosive blasting in bowhead habitat when whales are likely to be present (Hill 1978, Goertner 1982, Richardson et al. 1985b).

(2) Specific guideline. Minimize injuries to bowhead whales by using formulae in Hill (1978) and Goertner (1982) to determine safe distances and conditions for blasting with high explosives.

2. Dredging. Although some bowheads have been observed within 5 km (3 mi) of an active dredge, bowheads responded to two of three playback experiments of dredge noise at lower levels of received sound.

Harassment

(1) General guideline. Avoid dredging in bowhead whale habitat when whales are likely to be present (derived from Richardson et al. 1985b).

(2) Specific guidelines. Minimize harassment from dredge noise to bowheads by avoiding dredging within 5 km (3 mi) of bowheads (Richardson et al. 1985b).

3. Drilling. Behavioral responses of bowheads to noise from drill ships were documented; whales were not observed in areas ensonified by drilling from caisson-retained islands or artificial islands. The distance at which whales could probably hear noise from drilling platforms in lower Cook Inlet was calculated but not tested.

Harassment

(1) General guideline. Avoid drilling in bowhead whale habitat when whales are likely to be present (derived from Richardson et al. 1985b).

(2) Specific guideline. Minimize harassment to bowheads by avoiding drilling within 5 km (3 mi) of whales (derived from Fraker et al. 1982, Gales 1982, Richardson et al. 1985b).

4. Transport of oil/gas/water - water. Crude oil has been shown to foul bowhead baleen, thus reducing feeding efficiency. Contact with oil sometimes damages cetacean skin.

Morbidity/mortality by ingestion of petroleum

General guideline. Avoid activities that could result in oil spills with subsequent contact by bowhead whales (Geraci and St. Aubin 1982, Braithwaite 1983).

5. Transport of personnel/equipment/material - air. Bowhead response to overflights by small twin-engine fixed-wing aircraft was usually a quick dive; as the aircraft continued circling below 457 m (1,500 ft), blow intervals tended to be shorter. Several single passes of helicopters at 150 m (500 ft) flight altitude resulted in responses ranging from none to diving as the aircraft approached.

Harassment

(1) General guideline. Avoid flying over bowheads with either helicopters or fixed-wing aircraft (derived from Richardson et al. 1985b).

(2) Specific guideline. Minimize harassment to bowheads by overflying at or above 457 m (1,500 ft) and refraining from circling the whales (Richardson et al. 1985b).

6. Transport of personnel/equipment/material - water. Bowheads reacted more strongly to boats than to any other form of

industrial activity and began to swim away rapidly as boats approached to within 1-4 km (0.6-2.4 mi).

Harassment

(1) General guideline. Avoid operating boats in bowhead whale habitat when whales are likely to be present (derived from Richardson et al. 1985b).

(2) Specific guideline. Minimize harassment to bowheads by not operating boats within 5 km (3 mi) of whales (Richardson et al. 1985b).

3. Harbor Seal

Table 1. Impacts Associated With Each Activity - Harbor seal

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change																														
Attraction to artificial food source	?		?	?			?	?		?									?	?	?	?				?		?	?	
Barriers to movement, physical and behavioral	?		?				?	?		?				?	?		?	?	?	?	?	?			?	?	?	?	?	
Collision with vehicles or structures			?				?	?		?					?		?	?	?	?						?			?	
Entanglement in fishing nets, debris			?				?	?		?					?	X	?	?	?	?		?				?			?	
Entrapment in impoundments or excavations	?		?				?										?									?		?		
Harassment, active or passive	X		?				?	?		?				X	?		?	?	?	?	?	?			?	?	X	X	X	
Harvest, change in level			?				?	?		?				?	?										?	?	?	?	?	
Introduced wild/domestic species, competition																														
Morbidity/mortality by ingestion of petroleum			?	X			?	X												X					?	X	?	?	?	
Parasitism/predation, increased susceptibility	?		?	?			?	?		?				?	?		?	?	?	?	?	?			?	?	?	?	?	
Prey base, alteration of	?		?	?			?	?		?				?	?		?	?	?	?	?	?			?	?	?	?	?	
Shock waves (increase in hydrostatic pressure)	X																													
Terrain alteration or destruction	?		?				?																							
Veg. composition, change to less preferred																														
Veg. damage/destruction due to air pollution																														
Veg. damage/destruction due to fire/parasitism																														
Veg. damage/destruction due to grazing																														
Veg. damage/destruction due to erosion																														
Water level or water quality fluctuations																														

X - Documented impact (see text).
? - Potential impact.

3. HARBOR SEAL - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Will the proposed project affect terrestrial haulouts that are used repeatedly by harbor seals for pupping, molting, and hauling out? Such haulouts are commonly located in areas remote from human disturbance.

2. Will the proposed project increase the probability of human disturbance of harbor seals during the molt? Molting may be necessary for proper thermoregulation of harbor seals, and during that period harbor seals exhibit a higher level of hormones associated with stress.

3. Will the proposed project increase the likelihood of human disturbance of harbor seals during pupping? Unlike that of sea otters and sea lions, the harbor seal mother/infant bond is not well developed at birth; therefore, disturbance during the first few hours after parturition can result in permanent abandonment of the pup by the mother and subsequent death of the pup.

4. Will the proposed project increase boat traffic in nearshore areas (e.g., inland of the 80 fathom [480 ft] isobath), where harbor seals are most commonly found?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the species or its habitat use.

Harbor seals prey on a number of marine fish and marine life stages of anadromous fish. Impacts and guidelines for those prey species that are also featured in the Alaska Habitat Management Guides have been prepared in the companion fish impacts and guidelines volumes. Guidelines have not been prepared for prey species not featured in the regional guides project unless a reference specifically documented an impact on the prey species <u>and</u> referred to the secondary impact on harbor seals.

1. <u>Blasting</u>. Harbor seals have abandoned terrestrial haulouts because of harassment due to onshore blasting associated with nearby road construction. Harbor seals have been killed or injured when underwater during the detonation of a blast. Two references have provided formulae that predict when blasting may cause either death or injury to seals and other marine mammals (<u>Note</u>: Although these references do not meet the criteria for documentation in the strictest sense, they are included here because they provide sufficient information to determine when shock waves that are in the water column and that exceed a specified criterion will result in death or injury to seals.).

   a. <u>Harassment, active or passive</u>

      General guideline. Avoid blasting near harbor seal haulouts when such blasting may result in active or passive harassment and especially temporary or permanent abandonment of a haulout (derived from Hazard 1977).

   b. <u>Shock waves, increase in hydrostatic pressure</u>.

      (1) General guideline. Avoid blasting when harbor seals are in the water and the impulse level generated by the blast will exceed 0.39 bar-m sec (derived from Goertner 1982 and Hill 1978).

      (2) Specific guideline. Minimize the impact of shock waves on harbor seals by ensuring that the impulse level generated by the blast does not exceed 0.69 bar-m sec (derived from Hill 1978).

2. Chemical application. Harbor seals have been found with elevated levels of organochlorines (e.g., DDT) and PCBs, and these contaminants have been linked with seal reproductive failure.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid the applications of chemicals such as DDT and PCBs when such chemicals could contaminate harbor seal habitat or prey species (derived from Helle 1981, and Helle et al. 1976a, b).

3. Drilling. Contamination with crude oil has resulted in death of juvenile harbor seals and debilitation of juvenile and adults. Debilitation included ulceration of the eyes and skin and damage to liver and kidneys.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid oil drilling when such drilling can result in oil contamination of harbor seal habitat or prey species (derived from, e.g., Calkins 1983, Davis and Anderson 1976).

(2) Specific guidelines:

° Minimize oil contamination of harbor seal pups and molting adults by prohibiting oil exploration and production drilling in areas where harbor seal haulout concentrations occur (derived from, e.g., Calkins 1983, Davis and Anderson 1976). [Note: See the harbor seal distribution and abundance narratives and maps in the Alaska Habitat Management Guides in the Southcentral and Southwest regions, respectively, for locations of haulout concentrations.]

° Minimize oil contamination of harbor seals by ensuring that adequate spill-containment procedures and materials are available to prevent a petroleum or petroleum product spill from affecting harbor seal haulouts (derived from Calkins 1983).

4. Human disturbance. Harbor seals have temporarily and permanently abandoned haulouts because of noise and general human activity associated with settlements.

Harassment, active or passive

(1) General guideline. Avoid human disturbance (e.g., settlements) near harbor seal haulouts (derived from, e.g., Everitt and Beach 1982, Hazard 1977).

(2) Specific guideline. Minimize the harassment of harbor seals while they are on haulouts by restricting sources of human disturbance such as settlements within 1.5 km (1 mi) of haulouts if the settlement is small (derived from Hazard 1977) or farther if the settlement is large (derived from Schneider and Payne 1983). (Note: No specific distance has been found in the latter case.)

5. Netting. Harbor seals have been injured or killed by entanglement in fishing nets, especially drift and gill nets.

Entanglement in fishing nets, debris

(1) General guideline. Avoid netting in nearshore areas (i.e., shallower than 60 fathoms [180 ft]) in harbor seal habitat (derived from, e.g., Everitt and Beach 1982, Miller et al. 1983). [Note: See harbor seal distribution and abundance maps in the Alaska Habitat Management Guides in the Southcentral and Southwest regions for range of harbor seals in those regions.]

(2) Specific guideline. Minimize the entanglement of harbor seals by prohibiting gill net fisheries near harbor seal haulouts (derived from Miller et al. 1983).

6. Processing oil and gas. Contamination with crude oil has resulted in the death of juvenile harbor seals and debilitation of juveniles and adults. Debilitations has included ulceration of the eyes and skin and damage to kidneys and liver.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid oil and gas processing facilities when petroleum or petroleum products could contaminate harbor seal habitat or prey species (derived from, e.g., Calkins 1983).

(2) Specific guidelines.

See Drilling, 3., for applicable guidelines.

7. Transport of oil/gas/water - water. Contamination with crude oil has resulted in the death of juvenile harbor seals and debilitation

of juveniles and adults. Debilitation has included ulceration of the eyes and skin and damage to kidneys and liver.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid marine transportation corridors near harbor seal haulouts when petroleum or petroleum products are being shipped along such corridors (derived from Davis and Anderson 1976). (Note: See the Alaska Habitat Management Guides in the Southcentral and Southwest regions for locations of harbor seal haulouts in those regions.)

(2) Specific guidelines.

See Drilling, 3., for appropriate guidelines.

8. Transport of personnel/equipment/material - air. Harbor seals have temporarily and permanently abandoned haulouts when harassed by aircraft. Pup mortality has resulted when seals panic at the approach of aircraft, and during the ensuing stampede, pups become separated from their mothers and abandoned by them.

Harassment, active or passive

(1) General guideline. Avoid aircraft traffic near harbor seal haulouts when harassment could result (derived from Hazard 1977 and Johnson 1976).

(2) Specific guidelines:

- Minimize effects of harassment of harbor seals by aircraft by avoiding flights over harbor seal haulouts during the pupping season (Johnson 1976, Murphy and Hoover 1981). [Note: See the harbor seal life history section of the Alaska Habitat Management Guides in the Southcentral and Southwest regions, respectively, for dates of pupping season.]

- Minimize harassment of harbor seals by small, fixed-wing aircraft by maintaining a constant flight direction and airspeed and a minimum flight elevation of 170 m (500 ft) ASL (derived from Murphy and Hoover 1981, Risebrough et al. 1980).

9. Transport of personnel/equipment/material - water. Boat traffic has resulted in the temporary and permanent abandonment of harbor seal haulouts and changes in use patterns of haulouts from day-long to nocturnal only. Isolation from boat traffic has become a

significant feature of many haulouts, indicating that prolonged disturbance has changed the distribution of such haulouts. Boat traffic near haulouts has resulted in panicked stampedes by seals into the water, and pups have become separated from their mothers, resulting in mortality of the former.

Harassment, active or passive

(1) General guideline. Avoid boat traffic near harbor seal haulouts when such traffic would result in harassment of seals (derived from, e.g., Brown and Mate 1983, Hazard 1977, and Terhune 1985).

(2) Specific guidelines:

- Minimize harassment of seals by boat traffic by approaching hauled-out seals slowly and with a minimum of on-board human activity (Murphy and Hoover 1981).

- Minimize harassment of seals with pups by remaining at least 100 m (300 ft) from parturient seals and 60 m (190 ft) from hauled-out seals with pups at other times (Murphy and Hoover 1981). (Note: These distances are derived from a study conducted in a park where hunting is prohibited and access is restricted and where viewing seals is encouraged. These distances may be too liberal in situations where access and hunting are not controlled and where seals would be expected to be more reactive to boat traffic.)

- Minimize effects of boat traffic on molting harbor seals by prohibiting unnecessary boat traffic near haulouts where seals are molting (derived from Johnson 1976).

4. Pacific Walrus

Table 1. Impacts Associated With Each Activity - Pacific walrus

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove			?			?	?	?											?	?	?	?			?	?		?	?	
Aquatic vegetation, destruction or change																														
Attraction to artificial food source																														
Barriers to movement, physical and behavioral	?		?				?	?		?				?			?		?	?	?				?	?	?	?	?	
Collision with vehicles or structures	?		?			?	?	?		?							?		?	?					?	?		?	?	
Entanglement in fishing nets, debris																?	?		?	?		?			?	?		?	?	
Entrapment in impoundments or excavations			?			?	?										?		?	?					?	?		?	?	
Harassment, active or passive	X		?			?	?	?		?				X			?		?	?		?			?	?	X	X	X	
Harvest, change in level				?			?	?						?			?		?	?					?	?	?	?	?	
Introduced wild/domestic species, competition																														
Morbidity/mortality by ingestion of petroleum				?			?	?											?	?					?	?		?	?	
Parasitism/predation, increased susceptibility	?			?		?	?							?					?	?					?	?	?	?	?	
Prey base, alteration of	?		?	?		?	?	?						?			?		?	?	?					?			?	
Shock waves (increase in hydrostatic pressure)	X																													
Terrain alteration or destruction	?		?				?			?									?	?					?			?		
Veg. composition, change to less preferred																														
Veg. damage/destruction due to air pollution																														
Veg. damage/destruction due to fire/parasitism																														
Veg. damage/destruction due to grazing																														
Veg. damage/destruction due to erosion																														
Water level or water quality fluctuations																														

X - Documented impact (see text).
? - Potential impact.

4. PACIFIC WALRUS - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impacts category under each activity. For a complete list of activities and impacts categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Will the proposed activities affect walrus use of "traditional" terrestrial haulouts? (Note: See the walrus distribution maps of the Alaska Habitat Management Guides in the Southwest, Western, and Arctic regions, respectively, for the locations of such haulouts in those regions.)

2. Will proposed activities affect walrus ability to feed on benthic organisms, especially sessile bivalves (their primary prey)?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the species or its habitat use.

Pacific walruses prey on a number of marine benthic species. Impacts and guidelines for those prey species that are also featured in the Alaska Habitat Management Guides have been prepared in the companion fish impacts and guidelines volumes. Guidelines have not been prepared for prey species not featured in the regional guides project unless a reference specifically documented an impact on the prey species and referred to the secondary impact on Pacific walrus.

1. Blasting. Two references have provided formulae that predict when submerged marine mammals would be injured or killed by shock waves generated by an underwater blast. (Note: Although these references do not meet the criteria for documentation in the strictest sense, they are included here because they provide sufficient information to determine when shock waves that are in the water column and that exceed a specified criterion will result in death or injury to walrus.)

   Shock waves, increase in hydrostatic pressure

   (1) General guideline. Avoid blasting when walruses are in the water and the impulse level generated by the blast will exceed 0.39 bar-m sec (derived from Goertner 1982 and Hill 1978).

   (2) Specific guideline. Minimize the impact of shock waves on walruses in the water by ensuring that the impulse level generated by the blast does not exceed 0.69 bar-m sec (derived from Hill 1978).

2. Human disturbance. Walruses have permanently abandoned historically used terrestrial haulouts in areas where new settlements and associated construction and transportation activity occurred.

   Harassment, active or passive

   General guideline. Avoid prolonged human disturbance (e.g., new settlements, construction activity) where such disturbance can result in walruses abandoning haulouts (derived from Fay et al. 1984).

3. Transport of personnel/equipment/material - air. Walruses have temporarily abandoned terrestrial and ice haulouts when aircraft flew over at low elevations (less than ca. 300 m [1,000 ft]). In some instances, walruses have fled haulouts in panicked stampedes during which calves have been trampled or separated from their mothers and adults injured. Aircraft landings near terrestrial haulouts appear to be especially disruptive to walruses.

   Harassment, active or passive

   (1) General guideline. Avoid aircraft flights and landings near walrus haulouts when harassment would result

(derived from, e.g., Davis and Thomson 1984, Fay 1981, Taggert and Zabel 1983).

(2) Specific guidelines:

- Minimize harassment of walruses by prohibiting aircraft landings near walrus terrestrial haulouts (derived from Taggert and Zabel 1983). (Note: See the walrus distribution maps in the Alaska Habitat Management Guides in the Southwest, Western, and Arctic regions, respectively, for locations of terrestrial haulouts in those regions.)

- Minimize harassment of walruses on terrestrial haulouts by restricting small, fixed-wing aircraft flights to at least 300 m (1,000 ft) AGL over haulouts (Davis and Thomson 1984, Salter 1979).

- Minimize harassment of walruses on terrestrial haulouts by prohibiting low-elevation helicopter flights within 5 km (3 mi) of such haulouts (derived from Salter 1979).

4. Transport of personnel/equipment/material - land, ice. Walruses have been harassed and have temporarily abandoned haulouts when approached by humans on land.

Harassment, active or passive

General guideline. Avoid approaching walruses that are on terrestrial haulouts when harassment would result (derived from Fay 1981).

5. Transport of personnel/equipment/material - water. Prolonged harassment of walruses on terrestrial haulouts due to shipping traffic has resulted in abandonment of such haulouts. Short-term disturbance by boats has resulted in temporary abandonment of terrestrial and ice haulouts. Occasionally such abandonment occurs as panicked stampedes during which calves are trampled or separated from their mothers. A polar bear was observed to kill a calf that had become separated from its mother when an approaching ship caused the walrus group to abandon an ice floe.

Harassment, active or passive

(1) General guideline. Avoid boat traffic near hauled out walruses when such traffic will cause harassment of walruses (derived from, e.g., Davis and Thomson 1984, Fay et al. 1981, Taggert and Zabel 1983).

(2) Specific guidelines:

- Minimize harassment of walruses by maintaining a distance of several kilometers between shipping lanes and terrestrial haulouts (derived from Fay et al. 1981).

- If walruses hauled out on the ice must be approached by boat, minimize harassment by remaining at least 300 m (1,000 ft) distant when approaching with the wind and 100 m (300 ft) distant when approaching against the wind (derived from Fay et al. 1981).

- Minimize harassment of walruses, especially cows and calves, by prohibiting ice-breaking operations within 1 km (0.6 mi) of concentrations of cows and calves hauled out on the ice (derived from Fay et al. 1981).

5. Polar Bear

Table 1. Impacts Associated With Each Activity - Polar Bear

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change																														
Attraction to artificial food source														X								X								
Barriers to movement, physical and behavioral																														
Collision with vehicles or structures																														
Entanglement in fishing nets, debris																														
Entrapment in impoundments or excavations																														
Harassment, active or passive	?						?	?						X					?								?	X	?	
Harvest, change in level	?													X																
Introduced wild/domestic species, competition																														
Morbidity/mortality by ingestion of petroleum				?															?						X	X				
Parasitism/predation, increased susceptibility																														
Prey base, alteration of																														
Shock waves (increase in hydrostatic pressure)																														
Terrain alteration or destruction																														
Veg. composition, change to less preferred																														
Veg. damage/destruction due to air pollution																														
Veg. damage/destruction due to fire/parasitism																														
Veg. damage/destruction due to grazing																														
Veg. damage/destruction due to erosion																														
Water level or water quality fluctuations																														

X - Documented impact (see text).
? - Potential impact.

5. POLAR BEAR - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Will the proposed project or activity interfere with maternity denning either on land or sea ice? (Note: See the distribution and abundance section of the Alaska Habitat Management Guides for the Arctic and Western regions.)

2. Will the proposed project or activity interfere with the movement of polar bears between areas of important habitat (e.g., denning areas and feeding areas)? (Note: See the life history and distribution and abundance sections of the Alaska Habitat Management Guides for the Arctic and Western regions for information on seasonal use of habitat.)

3. Will the proposed project or activity concentrate many bears of all sex and age groups in a relatively small area, thus potentially increasing aggressive encounters and cannibalism? (Note: See the life history and distribution and abundance sections of the Alaska Habitat Management Guides for the Arctic and Western regions.)

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

Polar bears prey on a number of marine fish and marine life stages of anadromous fish. Impacts and guidelines for those prey species that are also featured in the Alaska Habitat Management Guides have been prepared in the companion fish impacts and guidelines volumes. Guidelines have not been prepared for prey species not featured in the regional guides project unless a reference specifically documented an impact on the prey species and referred to the secondary impact on polar bears.

1. Human disturbance. Four references discuss human/bear encounters, including attraction to improperly stored food, garbage, camps, and towns. Active harassment commonly occurs when bears are driven from camps or other areas of human habitation. Polar bears have attacked the harassers in such situations, as well as persons involved in inadvertent encounters. Interactions between humans and bears often resulted in killing "problem bears," those that have repeatedly approached humans, camps, or dwellings or that have attacked humans.

   a. Attraction to artificial food source

      (1) General guideline. Avoid human behavior or storage of food that could attract polar bears (derived from Bromley 1985, Lunn and Stirling 1985, Stirling et al. 1977, Wooldridge 1980).

      (2) Specific guidelines. (Note: See also Solid waste disposal, 3., for additional appropriate guidelines.)

         ° Minimize the attractiveness of work camps to bears searching for food by surrounding the camps with electric fences or acoustic deterrents (derived from Bromley 1985, Wooldridge 1980).

         ° Minimize attraction of bears to work camp food supplies by storing food in buildings or animal-proof containers surrounded by electric fences or acoustical deterrents (derived from Bromley 1985, Wooldridge 1980). (Note: These references also contain detailed information on safe camp construction and food storage.)

b. Harassment

(1) General guideline. Avoid human disturbance in occupied polar bear habitat when this activity could lead to harassment in the form of abandonment of dens or encounters between bears and humans that could lead to injury or death of bears (derived from Bromley 1985, Stirling et al. 1977, Wooldridge 1980).

(2) Specific guideline. Minimize harassment of bears and hazardous encounters between bears and humans by surrounding work camps or permanent facilities in occupied polar bear habitat with electrified fences, acoustic deterrents, or trip-wire detection systems (derived from Bromley 1985, Wooldridge 1980; see these references for more detailed information.) (Note: See also a. above.)

c. Harvest, change in level

(1) General guideline. Avoid human disturbance in polar bear habitat that could lead to an increase in the harvest of bears, particularly those situations that would create "problem bears" (Bromley 1985, Stirling et al. 1977, Wooldridge 1980).

(2) Specific guidelines. (Note: See also a. and b. above, and Solid waste disposal, 3.)

- Minimize killing polar bears by using means other than shooting to deter bears (e.g., acoustic deterrents, electric fences) from camps and areas of human habitation (Bromley 1985, Stirling et al. 1977, Wooldridge 1980).

- Minimize the killing of bears involved in human/bear conflicts by removing problem bears immediately by transplanting, donating to zoos, or as a last resort, by killing, to minimize the probability of the animal becoming accustomed to obtaining a reward in areas of human activity (Bromley 1985, Stirling et al. 1977).

3. Solid waste disposal. Four references documented attraction of bears to dumps.

Attraction to artificial food source

(1) General guideline. Avoid disposing of solid waste in such a manner as to attract polar bears (derived from

Bromley 1985, Lunn and Stirling 1985, Stirling et al. 1977).

(2) Specific guideline. Minimize attraction of bears to dumps by incinerating putrescible items (e.g., food waste) in fuel-fired incinerators or burying solid waste. Material awaiting processing should be stored in a fenced area (derived from Bromley 1985, Stirling et al. 1977).

4. Transport of oil/gas/water - land. Two references documented illness and death of two of three polar bears exposed to oil.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid spilling oil in polar bear habitat to reduce the number of bears killed (derived from Engelhardt 1983, Hurst and Øritsland 1982).

5. Transport of oil/gas/water - water. Two references documented illness and death of two of three polar bears exposed to oil.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid spilling oil in polar bear habitat, to reduce the number of bears killed (derived from Engelhardt 1983, Hurst and Øritsland 1982).

6. Transport of personnel/equipment/material - land, ice. One reference noted that a bear abandoned her den early and probably lost her cub(s) due to vehicular traffic within 200 m (650 ft), 450 m (1,400 ft), and 800 m (2,600 ft) of the den site.

Harassment

General guideline. Avoid disturbing denning polar bears by not routing vehicular traffic closer than 500 m (1,600 ft) to known den sites during denning season (derived from Amstrup 1985).

6. Ringed Seal

Table 1. Impacts Associated With Each Activity - Ringed seal

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change																														
Attraction to artificial food source																														
Barriers to movement, physical and behavioral										?																				
Collision with vehicles or structures																														
Entanglement in fishing nets, debris																?														
Entrapment in impoundments or excavations																														
Harassment, active or passive	X						?			?				X			?		?	?							X	X		
Harvest, change in level																														
Introduced wild/domestic species, competition																														
Morbidity/mortality by ingestion of petroleum	?			X															?	?	?	?			X	X				
Parasitism/predation, increased susceptibility																														
Prey base, alteration of																														
Shock waves (increase in hydrostatic pressure)	X																													
Terrain alteration or destruction																														
Veg. composition, change to less preferred																														
Veg. damage/destruction due to air pollution																														
Veg. damage/destruction due to fire/parasitism																														
Veg. damage/destruction due to grazing																														
Veg. damage/destruction due to erosion																														
Water level or water quality fluctuations																														

X - Documented impact (see text).
? - Potential impact.

6. RINGED SEAL - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impacts categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impacts categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Will the proposed project or activity disturb ringed seals after the pups are born and before they are weaned, when they are in under-snow lairs and especially vulnerable to desertion by the female?

2. Will the proposed project or activity disturb ringed seals during their annual molt, when they feed little and are under an already heavy metabolic stress?

3. Will the proposed project or activity decrease the available fast-ice breeding habitat, especially in areas suspected to be important pupping areas?

4. Will the proposed project or activity increase the number of arctic foxes or polar bears (especially on fast ice in pupping season), which could increase the mortality of adult or pup ringed seals?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar

conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

Ringed seals prey on a number of marine fish and marine life stages of anadromous fish. Impacts and guidelines for those prey species that are also featured in the Alaska Habitat Management Guides have been prepared in the companion fish impacts and guidelines volumes. Guidelines have not been prepared for prey species not featured in the regional guides project unless a reference specifically documented an impact on the prey species <u>and</u> referred to the secondary impact on ringed seals.

1. <u>Blasting</u>. One reference concluded that some localized displacement of ringed seals occurs in the immediate area of seismic shot lines on ice because of noise caused by the explosions.

   Two references provided formulae for predicting when blasting would injure or kill ringed seals. (<u>Note</u>: Although these references do not meet the criteria for documentation in the strictest sense, they are included here because they provide sufficient information to determine that shock waves in the water column that exceed the specified threshold will result in death or injury to a number of marine mammal species, including ringed seal.)

   a. <u>Harassment, active or passive</u>

      (1) General guideline. Avoid seismic testing in ringed seal habitat (derived from Burns and Kelly 1982).

      (2) Specific guideline. Minimize harassment of ringed seals by not conducting seismic testing within 150 m (500 ft) of ringed seal breathing holes, lairs, or haulout sites (derived from Burns and Kelly 1982).

   b. <u>Shock waves, increase in hydrostatic pressure</u>

      (1) General guideline. Avoid blasting in ringed seal habitat when the impulse level generated by the blast will exceed 0.39 bar-m sec (derived from Goertner 1982 and Hill 1978).

      (2) Specific guideline. Minimize the impact of shock waves on ringed seals by ensuring that when blasting in ringed seal habitat the impulse level of the blast will remain at or below 0.69 bar-m sec (derived from Goertner 1982 and Hill 1978).

2. Chemical application. Three references documented that high levels of DDT and PCBs reduce productivity in adult female ringed seals.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid application of DDT or PCBs that could contaminate ringed seal habitat and therefore female ringed seals (derived from Helle 1981; Helle et al. 1976a, 1976b).

3. Human disturbance. One reference documented temporary abandonment of subnivean snow lairs by ringed seals due to human disturbance.

Harassment, active or passive

General guideline. When in ringed seal habitat avoid disturbing ringed seals in their snow lairs (derived from Kelly et al. 1986).

4. Transport of oil/gas/water - land, ice. Four references documented physiological effects (e.g., eye irritation) of acute exposure of ringed seals to crude oil. Chronic exposure was not investigated.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid spilling oil in areas where runoff from the spill area could contaminate ringed seals or their habitat (derived from Engelhardt 1982, 1983; Engelhardt et al. 1977; Geraci and Smith 1976).

(2) Specific guideline. Minimize morbidity and mortality of ringed seals due to exposure to oil by cleaning up oil as soon as possible to reduce the amount of time the seals are exposed (derived from, e.g., Englehardt 1982, 1983).

5. Transport of oil/gas/water - water. Four references documented physiological effects (e.g., eye irritation) of acute exposure of ringed seals to crude oil.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid spilling oil in ringed seal habitat (derived from Engelhardt 1982, 1983; Engelhardt et al. 1977; Geraci and Smith 1976).

(2) Specific guideline. Minimize morbidity and mortality of ringed seals due to exposure to oil by cleaning up oil as soon as possible to reduce the amount of time the seals are exposed (derived from, e.g., Engelhardt 1982, 1983).

6. Transport of personnel/equipment/material - air. One reference documented temporary abandonment of snow lairs by ringed seals when helicopters flew over the lairs at altitudes at or below 450 m (1,400 ft).

Harassment

General guideline. When flying over ringed seal habitat, avoid harassment of ringed seals at their lairs by remaining at flight altitudes greater than 450 m (1,400 ft) above ice level (derived from Kelly et al. 1986).

7. Transport of personnel/equipment/material - land, ice. One reference documented abandonment (temporary and permanent) of under-snow lairs by ringed seals when approached by vehicles or pedestrians on ice.

Harassment

General guideline. When in ringed seal habitat avoid harassment of ringed seals by remaining at a distance from the lair of at least 0.5 km (0.5 mi) when on a snowmachine or at least 200 m (700 ft) when on foot (derived from Kelly et al. 1986).

7. Sea Otter

Table 1. Impacts Associated With Each Activity - Sea otter

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change			?	?		?	?			?				?	?			?	?	?	?	?				?	?		?	
Attraction to artificial food source	?						?	?													?	?								
Barriers to movement, physical and behavioral	?						?	?		?					?		?	?	?	?	?					?		?	?	
Collision with vehicles or structures							?	?		?					?		?	?	?	?						?		?	?	
Entanglement in fishing nets, debris							?	?		?					?	X	?	?	?	?		?				?			?	
Entrapment in impoundments or excavations	?		?			?	?								?															
Harassment, active or passive	X		?			?	?	?		?				?	?		?	?	?	?						?	?		X	
Harvest, change in level			?											?	?		?	?	?	?						?			?	
Introduced wild/domestic species, competition																														
Morbidity/mortality by ingestion of petroleum				?				X										?	?	X						X			?	
Parasitism/predation, increased susceptibility	?		?	?			?			?				?	?		?	?	?	?	?	?			?	?	?	?	?	
Prey base, alteration of	?		?	?			?			?				?	?			?	?	?	?					?			?	
Shock waves (increase in hydrostatic pressure)	X																													
Terrain alteration or destruction	?						?								?															
Veg. composition, change to less preferred																														
Veg. damage/destruction due to air pollution																														
Veg. damage/destruction due to fire/parasitism																														
Veg. damage/destruction due to grazing																														
Veg. damage/destruction due to erosion																														
Water level or water quality fluctuations																														

X - Documented impact (see text).
? - Potential impact.

7. SEA OTTER - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Concerns

1. Will the proposed activity disrupt sea otter feeding and grooming or contaminate the otter's fur with oil or other pollutants? Sea otter thermoregulation depends on a constant source of high-energy food and on well-groomed fur for insulation.

2. Will the proposed activity occur inland of the 30-fathom (180-ft) isobath and within 16 km (10 mi) of shore, where sea otters forage? (Note: See the distribution maps in the Alaska Habitat Management Guides in the Southcentral and Southwest regions, respectively, for sea otter range and feeding areas in those regions.)

3. Will the proposed activity affect shallow, protected (from wind and high seas) waters where females and pups are common?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not specifically formulate the guideline. The term "derived from e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss indentical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the species or its habitat use.

Sea otters prey on a number of marine species. Impacts and guidelines for those prey species that are also featured in the Alaska Habitat Management Guides have been prepared in the companion fish impacts and guidelines volumes. Guidelines have not been prepared for prey species not featured in the regional guides project unless a reference specifically documented an impact on the prey species and referred to the secondary impact on sea otters.

1. Blasting. Blasts that were detonated when sea otters were in the water have killed and injured otters. Sea otters resting onshore have also been killed or injured by falling rocks dislodged by blasts.

   Shock waves (increase in hydrostatic pressure)

   (1) General guideline. Avoid blasting when sea otters are in the water and the impulse level generated by the blast will exceed 0.39 bar-m sec (derived from Goertner 1982 and Hill 1978).

   (2) Specific guideline. Minimize the impact of shock waves on sea otters by ensuring that the impulse level generated by the blast does not exceed 0.69 bar-m sec (derived from Hill 1978).

2. Drilling. Sea otters have died from hypothermia after their fur became contaminated with oil.

   Mortality or morbidity due to ingestion of or contact with petroleum, petroleum products, or other chemicals

   (1) General guideline. Avoid oil exploration or production drilling when such drilling can result in oil contamination of sea otters or their habitat (derived from Calkins 1983, Engelhardt 1983).

   (2) Specific guideline. Minimize oil contamination of sea otters by ensuring that adequate spill containment procedures and material are available to prevent a petroleum or petroleum product spill from affecting sea otter habitat (derived from Calkins 1983). (Note: If oil contamination occurs, do not use detergents to wash otters unless they can be held in water at or above 20°C for at least 8 d [Costa and Kooyman 1982]).

3. Netting. Sea otters have been killed by drowning while entangled in nets.

(1) General guideline. Avoid netting in sea otter habitat (derived from Marine Mammal Commission 1986, Matkin and Fay 1980).

(2) Specific guideline. Minimize the incidental take of sea otters by prohibiting trammel and gill net fisheries inshore of the 20-fathom (120-ft) isobath in sea otter range (Marine Mammal Commission 1986). (Note: This guideline was derived from a study conducted in California. It may not be appropriate for Alaska, where sea otters are more numerous and their habitat more extensive.)

4. Processing oil and gas. Sea otters have died from hypothermia after their fur became contaminated with oil.

Mortality or morbidity due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid oil and gas processing facilities when petroleum or petroleum products could contaminate sea otters or their habitat (derived from, e.g., Calkins 1983).

(2) Specific guideline. See Drilling, 2., for appropriate guideline.

5. Transport of oil/gas/water - water. Sea otters have died from hypothermia after their fur became contaminated with oil.

Mortality or morbidity due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid creating marine oil transport corridors where oil spills from such corridors could contaminate sea otters or their habitat (derived from, e.g., Calkins 1983).

(2) Specific guideline. See Drilling, 2., for appropriate guideline.

6. Transport of personnel/equipment/material - water. Sea otter use of habitat has been influenced by vessel traffic. Females with pups avoid areas of high boat traffic and move between resting and feeding areas only when boat traffic levels are low.

Harassment, active or passive

(1) General guideline. Avoid boat traffic in sea otter habitat when such traffic will result in harassment of sea otters (derived from Garshelis and Garshelis 1984).

(2) Specific guidelines:

- Minimize vessel traffic in areas of sea otter feeding and resting concentrations (derived from Garshelis and Garshelis 1984).

- Minimize vessel traffic in sea otter habitat (generally within the 20-fathom [120-ft] isobath) following prolonged stormy periods when sea otters have been unable to feed (derived from Garshelis and Garshelis 1984).

8. Steller Sea Lion

Table 1. Impacts Associated With Each Activity - Steller sea lion

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change																														
Attraction to artificial food source	?		?	?			?	?		?									?	?	?	X				?		?	?	
Barriers to movement, physical and behavioral	?		?				?	?		?				?	?		?	?	?	?	?				?	?	?	?	?	
Collision with vehicles or structures			?				?	?		?					?		?	?	?	?						?			?	
Entanglement in fishing nets, debris			?				?	?		?					?	X	?	?	?	?		?				?			?	
Entrapment in impoundments or excavations	?		?				?										?									?		?		
Harassment, active or passive	X		?				?	?		?				?	?		?	?	?	?	?	?			?	?	X	?	X	
Harvest, change in level			?				?	?		?				?	?		?	?	?	?	?	?					?	?	?	
Introduced wild/domestic species, competition																														
Morbidity/mortality by ingestion of petroleum			?	X			?	?												?					?	?	?	?	?	
Parasitism/predation, increased susceptibility	?		?	?			?	?		?				?	?		?	?	?	?	?	?			?	?	?	?	?	
Prey base, alteration of	?		?	?			?	?		?				?	?		?	?	?	?	?	?			?	?	?	?	?	
Shock waves (increase in hydrostatic pressure)	X																													
Terrain alteration or destruction	?		?				?																							
Veg. composition, change to less preferred																														
Veg. damage/destruction due to air pollution																														
Veg. damage/destruction due to fire/parasitism																														
Veg. damage/destruction due to grazing																														
Veg. damage/destruction due to erosion																														
Water level or water quality fluctuations																														

X - Documented impact (see text).
? - Potential impact.

8. STELLER SEA LION - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Will the proposed project occur near Steller sea lion haulouts or rookeries? (Note: See the sea lion distribution maps in the Alaska Habitat Management Guides in the Southwest and Southcentral regions, respectively, for locations in those regions.)

2. During the sea lion breeding and pupping season, will the proposed activity occur within 16-24 km (10-15 mi) of a rookery or haulout? During this period large groups of sea lions, especially feeding maternal females associated with rookeries, are found in this area.

3. Will the proposed activity result in an increase in marine debris (e.g., net fragments, plastic bands) in which sea lions can become entangled?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

Steller sea lions prey on a number of marine fish and marine life stages of anadromous fish. Impacts and guidelines for those prey species that are also featured in the Alaska Habitat Management Guides have been prepared in the companion fish impacts and guidelines volumes. Guidelines have not been prepared for prey species not featured in the regional guides project unless a reference specifically documented an impact on the prey species and referred to the secondary impact on sea lions.

1. Blasting. Sea lions have been killed or injured when under water during the detonation of a blast. Two references have provided formulae that predict when blasting may cause either death or injury to seals and other marine mammals. (Note: Although these references do no meet the criteria for documentation in the strictest sense, they are included here because they provide sufficient information to determine when shock waves that are in the water column and that exceed a specified criterion will result in death or injury to sea lions.)

   a. Harassment, active or passive

      General guideline. Avoid blasting near sea lion haulouts or rookeries when such blasting may result in active or passive harassment and, especially, temporary or permanent abandonment of a haulout (derived from Goertner 1982, Hill 1978).

   b. Shock waves, increase in hydrostatic pressure

      (1) General guideline. Avoid blasting when sea lions are in the water and the impulse level generated by the blast will exceed 0.39 bar-m sec (derived from Goertner 1982, Hill 1978).

      (2) Specific guideline. Minimize the impact of shock waves on sea lions by ensuring that the impulse level generated by the blast does not exceed 0.69 bar-m sec (derived from Hill 1978).

2. Chemical application. One reference documented impaired reproductive performance of California sea lions, a related species, due to contamination with DDT and PCBs.

Morbidity/mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid application of chemicals such as DDT or PCBs when such chemicals could contaminate Steller sea lions, their habitat, or prey species (derived from Gerlach 1981).

3. Netting. Sea lions have been injured or killed by entanglement in fishing nets and debris, primarily in the offshore fishery (i.e., in contrast to harbor seals and sea otters) or near sea lion rookeries and haulouts. (Note: See also Solid waste disposal, 4., for appropriate guidelines.)

Entanglement in fishing nets, debris

(1) General guideline. In Steller sea lion habitat, avoid netting methods such as trawling (offshore fishing) or drift and gillnets (near haulouts or rookeries) that may entangle sea lions (derived from e.g., Loughlin et al. 1983, Miller et al. 1983).

(2) Specific guidelines:

° Minimize the entanglement of sea lions by reducing disposal of fish offal that attracts sea lions to offshore trawling operations and thus exposes them to entanglement (derived from Loughlin et al. 1983).

° Minimize entanglement of sea lions by employing nonlethal scaring devices to drive sea lions away from nets (derived from Miller et al. 1983). (Note: Such devices as small explosives may be successful initially, but seals and sea lions appear to rapidly habituate to them. Other techniques, such as recordings of killer whale vocalizations, are also being tested.)

4. Solid waste disposal. Steller sea lions are attracted to offal and garbage associated with the offshore fishing fleet. Since the advent of wide spread offshore groundfish trawling in the 1960's, there has been a shift of sea lion habits from being a predominately nearshore species to more of a pelagic species following the fleet. This change of habits has resulted in more sea lions being entangled in fishing gear. (Note: See Netting, 3. above.)

Attraction to artificial food source

General guideline. Avoid disposal of garbage and fish offal in a manner that will attract sea lions (derived from Loughlin et al. 1983).

5. Transport of personnel/equipment/material - air. One reference noted that low-level aircraft flights have caused sea lions to temporarily abandon haulouts.

Harassment, active or passive

General guideline. Avoid low-level aircraft flights over sea lion haulouts and rookeries (derived from Calkins 1983).

6. Transport of personnel/equipment/material - land. Harassment by hikers and all-terrain vehicles has caused abandonment of rookeries by Steller sea lions.

Harassment, active or passive

General guideline. Avoid harassment of Steller sea lions on their rookeries and haulouts (derived from Calkins 1983).

Terrestrial Mammals

9. Brown Bear

Table 1. Impacts Associated With Each Activity - Brown bear

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove	?		?			?	?			?												?								
Aquatic vegetation, destruction or change	?		?	?		?	?			?								?	?	?	?	?								?
Attraction to artificial food source								?					X	X								X			X					
Barriers to movement, physical and behavioral					X				?			?													?			?	?	?
Collision with vehicles or structures																												X	?	
Entanglement in fishing nets, debris									?																					
Entrapment in impoundments or excavations												?													?					?
Harassment, active or passive	X		?		X		?	X		?	?	X	X	X	?		?	?	?	?	X				X		X	X	?	
Harvest, change in level					X								X	X														X		
Introduced wild/domestic species, competition													X																	
Morbidity/mortality by ingestion of petroleum																			?	?					?					
Parasitism/predation, increased susceptibility																														
Prey base, alteration of														X																?
Shock waves (increase in hydrostatic pressure)																														
Terrain alteration or destruction						?	?					X										?								?
Veg. composition, change to less preferred		X	?	?	X	?	?			?	?	X	X	X	?						?									?
Veg. damage/destruction due to air pollution				?														?	?	?										
Veg. damage/destruction due to fire/parasitism		X			?																									
Veg. damage/destruction due to grazing													X																	
Veg. damage/destruction due to erosion					X							X	?		?							?								
Water level or water quality fluctuations					?	?	?			?					?															?

X - Documented impact (see text).
? - Potential impact.

9. BROWN BEAR - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categoreis for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Will the proposed project or activity affect the presence, distribution, or use of seasonal food items (e.g., caribou, berries, fish, spring forage) used by bears? (Note: See appropriate maps in the Alaska Habitat Management Guides [brown bear distribution maps were not prepared for the Southcentral and Southeast regions].)

2. Will the project or activity interfere with the movement of bears between areas of important habitat, either on specific trails or on general movement routes? (Note: See brown bear distribution maps in the Alaska Habitat Management Guides [brown bear distribution maps were not prepared for the Southcentral and Southeast regions].)

3. Are adequate measures proposed to prevent attraction of bears to the project or activity (e.g., proper storage of food, incineration of garbage)?

4. Are adequate measures proposed to keep bears from food, garbage, or living areas (e.g., fences) in the event that bears are attracted to or merely encounter the proposed project or activity?

5. Are adequate measures proposed to maintain a regulated harvest of bears?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

1. Blasting. Two references have documented responses of denning brown bears to seismic oil exploration. Increased movement of bears within their dens was associated with drilling and detonation of nearby seismic shot holes.

   Harassment

   (1) General guideline. Avoid seismic blasting within brown bear habitat (derived from Reynolds et al. 1983).

   (2) Specific guideline. Minimize harassment of denning brown bears by avoiding drilling and blasting of seismic shot holes within 0.8 km (0.5 mi) of known active brown bear dens (derived from Reynolds et al. 1983).

2. Burning. Limited studies have documented the impacts of burning within brown bear habitat. These studies primarily discussed the burning of slash piles associated with logging, the impacts of effective wildfire suppression on plant community succession, and the associated impacts of destruction of plant communities used by bears or changes to successional stages that are less productive or less suitable for use by bears.

   a. Vegetation composition, change to less preferred or useable species or successional stage

   (1) General guideline. Avoid effective wildfire suppression in brown bear habitat to maintain or produce habitat heterogeneity in wildfire-influenced systems that provides both cover and feeding areas for bears, and to minimize encroachement of seral stages (e.g., conifers into shrub fields) that may produce less food for bears (derived from Martin 1983, Mealey et al. 1977, Zager et al. 1983). (Note: Fire is detrimental to short-term berry production [see memorandum S. Miller to G. Boss, 9/9/85]. Shortly after fire, increased production of vegetative parts of berry-producing shrubs takes place. Berry production is absent or reduced during this period

of vegetative growth; however, berry production rapidly increases within 3 to 20 yr after fire. Fire is often required, however, to release nutrients for new plant growth and to perpetuate seral stages favorable for shrub growth and berry production.)

(2) Specific guidelines:

- After clear-cut logging, minimize damage to rhizomes and root crowns of shrubs that after regrowing could be used by bears for food or cover, by broadcast-burning logging slash, as opposed to piling and burning of slash combined with soil scarification (Martin 1983, Zager et al. 1983).

- Minimize damage to shrub rhizomes and root crowns by avoiding hot fires during slash-burning operations in clear-cut areas (Zager et al. 1983).

b. Vegetation damage/destruction due to fire or induced parasitism

See a. above for appropriate guidelines.

3. Clearing and tree harvest. Several impacts of clearing and tree harvest on brown bears have been documented. Barriers to movement have been created by clear-cuts and associated logging slash. Bears have avoided areas that were being logged, likely due to the noise or other factors associated with the operation. Increased access via logging roads has led to a greater harvest of bears from legal and illegal hunting. Tree harvest, particularly through the use of clear-cuts, has led to changes in the structure and productivity of plant communities that are less preferred and thus used less by brown bears. Mechanical clearing of slash, soil scarification, and other seedbed preparation techniques associated with clear-cut operations often adversely affect or destroy berry-producing shrubs and other plants that can be used by bears for food or cover.

a. Barriers to movement, physical and behavioral

(1) General guideline. Avoid extensive clear-cuts in brown bear habitat that may pose barriers to normal movements of brown bears (derived from Archibald 1983, Sigman 1985, Zager et al. 1983).

(2) Specific guidelines:

- Minimize the effects of clear-cuts on the movements of brown bears by retaining stringers of uncut forest for cover and as travel corridors, especially along creeks and between harvested patches (derived from Zager et al. 1983).

- Minimize disruption of movements of bears by minimizing the amount of slash left after clear-cut logging (derived from Archibald 1983, Zager et al. 1983).

b. Harassment

(1) General guideline. Avoid clearing and tree harvest in brown bear habitat whenever this activity could cause harassment of brown bears (derived from, e.g., Elgmork 1976, Sigman 1985, Zager and Jonkel 1983). (Note: See Grading and Plowing, 6.a., and Transporting personnel/equipment/material - land, 13.b., for guidelines concerning roads).

(2) Specific guidelines:

- Minimize harassment of bears by avoiding tree harvest in bear seasonal use areas when bears are present (derived from Zager and Jonkel 1983).

- Minimize harassment of bears by avoiding concurrent harvest operations in adjacent drainages to prevent reducing substantially the bears' options to avoid harassment (derived from Zager and Jonkel 1983).

- Minimize harassment of bears by avoiding tree harvest near denning areas when bears are present (derived from Elgmork 1976).

c. Harvest, change in level

General guideline. Avoid overharvest of brown bears in areas where access has been increased by the construction of logging roads by limiting access to these roads and by increasing the monitoring effort of legal and illegal harvest of bears (derived from Archibald 1983). (Note: See also Grading and plowing, 6.a., for additional guidelines concerning roads and increased access.)

d. Vegetation composition, change to less preferred or useable species or successional stage

(1) General guideline. Avoid clearing and tree harvest in brown bear habitat to avoid loss of successional stages

of vegetation important to bears and consequent replacement with less preferred stages (e.g., cutting of old-growth forest and replacement by clear-cuts and short-rotation-managed forest) (derived from, e.g., Sigman 1985).

(2) Specific guidelines:

- Minimize damage to shrub rhizomes and root crowns that would slow postfire regeneration by using burning rather that mechanical methods for clearing (derived from Martin 1983, Zager et al. 1983).

- Minimize damage to shrub rhizomes and root crowns necessary for the regeneration of shrubs important to bears by not using hot fires for clearing or burning slash (derived from Martin 1983).

- Minimize damage to shrub rhizomes and root crowns necessary for the regeneration of shrubs important to bears by minimizing the use of soil scarification for tree regeneration and by minimizing mechanical piling of slash (derived from Martin 1983, Zager and Jonkel 1983, Zager et al. 1983).

- Minimize damage to shrub rhizomes and root crowns by broadcast-burning slash or leaving the slash untreated (derived from Zager and Jonkel 1983).

e. <u>Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay</u>

(1) General guideline. Avoid clearing or damage to vegetation in important brown bear habitat (derived from Mealey et al. 1977, Sigman 1985, Zager et al. 1983). [<u>Note</u>: See also d. above.]

(2) Specific guidelines (<u>Note</u>: See also b. above.):

- Minimize damage to shrubs and other understory plants used by bears by using high lead yarding rather than using ground vehicles when clear-cut logging (derived from Zager et al. 1983).

- Minimize damage to resprouting plants used by bears by avoiding the use of soil scarification to the greatest degree possible. Scarification should be kept to a maximum of 20% of the area of a site (derived from Mealey et al. 1977).

- Minimize soil disturbance and damage to roots of shrubs by using a brush blade rather than an excavation blade on bulldozers where all-aged management is employed and slash must be piled (Zager and Jonkel 1983).

- Minimize damage to plants and soil compaction by using equipment no heavier than necessary (Zager and Jonkel 1983).

- Minimize loss of bear food and cover by using all-aged or uneven-aged silvicultural systems, as species that provide food and cover for bears generally remain vigorous after such silvicultural treatments (derived from Mealey et al. 1977, Zager and Jonkel 1983).

- Minimize the effects of timber harvest on bears by using group selection cuts and small (4-8 ha [10-20 acre]), irregularly shaped clear-cuts that are broadcast-burned (derived from Mealey et al. 1977). Such techniques appear desirable for creating openings that produce abundant growth of plant species used by bears for food.

- Minimize the effects of timber harvest on bears by leaving patches of timber (less than 1 ha [2.5 acres]) within clear-cuts for security cover, particularly where cutting units are larger than 20 ha (50 acres) (Zager and Jonkel 1983, Zager et al. 1983). Distance to escape cover is considered more important to bears than the overall size of the clear-cuts (Zager et al. 1983).

- Minimize the effects of timber harvest on bears by retaining timbered strips for cover around feeding areas such as wet meadows, avalanche chutes, and riparian areas. Timbered strips should also be left as travel routes between cutting areas, along snowchutes, riparian zones, ridge tops, and drainage heads (Zager and Jonkel 1983).

4. <u>Drilling</u>. The primary impact that has been associated with the activity of drilling is passive harassment. Drilling in bear habitat, primarily seismic drilling associated with oil and gas exploration, caused increased heart rates and movements of bears within dens, abandonment of dens, and a general avoidance of the

areas occupied by the drilling operations. (Note: Bears have also been attracted to garbage at drilling camps; however, this situation is considered under the activity of Solid waste disposal, 10.)

a. Harassment

(1) General guideline. Avoid drilling in brown bear habitat when this activity could cause harassment of brown bears (derived from, e.g., Harding and Nagy 1980, Pearson 1980, Reynolds et al. 1983).

(2) Specific guidelines (Note: See also Grading and plowing, 6.a., and Transport of personnel/equipment/ material - land, 13.b.):

- Minimize harassment to brown bears by avoiding the winter operation of seismic drill rigs , vehicles, or cat trains within 0.8 km (0.5 mi) of known bear dens (derived from Reynolds et al. 1983).

- Minimize harassment to brown bears by leasing lands for petroleum exploration only, then, if petroleum is found, weighing the costs and benefits of extracting it (derived from Schallenberger 1980).

- Minimize harassment to brown bears by permitting exploration for petroleum only once on a given land area and making the data public to prevent duplicate exploration of the same area (derived from Schallenberger 1980).

- Minimize harassment to brown bears by greatly restricting drilling activities when bears make heavy seasonal use of an area (derived from Schallenberger 1980).

- Minimize harassment of bears by locating drilling camps away from known travel routes or feeding areas if periods other than winter, when bears are in dens, are to be used for drilling (derived from Zager and Jonkel 1983).

- Minimize harassment of bears by using directional drilling in areas determined to be particularly important to bears (derived from Zager and Jonkel 1983).

5. Fencing. References discussed the effectiveness of fences designed to keep bears out of garbage dumps and remote

construction camps. Specially designed fences were successful in keeping bears out of dumps and camps.

Barriers to movement, physical and behavioral

(1) General guideline. Avoid the erection of fences that could restrict the movements of bears, except when the objectives are to keep bears out of limited areas (e.g., garbage dumps, camps), and minimize bear-human encounters that often lead to the creation and control of nuisance bears (derived from Bromley 1985, Follmann and Hechtel 1983, Follmann et al. 1980).

(2) Specific guidelines (Note: See also Human disturbance, 8.a. and 8.b., and Solid waste disposal, 10.):

° Minimize the attraction of bears to work camp food supplies by storing food within buildings or animal-proof containers that are surrounded by a fence separate from the perimeter fence (Herrero 1982, 1985; Milke 1977).

° Minimize hazardous encounters between bears and humans by surrounding work camps or permanent facilities in occupied bear habitat with an electrified fence and requiring that attendants be present at all times at gates in the fence (derived from Follmann and Hechtel 1983; Follmann et al. 1980; Herrero 1982, 1985). (Note: See Follmann et al. 1980 for detailed specifications concerning animal-proof fences and camp layout and design.)

6. Grading/plowing. Several impacts to brown bears have been documented to occur as the result of grading and plowing. Avoidance by bears of areas containing roads and areas of active road construction or site preparation has been documented. Dens have been destroyed during gravel removal operations. Grading of sites after timber harvest to enhance tree regeneration has decreased the regeneration and productivity of shrubs and other plants used by bears for food and cover. Grading and plowing associated with tree harvest has led to destruction and damage of vegetation used by bears for food and cover.

a. Harassment

(1) General guideline. Avoid grading and plowing in brown bear habitat when this activity could cause harassment to bears (derived from, e.g., Elgmork 1976, Harding and Nagy 1980, Pearson 1980, Zager and Jonkel 1983).

(2) Specific guidelines (Note: See also d. and Transport of personnel/equipment/material - land, 13.b. for applicable guidelines.):

- Minimize harassment to bears by restricting road construction and gravel removal near dens, particularly during den entry and den emergence (derived from Elgmork 1976, Harding and Nagy 1980, Schoen et al. 1985).

- Minimize disturbance of den sites by beginning activities at winter worksites in or near denning areas in September, before bears choose den sites, in an attempt to influence bears to select a den site that would not be disturbed by winter activity (derived from Pearson 1980).

- Minimize harassment of bears by not constructing loop roads, because this type of road encourages heavier use and consequently greater disturbance to bears (derived from Zager and Jonkel 1983).

- Minimize harassment of bears by minimizing the construction of new roads in occupied bear habitat, by minimizing vehicular traffic on the roads, and by permanently closing roads upon completion of the activity or land use (derived from Zager and Jonkel 1983).

- Minimize harassment of brown bears by not permitting construction of roads in proposed timber harvest areas prior to timber sales, particularly when no timber harvest activity is scheduled within 5- or 10-yr planning horizons (derived from Sigman 1985).

- Minimize damage or destruction of vegetation important to bears by routing roads through areas that are not important for feeding or travel. Provide a 100-m (330-ft) buffer between roads and feeding areas or travel routes (derived from Zager and Jonkel 1983).

b. Terrain alteration or destruction

General guideline. Avoid disruption or loss of important bear habitat (e.g., denning areas) by carefully choosing sites to be used for gravel removal operations (derived from, e.g., Pearson 1980).

c. Vegetation composition, change to less preferred or useable species or successional stage

General guideline. Avoid grading and plowing in brown bear habitat when this activity could adversely affect the composition, structure, or productivity of plants used by bears for food or cover (derived from Sigman 1985).

d. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

(1) General guideline. Avoid damage to vegetation used by brown bears.

(2) Specific guideline. Minimize the construction of new roads in occupied bear habitat, and use the minimum construction standards necessary when new roads are required, to minimize damage to vegetation and ultimately disturbance to bears (derived from Zager and Jonkel 1983).

7. Grazing. Several impacts of sheep and cattle grazing have been documented to occur to brown bears. Bears often were attracted to livestock, either to feed on live animals or to feed at livestock carcass dumps. An increase in the harvest of bears in the livestock grazing area often occurred, usually to eliminate stock-raiding bears. Harassment of bears, both active (involving chasing of bears from livestock grazing areas) and passive (involving avoidance of areas by bears that are occupied by livestock), has been documented. Competition between bears and sheep or cattle for succulent forage, particularly in spring, has been noted. Livestock grazing has led to overgrazing and decreased abundance of plant species preferred by both bears and livestock. Cattle and sheep have trampled succulent forbs and graminoids and have reduced the vigor or even destroyed fruit-producing shrubs preferred by bears.

a. Attraction to artificial food source

(1) General guideline. Avoid grazing livestock in occupied brown bear habitat if populations of brown bears are to be maintained, as bears are inevitably attracted to the livestock and killed when depredation of stock occurs (derived from, e.g., Eide 1965, Griffel 1982, Jonkel 1980).

(2) Specific guidelines (Note: See also Solid waste disposal, 10, for guidelines regarding livestock carcasses):

- Minimize the potential for bear/livestock encounters by keeping livestock out of key brown bear range by regional land planning and regulation on government lands and by land trades or acquisition of private grazing lands (derived from Jonkel 1980).

- Minimize the potential of attracting bears to livestock, by not bringing livestock onto range heavily used by bears (areas of succulent vegetation in spring and early summer and berry patches in late summer) (derived from Jonkel 1980, Jorgensen 1983, Zager and Jonkel 1983).

- Minimize the potential for bear/livestock encounters by avoiding the bedding of livestock in cover that serves as travel corridors for bears, particularly during periods when immature bears are dispersing (derived from Jonkel 1980).

- Minimize potential bear/livestock interactions by not moving livestock into brown bear summer range during years in which weather variation results in low bear food production and for a year thereafter (derived from Jonkel 1980).

- Minimize potential livestock/bear interactions by using aversion methods, portable corrals, or livestock-protecting dogs (derived from Jorgensen 1983).

- Minimize the potential of attracting bears to livestock feed by securing such feed in bear-proof containers or out of reach of bears (derived from Hoak et al. 1983).

b. Harassment

General guideline. Avoid grazing livestock in occupied brown bear habitat when this activity could cause harassment to brown bears (derived from Jonkel 1980, Zager and Jonkel 1983).

c. Harvest, change in level

(1) General guideline. Avoid grazing livestock in occupied brown bear habitat as bears are inevitably attracted to livestock and then killed when depredation of stock occurs (derived from, e.g., Eide 1965, Griffel 1982, Jonkel 1980, Lentfer et al. 1968).

(2) Specific guidelines (Note: See also a. above):

- Minimize killing of non-stock-raiding bears by allowing removal of bears only if the bear has been positively identified as a livestock-killing individual (derived from Jorgensen 1983).

- Minimize the killing of innocent scavenging bears by avoiding the setting of snares for suspected stock-killing bears after livestock have been moved to new pastures (derived from Jorgensen 1983).

- Minimize the killing of non-stock-raiding bears by thoroughly investigating alleged cases of brown bear predation on livestock prior to considering or permitting any bear-control activities (derived from Jonkel 1980).

d. Introduced wild or domestic species, competition with or disease transmission from

(1) General guideline. Avoid grazing livestock in occupied brown bear habitat when this activity would lead to competition between livestock and bears for forage and space (derived from, e.g., Jonkel 1980, Mealey et al. 1977, Zager and Jonkel 1983).

(2) Specific guideline. Minimize competition for forage and space between bears and livestock by not bringing livestock onto important bear feeding sites when bears are present. These sites include areas of succulent forage in spring and early summer and berry patches in late summer (derived from Jonkel 1980, Jorgensen 1983, Mealey et al. 1977, Schallenberger 1980, Zager and Jonkel 1983).

e. Vegetation composition, change to less preferred or useable species or successional stage

General guideline. Avoid changes in composition of plant communities used as feeding areas by bears, by regulating the number and type of livestock grazed and the season of grazing or trailing, as a means to prevent trampling or overgrazing and/or decreases in abundance of highly palatable plant species, particularly in areas of succulent vegetation (spring or early summer), berry patches (late summer), or riparian zones (derived from Jonkel 1980, Jorgensen 1983, Schallenberger 1980, Zager and Jonkel 1983).

f. Vegetation damage/destruction due to grazing by domestic or introduced animals

See e. above for appropriate guideline.

8. Human disturbance. Many references describe impacts of human disturbance on brown bears. Humans have been observed hand-feeding bears, which often leads to bears searching picnic areas and campgrounds for additional handouts. Active harassment of bears by humans has commonly occurred, either to get close to bears for photographs or excitement or to drive bears away from areas of human habitation or from livestock. Such activities have led to attacks by bears against the persons involved in the harassment. Attacks have also followed inadvertent encounters between humans and bears. Passive harassment, through scent, noise, increased settlement, or the building of rural recreational cabins has led to decreased use or abandonment of range by bears. Interactions between humans and bears often lead to the killing of "problem bears," those that repeatedly approach humans, campgrounds, or dwellings, or that have attacked humans. Impacts of human developments have led to decreases in ungulate prey species, which have led to an increase in predation on domestic livestock. Expansion of rural subdivisions and effective wildfire suppression has created changes in vegetation successional stages that are less often preferred or used by brown bears.

a. Attraction to artificial food source

(1) General guideline. Avoid human behavior (direct hand-feeding) or storage of food items that could attract brown bears (derived from, e.g., Bromley 1985, Follmann et al. 1980, Follmann and Hechtel 1983, Milke 1977).

(2) Specific guidelines (Note: See also Human disturbance, 8.a. and 8.b., Fencing, 5., and Solid waste disposal, 10.):

° No person may intentionally feed bears, wolves, foxes, or wolverines, or intentionally leave human food or garbage in a manner that attracts these animals. This prohibition does not apply to the use of legal bait materials for trapping fur animals, nor does it apply to the use of bait for hunting black bears under 5 AAC 81.040(4) (5 AAC 81.218. Feeding of Game).

- Minimize the attraction of bears to humans by holding environmental briefings for workers on projects and other individuals in bear habitat, before they enter the field, that explain the problems that occur when bears are fed by humans (derived from Follmann et al. 1980, Follmann and Hechtel 1983, Milke 1977). The initial briefing should be followed with supplemental briefings at the work camps (derived from Follmann and Hechtel 1983).

- Minimize the attraction to humans of bears searching for food by immediately dismissing any worker caught feeding bears (derived from Follmann and Hechtel 1983).

b. Harassment

(1) General guideline. Avoid human disturbance in occupied brown bear habitat when this activity could lead to harassment causing abandonment of range or encounters between bears and humans that could lead to injury or death of either humans or bears (derived from, e.g., Elgmork 1983, Herrero 1985).

(2) Specific guidelines (Note: See also Fencing, 5., Solid waste disposal, 10., and Human disturbance, 8.a. and 8.b.):

- Minimize passive harassment and abandonment of habitat by brown bears by restricting the establishment of recreational cabins and subdivisions in brown bear habitat (derived from Elgmork 1976, Schallenberger 1980).

- Minimize harassment of bears and hazardous encounters between bears and humans by establishing construction camps or permanent facilities at least 300 m (1,000 ft) from bear cover and maintaining bright outdoor lighting during periods of darkness to potentially discourage approach by bears (derived from Herrero 1982).

- Minimize harassment of bears and hazardous encounters between humans and bears by locating campgrounds in areas outside of heavily used brown bear habitat (derived from Herrero 1985, Mundy and Flook 1973). If this is not entirely possible, locate campgrounds well away from major bear trail systems to avoid directing bears through campgrounds (Merrill 1978).

- Minimize harassment of bears and hazardous encounters between humans and bears by locating trails to avoid important bear habitat (derived from Herrero 1985). If it is necessary to route trails through bear habitat, trials should be designed to allow people to see at least 50 m (165 ft) ahead, to minimize surprizing bears (derived from Herrero 1985).

- Minimize harassment of bears and hazardous encounters between humans and bears by alternating seasonal use of backcountry campgrounds, to abate regular conditioning of bears to humans at particular campgrounds, and by lowering group size limits, to reduce the concentrated use of specific campgrounds (Merrill 1978).

- Minimize the potential for hazardous encounters between humans and bears by negatively conditioning bears to humans by nonlethal means (e.g., rubber bullets, noxious or debilitating gases, running with dogs) in all areas, particularly those closed to hunting (e.g., parks) and also by hunting in areas open to hunting (derived from, e.g., Bromley 1985, Herrero 1985, McCullough 1982).

- Minimize the potential for hazardous encounters between humans and bears by protecting campgrounds with night patrols or electrified drift fences, converting campgrounds to daytime use only, or by closing or relocating campgrounds prone to bear/human conflicts (derived from Cole 1972, Cowan 1972).

- Minimize the potential for hazardous encounters between humans and bears by recommending or requiring individuals or small parties (e.g., hikers, survey crews) to wear bells or other devices to warn bears of their approach, by avoiding areas of high concentrations of bears, maximizing the distance between sleeping quarters and food sources (in excess of 137 m [450 ft]), using dried food instead of fresh or canned food, and by ensuring that food or food containers are not left in caches for extended periods (derived from Bromley 1985, Chester 1980, Cole 1972, Herrero 1985, Hoak et al. 1983, Mundy and Flook 1973).

c. Harvest, change in level

(1) General guideline. Avoid human disturbance within brown bear habitat that could lead to an increase in the harvest of bears, particularly those situations that would create "problem bears" or exacerbate the situation. (Note: See a. above, Solid waste disposal, 10., Fencing, 5., and Grazing, 7.a. and 7.c., for additional recommendations to minimize bear/human conflicts, the creation of "problem bears," and subsequent loss of bears.)

(2) Specific guidelines:

- Minimize killing of bears by using means other than shooting to deter bears (e.g., hazing, aversive conditioning, Follmann and Hechtel 1983) from campgrounds and other facilities (derived from Cowan 1972).

- Minimize bear/human encounters and the killing of bears at outfitter camps by packing out game carcasses immediately or by hanging them at least 4.6 m (15 ft) above the ground surface, with a 3.1 m (10 ft) minimum clearance between suspension ropes and the highest access point and a minimum of 2 m (6.5 ft) between meat and the nearest vertical structure of the tree (derived from Hoak et al. 1983).

- Minimize the killing of bears involved in bear/human conflicts by transplanting bears to areas of little or no human use (derived from Cowan 1972, Knight and Judd 1983, Mundy and Flook 1973). (Note: This recommendation was developed primarily for areas with small, isolated endangered brown bear populations (e.g., Yellowstone National Park) and does not reflect the current policy within the State of Alaska to avoid the transplanting of bears. Miller and Ballard [1982], J. Wildl. Manage 46(4):869-876, found that transplanted brown bears returned to their area of capture even when transplanted up to 255 km [158 mi] away.)

- Minimize the killing of bears involved in bear/human conflicts by removing nuisance bears immediately and effectively for the long term by hazing (Follmann and Hechtel 1983), by transplanting (Cole 1972, Follmann and Hechtel 1983, Marsh 1972), by aversive conditioning - e.g., rubber bullets (McCullough 1982), by donating to zoos (Cole 1972), or, as a last resort, by killing (Cole 1972, Follmann and Hechtel 1983) to minimize the probability of the animal becoming accustomed to obtaining a reward in areas of human activity. (Note: See previous note.)

- Minimize killing of bears involved in human/bear conflicts by removing only four-time offender bears (by capturing and sending to zoos or shooting), as bears not habituated to man and not dangerous occasionally visit areas of human activity (derived from Craighead and Craighead 1972). (Note: See previous notes.)

d. Prey base, alteration of

General guideline. Avoid human disturbance that could lead to decreases in prey populations that could adversely affect bears (derived from Schallenberger 1980).

e. Vegetation composition, change to less preferred or useable species or successional stages

General guideline. Avoid loss of preferred habitat used by bears by avoiding the expansion of rural subdivisions (Zager and Jonkel 1983) and by avoiding extensive wildfire suppression that produces successional advances toward mature forests that may be less suited for brown bears (derived from Martinka 1976, Zager et al. 1983). (Note: See Burning, 2a, for a note concerning wildfire.)

9. Sewage disposal. One reference discussed a brown bear that remained in the area of a hydrocarbon exploration camp's sewage lagoon and that was tranquilized and relocated.

Harassment

General guideline. Avoid placement and operation of sewage lagoons in occupied brown bear habitat by using other means of sewage disposal if this activity could lead to harassment of bears (Harding and Nagy 1980).

10. Solid waste disposal. Many references discuss solid waste disposal and bears. The most commonly described situation is the attraction of bears to improperly handled or disposed garbage at dumps, campgrounds, worksites, construction camps, and other facilities. Bears have also been attracted to improperly disposed livestock carcasses on some rangelands. These situations often lead to bear/human conflicts and either harassment or killing of bears.

Attraction to artificial food source

(1) General guideline. Avoid disposal of garbage, livestock carcasses, or other materials in any manner that would serve to attract bears (derived from, e.g., Bromley 1985; Follmann and Hechtel 1983; Herrero 1982, 1985, Jonkel 1980).

(2) Specific guidelines (Note: See also Human disturbance, 8.a. and 8.b., and Fencing, 5., for additional guidelines):

- Minimize attracting bears, by disposing of livestock that die on the trail by burial or treatment with strong chemicals (derived from Jonkel 1980). Burn or bury carcasses away from houses, corrals, and calving grounds (derived from Jonkel 1980, Zager and Jonkel 1983).

- Minimize attracting bears, by incinerating garbage and food remains daily in supplementary-fueled incinerators at work camps and permanent facilities (derived from, e.g., Follmann and Hechtel 1983, Milke 1977, Mundy and Flook 1973, Zager and Jonkel 1983). Storage of garbage prior to incineration should be within a fenced area separate from the rest of the camp (Herrero 1982).

- Minimize attracting bears, by installing bear-proof garbage receptacles and removing litter and garbage prior to or on every evening (prior to bears feeding at night) (derived from Cole 1972, Milke 1977, Mundy and Flook 1973).

- Minimize attracting bears to campgrounds in occupied bear habitat, by isolating campgrounds from developed facilities where garbage occurs and away from lakeshores to discourage disposal of fish entrails in the campground (derived from Merrill 1978).

- Minimize attracting bears to campgrounds and nearby areas, by maintaining at least 13 km (8 mi) between landfills and these developments (derived from Cole 1972).

- Minimize the attraction of bears to individuals or small parties (e.g., hikers, survey crews) by requiring the use of self-contained stoves, to minimize the accumulation of partially burned refuse, and by packing out all garbage (derived from Bromley 1985, Merrill 1978).

- Minimize the problem of bears searching for food in areas of human occupancy by slowly phasing out garbage dumps to allow bears to adopt more natural feeding habits (derived from Cowan 1972, Craighead and Craighead 1972), and consider providing temporary food (e.g., carcasses) in remote areas to aid in the adjustment to closure of dumps (Cowan 1972). (Note: These recommendations were made for a small, isolated brown bear population with a large number of human visitors [i.e., Yellowstone National Park], and they conflict with the following guideline.)

- Minimize the attraction of bears to areas of human occupancy by abruptly removing all artificial food sources, to minimize the number of bears requiring removal (derived from Cole 1972). (Note: See the previous, conflicting guideline.)

11. Transport of oil/gas/water - land. Several impacts to brown bears were documented during the construction of the trans-Alaska oil pipeline. Bears were attracted to improperly collected and stored garbage and by direct feeding by workers at camps and worksites. Bears were hazed away from work sites and camps with firecrackers, vehicles, and helicopters. Problem bears were shot when all other means of driving them from the area failed.

    a. Attraction to artificial food source

    (Note: See Human disturbance, a., b., and c., and Solid waste disposal, 10, for applicable guidelines.)

    b. Harassment

    (Note: See Grading and plowing, 6.a. and 6.b., and Human disturbance, 8.a., b., and c., for appropriate guidelines.)

12. Transport of personnel/equipment/material - air. Several references discuss harassment of brown bears by aircraft. Aircraft, particularly helicopters, were used to haze bears from work camps and work sites. Bears have also abandoned den sites when overflown by helicopters and fixed-wing aircraft in late fall-early winter. Reactions of bears to overflights vary from no apparent response to running, depending on conditions, with helicopters generating the greatest response. Telemetered bears already habituated to aircraft have shown increased heart rates with no obvious behavioral changes when overflown by aircraft.

Harassment

(1) General guideline. Avoid low-level flights and unnecessary circling or hovering over brown bears (derived from, e.g., Doll et al. 1974, McCourt et al. 1974, Quimby 1974, Reynolds et al. 1983, Schoen et al. 1985).

(2) Specific guidelines:

- Minimize harassment of brown bears by requiring aircraft to maintain a flight level a minimum of 304 m (1,000 ft) above ground level (agl) (derived from McCourt et al. 1974).

- Minimize harassment of brown bears in arctic areas by restricting flights of aircraft over known denning areas between May 1-15 to altitudes above 304 m (1,000 ft) agl and to altitudes above 152 m (500 ft) agl at other times of the year (derived from Reynolds et al. 1983).

- Minimize harassment of bears by maintaining rapid linear flight paths over bears and avoiding low-level flights over areas with known concentrations of bears (derived from McCourt et al. 1974).

- Minimize harassment of brown bears by avoiding aircraft flights, particularly by helicopters, over denning areas, especially during den entry and emergence (derived from Schoen et al. 1985).

13. Transport of personnel/equipment/material - land, ice. Several references have documented impacts of land transportation systems and vehicles on brown bears. Collisions between bears and trains and trucks have been reported. Trucks have also been used to haze bears from worksites and camps. Operation of a seismic vehicle near a den site caused abandonment of this site by the bear.

Avoidance by bears of areas with roads or increased traffic has been recorded. Increased access from the construction of roads in previously roadless areas has led to an increased harvest of bears.

a. Collision with vehicles or structures, or electrocution by powerlines

General guideline. Avoid operation or reduce speed of vehicles in conditions, areas, and during time periods (e.g., diurnal, seasonal) when collisions with brown bears could occur (derived from Marsh 1972, Milke 1977).

b. Harassment

(1) General guideline. Avoid using vehicles to actively harass brown bears and when harassment of bears could occur as the result of normal vehicle operation (derived from, e.g., Douglass et al. 1980, Harding and Nagy 1980, Tracy 1977).

(2) Specific guidelines (Note: See also Drilling, 4.a., and Grading and plowing, 6.a., for applicable guidelines):

- Minimize harassment of bears by using mass-transit systems to reduce the number of vehicles and the frequency of their use on roads (derived from Zager and Jonkel 1983).

- Minimize harassment of bears by restricting traffic on roads during development and operational phases of activities or land uses (e.g., logging) and then closing the roads upon completion of the activity or land use. Provide permanent closure of the road (e.g., excavation, concrete barriers) rather than using gates or posting the road as closed (derived from Zager and Jonkel 1983).

c. Harvest, change in level

General guideline. (Note: See Clearing and tree harvest, 3.c., and Grading and plowing, 6.a., for guidelines concerning roads, increased access, and increased harvest.)

10. Caribou

10. CARIBOU - GUIDELINES

Two technical reports presenting a detailed discussion of the impacts of human land use and developments on caribou have been prepared in lieu of the guidelines section. These reports are:

Shideler, R.T., M.H. Robus, J.F. Winters, and M. Kuwada. 1986. Impacts of human developments and land use on caribou: a literature review. Volume I. A worldwide perspective. Tech. Rept. 86-2. Div. Habitat. ADF&G, Juneau.

Shideler, R.T. 1986. Impacts of human developments and land use on caribou: a literature review. Volume II. Impacts of oil and gas development on the Central Arctic Herd. Tech. Rept. 86-3. Div. Habitat. ADF&G, Juneau. 128 pp.

11. Dall Sheep

Table 1. Impacts Associated With Each Activity - Dall sheep

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change																														
Attraction to artificial food source				X	X							X													X			X		
Barriers to movement, physical and behavioral			X		X				X			X		?					?						X			X		?
Collision with vehicles or structures																												X		
Entanglement in fishing nets, debris					?				X																					
Entrapment in impoundments or excavations			X									?										?			X			?		X
Harassment, active or passive	X				X			X			?	X	X	X					X	?	X	?			X		X	X		?
Harvest, change in level								?				?	?						?						?			X		
Introduced wild/domestic species, competition				X									X	X														X		
Morbidity/mortality by ingestion of petroleum				?				?												?					?					
Parasitism/predation, increased susceptibility					X				X			X	X	X					?						?		X	?		
Prey base, alteration of																														
Shock waves (increase in hydrostatic pressure)																														
Terrain alteration or destruction	?										?	X							?			?			X					?
Veg. composition, change to less preferred		X			X							X	X						?											?
Veg. damage/destruction due to air pollution				?															?	?										
Veg. damage/destruction due to fire/parasitism																														
Veg. damage/destruction due to grazing													X																	
Veg. damage/destruction due to erosion		?			X						?	X							?			?								
Water level or water quality fluctuations			?									?	X						?		?									X

X - Documented impact (see text).
? - Potential impact.

11. DALL SHEEP - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. What is the number, proximity to, and importance of mineral licks in the area of the proposed activity (e.g., a minor lick used by one or two animals occasionally or a major lick used by hundreds)?

2. Can structures or facilities be located on summer ranges rather than on generally more restricted winter ranges (vegetated south slopes and windblown ridges)?

3. Can facilities or projects be sited in areas that do not include traditional ranges used by sheep, because sheep are relatively reluctant to move outside of traditional ranges?

4. Can the proposed activity or project be carried out so as not to affect lambing cliffs, the most inaccessible and precipitous areas of sheep range, during the spring lambing period?

5. Can the proposed activity result in the introduction to Dall sheep range of diseases or parasites of domestic sheep, to which wild sheep are highly susceptible?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

1. Blasting. Two references have documented displacement of sheep and interruption of ongoing activities because of blasting during seismic exploration for oil and gas.

   Harassment, active or passive

   (1) General guideline. Avoid blasting in areas of important Dall sheep habitat (e.g., winter range, lambing areas, or mineral licks) to avoid disturbing or displacing sheep (derived from Graf 1980, Pendergast et al. 1974). (Note: See the life history and distribution sections of the Alaska Habitat Management Guide for important habitat areas.)

   (2) Specific guideline. Minimize harassment by avoiding blasting within 5.6 km (3.5 mi) of Dall sheep (derived from USDI 1976a).

2. Chemical application. Mineral salt blocks have been placed in mountain sheep range specifically to attract sheep for viewing. Accumulations of salt used to melt ice from roads in winter have attracted sheep to roadsides. (Note: Salt blocks have been strongly implicated in enhancing the spread of contagious ecthyma, a viral disease that is believed to have been introduced by domestic sheep, among bighorn sheep. However, salt blocks are not important in spreading the disease among Dall sheep in the eastern Alaska Range [Heimer 1985]).

   a. Attraction to artificial food source

   (1) General guideline. Avoid attracting Dall sheep to artificial sources of salt by not placing mineral salt blocks in Dall sheep range for the purpose of viewing sheep and by avoiding the use of salt on roads that traverse Dall sheep range (derived from Blood 1971, Samuel et al. 1975). (Note: It is recognized that salt blocks may be used at natural mineral licks for research purposes.)

   (2) Specific guideline. If de-icing chemicals must be applied to roads through Dall sheep range, use the methods described under Moose, Chemical Application, 3a, to minimize salt accumulation and attraction of Dall

sheep to roadsides where they could be killed by collisions with vehicles.

b. <u>Introduced wild or domestic species, competition with or disease transmission from</u>

See Grazing 7.b. for a guideline prohibiting the grazing of domestic livestock on or anywhere near Dall sheep ranges.

3. <u>Clearing and tree harvest</u>. Although commercial tree harvest is unlikely to occur near enough to Dall sheep habitat to result in any impacts, clearing of subalpine or alpine tundra vegetation (e.g., along roads or around mines) could affect Dall sheep. Direct loss of bighorn sheep winter range has resulted from clearing associated with mining, settlement, and roads. While clearing is occurring, bighorn sheep have been harassed and have abandoned portions of their range. Mountain sheep, including Dall sheep, have been attracted to the vegetation that grows back in cleared areas.

a. <u>Attraction to artificial food source</u>

General guideline. To avoid attracting Dall sheep to vegetation regrowth in clearings, facilitate natural revegetation or revegetate clearings with species of forage quality comparable to the surrounding native vegetation (Elliott 1983) and avoid fertilizing the area if it is necessary to revegetate with non-native species (derived from Ellis et al. 1978, Geist 1971a).

b. <u>Harassment, active or passive</u>

General guideline. Avoid clearing vegetation within or adjacent to Dall sheep range whenever harassment of sheep could occur (derived from DeForge 1972, Light 1971).

c. <u>Parasitism and predation, increased susceptibility to</u>

General guideline. Avoid clearing a large proportion of the vegetation from areas of Dall sheep range that are limited in extent (e.g., winter range), so that the amount of forage available to sheep and their resistance to parasites will not be decreased (derived from Woodard et al. 1974).

d. <u>Vegetation composition, change to less preferred or useable species or successional stage</u>

General guideline. Avoid clearing Dall sheep winter range and revegetating it to species of lower forage quality to Dall sheep (Elliott 1983). (See a. above for another applicable guideline.)

e. <u>Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay</u>

See a. above for an appropriate guideline.

4. <u>Drilling</u>. Human activity associated with drilling for oil and gas has been shown to disturb mountain sheep.

<u>Harassment, active or passive</u>

General guideline. Avoid drilling in or adjacent to important Dall sheep habitats such as winter range, lambing cliffs, and mineral licks (derived from Geist 1971a).

5. <u>Fencing</u>. Fences through which mountain sheep cannot pass have prevented them from reaching important seasonal ranges and mineral licks and have blocked gene exchange among neighboring populations. Bighorn sheep have been stressed by overcrowding and loss of access to essential minerals and have become more susceptible to parasites. Some commonly used types of fences have entangled and killed mountain sheep.

a. <u>Barriers to movement, physical and behavioral</u>

(1) General guideline. On Dall sheep range, including areas through which rams occasionally pass during the rut, avoid building fences through which Dall sheep cannot pass (Hansen 1971, and derived from Graham 1980, Helvie 1971).

(2) Specific guidelines:

° If fences that block Dall sheep movement must be built on Dall sheep range, minimize their impact by building such fences where they do not block access to important limited habitats such as winter range, lambing cliffs, or mineral licks (derived from Graf 1980, Packard 1946).

- If fences are needed on Dall sheep range only to prevent vehicle access, minimize impacts on Dall sheep by using a single cable or rail (Helvie 1971).

- If fences across which Dall sheep can pass are needed on Dall sheep range, minimize impacts on Dall sheep by designing such fences according to the recommendations in Helvie (1971). (Note: The fences described in Helvie 1971 were tested on bighorn sheep and may not be applicable to Dall sheep. Grazing of domestic livestock should be prohibited on or anywhere near Dall sheep range [see guidelines for Grazing, 7.a.], so no livestock fences should be needed.)

b. Entanglement in fishing nets, marine or terrestrial debris, or structures

General guideline. On Dall sheep range, avoid building fences that can entangle and kill Dall sheep (e.g., typical five-strand barbed wire fences or woven wire fences with large mesh sizes) (Graham 1980, Helvie 1971). (Note: See Helvie 1971 for fence designs that will not entangle bighorn sheep but that have not been tested on Dall sheep.)

c. Parasitism and predation, increased susceptibility to

General guideline. Avoid building fences through which Dall sheep cannot pass on Dall sheep range where they would limit use of important areas such as winter range and mineral licks, because decreased vigor and increased susceptibility to parasites could result (derived from Buechner 1960, Packard 1946).

6. Grading/plowing. Several impacts upon Dall sheep or upon the closely related and behaviorally similar Stone and bighorn sheep have been documented as resulting from grading/plowing. Sheep are attracted to stands of grass or legumes revegetating graded areas along roads or in strip mines and to fields of grass or hay. Grading of wide roads and roadside areas results in greater collision mortality than does grading of narrower roads and also results in greater barriers to movement. Continuous vertical snow walls or piles created by plowing of roads form barriers to sheep movements. Harassment results from grading/plowing of roads or trails when sheep are present, and displacement of sheep by harassment or habitat loss increases competition with sheep on adjacent ranges. Loss of winter range to subdivisions increases the susceptibility of bighorn sheep to a lungworm-pneumonia

complex. Revegetated areas near Healy, Alaska, provide low-quality winter range compared to undisturbed vegetation.

a. Attraction to artificial food source

(1) General guideline. Avoid planting fields of grass or legume crops in Dall sheep habitat, and avoid revegetating graded areas in Dall sheep habitat to fertilized grass or legume stands in order to avoid attracting sheep (derived from Elliott 1983, Jakimchuk et al. 1984, Riggs and Peek 1980).

(2) Specific guidelines:

- Minimize attraction of sheep to revegetated areas by reseeding or replanting disturbed areas to a mixture of native plant species including forbs and shrubs, by planting nonpersistent grasses, or by enhancing natural revegetation (derived from Elliott 1983, McKendrick et al. 1984).

- If seed or cuttings of native forbs or shrubs are not available and long-term erosion control is necessary, minimize impacts of attraction of sheep by planting grasses that withstand grazing (e.g., red fescue [Festuca rubra]) and by retaining escape habitat (e.g., headwalls) if it is already present (Elliott 1983, McKendrick et al. 1984).

- Minimize attraction of Dall sheep to graded cuts by avoiding making cuts through areas containing minerals attractive to sheep or by covering such cuts with surrounding surface material (derived from McCrory 1975).

- Minimize death of Dall sheep from rumen compaction by avoiding cutting and drying hay in Dall sheep range or by drying and storing hay in areas not accessible to Dall sheep (derived from Goodson 1982).

- See Clearing and tree harvest, 3.d., for a guideline applicable to winter range.

b. Barriers to movement, physical and behavioral

(1) General guideline. When grading or plowing in Dall sheep habitat, avoid creating physical (e.g., vertical cuts) or behavioral (e.g., wide, open areas) barriers to sheep (derived from Geist 1971a, Millar 1983).

(2) Specific guidelines:

- In areas of sheep habitat where snow removal from roads would create lengthy stretches of deep piles of snow or vertical walls along roads, minimize impacts to sheep by plowing breaks in the piles or walls, through which sheep can pass (derived from Geist 1971a).

- Minimize the barrier effects of roads through sheep habitat by limiting the width of the graded area to that necessary for a road to accommodate the expected traffic and by avoiding excessively wide graded areas (derived from Millar 1983).

c. Harassment, active or passive

(1) General guideline. Avoid grading/plowing in Dall sheep habitat when passive harassment could result (Geist 1975, McCourt et al. 1974).

(2) Specific guidelines:

- Minimize passive harassment by routing trails or roads to avoid mineral licks, lambing cliffs, major migration routes, and other essential habitat (Graf 1980, Hicks and Elder 1979).

- Minimize effects of trails or roads that must pass near essential habitat by constructing them below rather than above the essential habitat area (Hicks and Elder 1979).

- If trails or roads must pass through Dall sheep winter range or near lambing cliffs, mineral licks, or rutting areas, minimize effects of harassment during construction of such trails or roads by working during times of the year when sheep are not present (derived from Packard 1946).

d. Harvest, change in level

General guideline. Avoid upgrading primitive roads or developing new roads into Dall sheep range where sheep could be subject to excessive hunting pressure, unless restrictions on harvest are implemented (derived from e.g., Geist 1971a, Graf 1980, Jakimchuk et al. 1984). (Note: The Alaska Board of Game is responsible for preparation of hunting regulations, and the departments of Public Safety and Fish and Game are responsible for enforcement.)

e. Parasitism and predation, increased susceptibility to

See Clearing and tree harvest, 3.c., for an applicable guideline.

f. Terrain alteration or destruction

General guideline. Avoid grading/plowing within or near important Dall sheep habitat such as mineral licks, lambing cliffs, and winter range (Graf 1980).

g. Vegetation composition, change to less preferred or useable species or successional stage

See a. and b. above for applicable guidelines.

h. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

(1) General guideline. Avoid grading/plowing of winter range of Dall sheep (derived from Graf 1980, Hansen 1971, Packard 1946).

(2) Specific guidelines:

- If winter range of Dall sheep must be graded or plowed, see a. above for revegetation methods that minimize vegetation destruction.

- If roads must be constructed in Dall sheep winter range, see a. above for methods of minimizing vegetation destruction.

7. Grazing. Grazing of domestic livestock on summer or winter ranges of mountain sheep has resulted in severe impacts to bighorn sheep and is beginning to affect Dall sheep in Canada. Among the impacts of grazing are those that resulted in the loss of 99% of bighorn sheep in the western United States and Canada since the mid 1800's and that have extirpated or severely reduced local remnant populations more recently. The presence of domestic sheep herders and their dogs results in active and passive harassment of mountain sheep. Domestic livestock, including cattle, horses, and especially sheep, compete with mountain sheep for limited forage produced on winter range. Livestock also compete for space, excluding mountain sheep from their range through social avoidance. Several serious diseases have been introduced into

mountain sheep herds from domestic livestock, including scabies (historically), contagious ecthyma, chronic sinusitis, bluetongue, parainfluenza-3, and bacterial pneumonia. The latter is a particularly severe problem because it is carried by healthy domestic sheep, is usually lethal to mountain sheep, and spreads readily. In one case, a herd of bighorn sheep separated from domestic sheep by a fence was wiped out by transmission of this disease from the domestic sheep. Dall sheep in Alaska have had little if any exposure to domestic sheep or other livestock and would be expected to suffer massive die-offs comparable to those of bighorns in the 1800's if livestock were introduced to Dall sheep ranges. Social stress, range limitation, and introduced diseases that would result from grazing also render mountain sheep more susceptible to parasitism by lungworms. Increases in predation on mountain sheep occur after predators are attracted to the area by livestock. Overgrazing by domestic livestock changes the composition of range vegetation to less palatable species, and in severe cases destroys vegetation.

a. <u>Harassment, active and passive</u>

General guideline. Avoid grazing domestic livestock on or anywhere near Dall sheep range at all times (Goodson 1982, and derived from, e.g., Klebesadel and Restad 1981, Robinson et al. 1967).

b. <u>Introduced wild or domestic species, competition with or disease transmission from</u>

(1) General guideline. Avoid grazing domestic livestock on or anywhere near Dall sheep range at all times to avoid transmission of lethal diseases to which mountain sheep have no immunity (Graham 1980, and derived from e.g., Klebesadel and Restad 1981, Preston 1983b). (<u>Note</u>: Transmission of diseases from domestic livestock to sheep is the most severe impact of grazing.)

(2) Specific guideline. Minimize the likelihood that any disease that could become epizootic in Dall sheep and cause widespread morbidity or mortality could be transmitted from domestic livestock to Dall sheep by maintaining a separation of at least 3.2 km (2 mi) of habitat unsuitable for use by Dall sheep between Dall sheep range and domestic livestock (derived from Goodson 1982) and by herding or otherwise controlling the livestock (e.g., by a fence) so that they do not enter the 3.2 km (2 mi) separation zone (derived from, e.g., Howe et al. 1966, Preston 1983b, Robinson et al. 1967). A fence alone is inadequate because bacterial pneumonia was transmitted from a herd of domestic sheep to a herd

of bighorn sheep that were separated only by a fence, resulting in the death of all of the bighorns from pneumonia (Foreyt and Jessup 1982).

c. Parasitism and predation, increased susceptibility to

General guideline. Avoid grazing domestic livestock on or anywhere near Dall sheep range at all times to avoid transmitting parasites that could cause morbidity or mortality of Dall sheep (Buechener 1960) and to avoid attracting predators that would feed on Dall sheep as well as on the livestock (derived from Hansen 1971).

d. Vegetation composition, change to less preferred or useable species or successional stage

See a. above for an applicable guideline.

e. Vegetation damage/destruction due to grazing domestic or introduced animals

See a. above for an applicable guideline.

8. Human disturbance. Abundant documentation is available on both active and passive harassment of Dall sheep or of the closely related and behaviorally similar Stone and bighorn sheep as a result of human disturbance. Pursuit of sheep for the purposes of observation, photography, or hunting is a common cause of active harassment. Panic running during pursuit can result in injuries from falls, separation of lambs from ewes, or trampling of lambs. Hiking and camping, vacation cabins, and recreational developments have all been documented to cause passive harassment. Altered daily behavior patterns, increased energy expenditure, and abandonment of range commonly result. Long-term human disturbance in essential habitat has caused sheep to move to a new range. If the new range is already occupied by other sheep, competition results. Free-running domestic dogs are responsible for more severe harassment of sheep than are humans, and humans with a leashed dog cause a greater response than do humans alone. Although sheep are relatively sensitive to human disturbance, they usually become habituated rather than sensitized by repeated, predictable encounters. References discussing human disturbance at water sources used by desert bighorns are included in analogy to mineral licks used by Dall sheep. (Note: Although seasonal activities including human disturbance, generally of short duration, had no effect on population parameters of Dall sheep in the Alaska Range [Heimer 1978], these guidelines are intended to avoid or minimize impacts on individual sheep or groups of sheep as well as on populations and to avoid or minimize impacts on Dall sheep use of habitat.)

a. <u>Harassment, active or passive</u>

(1) General guideline. Avoid human disturbance in Dall sheep habitat, particularly in winter range, in lambing areas, and at mineral licks, whenever sheep are present. Except when hunting, avoid approaching or disturbing sheep, in particular ewes (Horejsi 1976, and derived from, e.g., Geist 1975, Graham 1980, MacArthur et al. 1982, Packard 1946, USDI 1976a).

(2) Specific guidelines:

- Except when hunting, minimize harassment by stopping a minimum of 110 m (360 ft) away from habituated rams and 320 m (1,050 ft) away from habituated ewes when approaching sheep on foot (Light 1973) and more than 460 m (1,500 ft) away from nonhabituated sheep (derived from Jakimchuk et al. 1984).

- In areas in which humans on foot repeatedly approach sheep, minimize harassment by approaching sheep on established trails and from a consistent direction. On a slope, approach sheep from below, rather than from above (Hicks and Elder 1979, MacArthur et al. 1982, and derived from Horejsi 1976).

- Except when hunting, minimize active harassment by avoiding entering sheep escape terrain when approaching sheep on foot (derived from Horejsi 1976).

- Except when hunting, minimize harassment by avoiding approaching on foot within 460 m (1,500 ft) of sheep in areas intensively used by sheep, including lambing cliffs, mineral licks, bedding areas, and winter range (Horejsi 1976, Price and Lent 1972, and derived from DeForge 1982, Graham 1980, Hicks and Elder 1979).

- Minimize harassment by not approaching sheep on foot when accompanied by a leashed or unrestrained dog and by avoiding taking dogs into sheep habitat when sheep are present (MacArthur et al. 1982 and derived from MacArthur et al. 1979).

- Except when hunting, minimize harassment by making only a single approach to sheep, rather than repeated approaches after the sheep flees or moves away (derived from Stemp 1982).

- Minimize passive harassment by limiting use of sheep summer range by humans on foot to a maximum of 500 visitor-days annually, and preferably restrict use to 100 visitor-days or less (Light 1973, and derived from Graham 1971, Light 1971).

- In areas of limited Dall sheep summer range that are heavily used for recreation, minimize harassment, except when hunting sheep, by limiting group sizes to 10 people or fewer, travelling cross-country only with a guide familiar with sheep behavior, and remaining on trails during the lambing season (Light 1973).

- In areas of limited Dall sheep summer range, minimize harassment by avoiding development of summer recreational facilities. If they must be built, construct them during seasons when sheep are not using the range and in a location more than 457 m (500 yd) and out of sight of areas important for use and travel by sheep (Light 1973).

- Minimize passive harassment by avoiding short-term or seasonal human occupancy, such as surveying or recreational camping, within 400 m (0.25 mi) of mineral licks, lambing cliffs, and other essential sheep habitat (Hicks and Elder 1979 and derived from Graf 1980).

- Minimize passive harassment by avoiding long-term human occupancy, such as permanent structures or regular occupancy throughout several months, within 800 m (0.5 mi) of essential sheep habitat (derived from Campbell and Remington 1981, Graham 1980, Heimer 1978, Leslie and Douglas 1980).

- To minimize harassment of hunted sheep populations, minimize all other contact between sheep and humans, and preferably avoid such contact entirely (Geist 1975, and derived from Horejsi 1976).

b. <u>Introduced wild or domestic species, competition with or disease transmission from</u>

General guidelines. Avoid continuous human disturbance in essential Dall sheep habitat (e.g., at mineral licks) if sheep could be displaced into habitat already in use by other Dall sheep (derived from Geist 1971a, Leslie and Douglas 1980). Avoid human disturbance of other ungulates (e.g., caribou) utilizing adjacent ranges that could cause them to move onto limited sheep range (Buechner 1960).

c. Parasitism and predation, increased susceptibility

General guideline. Avoid human disturbance that could cause repeated or prolonged harassment of Dall sheep or harassment that could cause sheep to abandon important habitat (e.g., mineral licks) in order to avoid increasing the susceptibility of the sheep to parasites (derived from Buechner 1960, Packard 1946).

9. Processing minerals (including gravel). A single impact, that of harassment, has been documented for processing of minerals in mountain sheep habitat.

Harassment, active or passive

General guideline. Avoid processing minerals in important Dall sheep habitat (e.g., winter range, mineral licks) when harassment of Dall sheep could result (derived from Geist 1975).

10. Sewage disposal. Operation of sewage disposal facilities has interfered with access by desert bighorn sheep to a water supply because the sheep avoided the sensory disturbance caused by the facilities.

Harassment, active or passive

General guideline. Avoid constructing and operating sewage disposal facilities within 800 m (0.5 mi) of important Dall sheep areas such as mineral licks (derived from Graham 1980).

11. Transport of oil/gas/water - land. Transporting oil, gas, and water by land has resulted in several documented impacts on mountain sheep. Dall sheep have been attracted to man-made mineral licks and to right-of-way revegetation along oil and gas pipelines. Aqueducts have blocked movement of desert bighorns and caused entrapment. Operation of large-scale water-pumping facilities for irrigation or city use has harassed desert bighorns, causing range abandonment. Dall sheep have avoided simulated gas compressor stations.

a. Attraction to artificial food source

See Grading/plowing, 6.a., for applicable guidelines.

b. Barriers to movement, physical and behavioral

(1) General guideline. Avoid constructing aqueducts with steep banks (e.g., concrete-lined aqueducts) in Dall sheep habitat so that movement of sheep will not be blocked and entrapment will not occur (derived from Graf 1980, Graham 1980).

(2) Specific guidelines. If aqueducts must be built in Dall sheep habitat, minimize blocking movements of sheep or entrapping sheep by constructing the aqueducts with gently sloping, firm banks that sheep can easily descend and climb. If such technique is not possible, bury sections of the aqueduct to provide passage for sheep, and fence open sections to prevent entrapment of sheep (derived from Graham 1980).

c. Entrapment in impoundments or excavations

See b. above for appropriate guidelines.

d. Harassment, active or passive

(1) General guideline. Avoid constructing facilities for transporting oil, gas, or water by land in Dall sheep habitat, especially at or near important habitats such as mineral licks, lambing cliffs, or winter range, to avoid passive harassment, loss of habitat, and decreased lamb production and survival (derived from Campbell and Remington 1981, Graf 1980, Leslie and Douglas 1980, USDI 1976a).

(2) Specific guidelines:

° To minimize loss of summer range by Dall sheep, construct gas pipeline compressor stations at least 3.2 km (2 mi) from summer range, or install sound attenuators (McCourt et al. 1974).

° Minimize loss of use of mineral licks and other high-value habitats by Dall sheep by avoiding construction of gas pipeline compressor stations near or within a minimum of 1.2 km (0.75 mi) of such habitats (Leslie and Douglas 1980, Reynolds 1974). Passive harassment can still occur at this distance.

e. Terrain alteration or destruction

General guideline. Avoid constructing facilities for transporting oil, gas, or water by land upon or through high-value Dall sheep habitats such as mineral licks and lambing cliffs (Graf 1980).

12. Transport of personnel/equipment/material - air. Flying small fixed-wing aircraft or helicopters over or in the vicinity of sheep has been responsible for harassment. Compared to other large mammals in Alaska, sheep are relatively reactive to the approach of aircraft even at high altitudes, and reactions can be severe. Approaching sheep directly by aircraft or circling for observation or photography often causes panic-running. Injuries from falls, separation of lambs from ewes, or trampling of lambs can result. Eagles have killed lambs that became separated from their mothers. Long-term effects include sensitization to aircraft disturbance, desertion or reduced use of traditional range, and alteration of daily behavior patterns such that growth and weight gain are reduced because of increased energy expenditure and decreased foraging time. On the other hand, repeated exposure to aircraft traffic that does not approach or circle sheep can result in habituation. (Note: The note under the activity no. 8, Human disturbance, is also applicable to this activity.)

a. Harassment, active or passive

(1) General guideline. Avoid flying small aircraft within 1.6 km (1 mi) vertical and horizontal distance from Dall sheep (derived from Horejsi 1976, Lenarz 1974, McCourt 1974, Reynolds 1974).

(2) Specific guidelines: if air transport within 1.6 km (1 mi) of sheep cannot be avoided,

- minimize harassment by avoiding sheep on summer and winter range by a minimum of 250 m (800 ft) vertical and horizontal distance for both helicopters and fixed-wing airplanes (derived from McArthur et al. 1979 and 1982, Price and Lent 1972, Reynolds 1974);

- minimize harassment by avoiding sheep at mineral licks, lambing cliffs, and other essential habitat by a minimum of 500 m (1,640 ft) vertical and horizontal distance (derived from Lenarz 1974, McArthur et al. 1979 and 1982, Price and Lent 1972, Reynolds 1974);

- minimize harassment by limiting the duration and scope of the air transport system over sheep habitat (Heimer 1978);

- minimize active harassment by avoiding low passes over sheep at less than 100 m (328 ft), circling around, or hovering low over sheep (Krausman and Hervert 1983, Singer and Mullen 1981);

- minimize harassment by veering away at once if a group of sheep being approached breaks into a full run (Singer and Mullen 1981).

b. Parasitism and predation, increased susceptibility to

General guideline. Avoid flying small aircraft close enough to bands of ewes with lambs that they begin to run, because eagles can kill lambs that become separated from their mothers (derived from Nette et al. 1984).

13. Transport of personnel/equipment/material - land. This activity has resulted in several significant impacts to Dall and other mountain sheep. Sheep have been attracted to revegetated areas along roads and electric power transmission lines and to road salt. Once along roads, they are likely to be hit by vehicles. Wide, high-speed roads are avoided by sheep and greatly limit the sheep's movements; and sheep hesitate to cross even two-lane gravel roads. Road and especially off-road vehicular traffic harasses sheep and causes range abandonment. Bighorn sheep subjected to continuous harassment in areas of essential habitat have been displaced to occupy new ranges, thereby competing with resident sheep populations. Harvest of sheep increases after new roads are constructed or old roads or trails are improved in areas where access is limited.

a. Attraction to artificial food source

(1) General guidelines. In Dall sheep habitat, avoid attracting Dall sheep to revegetated or landscaped road rights-of-way, and in order to decrease the probability of collisions, revegetate rights-of-way with native vegetation or allow them to naturally revegetate (derived from Geist 1971a, Jakimchuk et al. 1984). Avoid clearing or revegetating electric power transmission line rights-of-way in Dall sheep habitat because sheep can be attracted to open areas of regrowth (derived from Ellis et al. 1978). Avoid applying salt to roads that traverse Dall sheep habitat to avoid attracting sheep (derived from Samuel et al. 1975).

(2) Specific guidelines.

See Grading/plowing, 6.a., for applicable specific guidelines for revegetation.

See Chemical application, 2.a., for applicable specific guidelines for road salt application.

b. Barriers to movement, physical and behavioral

(1) General guideline. Avoid constructing roads in Dall sheep habitat, especially in important limited-area habitats such as winter range or mineral licks, because sheep are hesitant to cross roads (derived from Graf 1980, Horejsi 1976, Jorgensen 1974, Millar 1983, Tracy 1977).

(2) Specific guidelines:

- If multilane roads must be constructed through Dall sheep habitat, construct underpasses where commonly used sheep trails intersect the road (Graham 1980, and derived from Hansen 1971).

- If a multilane road must be constructed or is in use adjacent to a mineral lick or other high value Dall sheep habitat, minimize blocking movement of sheep to the area by closing the road when the habitat is in use or, if the road cannot be closed at that time, by erecting signs warning motorists to stop for sheep (Heimer 1985).

- See Grading/plowing, 6.b., for other applicable guideline.

c. Collision with vehicles or structures, or electrocution by powerlines

(1) General guideline. Avoid constructing medium- and high-speed roads in Dall sheep habitat so that sheep will not be injured or killed by collisions with highway vehicles (derived from Hansen 1971, Jakimchuk et al. 1984).

(2) Specific guidelines:

- Minimize collisions of vehicles with Dall sheep by monitoring roadkills in sheep concentration areas and by applying mitigative measures such as those listed below if the injury or death rates are increasing or are unacceptably high (Jakimchuk et al. 1984).

- Minimize collisions of vehicles with Dall sheep by limiting vehicle speed to 32 km/hr (20 mph) in areas where sheep are concentrated (Heimer 1985, and derived from Millar 1983).

- Minimize collisions of vehicles with Dall sheep by providing underpasses for sheep where commonly used sheep trails intersect roads and by fencing the highway in such areas (Graham 1980). See Fencing, 5.b., for guidelines for fences that will not entangle sheep.

d. <u>Harassment, active or passive</u>

(1) General guideline. Avoid establishing land transportation routes through or within 400 m (1,312 ft) of Dall sheep habitat (Graf 1980, and derived from Tracy 1977), and avoid use of off-road vehicles within the same distance, to avoid harassment of sheep (derived from Geist 1971a, Jorgensen 1974, Packard 1946).

(2) Specific guidelines:

- If roads must be built through Dall sheep habitat, minimize harassment by avoiding lambing areas, mineral licks, and winter range by at least 400 m (1,312 ft) (DeForge 1972, Horejsi 1976, Price and Lent 1972).

- If roads must be built through Dall sheep habitat, minimize harassment by confining vehicle use to roads (MacArthur et al. 1982).

- If roads must be built through Dall sheep habitat, minimize harassment by limiting the scope of the road system or the seasons during which it is used, to protect sheep during critical life stage periods (Heimer 1978).

- If transporting people through Dall sheep habitat, minimize harassment by avoiding stopping to view sheep, getting out of the vehicle to view sheep, or making loud noises in the vicinity of sheep (derived from Tracy 1977).

e. Harvest, change in level

See Grading/plowing, 6.d., for an applicable guideline.

f. Introduced wild or domestic species, competition with or disease transmission from

See Human disturbance, 8.b., for a guideline also applicable to range abandonment because of land transportation corridors.

14. Water regulation/withdrawal/irrigation. Several references have documented impacts of reservoirs on desert bighorn sheep. Reservoirs block movement of sheep, and reservoirs with steep sides entrap and drown sheep.

a. Barriers to movement, physical and behavioral

(1) General guideline. In Dall sheep habitat, avoid constructing large impoundments or impoundments with steep banks that sheep cannot climb so that movement of sheep will not be blocked and sheep will not be entrapped (derived from Graf 1980, Graham 1980).

(2) Specific guideline. If impoundments must be constructed in Dall sheep habitat, minimize blocking sheep movements or entrapping sheep by limiting the width of impoundments to 0.2 km (0.125 mi) or less and by contouring gently sloping, firm shorelines that sheep can easily descend and climb (Graham 1980).

b. Entrapment in impoundments or excavations

See a. above for an applicable guideline.

12. Furbearers

Table 1. Impacts Associated With Each Activity - Furbearers

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove		X	X		?		X			X		?	X		?							?	?							?
Aquatic vegetation, destruction or change			X		X	?	X			X					?			?					?							X
Attraction to artificial food source				?	X							X	X	X							?	X			X			X		
Barriers to movement, physical and behavioral		?	?		X	?	?		X			?		?					?						?			?		?
Collision with vehicles or structures																												X		
Entanglement in fishing nets, debris					?				?							?														
Entrapment in impoundments or excavations												?										?						?		?
Harassment, active or passive	X		?		?	?	?	?		?	?	?	?	X	?		?	?	X	?	?	?			X	?	X	X	?	?
Harvest, change in level		?			X	?	?	?				X		X				?	?						X			X	?	?
Introduced wild/domestic species, competition													?	X																?
Morbidity/mortality by ingestion of petroleum				X				?												?					X					
Parasitism/predation, increased susceptibility					?									?																X
Prey base, alteration of		?	X		X	?	?			?		X	?															X		?
Shock waves (increase in hydrostatic pressure)	?																													
Terrain alteration or destruction	?		X				X			X	?	?			?							?						X		?
Veg. composition, change to less preferred		?			X	?						?	?							?										X
Veg. damage/destruction due to air pollution				?															?	?										
Veg. damage/destruction due to fire/parasitism		X																												
Veg. damage/destruction due to grazing													X																	
Veg. damage/destruction due to erosion		?	X		X	?	X			X		X			?				?											
Water level or water quality fluctuations			X		X	?	X			X			X								X				X					X

X - Documented impact (see text).
? - Potential impact.

12. FURBEARERS - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Can structures or facilities be located to avoid riparian vegetation utilized by beaver and muskrat and also to avoid large areas currently without long-term human presence utilized by wolf and wolverine?

2. Can developments be located to avoid removal or disturbance of stands of mature conifers important for marten and red squirrel?

3. What are the effects a development project may have, directly or indirectly, on characteristics of any surface waterbodies in the area?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

1. Blasting. A single reference documented abandonment of habitat and decreased production of young by muskrats as a result of blasting during seismic exploration.

Harassment, active or passive

(1) General guideline. Avoid blasting in areas of furbearer habitat when harassment could result (derived from Sopuck et al. 1979).

(2) Specific guideline. To minimize harassment and habitat abandonment, avoid blasting on seismic lines within 180 m (590 ft) of muskrat habitat in active use (derived from Sopuck et al. 1979).

2. Burning. Although burning is beneficial to furbearers overall, some impacts of burning on beaver and red squirrel have been documented under certain conditions. Repeated burning of watersheds has increased stream siltation and killed trees on which beavers feed. Burning of mature white spruce forests eliminates red squirrel habitat for about 50 yr.

a. Aquatic substrate materials, addition or removal

General guideline. Avoid repeated burning of streamside vegetation or watersheds supporting beaver, to avoid increasing siltation and causing loss of beaver denning habitat (derived from Sopuck et al. 1979).

b. Vegetation damage/destruction due to fire or induced parasitism

General guidelines:

- Avoid repeated burning of streamside vegetation or watersheds supporting beaver, to avoid destroying trees and shrubs on which beaver feed (derived from Sopuck et al. 1979). (Note: It is recognized that burning mature forest adjacent to watercourses results after about 10 yr in regrowth of willow, aspen, and other seral vegetation that is beneficial to beaver.)

- Avoid burning mature spruce forests that provide red squirrel habitat (derived from Stephenson 1984). (Note: It is recognized that the beneficial effects of burning on other wildlife species may outweigh the negative effects on red squirrels.)

3. Channelizing waterways. Habitat quality for beaver, mink, and muskrat has been reduced by channelizing waterways. Low water levels preclude underwater entrances to burrows, and deposition of sand and gravel on banks further reduces denning opportunities. Straightening the channel destroys aquatic and terrestrial vegetation eaten by beaver and muskrat and reduces the foraging area. Fewer riverine food sources for mink are available due to deposition of sand and gravel.

   a. Aquatic substrate materials, addition or removal

      (1) General guideline. Avoid channelizing waterways in aquatic furbearer habitat (derived from Gray and Arner 1977).

      (2) Specific guideline. If waterways must be channelized, minimize decreasing riverine food resources for mink by avoiding deposition of sand and gravel from dredging and upstream erosion (derived from Gray and Arner 1977).

   b. Aquatic vegetation, destruction or change in composition

      General guideline. Avoid channelizing waterways in aquatic furbearer habitat, to avoid destroying aquatic and emergent vegetation on which beaver and muskrat feed (derived from Arner et al. 1975).

   c. Prey base, alteration of

      General guideline. Avoid channelizing waterways in mink habitat, to avoid decreasing riverine food resources (derived from Gray and Arner 1977).

   d. Terrain alteration or destruction

      (1) General guideline. Avoid channelizing waterways in aquatic furbearer habitat (derived from Simpson et al. 1982).

      (2) Specific guideline. If a watercourse must be channelized, minimize impacts to beaver and muskrat by 1) avoiding deposition of dredged material on banks that would otherwise be suitable for den construction, 2) minimizing the amount of straightening of the watercourse, 3) retaining aspen stands and other foraging areas along the watercourse, 4) preventing bank erosion, and 5) designing the channel so that water levels similar to those prior to channelization are maintained (derived from Grey and Arner 1977, Simpson et al. 1982).

e. <u>Vegetation damage or destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay</u>

(1) General guideline. See b. above for an applicable guideline.

(2) Specific guideline. If a watercourse must be channelized, minimize impacts of vegetation damage on beaver by minimizing clearing of aspen stands and other food plants, including alder and willow (derived from Simpson et al. 1982).

f. <u>Water level or water quality fluctuations</u>

(1) General guideline. Avoid channelizing waterways in aquatic furbearer habitat, to avoid making the water so shallow that beaver and muskrat cannot build underwater burrows (derived from Grey and Arner 1977, Simpson et al. 1982).

(2) Specific guideline. If waterways must be channelized, minimize impacts to beaver and muskrat by maintaining water depths that were present prior to channelization (derived from Gray and Arner 1977, Simpson et al. 1982).

4. <u>Clearing and tree harvest</u>. The most frequent documented impact of clearing and tree harvest is vegetation destruction and loss of habitat for furbearers such as marten, weasel, red squirrel, and beaver. Other impacts include decreased numbers of redbacked wolves (prey for marten); attraction of wolves, foxes, and coyotes to food left by loggers; increased access and harvest of furbearers; and increased turbidity resulting in decreased growth of aquatic plants eaten by beaver and muskrat.

a. <u>Aquatic vegetation, destruction or change in composition</u>

General guideline. Avoid clearing riparian vegetation along streams that include beaver ponds so that water turbidity will not increase and growth of aquatic vegetation will not decrease (derived from Sopuck et al. 1979).

b. <u>Attraction to artificial food source</u>

General guideline. Avoid leaving food or garbage in areas where clearing or tree harvest are going on, to avoid attracting scavenging furbearers such as wolves, foxes, or coyotes (derived from Sopuck et al. 1979).

c. <u>Harvest, change in level</u>

General guideline. Avoid clearing and tree harvest in furbearer habitat when excessive harvest of furbearers could result, unless restrictions on harvest are implemented (derived from Klebesadel and Restad 1981). (<u>Note</u>: The Alaska Board of Game is responsible for preparation of hunting regulations, and the Departments of Public Safety and Fish and Game are responsible for enforcement.)

d. <u>Prey base, alteration of</u>

General guidelines. Avoid clearing or tree harvest in forests that provide marten habitat, to avoid eliminating red-backed wolves that are the primary prey of marten (derived from Sopuck et al. 1979). Avoid clearing of forests or other vegetation that provides hare habitat, to avoid decreasing the short-term availability of prey for coyotes and wolves (derived from Elliott 1983). (<u>Note</u>: It is recognized that if plant succession to shrubs such as willows occurs after clearing, hare habitat can be enhanced a few years after clearing.)

e. <u>Vegetation composition, change to less preferred or useable species or successional stage</u>

(1) General guidelines. Avoid clearing or tree harvest in forests that provide marten habitat because marten do not use revegetating clear-cuts that are younger than 20 yr of age and use older regenerating forests less frequently than mature forests (derived from Sopuck et al. 1979). Avoid revegetating cleared areas to grasses in coyote or wolf habitat, in order to avoid loss of suitable habitat for hares, upon which coyotes and wolves prey (derived from Elliott 1983).

(2) Specific guidelines:

- If trees must be harvested in marten habitat, minimize decreasing the marten population by selective cutting of no more than 60% of the basal area and by retaining uncut forest adjacent to harvest areas (derived from Sopuck et al. 1979).

- If vegetation must be cleared in coyote or wolf habitat and the area is to be revegetated, minimize the loss of habitat suitable for hares by encouraging natural revegetation of shrubs (derived from Elliott 1983).

f. Vegetation damage or destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

(1) General guideline. Avoid clearing or tree harvest in furbearer habitat, to avoid short- or long-term destruction of habitat (derived from Baster and Glaude 1980, Klebesadel and Restad 1981, Slough and Sadlier 1977).

(2) Specific guidelines:

- If forests that provide marten habitat must be harvested, minimize habitat loss by selectively cutting no more than 60% of the basal area and retaining undisturbed forest adjacent to harvest areas (derived from Sopuck et al. 1979).

- If coyote habitat must be cleared, minimize loss of hunting habitat by harvesting several small areas rather than one large area (derived from Sopuck et al. 1979).

- If beaver habitat must be cleared, minimize destruction of food supplies by avoiding cutting or clearing of aspen, alder, and willow stands within 100 m (328 ft) of existing surface water and potential beaver pond sites (derived from Sopuck et al. 1979).

- If mink habitat must be cleared, minimize loss of hunting habitat by retaining undisturbed vegetation within 100 m (328 ft) of all waterbodies (derived from Sopuck et al. 1979).

- If other habitat must be cleared, minimize loss of the highest value habitat by avoiding clearing of vegetation along river banks (derived from Sopuck et al. 1979).

- If red squirrel habitat must be cleared, minimize loss of habitat by selective cutting instead of clear-cutting of mature white spruce forests (derived from Sopuck et al. 1979).

g. Water level or water quality fluctuations

See a. above for an applicable guideline.

5. Dredging. Removal of gravel from floodplains for construction use or during placer mining for gold has resulted in immediate and long-term loss of riparian shrubs and trees that provide food and cover for aquatic furbearers. Mining of vegetated gravel bars results in immediate habitat loss. In some cases, additional loss over a period of years results from changes in river hydraulics and water levels that change patterns of permanent or annual flooding or aufeis accumulation.

a. Aquatic substrate materials, addition or removal

General guideline. Avoid removal of gravel from vegetated riparian areas in aquatic furbearer habitat (derived from Joyce 1980).

b. Aquatic vegetation, destruction or change in composition

See a. above for an applicable guideline.

c. Terrain alteration or destruction

(1) General guideline. Avoid gravel removal from floodplains in areas where riparian shrub or tree stands provide habitat for aquatic furbearers (derived from Joyce et al. 1980).

(2) Specific guidelines.

° Minimize loss of habitat for muskrat and beaver as a result of gravel removal by dredging in such a way that ponded areas suitable for use by aquatic furbearers are formed (derived from Joyce 1980).

° See statewide Moose, Dredging, 6.a., for other applicable guidelines.

d. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

See guidelines discussing alteration of river channels in c. above.

7. Drilling. Improper disposal of garbage and deliberate feeding by humans has attracted wolves and foxes to drilling camps.

Attraction to artificial food source

General guideline. Avoid attracting wolves and foxes to drilling camps by disposing of garbage so that it is inaccessable to scavenging furbearers and by avoiding deliberately feeding furbearers (derived from Hanley et al. 1981).

8. Fencing. Although carnivorous furbearers easily cross livestock fences, several fence designs have been developed specifically to deter predation by coyotes and foxes on domestic sheep and on waterfowl.

Barriers to movement, physical and behavioral

(1) General guideline. Avoid constructing predator-directing or deterrent fences in carnivorous furbearer habitat, to avoid blocking the movements of those furbearers, unless lethal means of predator control would be used to protect livestock or other prey if fences were not built (derived from Preston 1983b).

(2) Specific guidelines. If predator directing or deterrent fences must be built in order to avoid the use of lethal means of predator control to protect domestic livestock, the following guidelines are applicable:

- Minimize the area fenced where predator density is low by herding livestock into an area surrounded by a predator fence each evening (deLorenzo 1977).

- Minimize unnecessary expense when constructing high-tensile electric fences by designing fences according to the predator density in the area. In areas of high coyote densities, a 12-wire fence 1.5 m (5 ft) tall is recommended as an impenetrable barrier (Gates 1978). In areas of lower predator density, a nine-wire fence 1.7 m (5.6 ft) tall is crossed very seldom, and only a few coyotes can jump over a seven-wire fence 1.3 m (4.4 ft) tall (deCalesta 1983). In areas of low predator density, a five-wire electric fence will suffice (Jepson et al. 1983). Design and construction details for high-tensile electric predator fences are described by Jepson et al. 1983.

- Minimize unnecessary expense when constructing predator fences in areas of low predator density by adding charged strands of smooth wire to existing wire mesh domestic sheep fences or by using electro- plastic netting (deCalesta 1983, Jepson et al. 1983).

- Minimize burrowing or crawling under electric predator fences by coyotes, foxes, or other carnivorous furbearers by stringing an uncharged, barbed wire at ground level or by using a charged outrigger wire at the base of the fence (deCalesta 1983) and by sterilizing the soil along the fence so that vegetation will not short out lower wires (Lokemoen et al. 1982).

- In areas of high predator density where electric fences cannot be used, minimize use of lethal means of predator control by constructing coyote deterrent or directing fences of woven wire (deLorenzo 1977).

9. Filling and pile-supported structures (aquatic and wetland habitats). Filling is often associated with dredging of gravel from floodplains, for construction of access roads, or stockpiling of gravel. The impacts upon furbearers that result are the same as those from dredging: immediate and long-term habitat loss. Under fill, the water table is at a greater depth, and productive vegetation characteristic of floodplains cannot be reestablished.

   a. Aquatic substrate materials, addition or removal

      See Dredging, 5.a., for an applicable guideline.

   b. Aquatic vegetation, destruction or change in composition

      See Dredging, 5.a., for an applicable guideline.

   c. Terrain alteration or destruction

      See Dredging, 5.c., for applicable guidelines.

   d. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

      See Dredging, 5.c., for applicable guidelines.

   e. Water level or water quality fluctuations

      See guidelines discussing alteration of river channels in Dredging, 5.c.

10. Grading/plowing. In addition to direct destruction of furbearer habitat, grading and plowing have resulted in the attraction of furbearers to crops and to Dall sheep that were attracted by crops, overharvest of furbearers due to increased access, and loss of prey species for carnivorous furbearers.

a. Attraction to artificial food source

(1) General guideline. Avoid growing vegetable gardens or other palatable crops in red squirrel habitat, and in carnivorous furbearer habitat avoid growning crops to which moose, Dall sheep, or other prey species would be attracted (derived from Elliott 1983, Preston 1983b).

(2) Specific guideline. Minimize attracting prey species and carnivorous furbearers to palatable crops by fencing the latter so that prey or carnivores cannot enter the fields (derived from Preston 1983b).

b. Harvest, change in level

See Clearing and tree harvest, 4.c., for an appropriate guideline.

c. Prey base, alteration of

See Clearing and tree harvest, 4.d., for an appropriate guideline.

d. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

General guideline. Avoid grading or plowing in furbearer habitat (derived from Klebesadel and Restad 1981).

11. Grazing. Grazing of domestic sheep, cattle, and horses and raising of poultry commonly result in attracting carnivorous furbearers such as coyotes, wolves, or foxes. In addition, overgrazing of riparian vegetation by domestic livestock prevents regeneration of aspen and willow, essential foods for beaver, and the resulting erosion causes siltation and decreases water levels.

a. Aquatic substrate materials, addition or removal

General guideline. Avoid grazing livestock in aquatic furbearer habitat unless the intensity of grazing is limited so that vegetation damage, erosion, and siltation of watercourses does not occur (derived from Yeager and Hill 1954).

b. <u>Attraction to artificial food source</u>

(1) General guideline. Avoid grazing of domestic livestock or raising of poultry in carnivorous furbearer habitat, to avoid attracting furbearers to the domestic animals (derived from Jepson 1983, Preston 1983b).

(2) Specific guidelines. If domestic livestock must be grazed in carnivorous furbearer habitat, the following guidelines are applicable:

- Minimize attraction of predators by constructing a predator fence around the area (derived from Jepson 1983). (<u>Note</u>: See Fencing, 8., for guidelines on fencing.)

- Minimize attraction of predators to newborn lambs or calves by restricting lambing and calving to easily monitored areas (Preston 1983b), by constructing a predator fence around such areas (derived from deLorenzo 1977), or by providing alternate food sources for predators during the lambing or calving season (Klebesadel and Restad 1981).

- Minimize attraction of predators to areas where livestock are grazed by rapidly disposing of livestock carcasses so that predators cannot feed on them (Klebesadel and Restad 1981).

c. <u>Vegetation damage/destruction due to grazing by domestic or introduced animals</u>

General guideline. Avoid grazing livestock in aquatic furbearer habitat unless the intensity of grazing is limited so that riparian shrubs and trees are not damaged or destroyed and can continue to provide food and cover for furbearers (derived from Yeager and Hill 1954).

d. <u>Water level or water quality fluctuations</u>

See a. above for an appropriate guideline.

12. <u>Human disturbance</u>. Human presence in furbearer habitat frequently results in passive harassment of certain furbearer species. Wolves are particularly sensitive, avoiding hunting in areas of

frequent human presence and abandoning dens after single visits by humans. Passive harassment of foxes, lynx, marten, and otter by the presence of humans has also been documented. Other impacts of human disturbance are attraction of wolves and foxes to handouts of food by national park visitors and construction workers in remote camps, increased harvest by the same workers, and transmission of distemper from domestic dogs to wolves, resulting in death of the latter.

a. <u>Attraction to artificial food source</u>

General guideline. Avoid attracting wolves, foxes, and other carnivorous furbearers to handouts of food by educating visitors to parks, construction workers in remote camps, and other humans in furbearer habitat not to feed them (Milke 1977 and derived from Tracy 1977).

b. <u>Harassment, active or passive</u>

(1) General guideline. Avoid frequent human presence or activities in furbearer habitat when harassment of furbearers may occur (derived from Gipson et al. 1982, Sopuck et al. 1979).

(2) Specific guidelines:

- Minimize harassment of otters by avoiding regularly fishing or walking along streambanks in otter habitat (derived from Sopuck et al. 1979).

- Minimize harassment of lynx by approaching on foot quietly and no closer than 100 m (328 ft) (derived from Tracy 1977).

- Minimize approaching on foot or establishing camps or other centers of human activity within 2.4 km (1.5 mi) of wolf dens, to avoid causing den abandonment (Ballard et al. 1982). If closer approaches must be made, remain at least 0.8 km (2,624 ft) away from dens in open habitat and 0.4 km (1,312 ft) in forested habitats (Sopuck et al. 1979). If a person must visit a den on foot, minimize harassment of wolves by doing so in late evening or early morning when most wolves are out hunting and by visiting for as short a time as possible no earlier in the year than 4 June (in Interior Alaska) (Ballard et al. 1982).

- Minimize the amount of intensive land development and frequent human presence in wolf habitat to minimize loss of areas in which wolves hunt (derived from Bangs et al. 1982 and Elliott 1983).

- Minimize the occasions in which wolves or foxes must be harassed with gunfire to drive them away from construction camps or work sites, by avoiding feeding the furbearers and by properly disposing of garbage (derived from Milke 1977). (Note: See Fencing, 8., Human disturbance, 12.a., and Solid waste disposal, 15.a., for the other applicable specific guidelines.)

- Minimize harassment of fox by maintaining a distance of 500 m (1,640 ft) from fox dens when on foot (derived from Gipson 1982). If this is not possible, minimize harassment of fox by avoiding dens by a minimum of 150 m (492 ft) (derived from Gipson et al. 1982, Ruttan 1974).

c. Harvest, change in level

(1) General guideline. Avoid establishing centers of human presence or increasing the frequency of human presence in furbearer habitat when excessive harvest of furbearers could result, unless restrictions on harvest are implemented (derived from Bangs et al. 1982, Sopuck et al. 1979). (Note: The Alaska Board of Game is responsible for preparation of hunting regulations, and the Departments of Public Safety and Fish and Game are responsible for enforcement.)

(2) Specific guideline. Minimize excessive harvest of scavenging furbearers such as foxes or wolves by workers in remote construction camps by educating workers and enforcing the applicable hunting and trapping regulations (derived from Milke 1977).

d. Introduced wild or domestic species, competition with or disease transmission from

General guideline. Avoid introducing domestic dogs to canid furbearer habitat, in order to avoid transmission of diseases such as distemper to furbearers, such as wolves (derived from Bangs et al. 1982).

13. Processing minerals (including gravel). Processing of minerals on the Kenai Peninsula has resulted in wolves avoiding the areas around such developments.

Harassment, active or passive

General guideline. Avoid developing mineral processing facilities in wolf habitat to avoid passive harassment and loss of habitat use by wolves (derived from Bangs et al. 1982).

14. Sewage disposal. The presence of sewage increased river turbidity and was associated with decreased use of a stretch of a river by beaver.

Water level or water quality fluctuations

General guideline. Avoid disposing of sewage into watercourses inhabited by aquatic furbearers unless the sewage has been properly treated so that turbidity will not be increased (derived from Arner et al. 1975).

15. Solid waste disposal. Wolves and foxes have been attracted to food and garbage at construction camps in remote areas.

Attraction to artificial food source

(1) General guideline. Avoid attracting wolves, foxes, or other carnivorous furbearers to construction camps or other areas where garbage is disposed of, by avoiding locating such areas in carnivorous furbearer habitat (derived from Milke 1977).

(2) Specific guideline. Minimize attraction of carnivorous furbearers to remote construction camps or dumps by immediately removing litter or garbage from work sites, incinerating edible garbage, storing garbage prior to incineration in animal-proof containers, and fencing dumps (Milke 1977). (Note: See Fencing, 8., for specific guidelines for fences.)

16. Transport of oil/gas/water - land. Carnivorous furbearers have been attracted to food and garbage at pumping stations along oil pipelines and have been harassed with gunfire to induce them to leave. Furbearers have also been poached by workers in those facilities. Foxes do not hunt near gas pipeline compressor stations. Spills during transportation of oil have coated and killed aquatic furbearers and have polluted water.

a. Attraction to artificial food source

See Human disturbance, 12.a., and Solid waste disposal, 15., for appropriate guidelines.

b. Harassment, active or passive

(1) General guideline. Avoid constructing pump stations or other centers of human activity in remote areas of carnivorous furbearer habitat to avoid passive harassment from human presence or the noise of machinery or active harassment by workers (derived from Milke 1977, Reynolds 1974).

(2) Specific guidelines:

° Minimize constructing gas pipeline compressor stations within 1.6 km (1 mi) of fox habitat, because foxes do not hunt within that distance from compressor stations (derived from Reynolds 1974).

° See Human disturbance, 12.b. (bullet no. 5), for a guideline applicable to active harassment.

c. Harvest, change in level

See Human disturbance, 12.c., for an applicable guideline.

d. Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid spilling petroleum or liquid petroleum products in aquatic furbearer habitat to avoid polluting water and exposing furbearers to liquid petroleum, a toxic substance (derived from Peller 1963).

e. Water level or water quality fluctuations

See d. above for an applicable guideline.

17. Transport of oil/gas/water - water. Aquatic furbearers have been coated with and poisoned by liquid petroleum spilled into waterbodies.

a. Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

See Transport of oil/gas/water - land, 16.d., for an appropriate guideline.

b. Water level or water quality fluctuations

See Transport of oil/gas/water - land, 16.d., for an applicable guideline.

18. Transport of personnel/equipment/material - air. Wolves, foxes, and marten have been harassed by light aircraft flying over them or over their dens.

Harassment, active or passive

(1) General guideline. Avoid flying light aircraft over wolf or fox habitat, because carnivorous furbearers may flee from aircraft, especially at dens (derived from Ruttan 1974, USDI 1976a).

(2) Specific guidelines:

- Minimize active harassment by avoiding flying small aircraft al low altitudes over wolves in areas where aerial wolf hunting is occurring or has recently occurred (derived from Klein 1973).

- Minimize active harassment by avoiding flying small aircraft directly over wolf dens (derived from Ballard et al. 1982).

- Minimize active harassment of wolves or foxes at construction areas or remote camps by helicopter to force them to leave the site, by avoiding feeding the furbearers and by properly disposing of garbage (derived from Milke 1977). (Note: See Fencing, 8., Human disturbance, 12.a., and Solid waste disposal, 15., for other applicable specific guidelines.)

- Minimize harassment of foxes at their dens by avoiding flying helicopters within 1.6 km (1 mi) of fox dens. If this distance cannot be maintained, minimize severe harassment by flying helicopters no closer than 300 m (984 ft) from fox dens.

19. Transport of personnel/equipment/material - land. Terrestrial furbearers are harassed by the passage of vehicles on roads and are attracted to road kills and to handouts of food from humans in vehicles. Collisions with highway vehicles kill furbearers, and poaching has increased as a result of traffic on roads through tundra areas. Hares attracted to natural and introduced roadside vegetation and to mineral deposits exposed along roads in turn attract furbearers such as wolves, lynx, and foxes. Dens have collapsed when driven over by off-road vehicles.

a. Attraction to artificial food source

(1) General guideline. Avoid transporting personnel, equipment, or material by land within furbearer habitat, to avoid causing road kills that attract carnivorous furbearers and to avoid feeding of foxes or wolves by personnel (derived from Tracy 1977). [Note: See Human disturbance, 12.a., for another applicable guideline.]

(2) Specific guideline. Minimize attraction of carnivorous furbearers to road kills by appropriately disposing of the carcasses as soon as possible (derived from Tracy 1977).

b. Collision with vehicles or structures, or electrocution by powerlines

General guideline. Avoid transporting personnel, equipment, or material by land within furbearer habitat unless vehicles travel so slowly that collisions with furbearers do not occur (derived from Milke 1977).

c. Harassment, active or passive

(1) General guideline. Avoid transporting personnel, equipment, or material by land within or adjacent to furbearer habitat (derived from Sopuck et al. 1979, Tracy 1977).

(2) Specific guidelines:

° Minimize passive harassment of fox by siting roads used by several vehicles per day at least 600 m (1,968 ft) from fox habitat. If that is not possible, minimize passive harassment of fox by siting roads more than 400 m (1,312 ft) from fox dens (derived from Sopuck et al. 1979, Tracy 1977).

° Minimize passive harassment of furbearers by siting roads or highways more than 200 m (656 ft) from lynx, wolf, or marten habitat (derived from Sopuck et al. 1979, Tracy 1977).

° Minimize passive harassment of red squirrel and weasel by siting heavily used roads to avoid habitat occupied by those furbearers (derived from Sopuck et al. 1979).

- Minimize passive harassment of wolves by siting roads or railroads at least 1 km (0.6 mi) from wolf dens (derived from Sopuck et al. 1979).

- Minimize harassment by continuing to drive past furbearers that are visible near roads rather than slowing down or stopping to observe them (derived from Sopuck et al. 1979).

d. Harvest, change in level

See Human disturbance, 12.c., for an applicable guideline.

e. Prey base, alteration of

General guideline. Avoid siting roads through carnivorous furbearer habitat, to avoid attraction of herbivores such as hares to natural or introduced roadside vegetation and consequent attraction of carnivorous furbearers (derived from Tracy 1977).

f. Terrain alteration or destruction

(1) General guideline. Avoid transport of personnel/-equipment/material by land along well-drained ridges that provide denning areas in fox or wolf habitat (derived from Ruttan 1974).

(2) Specific guideline. Minimize destruction of fox or wolf dens by ensuring that off-road vehicles are not driven over dens, which may collapse (derived from Ruttan 1974).

20. Water regulation/withdrawal/irrigation. Regulation of water levels has resulted in major impacts on aquatic furbearers and their habitat. Increased or highly variable water levels decrease the amount of emergent vegetation available as food for beaver and muskrat. Unusually high water levels increase predation on muskrat by flooding their houses, and low water levels allow predators to hunt under ice or force muskrats to congregate in remaining lakes. Decreased summer flooding allows emergent aquatic plant communities to change into meadow or willow vegetation that is unsuitable as muskrat habitat. High water levels in rivers during releases from dams destroy beaver and muskrat lodges, and low water levels downriver from dams that are being filled cause beaver to abandon colonies and cause lake depths to decrease so that lakes freeze to the bottom in winter, eliminating muskrat populations.

a. Aquatic vegetation, destruction or change in composition

(1) General guideline. Avoid artificially changing water levels in areas of emergent aquatic vegetation in muskrat or beaver habitat (derived from Sopuck et al. 1979). (Note: It is recognized that naturally occurring water level fluctuations are often necessary for the establishment or maintenance of emergent aquatic vegetation.)

(2) Specific guidelines:

- If water levels must be artificially changed in areas of emergent aquatic vegetation, minimize destruction of the vegetation by limiting water level fluctuations to 0.5 to 1.0 m (1.7 to 3.3 ft) in depth or less (derived from Sopuck et al. 1979).

- If impoundments must be constructed, minimize the long-term loss of emergent aquatic vegetation by avoiding drawdowns of the water so that such vegetation can become reestablished. If drawdowns are essential, harvest beaver and muskrat before flooding the area (derived from Baxter and Glaude 1980, Sopuck et al. 1979).

b. Parasitism and predation, increased susceptibility to

General guideline. Avoid artificially raising or lowering water levels in muskrat or beaver habitat, so that the aquatic furbearers are neither forced out of their lodges and exposed to predation nor exposed to predation by carnivorous furbearers in their lodges or dens or under an ice cover (derived from Sopuck et al. 1979).

c. Vegetation composition, change to less preferred or useable species or successional stage

General guideline. Avoid decreasing the amount of summer flooding that occurs along rivers, in order to avoid areas of emergent aquatic vegetation that provide food for muskrats being converted to meadows or willow stands by plant succession in the absence of flooding (derived from Sopuck et al. 1979, Vinogradov and Chernyavskoya 1976).

d. Water level or water quality fluctuations

(1) General guideline. Avoid constructing water regulation projects or withdrawing water from water bodies in beaver or muskrat habitat when alterations in water

13. Moose

Table 1. Impacts Associated With Each Activity - Moose

Impacts / Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change			?			?	?			?																				?
Attraction to artificial food source				X	?	X						X													X			X		
Barriers to movement, physical and behavioral		X	?		X	X	?		X			X		?					?						X			X		?
Collision with vehicles or structures																												X		
Entanglement in fishing nets, debris					?				X																					
Entrapment in impoundments or excavations												?										?						X		?
Harassment, active or passive	X		?		X		?	X		?	?	X	?	X	?		?	?	?	?	?	?			?	?	X	X	?	?
Harvest, change in level		X			X	?	?	X				X						?	?						X			X	X	?
Introduced wild/domestic species, competition													X																	?
Morbidity/mortality by ingestion of petroleum				?				?												?					?	?				
Parasitism/predation, increased susceptibility					?									X																
Prey base, alteration of																														
Shock waves (increase in hydrostatic pressure)																														
Terrain alteration or destruction	?	X					X			X	?	?			?							?			?					?
Veg. composition, change to less preferred		X			X	X	X					X	X						?											X
Veg. damage/destruction due to air pollution				X															?	?										
Veg. damage/destruction due to fire/parasitism		X																												
Veg. damage/destruction due to grazing													X																	
Veg. damage/destruction due to erosion		?			X	X	X			X	?	X			?				?			?								
Water level or water quality fluctuations			?			?	X			X			?								?									X

X - Documented impact (see text).
? - Potential impact.

13. MOOSE - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Will the proposed activity affect use of mineral licks by moose during the spring and early summer?

2. Would the proposed activity affect use of calving areas by cow moose in the spring, particularly well-drained, dense stands of trees or tall shrubs in wetland areas?

3. Will the proposed activity affect riparian or other willow stands, especially those near closed-canopy forests and mature forests, both of which are used as winter range by moose?

4. Will the proposed activity affect large areas of aquatic and emergent vegetation used by moose during the spring and summer?

5. Will the proposed activity affect travel corridors used by moose for movements between seasonal ranges?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

1. Blasting. Two references documented movements or displacement of moose because of blasting and associated human activity for road construction or seismic exploration.

   Harassment, active or passive

   (1) General guideline. Avoid production-level blasting (e.g., for road construction or seismic exploration) in areas of important moose habitat (e.g., winter range, calving areas, or mineral licks) to avoid displacing or disturbing moose (derived from Bangs and Bailey 1982, Sopuck et al. 1979). (Note: See the life history section of the Alaska Habitat Management Guides for the times and locations of calving and concentration areas.)

   (2) Specific guideline. Minimize harassment of moose on winter range during seismic exploration by remaining a minimum of 100 m (328 ft) from moose when working on foot and by avoiding moose concentration areas in winters of deep snow (derived from Bangs and Bailey 1982).

2. Burning. Although burning of forested areas is usually beneficial to moose, some impacts of burning on moose have been documented under certain conditions. Fires kill some moose or force them to move. Uniform, large, complete burns create large open areas that moose tend to avoid and eliminate patches of mature forest necessary for shelter in mid to late winter. A delay of 5-10 yr occurs before significant quantities of moose browse are produced in burned areas, and repeated, deep, high temperature burns retard succession such that total available browse could decline. Fire control operations often result in a network of roads and open areas that facilitate hunting.

   a. Barriers to movement, physical and behavioral

      General guideline. Avoid burning areas where moose are calving, to avoid burning very young calves or forcing them to move (derived from Davis and Franzmann 1979).

   b. Harvest, change in level

      (1) General guideline. Avoid large, uniform, complete burns in areas of moose habitat where moose populations could be subject to excessive hunting pressure unless restrictions on harvest are implemented (derived from

Davis and Franzmann 1979). (Note: The Alaska Board of Game is responsible for preparation of hunting regulations, and the departments of Public Safety and Fish and Game are responsible for enforcement.)

(2) Specific guideline. Minimize the potential for excessive hunting pressure after a large, uniform burn by closing fire control roads (derived from Tomm et al. 1981).

c. Terrain alteration or destruction

General guideline. Avoid burning areas heavily used as winter moose range that are in an early successional stage, because a delay of 5 to 10 yr would occur before large quantities of browse would again be produced. (Note: See the distribution and abundance section of the Alaska Habitat Management Guides for locations of winter range.) Avoid repeatedly burning areas where fires would burn hot and deep, to avoid destroying the soil and retarding vegetation succession (both guidelines derived from Davis and Franzmann 1979).

d. Vegetation composition, change to less preferred or useable species or successional stage

General guideline. Avoid burning areas of moose habitat under unusually dry conditions that would result in a large uniform burn in which no patches of mature forest would remain to provide midwinter cover for moose (derived from Eastman 1974, Irwin 1975, Peek et al. 1976, Sopuck et al. 1979).

e. Vegetation damage/destruction due to fire or induced parasitism

See d. above for an applicable guideline.

3. Chemical application. Documentation confirms two impacts of chemical application on moose: attraction in spring to saline pools along roads that had been treated with salt to melt ice during the winter or to salt blocks set out specifically to attract moose for viewing, and damage to winter browse (willows) by herbicides. Collisions resulting from attraction of moose to salt along roadsides are discussed under the activity Transport of personnel/equipment/material - land, 15c.

a. Attraction to artificial food source

(1) General guideline. Avoid application or placement of sodium salts (e.g., road de-icing salt or salt blocks) in areas of moose spring or summer range whenever saline pools or undissolved salt would be present during spring or summer (derived from Grenier 1973, Fraser and Thomas 1982, Murie 1934).

(2) Specific guidelines:

- Minimize accumulation of de-icing salt in roadside pools by covering road shoulders with an impermeable surface so rainwater will dilute the salt (Fraser and Thomas 1982).

- Minimize attraction of moose to saline roadside pools by draining the pools or by applying a cervid repellent to pools that cannot be otherwise treated (Fraser and Thomas 1982).

- If salt accumulation cannot be avoided or treated, minimize attraction of moose by substituting other de-icing chemicals for sodium chloride (e.g., calcium chloride). Urea may fertilize vegetation and is not recommended (Fraser and Thomas 1982). Likewise, ethylene glycol is toxic to canids and other wildlife and is not recommended.

- Only if no other method is completely successful, minimize attraction of moose to saline roadside pools by establishing artificial salt licks distant from the highway (Fraser and Thomas 1982).

b. Vegetation damage/destruction due to air pollution or contact with petroleum products or chemicals

General guideline. Avoid applying herbicides that kill willows in important winter moose range, unless necessary to prevent more severe impacts to moose (e.g., deaths of moose from collision with trains after the moose are attracted to railroad rights-of-way) (derived from Somerville 1965).

4. Clearing and tree harvest. Passive harassment results in moose avoiding areas that are being logged. Other impacts continue after harvest or clearing is complete. Windrows of bulldozed timber block movements of moose. Harvest of moose increases when access and visibility are improved. Removal of productive shrub stands used as winter habitat decreases the food supply for moose

during the critical winter period, and removal of closed-canopy forests over extensive areas eliminates the cover needed by moose during severe winter weather and whenever snow is deep. (Note: If a cleared area is left to revegetate, a shrub stand that provides optimum winter feeding habitat for moose may develop in a few years. However, procedures for artificially enhancing moose habitat in this way are not covered in the following guidelines because enhancement is not an impact, according to our definition.)

Habitat conditions in the coastal forests of Southcentral and Southeast Alaska are sufficiently different from those in the rest of the state that an additional set of guidelines has been written for coastal forests in those two regions (see d. below).

a. Barriers to movement, physical and behavioral

(1) General guideline. Avoid piling timber and slash into continuous long windrows that would block the movements of moose (derived from Sopuck et al. 1979).

(2) Specific guideline. If timber and slash must be piled in long windrows, minimize blocking the movements of moose by bulldozing breaks through the windrows through which moose can pass (derived from Sopuck et al. 1979).

b. Harassment, active or passive

(1) General guideline. To avoid harassment of moose, avoid clearing land or harvesting trees in areas of moose habitat when moose are present (derived from Sopuck et al. 1979, Tomm et al. 1981).

(2) Specific guideline. Minimize passive harassment of moose during clearing or tree harvesting by working at a distance of at least 1-2 km (0.6-1.25 mi) from moose from early winter through the calving period in May (derived from Hancock 1976).

c. Harvest, change in level

(1) General guideline. Avoid clearing land or harvesting trees in areas of moose habitat where moose populations could be subject to excessive hunting pressure unless restrictions on harvest are implemented (derived from Preston 1983a). (Note: The Alaska Board of Game is responsible for preparation of hunting regulations, and the departments of Public Safety and Fish and Game are responsible for enforcement.)

(2) Specific guideline. Minimize the potential for excessive hunting pressure after clearing land or harvesting trees by constructing no more roads than necessary and by closing the roads during the hunting season (derived from Tomm et al. 1981).

d. <u>Vegetation composition, change to less preferred or useable species or successional stage</u>

The following guidelines apply for all regions of the state. Additional guidelines specific to the coastal forest of Southeast and Southcentral Alaska are presented on pages 13-10.

(1) General guideline. Avoid clearing or tree harvest in areas that are important winter range for moose (derived from Telfer 1974). Avoid clearing or logging very large tracts of land in areas of moose habitat without retaining areas of mature forest (derived from Monthey 1984, Telfer 1974).

(2) Specific guidelines:

- Minimize the impact of removing mature forest stands used by moose as cover by leaving 20-80% of the mature forest standing in logging areas (derived from Peek et al. 1976, Telfer 1974).

- Minimize the impact of removing mature forest stands used by moose as cover by harvesting trees in a well-dispersed, heterogeneous pattern of cut blocks (Parker and Morton 1978) averaging about 97.1 ha (240 acres) in size, ranging from about 24 ha (60 acres) to about 130 ha (325 acres) (derived from Telfer 1974, Tomm et al. 1981).

- If the amount of mature forest in the area is limited or if harassment to moose due to any cause is expected to be moderate or high, minimize the impact of tree harvesting by limiting the maximum cut block size to about 40-50 ha (100-125 acres) (Parker and Morton 1978 and derived from Tomm et al. 1981).

- If any cut blocks must be made larger than about 130 ha (325 acres), minimize the loss of moose habitat by retaining stands of mature forest at least 2 ha (5 acres) in size within the cut blocks (derived from Monthey 1984) no greater than 201.2 m (660 ft) apart in areas of low harassment (Telfer

1974) or 121-161 m (397-528 ft) apart in areas of moderate or high harassment (Tomm et al. 1981).

- Minimize the clearing or logging of large areas in which the distance from cover and the presence of deep drifted snow limit the use of the central portions of the cleared areas by moose by cutting areas in strips no wider than 201.2 m (660 ft) in areas of low harassment (Telfer 1974) and 121-161 m (337-528 ft) in areas with moderate or high harassment (Tomm et al. 1981).

- Minimize the impact of removal of mature coniferous forest stands that intercept snow and provide moose habitat during periods of deep snow by retaining patches of coniferous forest as "leave blocks" (i.e., uncut areas). If only deciduous forest patches are available, minimize the impact of logging adjacent areas by retaining deciduous stands (derived from Sopuck et al. 1979).

- Minimize the impact of removing mature forest stands used by moose as cover adjacent to cut or cleared areas by retaining leave strips of mature forest a minimum of 101 m (330 ft) wide in areas of low harassment (Tomm et al. 1981) and 221-402 m (725-1,320 ft) wide in other areas (derived from Tomm et al. 1981).

- Minimize the impact of clearing on moose in areas with several cleared or harvested blocks by retaining forested corridors at least 100 m (328 ft) wide that connect the remaining blocks of mature forest so that moose can remain in cover when moving from one forested block to another (Preston 1983a).

- Minimize the impact of removing mature forest stands used by moose as cover by waiting at least 30 yr, the time required for a clear-cut area to regenerate to a closed-canopy forest, before cutting leave blocks adjacent to cut blocks (Telfer 1974).

- Minimize the impact of clearing and tree harvest on shrubs used as browse by moose by not scarifying areas from which trees have been harvested where shrubs or their root systems are present (derived from Sopuck et al. 1979).

- Minimize the impact of selective harvesting of trees by cutting a sufficient proportion of the trees to open the canopy to stimulate shrub growth, leaving a basal area of less than 17.2 m^2/ha (75 ft^2/acres) (derived from Telfer 1974) and by retaining adjacent, uncut blocks as in the case of clear-cut areas (Crete 1976).

- Minimize the harassment due to increased access after clearing or tree harvest that prevents moose from using the central portions of revegetating clearcuts by closing logging roads (derived from Tomm et al. 1981).

- Minimize the effects of the marked decline in the quality of winter feeding habitat for moose that occurs after revegetating clearcuts reach an age of 15 to 20 yr and of the loss of habitat values that occur from the time of cutting until revegetating shrubs provide winter browse at the age of 5 to 10 yr by planning a cutting rotation in which some areas are always at or near the period of peak browse productivity about 8 to 15 yr after cutting (derived from Davis and Franzmann 1979, Hunt 1976, Parker and Morton 1978, Telfer 1974, Sopuck et al. 1979). (Note: This guideline does not pertain to coastal coniferous forests of Southeast and Southcentral Alaska because clear-cuts there are not used as winter range by moose.)

The following guidelines apply to the coastal forests of Southcentral and Southeast Alaska.

(1) General guideline. Avoid clearing or tree harvest of old-growth coastal coniferous forests around and within important moose habitat areas used for feeding, breeding, or movement. Avoid clearing or tree harvest of old-growth forest types that are limited in extent in watersheds used by moose, and retain a portion of all old-growth forest types that provide cover and browse for moose during periods of deep snow (Sigman 1985).

(2) Specific guidelines. If old-growth coastal coniferous forests that provide moose habitat must be harvested,

   - minimize loss of mid-to-late-winter moose habitat by avoiding harvest of river terrace forests and high-volume forests at lower elevations (Doerr in press, Doerr 1983);

- minimize loss of cover adjacent to high-density moose use areas by avoiding harvest of coniferous or mixed hardwood-coniferous stands within 1,000 ft (305 m) of the use area (derived from Sigman 1985).

- minimize loss of mid-to-late-winter moose habitat by disproportionately harvesting lower-volume forests in clear-cut blocks less than 50 to 80 ha (125 to 200 acres) in size and retain sufficient uncut forest to maintain moose winter habitat needs (Doerr in press);

- minimize loss of the overall quality of moose habitat in clear-cut areas by maintaining equal proportions of forested mid-to-late-winter range and clear-cuts that are producing abundant forage by partitioning timber harvest equally throughout the rotation period (Doerr in press);

- minimize the loss of forage that occurs as young conifers develop in clear-cuts by clear-cutting new areas several years before browse production declines in previous clear-cuts as they reach about 25 to 35 yr of age, to allow for low forage production and low use by moose for the first 8 yr or so after clear-cutting (Doerr in press);

- minimize the loss of browse that occurs as young conifers develop in clear-cuts by thinning trees in regenerating stands at 15 to 20 yr of age to a spacing of 3.6 by 3.6 m (12 by 12 ft) without cutting shrubs (Doerr in press, Doerr et al. 1980);

- minimize the time period in which second-growth forests produce no browse and are unuseable by moose by shortening the harvest rotation period to 40 to 60 yr (Doerr in press, Doerr et al. 1980).

e. <u>Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay</u>

(1) General guideline. Avoid clearing marsh or willow habitats used by moose for winter browse, and avoid tree harvest in adjacent forests that provide cover for moose during periods of deep snow, especially when the resulting land use would not allow revegetation to occur (derived from Klebesadel and Restad 1981, Sopuck et al. 1979).

(2) Specific guidelines. See d. above for applicable guidelines, bearing in mind that if the area will not be allowed to revegetate, the guidelines designed to facilitate moose use of that area will not apply.

5. Draining. Draining of marsh and shallow lake areas for agriculture has destroyed aquatic vegetation types in which moose prefer to feed in spring and summer and which provide an important source of sodium in June. Draining and clearing of willow stands has destroyed an important forage type used by moose in late summer and in winter. Successional willow and aspen stands colonizing drained marshes may provide winter browse for several years, but the vegetation matures and becomes unuseable by moose if the area remains dry. Drainage ditches can act as barriers to free movement of moose, and willows growing along ditches attract moose to hazardous areas such as roadsides.

a. Attraction to artificial food source

General guideline. To prevent moose from being attracted to roadsides where they may be killed by collisions, avoid allowing willows to grow in drainage ditches along roads in areas where willows do not occur in the immediate surrounding natural vegetation (derived from Sopuck et al. 1979, Tracy 1977).

b. Barriers to movement, physical and behavioral

General guideline. Avoid digging large drainage ditches that would block the movements of moose through areas of high-quality moose habitat (e.g., intensive spring and summer feeding areas, calving areas, winter range, or migration areas), to enable moose to use important habitat areas uniformly (derived from Phillips et al. 1973).

c. Vegetation composition, change to less preferred or useable species or successional stage

(1) General guideline. Avoid draining areas of aquatic vegetation, marsh, or willow stands that provide feeding areas for moose during summer or winter (derived from Phillips et al. 1973, Somerville 1965, Sopuck et al. 1979).

(2) Specific guideline. Minimize the loss of moose habitat in areas that must be drained by allowing successional stands of browse plants such as willow to grow in areas not also cleared for development and by rejuvenating such stands before they mature (Phillips et al. 1973).

d. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

General guideline. Avoid clearing areas of aquatic vegetation, marsh, or willow vegetation used by moose at any time of the year in the process of draining areas for development (derived from Phillips et al. 1973).

6. Dredging. Removal of gravel from floodplains for construction use or during placer mining for gold has resulted in immediate and long-term impacts on riparian shrub vegetation that provides the only winter browse for moose in arctic areas and is also important in subarctic areas. Mining of vegetated gravel bars results in immediate habitat loss. In some cases, revegetation occurs, but changes in river hydraulics and water levels resulting from gravel removal in or adjacent to active channels have been shown to result in long-term moose habitat loss because of permanent or annual flooding or aufeis accumulation.

a. Terrain alteration or destruction

(1) General guideline. Avoid gravel removal from floodplains in areas where riparian shrub stands provide winter habitat for moose (derived from Joyce 1980, Joyce et al. 1980, Kertel 1984).

(2) Specific guidelines:

- Minimize destruction of gravel bars or floodplains that support vegetation by avoiding vegetated habitats during dredging and accompanying hauling or processing activities (Joyce 1980).

- Minimize alteration of river channels when scraping in active or inactive floodplains by maintaining buffers that will contain active channels to their original locations and configurations (Joyce 1980).

- To minimize damage to gravel bars supporting vegetation, select sites that will scrape only unvegetated gravel deposits when small quantities of gravel are required (less than 50,000 m^3 [65,350 yd^3]) (Joyce 1980).

- Minimize destruction of active floodplains of small rivers when large quantities of gravel are required (more than 50,000 m^3 [65,350 yd^3]) by selecting terrace locations on the inactive side of the floodplain and mining by pit excavation or by selecting large rivers containing sufficient gravel in unvegetated areas (Joyce 1980).

- Minimize the destruction of floodplain habitat useful to moose when pit mining gravel by designing pits with high shoreline and water depth diversity and providing islands, so that aquatic plants useful to moose in summer can grow (derived from Joyce 1980).

- If vegetated areas must be dredged, minimize the time required for revegetation and the degree of terrain destruction by saving all overburden, vegetative slash, and debris for use during site rehabilitation. Also retain undisturbed vegetated corridors through the sites. Pile or broadcast overburden and vegetative materials in such a manner that they will not be washed downriver. Plant native vegetation on the rehabilitated areas to accelerate revegetation, particularly if the overburden and vegetative materials have been stockpiled for more than one growing season and the vegetative materials and root stocks have died (Joyce 1980, and derived from Kertel 1984).

b. <u>Vegetation composition, change to less preferred or useable species or successional stage</u>

See a. above for applicable guidelines.

c. <u>Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay</u>

See a. above for applicable guidelines.

d. <u>Water level or water quality fluctuations</u>

See a. above for applicable guidelines.

7. <u>Drilling</u>. Human activity associated with drilling for oil and gas has been shown to disturb moose, and access improvements have resulted in increased harvest. Most of the impacts are due to the development of roads rather than to drilling itself.

a. <u>Harassment, active or passive</u>

(1) General guideline. Avoid drilling for oil or gas in areas of important moose habitat (e.g., calving areas, mineral licks, areas of aquatic vegetation, or winter

range) (derived from Somerville 1965). (Note: See the life history and distribution and abundance sections of the Alaska Habitat Management Guides for locations and times of use of such areas.)

(2) Specific guideline. If drilling is done in areas of important moose habitat, minimize harassment by constructing the minimum necessary road network and by closing roads after operations are completed (derived from Tomm et al. 1981).

b. Harvest, change in level

(1) General guideline. Avoid developing a road network during drilling in areas of moose habitat where moose populations could be subject to excessive hunting pressure unless restrictions on harvest are implemented (derived from Grauvogel 1984, Lynch 1973). (Note: The Alaska Board of Game is responsible for preparation of hunting regulations, and the Departments of Public Safety and Fish and Game are responsible for enforcement.)

(2) Specific guideline. Minimize the potential for excessive harvest pressure after a road network is developed by closing drilling roads after exploration or production and rehabilitation are complete (derived from Tomm et al. 1981).

8. Fencing. Barbed wire livestock fences have entangled and killed moose. High-tensile smooth-wire electric fences and barbed wire fences have blocked moose movements.

a. Barriers to movement, physical and behavioral

(1) General guideline. Avoid constructing fences in moose habitat that would block the movements of moose (derived from Preston 1983a).

(2) Specific guidelines. If fences that block moose movement must be built, e.g., to prevent moose from consuming crops or to direct moose to highway crossing structures, the following guidelines are applicable:

° Minimize the likelihood that a permanent fence will not successfully block moose movement by implementing the following: 1) construct a fence before crops become palatable, 2) make the fence highly visible to moose by clearing all vegetation in a 3 m (10 ft) wide strip outside the fence and by tying yellow flagging onto each strand of the fence at 1.5 to 1.8 m (5 to 6 ft) intervals (Burris 1965), and 3) construct a stout vertical fence of smooth high-tensile wire 1.8 m (6 ft) or more in height that is electrically charged according to the specifications in Hauge (1985).

- If only a temporary fence is needed during the snowfree season and the fence does not have to block all moose that attempt to cross it, minimize unnecessary expense by following the first two recommendations above, then stringing a single smooth, charged wire 55 cm (22 in) above the ground and hanging aluminum foil flags baited with an attractant such as peanut butter or corn oil on the wire to induce moose to touch the wire and recieve a strong shock (Kinsey 1976).

- See the guidelines for Sitka black-tailed deer, Fencing, 5.a., for other fence designs that could be made taller and stronger to block moose movements.

b. Entanglement in fishing nets, marine or terrestrial debris, or structures

General guideline. In moose habitat, avoid constructing fences that could entangle moose, such as typical barbed wire livestock fences (derived from Preston 1983a). Although documentation has not been located on livestock fences that allow moose to cross them without becoming entangled, see the Fencing, 5.a., guidelines for Sitka black-tailed deer for designs that might be successful.

9. Filling and pile-supported structures (aquatic). Filling is often associated with dredging of gravel from floodplains, for construction of access roads, or for stockpiling of gravel or tailings. Documented impacts to moose are the same as those from dredging: destruction of vegetation that provides important winter browse and cover, terrain alteration, and changes in river hydraulics and water levels, including depth to water under gravel bars. The latter is important in determining the type of vegetation, if any, that will colonize an area after filling.

a. Terrain alteration or destruction

See Dredging, 6.a., for appropriate guidelines.

b. Vegetation damage/destruction due to hydraulic or thermal erosion or disposition, mechanical removal, or material overlay

See Dredging, 6.a., for appropriate guidelines.

c. Water level or water quality fluctuations

See the guidelines discussing alteration of river channels in Dredging, 6.a..

10. Grading/plowing. Although it is recognized that successional stands of willows and other browse species that naturally revegetate areas disturbed by grading and plowing and subsequently abandoned are usually beneficial to moose, grading and plowing also cause impacts. Shrub stands naturally revegetating mined areas have attracted moose, as have vegetable gardens. Such moose have become nuisances. Roads and deep ditches for laying pipelines have blocked movement of moose. Moose have avoided areas of active road construction and agricultural land in production because of disturbance. Placing lands into agricultural production has resulted in increased harvest of moose because of the improved access and visibility created by such agricultural development. Moose browse and summer forage have been greatly reduced or eliminated on active farms, in mined areas revegetated to grasses, or where natural revegetation such areas of tailings is very slow, and in areas previously farmed on which willow regrowth has reached the mature stage.

a. Attraction to artificial food source

(1) General guideline. In areas of moose habitat, avoid growing vegetable gardens or other crops that are palatable to moose (derived from Burris 1965, Chatelain 1951, Preston 1983a and b). Avoid allowing graded areas to revegetate to young willow stands in areas where there are no naturally occurring young willow stands, because moose will be attracted to the new stands (derived from Chatelain 1951, Elliott 1983).

(2) Specific guideline. Minimize attracting moose to vegetable gardens, haystacks, and palatable crops by fencing fields with easily visible, sturdy materials (Burris 1965, Preston 1983a). (Note: See Fencing, 8.a., for specific guidelines for fencing that will exclude moose.)

b. Barriers to movement, physical and behavioral

(1) General guideline. Avoid grading roads or digging deep, long ditches (e.g., for buried large-diameter pipelines) in moose habitat (derived from Phillips et al. 1973, Sopuck and Vernam 1984, Van Ballenberge 1978).

(2) Specific guidelines:

- Minimize blocking moose movements during construction of buried pipelines by timing construction activities to avoid migration periods and by restricting the maximum length of deep (e.g., 3 m [10 ft]) ditches or of large diameter (e.g., 1.2 m [4 ft]) pipe sections lying on the ground to 0.8 km (0.5 mi) (Sopuck and Vernam 1984, Van Ballenberghe 1978).

- Minimize the time period during which deep ditches or pipe on the ground block moose movements by removing the blockage by burying or elevating the pipe as soon as possible (Van Ballenberghe 1978).

c. Harassment, active or passive

(1) General guideline. Avoid cultivating land or constructing roads in areas of moose habitat (derived from Mytton and Keith 1981, Sopuck et al. 1979, Tomm et al. 1981).

(2) Specific guideline. Minimize passive harassment of moose from plowing by working a minimum of 1.5 km (0.94 mi) from moose and by cultivating no more than 30% of the land in an area used by moose (derived from Mytton and Keith 1981).

d. Harvest, change in level

(1) General guideline. Avoid grading roads and plowing land in areas of moose habitat where moose populations could be subject to excessive hunting pressure unless restrictions on harvest are implemented (derived from Bergerud et al. 1968, Lynch 1973, Preston 1983a). (Note: The Alaska Board of Game is responsible for preparation of hunting regulations, and the departments of Public Safety and Fish and Game are responsible for enforcement.)

(2) Specific guideline. Minimize the potential for excessive hunting pressure after grading roads or

plowing land by closing any roads built for a specific job after that job is completed (derived from Tomm et al. 1981).

e. Vegetation composition, change to less preferred or useable species or successional stage

(1) General guideline. Avoid grading or plowing within areas used by moose for feeding or cover whenever a vegetation type equally or more useable by moose will not revegetate the area within a few years (derived from Elliott 1983, Kertel 1984, Preston 1983b, Somerville 1965).

(2) Specific guidelines:

° Minimize loss of moose habitat in revegetated mined areas by avoiding reseeding to grasses and by reseeding or replanting native shrubs instead (Elliott 1983, Kertel 1984).

° Minimize the impact of grading or plowing and hasten natural revegetation by retaining corridors of undisturbed shrub vegetation in riparian zones (Elliott 1983, Kertel 1984).

° Minimize loss of moose habitat in agricultural areas by allowing abandoned fields to revegetate to willows and by rejuvenating such willow stands when they become mature (derived from Phillips et al. 1973, Somerville 1965, Sopuck et al. 1979).

f. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

(1) General guideline. Avoid grading or plowing in areas of moose winter range and in other habitat areas important to moose (derived from EPA 1982, Mytton and Keith 1981, Somerville 1965).

(2) Specific guidelines:

° Minimize the impact of large farms, which provide very little moose habitat unless abandoned for several years, by retaining forested corridors a minimum of 100 m (330 ft) wide between large cleared fields (Preston 1983a, and derived from Phillips et al. 1973, Sopuck et al. 1979). Other means of minimizing the impact of farms include retaining undisturbed riparian shrub vegetation, minimizing establishment of farms in valley bottoms, allowing abandoned farms and roads to revegetate to willows, and on abandoned farms rehabilitating browse that has grown beyond the reach of moose (derived from Klebesadel and Restad 1981, Leopold and Darling 1953, Somerville 1965).

- Minimize the impact of farming by converting no more than 30% of the land in an area of moose habitat into farms (derived from Mytton and Keith 1981).

- Minimize the impact of clearing of winter moose habitat for roads by routing roads out of valley bottoms and along uplands and ridges (Grauvogel 1984).

- Minimize impacts of mining in riparian vegetation by leaving areas of undisturbed vegetation in mined areas, saving and reapplying overburden and fines, and replanting native vegetation (Kertel 1984).

- Minimize impacts of urban development on winter moose habitat by reserving continuous areas of riparian shrub vegetation connected to undisturbed habitat away from intensive development (derived from EPA 1982).

- See Dredging, 6.a., for additional guidelines appropriate to gravel removal from riparian areas.

11. <u>Grazing</u>. One type of impact to moose has been documented as resulting from grazing. Grazing of cattle in riparian areas has damaged shrubs that provide winter browse for moose.

   a. <u>Vegetation composition change to less preferred or useable species or successional stage</u>

      (1) General guideline. Avoid grazing cattle in moose winter habitat so that cattle will not concentrate in and cause damage to riparian shrub stands used as browse by moose (derived from Holechek et al. 1982, Knopf and Cannon 1982).

      (2) Specific guideline. If cattle must be grazed in moose winter habitats minimize damage to riparian shrub stands by using low stocking levels and limiting the length of time of grazing or the specific areas that are grazed, by keeping cattle away from riparian areas with fences

that do not block movements of nor entangle moose, or by grazing sheep controlled by herding instead of cattle (Holechek et al. 1982).

b. Vegetation damage/destruction due to grazing by domestic or introduced animals

See a. above for appropriate guidelines.

12. Human disturbance. Abundant documentation is available on both active and passive harassment of moose as a result of human disturbance. Active harassment commonly occurs when moose are approached for observation, photography, or hunting. Passive harassment results from a wide variety of tasks performed in moose habitat (e.g., hiking or skiing, vacation homes, or geological reconnaissance). The presence of dogs evokes a defense response much stronger than the response of moose to humans alone. Domestic dogs have also killed moose calves. Although moose are not so overtly sensitive to human disturbance as are social ungulates such as Dall sheep, apparently minor responses, such as moose walking slowly into cover while continuing to browse, have been shown to precede movement over a considerable distance to a totally different feeding area. Moose usually are not displaced from good habitat, but range abandonment has been documented to have resulted from human disturbance. The tendency of moose to stand motionless or to make delayed responses to human disturbance makes it difficult to determine the degree of harassment that occurs. Moose also become habituated to repeated, predictable passive harassment from human disturbance.

a. Harassment, active or passive

(1) General guideline. Avoid human disturbance in moose habitat, particularly in winter range and in calving areas, whenever moose are present. Avoid harassing or approaching moose, in particular cows with calves (derived from Doerr 1983, Geist 1971a, Murie 1934).

(2) Specific guidelines:

- Except when hunting, minimize approaching bulls in velvet and cows with calves at heel within 60 m (200 ft) and moose at other life stages within 30-50 m (100-150 ft), even if approaching habituated moose slowly and quietly (derived from Altmann 1958, McMillan 1954). Minimize approaching nonhabituated moose within 200-300 m (650-1,000 ft) (derived from LeResche 1966, McMillan 1944, Tracy 1977) or within 700 m (2,296 ft) in open tundra (derived from Mould 1977).

- Except when hunting, minimize talking within 366 m (1,200 ft) of moose across water or in other habitats where sound carries well (derived from Cobus 1972).

- Except when hunting, minimize making sharp, loud noises within 457-549 m (1,500-1,800 ft) of moose (derived from Geist 1963).

- Except when hunting, minimize approaching moose in open terrain (derived from Altmann 1958) or in water (derived from McMillan 1954).

- Except when hunting, minimize approaching moose at times other than dusk and dawn, and avoid approaching even habituated moose of both sexes within 90 m (300 ft) during a bull or cow moose hunting season (derived from Altmann 1958).

- Minimize passive harassment of moose by establishing cross-country skiing trails or areas for other public or private activities producing low noise levels at least 500 m (1,600 ft) from moose winter range, and minimize locating such areas in open terrain (derived from Ferguson and Keith 1982).

- Minimize passive harassment of moose by locating public or private areas for winter and early spring (through May) recreation, including cabins and/or motorized vehicle use, when high or moderate levels of use are anticipated, at least 1.2 km (0.6-1.25 mi) from winter moose range and calving areas (derived from Hancock 1976).

- Except when hunting, minimize passive harassment of moose by avoiding nonrepetitive tasks involving humans on foot within 1.5-2 km (1-1.25 mi) of moose (derived from Hancock 1976, Mytton and Keith 1981). If this distance cannot be maintained, minimize harassment by working in cover rather than in open areas and at a minimum of 100 m (328 ft) from habituated moose in winter (derived from Bangs and Bailey 1982, Mould 1977).

- Minimize passive harassment by locating developments away from riparian vegetation utilized by moose, particularly winter range (Grauvogel 1984 and derived from EPA 1982).

° Minimize the effects of developments and associated noise by visually screening the developments from moose habitat (derived from McMillan 1954).

b. Parasitism and predation, increased susceptibility to

General guideline. Avoid allowing domestic dogs to run free in areas where moose calve or feed during spring and early summer, because dogs can kill moose calves (derived from Bangs et al. 1982).

13. Transport of oil/gas/water - land. Pipelines have been documented to block movements of moose. Moose do not cross deep ditches opened for burial of large pipelines, nor do they cross large pipelines that are partially buried or elevated a few feet above the ground. Increased access and clearing associated with pipelines have increased harvest of moose and attracted moose to revegetating clearings.

a. Attraction to artificial food source

General guideline. To avoid attracting moose to shrub stands revegetating pipeline rights-of-way (ROWs), avoid allowing cleared ROWs to revegetate to shrub stands in areas where shrub stands do not occur adjacent to ROWs (derived from Brusnyk and Lunseth 1985).

b. Barriers to movement, physical and behavioral

(1) General guideline. To maintain freedom of movement for moose, avoid transporting oil, gas, or water by pipeline through moose habitat (derived from Eide and Miller 1979, Sopuck et al. 1979).

(2) Specific guidelines:

° See Grading/plowing, 10.b., for specific guidelines for ditches and pipe on the ground.

° Minimize blockage of moose migration by timing all pipeline construction work for nonmigratory periods (Sopuck and Vernam 1984).

° Minimize blocking moose movement by maintaining installed pipe clearances from the ground at a minimum of 1.2 m (5 ft) and an average of 1.8-2.4 m (6-8 ft) in areas of average snow depths of 0.3 m (1 ft) or less (derived from Eide and Miller 1979, Hanley et al. 1981, Van Ballenberghe 1978).

c. Harvest, change in level

See Transport of personnel/equipment/material - land, 15.f., for applicable guidelines.

14. Transport of personnel/equipment/material - air. This activity has been documented to result in a single impact to moose, that of harassment. Operating light aircraft near moose, whether or not the aircraft is flown directly toward them (e.g., for photography or sightseeing), results in interruption of activity, running, or panic. Habituation does occur, and even prior to habituation moose are less sensitive to light aircraft than are other ungulates such as caribou.

Harassment, active or passive

(1) General guideline. Avoid low-altitude flights over moose habitat, especially over calving areas and early to mid-summer range where cows with young calves occur, to avoid passive harassment of moose. Avoid flying directly toward or hovering over moose (derived from EPA 1982, Geist 1971b, LeResche 1966, Rausch 1958, USDI 1976a).

(2) Specific guidelines:

- Minimize harassment of moose by maintaining a minimum altitude of 180 m (600 ft) for small fixed-wing aircraft and helicopters over moose habitat (derived from Hanley et al. 1981, McCourt et al. 1974, Sopuck et al. 1979).

- Minimize harassment of moose by avoiding low-elevation flights over moose in open areas, because moose in open areas are more sensitive to disturbance than are moose in cover (derived from Bangs and Bailey 1982, Mould 1977).

- Minimize overflights of cow moose with young calves because they are more sensitive to disturbance than are moose without calves (derived from Klein 1973, Sopuck et al. 1979).

15. Transport of personnel/equipment/material - land. This activity has resulted in several documented impacts on moose, the most severe of which is collision with trains and with highway vehicles. The use of salt to de-ice highways and the growth of willows along roads and railroads attracts moose, which are then susceptible to death or injury from collision. Clearing snow from land transportation corridors enhances their attractiveness to

moose and also traps them between the snow berms, where they are injured or killed by collisions. The problem is worse in heavy snow years. Traffic on highways and especially by off-road vehicles causes harassment of moose. New land transportation corridors have caused increased access by humans and resulted in increased harvest.

a. Attraction to artificial food source

See Chemical application, 3.a., and to Draining, 5,a., for appropriate guidelines.

b. Barriers to movement, physical and behavioral

(1) General guidelines. Avoid developing roads or railroads in moose habitat, because they interfere with movement of moose. When roads or railroads are plowed in winter, the resulting snow berms increase the barrier severity (derived from Phillips et al. 1973, Rausch 1958).

(2) Specific guidelines:

- If roads or railroads in winter moose habitat must be cleared, minimize blocking movement of moose by plowing breaks through the berms, building overpasses, or using other means to maintain travel by moose across the corridor (derived from Sopuck et al. 1979).

- Minimize leading more moose onto cleared roads by not plowing breaks that connect to moose trails, other roads, or man-made trails used by moose (derived from Rausch 1958).

- See c. above for guidelines to minimize collisions between vehicles and moose.

c. Collision with vehicles or structures, or electrocution by powerlines

(1) General guideline. Avoid developing roads or railroads in moose habitat, especially if they are to be used in winter, because moose are killed or injured by collisions (derived from ADF&G 1983, Bangs et al. 1982, Child 1983, Rausch 1965, Tracy 1977).

(2) Specific guidelines:

- See Chemical application, 3.a., for specific guidelines appropriate to reducing collisions with moose attracted by salt used to de-ice roads.

- Minimize collisions of trains with moose by determining areas in which moose are concentrated near tracks by aerial surveys and reports of trainmen, then issuing temporary orders to reduce the speed of trains to less than 48 kph (30 mph) through concentration areas (Anonymous 1985a and b, Rausch 1958).

- Minimize collisions of trains with moose by operating trains through moose concentration areas only during daylight hours (Rausch 1958).

- Minimize collisions of trains with moose on tracks by sounding the horn at a distance of 91.5 m (300 ft) or less (Rausch 1958) or by turning off the headlight upon spotting a moose (Anonymous 1985b).

- Minimize collisions of trains with moose by clearing winter feeding yards away from the tracks and by bulldozing moose trails parallel to the tracks in moose concentration areas so that moose will feed in and travel along the cleared feeding yards and trails instead of along the railroad tracks (Anonymous 1985 a and b, Rausch 1958).

- Minimize collisions of trains with moose by plowing a wider swath along the tracks in moose concentration areas to enable moose to escape trains without leaving the cleared area (Foster 1985).

- Minimize collisions of road vehicles with moose by controlling traffic through moose habitat, particularly at night, near mineral licks during June and July and in winter moose habitat. Traffic control could include lowering speed limits (derived from Grenier 1973, Sopuck et al. 1979).

- See d. below for a specific guideline appropriate to minimizing movement of moose from roads onto railroads in winter.

d. <u>Entrapment in impoundments or excavations</u>

(1) See b. above for an appropriate guideline.

(2) Specific guidelines:

- To minimize movement of moose onto railroad tracks plowed free of snow and subsequent entrapment, construct moose guards across trails and roads that intersect the railroad (Rausch 1958).

- See b. above for other applicable specific guidelines.

e. Harassment, active or passive

(1) General guideline. Avoid establishing land transportation corridors through or within 2 km (1.25 mi) of moose habitat, and avoid repeated use of off-road vehicles within the same distance (derived from EPA 1982, Grauvogel 1984, Hancock 1976, Mould 1977).

(2) Specific guidelines:

- Minimize the effects of transport by land, including the use of frozen rivers, on moose winter range by avoiding moderate- or high-frequency transport within 1-2 km (0.6-1.25 mi) of winter range along rivers and in other areas, routing land transport by way of ridges rather than riparian areas, and keeping transportation corridors direct and to a minimum (Grauvogel 1984, and derived from Hancock 1976).

- Minimize the effects of moderate-to-high-frequency transport by land on moose calving areas by avoiding such areas by 1-2 km (0.6-1.25 mi) from late winter through the calving period in May (derived from Hancock 1976).

- Minimize the effects of transport by land on moose summer range by avoiding summer range by 300 m (1,000 ft) across vegetated areas or 457 m (1,500 ft) across water, maintaining a predictable pattern of transport schedules, and avoiding loud noises and off-road transport (derived from Cobus 1972, McMillan 1954, Sopuck et al. 1979, Tracy 1977).

- Minimize harassment of moose in areas in which single purpose roads (e.g., logging roads) have opened new access to moose habitat by closing such roads to the public (Tomm et al. 1981).

f. Harvest, change in level

(1) General guideline. Avoid developing new land transportation corridors into areas of moose habitat where moose populations could be subject to excessive hunting pressure or where small, local populations could be extirpated (e.g., isolated drainages with tall willow stands above or north of treeline) or where the migratory behavior of a moose population could be altered, unless restrictions on harvest are implemented (derived from Bergerud et al. 1968, Grauvogel 1984, Klein 1979, Wooley 1976). (Note: The Alaska Board of Game is responsible for preparation of hunting regulations, and the Departments of Public Safety and Fish and Game are responsible for enforcement.)

(2) Specific guidelines:

° Minimize the potential for excessive hunting pressure after developing new transportation corridors by closing any roads built for specific jobs after the jobs are completed (derived from Tomm et al. 1981).

° See e. above for specific guidelines applicable to routing of new roads.

16. Transport of personnel/equipment/material - water. Boats travelling through moose habitat have caused passive harassment. The increased harvest of moose as a result of the development of rivers as transportation corridors has possibly affected the migratory patterns of moose. Use of frozen rivers as transportation corridors is covered under Transport of personnel/equipment/material - land.

a. Harassment, active or passive

(1) General guideline. To avoid passive harassment of moose, avoid using rivers that flow through important moose habitat areas (e.g., calving areas) as corridors for moderate or high use levels of water transportation (derived from EPA 1982, Grauvogel 1984, Hancock 1976).

(2) Specific guideline. If rivers that flow through important moose habitat must be used for transport, minimize harassment of moose by avoiding medium and high levels of water transport use within 1-2 km (0.6-1.25 mi) of moose calving areas during the calving season (derived from Hancock 1976).

b. Harvest, change in level

See Transport of personnel/equipment/material - land, 15.f., for applicable guidelines.

17. Water regulation/withdrawal/irrigation. Impoundment of subarctic and arctic rivers for hydroelectric power has eliminated the spring flood and alluvial deposition responsible for maintaining successional stands of willow shrubs that moose browse upon in winter. Decreased water levels below dams also allow plant succession on alluvial bars to proceed more rapidly from willows to spruce forests, which provide little winter browse for moose.

a. Vegetation composition, change to less preferred or useable species or successional stage

(1) General guideline. Avoid impounding rivers that flow through moose habitat, either upriver of or within the moose habitat areas (derived from Gill 1973, Vinogradov and Chernyavskoya 1976).

(2) Specific guidelines:

° If rivers that flow through moose habitat must be impounded, minimize the downriver vegetation changes by duplicating the natural flow regime as closely as possible rather than impounding a maximum amount of spring runoff (Gill 1973).

° If rivers that flow through moose habitat must be impounded, minimize downriver vegetation changes by avoiding impounding such rivers for diversion, because maintenance of near-natural flows and habitats would be impossible (Gill 1973).

b. Water level or water quality fluctuations

See a. above for applicable guidelines.

14. Sitka Black-tailed Deer

Table 1. Impacts Associated With Each Activity - Blacktailed deer

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change																														
Attraction to artificial food source				X	X							X													?			X		
Barriers to movement, physical and behavioral			?		X		?		X			X		X				?	X						?			X		X
Collision with vehicles or structures					X																							X		
Entanglement in fishing nets, debris					?				X																					
Entrapment in impoundments or excavations												?										?						?		X
Harassment, active or passive	X				X		?	?		?	?	X	X	X	?		?	?	?	?	?	?			?		X	X		
Harvest, change in level			X		?		?	?				X		X				?	?						?			X		
Introduced wild/domestic species, competition													X	X																
Morbidity/mortality by ingestion of petroleum				X				?												?					?	?				
Parasitism/predation, increased susceptibility					X									X																
Prey base, alteration of																														
Shock waves (increase in hydrostatic pressure)																														
Terrain alteration or destruction	?										?	?			?							?								
Veg. composition, change to less preferred				X	X							?	X																	
Veg. damage/destruction due to air pollution				X															?	?										
Veg. damage/destruction due to fire/parasitism																														
Veg. damage/destruction due to grazing													X																	
Veg. damage/destruction due to erosion					X						?	X				?				?		?								
Water level or water quality fluctuations														?							?				?	?				X

X - Documented impact (see text).
? - Potential impact.

14. SITKA BLACK-TAILED DEER

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact cagegory under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Would the proposed activity damage stands of high-volume old-growth spruce-hemlock coastal forest that provide essential limited winter range for Sitka black-tailed deer or affect use of such forests by deer?

2. Would the proposed activity damage other stands of old-growth spruce-hemlock providing winter range during moderate winters?

3. How can the proposed activity be carried out so as to minimize impacts to beach-fringe climax Sitka spruce forests and to associated intertidal zones where deer feed during extended periods of deep snow?

4. Will the proposed activity affect large areas of alpine or avalanche path habitat utilized by deer during summer or affect migration of deer to and from alpine areas?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forests cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

1. Blasting. Blasting at a mine located in a deer migration area resulted in passive harassment of deer and delayed the arrival of deer at their winter range.

   Harassment, active or passive

   General guideline. Avoid production-level blasting (e.g., for mining) in areas of important deer habitat (e.g., winter range, migration corridors) when deer are present, to avoid delaying migrations or displacing deer from important habitat (derived from Kvale 1980). (Note: See the life history section of the Alaska Habitat Management Guide - Southcentral Region for the times of use and locations of important habitat areas in coastal forests of Southcentral Alaska.)

2. Channelizing waterways. Channelizing waterways increases human access to deer habitat and increases harvest of deer.

   Harvest, change in level

   General guideline. Avoid channelizing waterways in areas of deer habitat where improved access could result in excessive hunting pressure unless restrictions on harvest are implemented (derived from Simpson et al. 1982). (Note: The Alaska Board of Game is responsible for preparation of hunting regulations, and the Departments of Public Safety and Fish and Game are responsible for enforcement.)

3. Chemical application. The use of chemicals in horticulture and in forests has damaged deer forage plants or made them distasteful to deer, directly poisoned deer, and altered growth of vegetation in which deer browse. Spraying regenerating conifer stands with herbicides to decrease competition between shrubs and conifers decreases deer forage, and deer have been poisoned by eating crops sprayed with insecticides. Spraying tree or shrub crops with repellent chemicals makes them unpalatable to deer. Fertilization of shrub or tree crops or regenerating forests makes browse more palatable and attracts deer but in forests hastens canopy closure and loss of browse plants.

   a. Attraction to artificial food source

      (1) General guideline. Avoid applying fertilizer to regenerating stands of conifers or other tree or shrub

crops in deer habitat unless alternate browse is readily available because deer are attracted to the highly palatable fertilized browse plants (derived from Taber and Hanley 1979).

(2) Specific guideline. If fertilizer must by applied and alternate browse is not available, minimize attraction of deer to the desired crop by growing a less valuable "lure crop" so that deer control measures that would cause more severe impacts on deer will not be necessary (Taber and Hanley 1979). (Note: See d. below and Fencing, 5.a., for guidelines applicable to other deer control measures.)

b. Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid applying insecticides or other chemicals (e.g., arsenic compounds) that can poison deer to crops that are palatable to deer and that are grown in deer habitat, especially if natural browse is not abundant (derived from Case and Murphy 1962).

c. Vegetation composition, change to less preferred or useable species or successional stage

General guideline. Avoid fertilizing regenerating stands of conifers that have a shrub understory in areas of deer habitat where browse may be limited, in order to avoid hastening canopy closure and loss of browsable shrubs (derived from Taber and Hanley 1979).

d. Vegetation damage/destruction due to air pollution or contact with petroleum products or chemicals

(1) General guideline. Avoid applying chemicals that kill or damage woody browse plants or that make them unpalatable (e.g., herbicides or deer repellents) in areas where the availability of deer browse may be limited (e.g., in deer winter range) (derived from, e.g., Beasom and Scifres 1977, Caslick and Decker 1978, Hill 1977?). (Note: See the life history and distribution sections of the Alaska Habitat Management Guide - Southcentral Region for areas of important winter habitat in that region.)

(2) Specific guidelines:

° If herbicides must be applied (e.g., to regenerating conifer stands in which shrubs are inhibiting tree growth), minimize loss of deer browse by avoiding herbicide use in areas where alternative browse is not available (derived from Beasom and Scifres 1977, Merriam 1971, Taber and Hanley 1979).

- If deer repellent chemicals must be applied, minimize the likelihood that the repellents will fail and that other deer control measures with more severe impacts will have to be used by implementing the following measures: use repellents only in areas where deer use is light or moderate and where alternate browse is available; apply repellents during the dormant season so that deer will not browse on untreated new growth; apply repellents thoroughly and repeat treatments at the recommended intervals; and use odorant bags to protect small areas or individual woody plants from browsing (Caslick and Decker 1978, McAninch et al. 1983, Wingard and Palmer 1982). (Note: See Fencing, 5.a., for guidelines applicable to other deer control measures.)

5. Clearing and tree harvest. While trees are being harvested or land is being cleared, deer have been subjected to passive harassment resulting in abandonment of habitat and changes in activity patterns. After harvest or clearing are complete, several other impacts continue for years or decades. Deer have been attracted to revegetating roadsides and then killed by collisions with highway vehicles. Logging slash has prevented deer from crossing or feeding in clear-cuts in summer or winter. Snow accumulation is much greater in clear-cuts than in mature forests, preventing deer from utilizing or crossing clear-cuts under conditions of heavy snow accumulation. Clear-cutting of old-growth forests has destroyed essential winter habitat and decreased deer populations by 50 to 75%. Wolf predation has increased on deer that have been forced to congregate in "islands" of old-growth forest reserved in areas that have been clear-cut. Although recent clear-cuts produce browse that is available during the summer, when deer are not limited by the amount of browse, after 15 to 30 yr the regenerating conifers form a dense, closed canopy that prevents browse growth for the next 150 to 200 yr or more. Precommercial thinning has been recommended to prolong the period of browse production, but the technique has not been tested and is not expected to be successful for more than a few years.

   a. Attraction to artificial food source

      General guideline. To prevent deer from being attracted to roadsides where they may be killed by collisions, avoid clearing wide areas along roadsides in deer habitat, or avoid allowing such clearings to revegetate to shrubs that provide browse for deer (derived from Millar 1983, Sopuck et al. 1979).

b. Barriers to movement, physical and behavioral

(1) General guideline. Avoid clear-cutting areas in old-growth coastal forests that provide winter range for deer, so that snow will not accumulate and prevent use during critical winter periods and so that large logging debris and slash will not accumulate and prevent use throughout the year (derived from, e.g., Harris and Farr 1979, Parker et al. 1984).

(2) Specific guidelines.

- If old-growth coastal forests must be clear-cut, minimize the creation of barriers to deer movement by cleaning up slash and large logging debris by burning or by other means or by clearing deer trails through the debris to facilitate deer passage and use during periods of low snow accumulation (Hanley 1984, Sigman 1985).

- Minimize the barrier effects of roads by clearing only as wide a right-of-way through deer habitat as is required for safe human use of the road (derived from Millar 1983).

c. Collision with vehicles or structures, or electrocution by powerlines See a. above for an applicable guideline.

d. Harassment, active or passive

(1) General guideline. To avoid passive harassment of deer, avoid clearing land or harvesting trees in deer habitat whenever deer are present (derived from Eckstein et al. 1979, Loft et al. 1984, Sopuck et al. 1979).

(2) Specific guideline. If land clearing or tree harvesting must be conducted in deer habitat, minimize harassment by avoiding those activities in the vicinity of important habitat, such as wintering areas, whenever deer are present (derived from Loft et al. 1984). (Note: See the life history and distribution sections of the Alaska Habitat Management Guide - Southcentral Region for the locations and times of use of important deer habitat areas in that region.)

e. Parasitism and predation, increased susceptibility to

(1) General guideline. Avoid clear-cutting coastal forests that deer use as winter range so that deer will not be forced to concentrate in remaining forest stands, where they are more susceptible to wolf predation (derived from Schoen et al. 1983).

(2) Specific guidelines. See f. below for guidelines applicable to harvesting old-growth coastal forests.

f. Vegetation composition, change to less preferred or useable species or successional stage

(1) General guideline. Avoid clearing or tree harvest of areas in old-growth coastal forests that provide winter range for deer, because the availability of forage and cover in winter is a major limiting factor for deer populations in Alaska (derived from, e.g., Kirchhoff et al. 1982, Loft et al. 1984, Schoen and Kirchhoff 1983, Smith 1979, Wallmo and Schoen 1980).

(2) Specific guidelines. If old-growth coastal forests must be harvested, resulting in a vegetation change to less useable early successional stages, conduct operations according to the following:

- Minimize overbrowsing and resulting long-term loss of deer carrying capacity in the old-growth forest stands that remain after others are harvested, by retaining entire watersheds and harvesting other watersheds where deer are less abundant (Schoen et al. 1982, Schoen et al. 1983).

- Minimize overbrowsing of high-volume old-growth coastal forest stands that provide essential winter range in years of high snow cover by retaining both those stands and associated low-volume old-growth stands that provide winter range in years of low or moderate snow cover (derived from Jones 1974, Hanley 1984, Schoen et al. 1983).

- If harvesting old-growth coastal forest becomes necessary, minimize overbrowsing of remaining uncut forest that could occur during years of low or moderate snow cover by cutting those stands destined for harvest at intervals such that some clear-cuts in the area are always less than 15 to 30 yr old, therefore providing suitable alternate browse in low or moderate snow years to the uncut old growth (derived from Hanley 1984, Schoen and Wallmo 1979, Schoen et al. 1983). (Note: Commercial thinning is not likely to extend the period of browse production in clear-cuts more than a few years and is likely to result in a two-layered canopy [derived from Schoen et al. 1983, Sigman 1985].)

- Minimize loss of high-volume old-growth coastal forest stands that have high value as deer winter range by harvesting such stands in proportion to their occurrence within a deer population's range (derived from Hanley 1984, Sigman 1985).

- Minimize loss of essential winter range by avoiding harvest of beach fringe and inland, high-volume old-growth stands that provide temporary essential refuge during periods of very deep snow cover (derived from Hanley 1984, Sigman 1985).

- Minimize simultaneous loss of important forested components of deer habitat in a given watershed by spreading harvest over the entire remaining elevation gradient in the watershed rather than always starting at a low elevation and moving up (Hanley 1984).

- Minimize creating large openings in coastal forests that deer will not utilize even when snow cover is absent or shallow by clear-cutting small, irregularly shaped areas (unless windthrow is expected to be a problem [Hanley 1984]) of about 1 ha (2.5 ac) or less in size (derived from Billings and Wheeler 1979, Sopuck et al. 1979). (Note: This guideline conflicts with the conclusions of Kirschoff et al. 1982, who found that deer do not use clear-cuts of any size. The guideline presented here should therefore be viewed with caution.)

- Minimize the loss of habitat that results from clear-cutting coastal forests by using selective cutting to retain some cover and habitat use in cutting areas (derived from Sopuck et al. 1979, Schoen and Wallmo 1979).

- Minimize the impact of harvesting the remaining old-growth coastal forest stands used by deer as winter habitat in partially cut areas by waiting more than 200 yr (the estimated time required for a browse understory and arboreal lichens to develop after clear-cutting) before harvesting retained old-growth stands adjacent to cut blocks (Harestad et al. 1982 and derived from Regelin 1979, Schoen and Wallmo 1979).

- Minimize decreasing the regeneration of shrubs after clearcutting and resulting abundant production of deer browse by avoiding scarifying the ground, a procedure that stimulates the establishment of conifer seedlings, but kills shrub rootstocks that would otherwise vigorously resprout (derived from Sopuck et al. 1979).

5. Fencing. Although most deer easily jump over ordinary barbed wire livestock fences, they have become entangled when a hind foot was caught on the top one or two wires. Electric and tall wire mesh fences that effectively block deer movements are in use. (Note: References are included here that provide recommendations for fence designs that prevent deer movements so that orchards or other commercially valuable trees are protected from deer depredations and thus the necessity is reduced for more severe methods [e.g., shooting] to prevent depredations. As such, these references do not, in the strictest sence, meet our criteria of documented impacts; however, they are included here because fences incorporating such elements and that are not specifically in use to deter deer have been shown to interfere with deer movements and should be avoided.)

   a. Barriers to movement, physical and behavioral

      (1) General guideline. In deer habitat, avoid constructing fences that would block the movements of deer (derived from e.g., Jepson et al. 1983, Kvale 1980, McAninch et al. 1983, Preston 1983).

      (2) Specific guidelines.

      - Minimize the use of fences and/or small enclosures to protect forest regrowth by using and correctly applying deer repellents in situations where fences would affect deer more adversely than repellants (Note: See Chemical application, 3.d., for guidelines applicable to the use of repellants to deter deer browsing on commercial forest seedlings.)

      - Minimize blocking deer movements with livestock fences by constructing fences no higher than 1.1 m (42 in) and by building let-down fences and laying them on the ground when livestock are not being grazed.

- Wherever deer trails cross livestock fences, in addition to following the above guideline minimize blocking deer movements by preferably using a top rail or, for minor trails, by using smooth wire for the top two wires or by spacing the top two barbed wires at least 30.5 cm (12 in) apart (Jepson et al. 1983, Young 1955).

- If deer, but not livestock, are to be allowed access to a limited area of habitat, minimize behavioral blocking of deer movements by fencing as large an area as possible (derived from Young 1955).

- If fences must be built to prevent or reduce deer movement into certain areas (e.g., fields of palatable crops), minimize the likelihood that the fences would fail to control deer and that control methods that would cause more severe impacts to deer would have to be used by matching the type of fence to the intensity of deer pressure as follows:

  For areas with very low deer pressure or for temporary use, string a single charged wire baited with an attractant such as peanut butter or corn oil at a height of 55 cm (22 in). This fence is effective only during the snow-free season (derived from Kinsey 1976, Porter 1982).

  For areas or fields with low deer pressure build a double high-tensile electric fence with three to six wires and a height of 1 m (39 in) (McAninch et al. 1983).

  For areas or fields with moderate deer pressure, construct a vertical high-tensile electric fence with four to nine wires spaced 20 to 30 cm (8 to 12 in) apart, the lowest wire no more than 25 cm (10 in) above the ground, and a height of 1.2 to 2.1 m (4 to 7 ft) (Caslick and Decker 1978, Hauge 1985, McAninch et al. 1983). The effectiveness of the fence can be increased by clearing shrubs and trees from a 1.8 to 2.4 m (6 to 8 ft) wide strip outside the fence, so deer will stay a few feet away after being shocked and not jump over the fence, and by preventing vegetation from touching the wires and decreasing the voltage of the fence (Wingard and Palmer 1982). Yarded deer may still cross the fence (Stuht 1985).

For areas or crops with high deer pressure, totally exclude deer by building a 2.4 m (8 ft) high woven wire fence, and if necessary add strands of barbed wire at 23 cm (9 in) intervals atop the mesh to a height of 2.7 to 3 m (9 to 10 ft) (Jepson et al. 1983, McAninch et al. 1983). In areas with heavy snow cover, substitute 14 strands of barbed wire for the woven wire, and space posts and stays closely to avoid damage to the fence (Jepson et al. 1983). (Note: See also b. below for a fencing guideline appropriate to preventing entanglement rather than excluding deer.)

If only a few high-value shrubs or trees require protection, build individual wire mesh exclosures or plastic or paper coverings around such plants during winter (Caslick and Decker 1978, Hill 1977?).

See Chemical application, 3.d., for guidelines applicable to the use of repellant chemicals to deter deer browsing.

b. Entanglement in fishing nets, marine or terrestrial debris, or structures

General guideline. Avoid entanglement of deer in livestock fences at deer-crossing locations by substituting smooth wires for the top two barbed wires or by separating the top two barbed wires by at least 30 cm (12 in) (Jepson et al. 1983).

6. Grading/plowing. Grading land during road construction, mining, and subdivision construction has destroyed important deer habitat, including winter range, and the increased access created by new roads and power line rights-of-way has increased the legal and illegal take of deer by hunters. Wide roads and roadsides, as well as snow berms, have blocked migrating deer. The activity of plowing has attracted deer to crops (e.g., hay, alfalfa), seeded highway rights-of-way, and fertilized orchard and forest tree saplings.

a. Attraction to artificial food source

(1) General guideline. In deer habitat, especially in winter range, avoid growing crops such as fertilized trees or shrubs or storing crops such as hay in locations accessable to deer, in order to avoid attracting deer and making other deer-control measures necessary (derived from, e.g., Hill 1977, Kinsey 1976, Porter 1982). Avoid routing roads adjacent to or through deer winter range or other good deer habitat, to avoid attracting deer to successional browse along the road and exposing deer to collision with vehicles (derived from Carbaugh et al. 1975, Sopuck et al. 1979).

(2) Specific guideline. Minimize attraction of deer to stored hay by storing hay close to dwellings and far from cover rather than leaving bales or stacks in the field; by storing hay bales rather than in stacks; and, if stacks are used, by piling them in lines rather than in clumps (Vogel 1983).

(Note: See Fencing, 5.a., for guidelines applicable to preventing deer from reaching crops that must be grown or stored in deer habitat.)

b. Barriers to movement, physical and behavioral

(1) General guideline. Avoid constructing roads or grading snow berms along roads through deer habitat, to avoid blocking movements of deer (derived from Kvale 1980, Millar 1983).

(2) Specific guidelines:

- Minimize the barrier effects of roads through deer habitat by constructing roads and grading roadsides only as wide as necessary for the projected traffic volume (derived from Millar 1983).

- Minimize the barrier effects of snow berms by plowing gaps through snow berms, especially in areas through which deer migrate or wherever roads cross important winter habitat (derived from Kvale 1980).

c. Harassment, active or passive

General guideline. Avoid grading or plowing within or adjacent to important deer habitat at areas such as winter range whenever deer are present, in order to avoid passive harassment and habitat abandonment during the activity (derived from Sopuck et al. 1979).

(Note: See Transport of personnel/equipment/material - land, 13.d., for specific guidelines related to road traffic and deer harassment.)

d. Harvest, change in level

General guideline. Avoid constructing new transportation corridors in areas of deer habitat where deer populations could be subject to excessive hunting pressure unless restrictions on harvest are implemented (derived from Sopuck et al. 1979). (Note: The Alaska Board of Game is responsible for preparation of hunting regulations, and the Departments of Public Safety and Fish and Game are responsible for enforcement.)

e. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

(1) General guideline. Avoid grading or plowing in areas of important deer habitat, such as winter range or migration corridors, in order to avoid destroying vegetation required by deer for browse or cover (derived from, e.g., Kvale 1980, Michael 1978, Smith 1979).

(2) Specific guideline. If deer habitat must be graded for settlement use, minimize impacts to deer by avoiding settlement in winter range or by limiting any new settlement in winter range to small lots close to existing towns or villages (Vogel 1983).

7. Grazing. Deer have been harassed during cattle roundups and have avoided using parts of their range in which large numbers of cattle were being grazed. On Kodiak Island, cattle consume browse in areas that deer utilize heavily in winter, competing with the deer for forage. Domestic livestock, particularly sheep, have transmitted nematodes and other internal parasites to deer populations, and the parasites have persisted and have caused death of fawns.

a. Harassment, active and passive

General guideline. Avoid grazing cattle in deer habitat whenever the presence of cattle or roundups of cattle could cause harassment of deer (derived from Hood and Inglis 1974, Sopuck et al. 1979).

b. Introduced wild or domestic species, competition with or disease transmission from

(1) General guideline. Avoid grazing domestic livestock in deer habitat in order to avoid transmitting internal parasites to deer and to avoid displacement of deer due to competition for forage and for space.

(2) Specific guidelines:

° If livestock, particularly domestic sheep, must be grazed in deer habitat, minimize transmission of internal parasites from livestock to deer by maintaining proper stocking rates of both livestock and deer so that browse will not be damaged and deer will have adequate food; eradicate or control the parasites in the livestock before turning them onto deer range; and control parasites the deer have already acquired from livestock, if any (derived from Anderson 1962, Longhurst and Douglas 1953).

° If livestock must be grazed in deer habitat, minimize competition for forage and space by using a rest-rotation system for the livestock rather than continuous grazing, by maintaining proper stocking rates for cattle, and by preventing cattle from overutilizing browse in areas of deer winter range (derived from, e.g., Campbell and Johnson 1983, Klebesadel and Restad 1981, Holechek et al. 1982).

c. Vegetation composition, change to less preferred or useable species or successional stage

General guideline. Avoid grazing domestic livestock in important deer habitat, such as winter range, whenever grazing could alter the vegetation composition and decrease the amount of forage that deer could use (derived from Skovlin and Harris 1970).

d. Vegetation damage/destruction due to grazing by domestic or introduced animals

(1) General guideline. Avoid grazing domestic livestock in deer habitat, particularly in important areas such as winter range, whenever vegetation utilized by deer for browse or cover could be damaged (derived from Holechek et al. 1982, Young 1955).

(2) Specific guideline. If domestic livestock must be grazed in deer habitat, utilize a rest-rotation grazing system at a low stocking density that does not result in defoliation of shrubs, build fences around shrubby areas that deer use for winter range, or graze sheep under the control of a shepherd rather than cattle (Holechek et al. 1982).

8. Human disturbance. Abundant documentation confirms both active and passive harassment of deer as a result of human disturbance. Active harassment usually occurs when people approach deer to observe or photograph them or when people allow their dogs to chase deer. Passive harassment has been documented as a result of people hiking, snowshoeing, skiing, camping, hunting, or rounding up livestock when deer are nearby. People on foot cause greater harassment than do people on snowmachines. In addition to causing harassment, human disturbance has delayed migrating deer and has increased predation, particularly on fawns. Fawns are more likely than mature deer to be caught and killed by unrestrained or feral dogs. Repeated chases by dogs, as well as other forms of sustained human disturbance, have caused deer to abandon their home ranges.

a. Barriers to movement, physical and behavioral

General guideline. Avoid locating continuous sources of human disturbance (e.g., industrial processing plants, densely populated areas, or frequently used hiking trails) within, adjacent to, or across important areas of deer habitat, such as winter range or migration routes, in order to avoid blocking or delaying movements of deer and preventing full utilization of deer habitat (derived from Kvale 1980, Sopuck et al. 1979, Vogel 1983).

b. Harassment, active or passive

(1) General guideline. Avoid human disturbance in deer habitat, particularly in winter range, whenever deer are present. Avoid approaching or harassing deer, especially does with fawns (derived from, e.g., Altmann 1958, Bollinger et al. 1973, Geist 1971, Loft et al. 1984).

(2) Specific guidelines:

- Except when hunting, minimize harassment of deer by avoiding approaching on foot within 334 m (1,096 ft) of deer in open terrain. If this is not possible, avoid approaching within 191 m (626 ft), the mean distance at which deer flee from humans on foot (derived form Freddy et al. 1986).

- Except when hunting, minimize harassment of deer by avoiding repeatedly approaching a deer that has noticed a person on foot or that has taken flight, because deer become more sensitive to disturbance that is repeated in a short period of time (derived from Freddy et al. 1986).

- Minimize harassment of deer while livestock are being rounded up by avoiding grazing livestock in important deer habitat when deer are present and by avoiding unnecessary disturbance of patches of dense shrubs, which deer use as cover (derived from Hood and Inglis 1974).

- Except when hunting, minimize harassment of deer by avoiding approaching deer when they are in open habitat or from mid morning to mid afternoon (derived from Altmann 1958).

- Minimize harassment of deer during the critical winter period, especially when the snow cover is deep, by restricting access by humans other than hunters to important deer wintering areas (Parker et al. 1984). Minimize long-term harassment of deer during winter by avoiding development of settlements near or within important deer wintering areas (Vogel 1983).

- Minimize harassment of deer by avoiding establishing campgrounds within 800 m (2,624 ft) of important deer habitat and avoiding routing trails that will receive frequent use through such habitat. If campgrounds must be established near important deer habitat, maintain a minimum separation of 400 m (1,312 ft) (derived from Sopuck et al. 1979).

- Minimize harassment of deer by removing feral and free-roaming dogs from deer habitat (Anderson 1979) and by restraining dogs whenever entering deer habitat when deer are present (derived from Smith 1979, Vogel 1983). These measures are particularly important during periods of deep snow.

c. Harvest, change in level

General guideline. Avoid allowing dogs to chase deer because deer that have been chased out of cover are more susceptible to legal or illegal harvest than are deer in cover (derived from Anderson 1979).

d. Introduced wild or domestic species, competition with or disease transmission from

General guideline. Avoid repeatedly harassing deer, especially when they are in limited winter range, so that they will not be displaced into habitat already occupied by other deer and thus compete with the deer already there (derived from Geist 1971).

e. Parasitism and predation, increased susceptibility to

General guideline. Avoid allowing feral and free-roaming dogs to live in or enter deer habitat, especially during periods of deep snow and during the fawning period, because dogs kill both fawns and mature deer (derived from Anderson 1979, Smith 1979, Sopuck 1979, Vogel 1983).

9. Processing minerals (including gravel). Operation of a phosphate mine and processing facility within the migration route of deer delayed migrating deer so that they reached winter range a few days later than deer that did not have to avoid the processing facility.

Barriers to movement, physical and behavioral

General guideline. Avoid locating mineral-processing facilities in or adjacent to important deer habitat, such as migration routes or winter range, so that movement of deer and use of habitat will not be altered (derived from Kvale 1980).

10. Transport of personnel/equipment/material - air: Radio tracking of deer from low-flying aircraft has caused deer to change the habitat type they were using.

Harassment, active or passive

General guideline. Avoid significant active harassment of deer such that they change the habitat type they are using, by avoiding flying over deer at altitudes less than 150 m (492 ft) agl (derived from Krausman et al. 1986).

13. Transport of personnel/equipment/material - land, ice. This activity has resulted in several significant impacts to deer. Deer have been killed by collisions with highway vehicles when they attempted to cross roads or when they have been attracted to roadside vegetation and have become habituated to high-speed traffic. Paved and gravel roads have blocked or inhibited movements of some deer, even during migration. Deer have been harassed by traffic and avoided roads, especially paved highways, whenever alternate feeding areas were available. Deer have been harassed by the unintentional passage nearby of people on snowmachines and by the deliberate chasing by people on snowmachines. Harvest of deer has increased after new land transportation routes have been established or existing routes improved.

a. Attraction to artificial food source

(Note: See Clearing and tree harvest, 4.a., for an applicable guideline.)

b. Barriers to movement, physical and behavioral

(1) General guideline. Avoid developing land transportation routes other than dirt roads or trails through or across important deer habitat such as winter range or migration routes in order to avoid blocking movements of deer and preventing use of all of the available habitat (derived from, e.g., Greenwood and Dalton 1984, Kvale 1980, Millar 1983, Sopuck et al. 1979).

(2) Specific guidelines. If surfaced roads or aboveground linear transport systems (e.g., coal conveyors, pipelines) must be developed through or across important deer habitat, the following guidelines are applicable:

- Minimize blocking deer movement by identifying crossing areas and designing roads in those areas so that the road itself is below grade and the right of way slopes upward away from the road at least 4°, preferably 10 to 20° (derived from Sopuck et al. 1979).

- Minimize blocking deer movement by constructing underpasses for the use of deer beneath four-lane or larger highways (derived from Reed et al. 1975). However, deer are apprehensive about using underpasses, and only 60% may cross.

- Minimize disruption of deer movements when operating aboveground linear facilities (e.g., coal conveyors, pipelines) by constructing crossing structures (e.g., ramps, buried sections) at deer crossing areas; or, if construction of such crossing structures is not possible, elevate the facility a minimum of 1 m (3 ft) aboveground for at least 60-70% of its length (Greenwood and Dalton 1984).

- Minimize disruptions of deer movements when operating aboveground linear facilities (e.g., coal conveyors, pipelines) by retaining or enhancing growth of vegetation used by deer for food and cover along the facility and especially at deer crossing areas (Greenwood and Dalton 1984).

(Note: See Clearing and tree harvest, 4.b., and Grading/plowing, 6.b., for other guidelines that minimize the barrier effects of roads.)

c. Collision with vehicles or structures, or electrocution by powerlines

(1) General guideline. Avoid developing land transportation routes other than dirt roads or trails through or across important areas of deer habitat or movement such as wintering and migration areas, in order to avoid killing and injuring deer through collisions with vehicles (derived from, e.g., Anderson 1979, Carbaugh 1975, Vogel 1983).

(2) Specific guidelines. If two-lane gravel roads or roads of higher quality must be developed through important deer habitat, the following guidelines are applicable:

- Minimize collisions between vehicles and deer by limiting vehicle speed to 64 kph (40 mph) or less in deer concentration and crossing areas when deer are present (derived from Millar 1983) or by marking and fencing deer crossings (Vogel 1983). [Note: See Fencing, 5.a., for guidelines appropriate for fences that block deer movement.]

- Minimize collisions between vehicles and deer by designing highways so they avoid important feeding and cover habitat for deer (derived from Carbaugh et al. 1975).

(Note: See b. [underpasses] and Clearing and tree harvest, 4.a., for other guidelines applicable to decreasing collisions of vehicles with deer.)

d. Harassment, active or passive

(1) General guideline. Avoid developing land transportation routes, including snowmobile trails, through or near deer habitat, in order to avoid harassment of deer (derived from, e.g., Dorrance et al. 1975, Millar 1983, Sopuck et al. 1979).

(2) Specific guidelines. If land transportation routes must cross deer habitat, the following guidelines are applicable:

- Minimize passive harassment of deer by highway traffic by routing roads at least 400 m (1,312 ft) away from important deer habitats, such as winter range and densely forested shorelines (derived from Sopuck et al. 1979).

- Minimize passive harassment of deer by snowmobiles by operating them no closer than 470 m (1,542 ft) away from deer (Freedy et al. 1986). If that distance cannot be maintained, minimize causing deer to flee by operating snowmobiles no closer than 150 m (492 ft) from deer and by avoiding deer winter range that is being used by deer by that distance (derived from Freddy et al. 1986, Sopuck et al. 1979).

- Minimize passive or active harassment of deer by snowmobiles by avoiding high-speed operation, stopping and observing deer, driving directly toward or circling deer rather than passing tangentially by them, and chasing deer (derived from Moen et al. 1982, Sopuck et al. 1979).

- Minimize harassment of deer by snowmobiles by avoiding approaching deer in the open or in forest stands with little cover (derived from Richens and Lavigne 1978) and by passing through or near deer concentration areas at night or at dawn or dusk rather than during the day (derived from Altmann 1958, Eckstein et al. 1979).

e. Harvest, change in level

See Grading/plowing, 6.d., for a guideline applicable to new land transportation routes.

14. Transport of personnel/equipment/material - water. Recreational powerboats on a lake have passively harassed deer and caused them

to stop using lakeshore habitat during the day while boats are being used.

Harassment, active or passive

General guideline. Avoid operating motorized boats on water bodies that occur within or adjacent to important deer habitat whenever deer are present, in order to avoid causing deer to stop using suitable habitat (derived from Loft et al. 1984).

15. Water regulation/withdrawal/irrigation. Construction of two dams in deer habitat flooded a portion of the winter range and blocked migration of deer between winter and summer ranges. Deer attempted to swim across the reservoirs, but many, especially fawns, were trapped or drowned.

a. Barriers to movement, physical and behavioral

General guideline. Avoid constructing reservoirs across migration routes of deer, to avoid blocking deer movements and trapping or drowning deer that attempt to swim across (derived from Loft et al. 1984).

b. Entrapment in impoundments or excavations

See a. above for an applicable guideline.

c. Water level or water quality fluctuations

General guideline. Avoid constructing reservoirs that would flood areas of important deer habitat such as winter range, and result in loss of limited food sources and possible starvation of deer (derived from Loft et al. 1984).

Birds

15. Bald Eagle

Table 2. Impacts Associated With Each Activity - Bald Eagle

Impacts / Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove																														
Aquatic vegetation, destruction or change																														
Attraction to artificial food source													X									X								X
Barriers to movement, physical and behavioral																														
Collision with vehicles or structures																											X	X		
Entanglement in fishing nets, debris																						X								
Entrapment in impoundments or excavations																														
Harassment, active or passive	X	?	?		X		?					X		X	?			?	?	?							X	X	X	
Harvest, change in level																														
Introduced wild/domestic species, competition																														
Morbidity/mortality by ingestion of petroleum				X														?	X	X	?				?	?		?	?	
Parasitism/predation, increased susceptibility																														
Prey base, alteration of			?	?			?			?				?				?	?	?	?				?	?		?	?	?
Shock waves (increase in hydrostatic pressure)																														
Terrain alteration or destruction	?											?																		
Veg. composition, change to less preferred		?		?	?						?																			
Veg. damage/destruction due to air pollution				?																										
Veg. damage/destruction due to fire/parasitism		?																												
Veg. damage/destruction due to grazing																														
Veg. damage/destruction due to erosion					X																									
Water level or water quality fluctuations			?				?			?	?				?			?	?	?	?									?

X - Documented impact (see text).
? - Potential impact.

15. BALD EAGLE - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Has the susceptibility of Bald Eagles to heavy metal and pesticide accumulation been considered in conjunction with the proposed activity?

2. Have the requirements of Bald Eagles for large, mature trees near water for nesting and perching been considered in the area of the proposed activity?

3. Has the protection and maintenance of seasonal roosting sites for Bald Eagles been considered in the area of the proposed activity?

4. Are powerlines designed to eliminate or minimize electrocution hazards to Bald Eagles?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

1. Blasting. Two references attributed decreased nesting activity and reproductive success of eagles to several factors, including blasting.

Harassment

General guideline. Avoid blasting in Bald Eagle habitat to minimize harassment to eagles, particularly during egg laying, incubation, and early growth of eaglets (derived from Snow 1973, U.S. Army Corps of Engineers 1979). (Note: See the life history section of the Alaska Habitat Management Guides for the Southcentral Region for information on nesting chronology.)

2. Chemical application. Bald Eagles have been affected by chemicals primarily by ingesting pesticide-contaminated food items. Eagles have also died from ingesting parts of poisoned carcasses used for predator control. Biological magnification of pesticides, fungicides, and their metabolites has been associated with decreased productivity of eagles, although embryonic and early chick mortality have also been documented. Dieldrin, DDT and its metabolites, PCBs, and mercury compounds were among the more common compounds found in eagle tissues.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid use of chemicals (e.g., organochlorine pesticides) in Bald Eagle habitat that, if indirectly ingested, could be debilitating or lethal to eagles (derived from, e.g., Coon et al. 1970, Evans 1982, Snow 1973).

(2) Specific guideline. Minimize debilitation or death of eagles during predator control programs using poisons by avoiding placement of poisoned bait in areas used by or accessible to eagles, by using bait unattractive to eagles, and by rapidly removing and properly disposing of any carcasses of poisoned predators (derived from Olendorff et al. 1981, Redig et al. 1983, Snow 1973).

3. Clearing and tree harvest. References documented decreased use of nesting and roosting areas by eagles when trees used for perching, roosting, and nesting are harvested or when logging operations occurred adjacent to these areas.

a. Harassment

(1) General guideline. Avoid clearing and tree harvest in Bald Eagle habitat when eagles are present (derived

from, e.g., Corr 1974, Hansen 1977, Hansen et al. 1980, Sopuck et al. 1979, Thelander 1973).

(2) Specific guideline. Minimize harassment of eagles by avoiding clearing and tree harvest adjacent to areas used by eagles for nesting, perching, or roosting (derived from, e.g., Corr 1974, Hansen 1977, Hansen et al. 1980).

b. <u>Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay</u>

(1) General guideline. In Bald Eagle habitat, avoid clearing or tree harvest, particularly riparian old-growth trees and snags used or potentially used for nesting, perching, or roosting; and ensure retention and recruitment of snags and trees suitable for perching, roosting, or nesting (derived from Sigman 1985).

(2) Specific guidelines:

° To minimize loss of nest trees, establish and maintain zones around such trees in which certain activities (e.g., clearing) are prohibited (derived from Corr 1974). (<u>Note</u>: Current U.S. Forest Service (USFS) and U.S. Fish and Wildlife Service (USFWS) agreements establish an undisturbed wildlife habitat zone of at least 100 m [330 ft] radius around each eagle nest tree on federal land [Sigman 1985].)

° Minimize the possibility of nest trees and potential nest trees being blown down by retaining adequate "leave strips" around nest sites in timber harvest areas (derived from Corr 1974).

° Minimize loss of actual and potential nest sites along extensive reaches of shoreline by allowing only small scattered timber sales (derived from Corr 1974). (<u>Note</u>: Current USFS-USFWS agreements require that a tree or cluster of trees, if necessary to improve wind-firmness, be preserved as feeding and perch trees in each hundred yards of beachfront on federal land [Sigman 1985].)

° Minimize harvesting trees or groups of trees used by wintering Bald Eagles for nocturnal roosting sites (derived from Hansen et al. 1980, Stalmaster 1980).

- Minimize harvesting trees or groups of trees within 50 m (165 ft) of streams used by wintering Bald Eagles to protect diurnal perching sites (derived from Stalmaster 1980).

4. Grading/plowing. During road construction, Bald Eagles decreased their use of adjacent habitat.

Harassment

General guideline. Avoid grading and plowing in habitat used by Bald Eagles when eagles are present (derived from Hansen 1977, Sopuck et al. 1979).

5. Grazing. References documented the attraction of Bald Eagles to domestic sheep and subsequent killing of adult sheep and lambs by eagles.

Attraction to an artificial food source

General guideline. Avoid grazing small animals (e.g., sheep, goats) in habitat used by Bald Eagles (derived from Klebesadel and Restad 1981, McEneaney and Jenkins 1983).

6. Human disturbance: References documented harassment (including researcher-induced harassment) of eagles, which led to flushing birds from nests, perching, and feeding areas; premature fledging of nestlings when nest trees were climbed by humans; and decreased production of eaglets in areas subjected to human disturbance.

Harassment

(1) General guideline. Avoid harassment of Bald Eagles, their nests, or their young (derived from, e.g., Bangs et al. 1982, Hansen et al. 1984, Stalmaster 1980, Stalmaster and Newman 1978). (Note: Federal law [16 USC 668-668d, Protection of Bald and Golden Eagles], provides for protection of eagles, their eggs, or their nests.)

(2) Specific guidelines:

- Minimize harassment of Bald Eagles by not climbing trees containing active eagle nests (derived from Grier 1969, Grubb 1976).

- Minimize human disturbance near Bald Eagle nests during periods of egg laying, incubation, and early growth of eaglets (derived from Snow 1973, U.S. Army Corps of Engineers 1979).

- Minimize harassment of eagles at wintering areas by prohibiting human activity within 100 m (330 ft) of streams used by eagles, provided at least 50 m (165 ft) of this buffer zone contains dense shielding vegetation (derived from Stalmaster 1980, Stalmaster and Newman 1978). Where vegetation is minimal, increase the zone of prohibited activity to 250 m (820 ft) (derived from Stalmaster 1980).

- Minimize human activity on open gravel bars or in river channels within 300 m (1,000 ft) of sites used by Bald Eagles in wintering areas (derived from Stalmaster 1980).

- Minimize human disturbance at wintering Bald Eagle feeding sites, particularly during daily periods of intensive feeding activity (derived from Skagen 1980, Stalmaster 1980).

- Minimize harassment of eagles by prohibiting permanent development within buffer zones and by permitting temporary human activities that do not destroy eagle habitat only during periods when eagles are seasonally absent (derived from Stalmaster 1980).

7. Processing minerals (including gravel). Heavy metals, primarily mercury compounds, have been found in eagle tissues and eggs. Adult, embryonic, and early chick mortality has been linked to heavy metal contamination.

   Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

   General guideline. Avoid processing minerals that contain heavy metals in or near Bald Eagle habitat to minimize the exposure of eagles to heavy metal contamination (derived from Evans 1982, Snow 1973, U.S. Army Corps of Engineers 1979).

8. Processing oil/gas. References documented morbidity and mortality of eagles from organochlorine pesticides, fungicides, and PCBs. Eggshell thinning and embryonic and early chick mortality have been linked to petrochemical contamination.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid processing petrochemicals in or near Bald Eagle habitat to minimize the exposure of eagles to petrochemical (e.g., pesticides, fungicides, PCBs) contamination (derived from Coon et al. 1970, Evans 1982, Snow 1973, U.S. Army Corps of Engineers 1979).

9. Solid waste disposal. Bald Eagles have been observed attracted to and feeding in garbage dumps and on offal from meat packing plants. Eagles have also been observed entangled in discarded wire.

a. Attraction to an artificial food source

(1) General guideline. Avoid operation of open garbage dumps or disposal of material edible by eagles in Bald Eagle habitat (derived from Musselman 1949, Roseneau et al. 1981, Sherrod et al. 1976).

(2) Specific guideline. Minimize the availability of garbage to eagles by rapidly burying garbage or, preferably, by incinerating the garbage and maintaining proper collection and storage procedures prior to incineration (derived from, e.g., Roseneau et al. 1981, Sherrod et al. 1976).

b. Entanglement in fishing nets, marine or terrestrial debris, or structures

General guideline. Avoid open disposal of wire, nets, and other items that may entangle Bald Eagles (derived from Redig et al. 1983).

10. Transport of personnel/equipment/material - air. References have documented collisions between aircraft and Bald Eagles that were aggressively defending nest sites and flushing of eagles from nests and feeding areas. Frequent aircraft overflights were also implicated in the decreased nesting success of eagles observed in one study.

a. Collision with vehicles or structures, or electrocution by powerlines

General guideline. To avoid collisions of Bald Eagle with aircraft, avoid operation of aircraft at low altitudes in Bald Eagle habitat, particularly near nest sites (derived from Roseneau et al. 1981, White and

Sherrod 1973). [Note: See also b. below for appropriate guidelines.]

b. Harassment

(1) General guideline. To avoid harassment, avoid low-altitude aircraft overflights in Bald Eagle habitat when eagles are present (derived from, e.g., Hansen et al. 1984, Roseneau et al. 1981, Sherrod et al. 1976).

(2) Specific guidelines:

° Minimize aircraft and helicopter overflights of Bald Eagle nest sites during the periods immediately before and during egg laying and during incubation, to minimize desertion of nests, egg breakage, or dumping of eggs from the nest by the parents (derived from Sopuck et al. 1979, White and Sherrod 1973).

° Minimize flights of helicopters close to Bald Eagle nests to minimize attacks by adult eagles on the helicopter (derived from White and Sherrod 1973).

° Minimize harassment of nesting eagles when approaching the nest with an aircraft by approaching with the aircraft in full view of the birds to minimize startling the adults, which could cause panicked flight by the adults and possible breakage or loss of eggs from the nest (derived from White and Sherrod 1973).

° Minimize harassment of feeding eagles by restricting the use of gravel bars as landing sites for aircraft when eagles are present (derived from Hansen et al. 1984).

11. Transport of personnel/equipment/material - land. References documented collisions of eagles with powerlines, electrocution of eagles perching on powerpoles, collisions with vehicles, and harassment causing disruption of nesting, feeding, perching, and roosting activities.

a. Collisions with vehicles or structures, or electrocution by powerlines

(1) General guideline. Avoid the placement and operation of above-ground powerlines in Bald Eagle habitat, particularly in treeless areas, to minimize collision and electrocution hazards to eagles (derived from, e.g.,

Boeker and Nickerson 1975, Olendorff et al. 1981, Reiswig 1981, Sherrod et al. 1976).

(2) Specific guidelines:

- ° Minimize electrocution of Bald Eagles by proper design of power transmission systems (derived from, e.g., Boeker and Nickerson 1975, Olendorff et al. 1981, Steenhof 1978). (Note: Olendorff et al. [1981] and Steenhof [1978] provide detailed recommendations regarding construction of powerpoles and powerlines that eliminate or minimize electrocution of eagles and other raptors.)

- ° Minimize electrocution of eagles by modifying existing powerpoles that are known to have electrocuted eagles (derived from, e.g., Boeker and Nickerson 1975, Olendorff et al. 1981, Reiswig 1981). (Note: Olendorff et al. [1981] and Steenhof [1978] provide recommendations for modifying existing powerpoles.)

b. Harassment

(1) General guideline. Avoid transport of personnel/-equipment/material by land (e.g., automobiles, snow-machines) within Bald Eagle habitat when this activity could cause harassment (derived from, e.g., Skagen 1980, Snow 1973, Stalmaster 1980, U.S. Army Corps of Engineers 1979).

(2) Specific guidelines:

- ° Minimize vehicular activity near wintering Bald Eagle feeding sites, particularly during periods of intensive feeding activity (derived from Skagen 1980).

- ° Minimize vehicular activity near Bald Eagle nests during periods of egg laying, incubation, and early growth of eaglets (derived from Snow 1973, U.S. Army Corps of Engineers 1979).

- ° Minimize vehicular activity near wintering Bald Eagle roosts (derived from Hansen 1977).

12. Transport of personnel/equipment/material - water. Boating activity caused eagles to flush from feeding and perching sites.

Disturbance of eagles by boating activity decreased eagle nesting success.

Harassment

(1) General guideline. Avoid transport of personnel/-equipment/material by water within Bald Eagle habitat when this activity could cause harassment of eagles (derived from, e.g., Bangs et al. 1982, Russell 1980, Skagen 1980, Stalmaster 1980).

(2) Specific guidelines:

- Minimize use of watercraft near wintering Bald Eagle feeding sites (derived from Russell 1980, Stalmaster 1980, Knight and Knight 1984).

- Minimize the use of canoe-sized vessels within 350 m (1,150 ft) of shoreline trees used for perching by wintering Bald Eagles (derived from Knight and Knight 1984).

- Minimize the use of canoe-sized vessels within 450 m (1,475 ft) of river bars used by feeding wintering Bald Eagles (derived from Knight and Knight 1984).

- Minimize boating activity on rivers during periods of intense feeding activity (early morning and late evening) to minimize harassment to feeding wintering Bald Eagles (derived from Knight and Knight 1984).

13. Water regulation/withdrawal/irrigation. One reference documented the attraction of eagles to fish killed as they passed through hydroelectric turbines.

Attraction to an artificial food source

General guideline. Avoid placement of hydroelectric powerplants in Bald Eagle habitat if this activity could lead to nonnatural concentration of eagles attracted to fish kills below the powerplant (derived from Musselman 1949).

16. Ducks

Table 1. Impacts Associated With Each Activity - Ducks

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove	?		?			?	?			?									?				?							
Aquatic vegetation, destruction or change	?		?	X		X	?			?		X	?		?			?	X	X	X	?	?		?	?				X
Attraction to artificial food source												X	?									X								
Barriers to movement, physical and behavioral												?																		
Collision with vehicles or structures												X		X													X	X	X	
Entanglement in fishing nets, debris																X														
Entrapment in impoundments or excavations						X													X	X										
Harassment, active or passive	?				?			X				?		X											?		X	X	X	
Harvest, change in level																														
Introduced wild/domestic species, competition												?	?	?								X								
Morbidity/mortality by ingestion of petroleum				X										?				?	X	X		?			X	X			X	
Parasitism/predation, increased susceptibility					?	X				X		X	X	X													?	?	X	X
Prey base, alteration of			?	?		X	?			?								?	?	?	?	?			X	?		?	?	X
Shock waves (increase in hydrostatic pressure)	?																													
Terrain alteration or destruction			?		?	X	?			X		X										?								X
Veg. composition, change to less preferred		X	?	?	X	?	?			?		X	X																	X
Veg. damage/destruction due to air pollution				?	X													?	?	?	?							?	?	
Veg. damage/destruction due to fire/parasitism		X																												
Veg. damage/destruction due to grazing													X																	
Veg. damage/destruction due to erosion					X					?	?	X										?								
Water level or water quality fluctuations			?			?	?			X		X									?									X

X - Documented impact (see text).
? - Potential impact.

16. DUCKS - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices 2 and 4, respectively.

A. Species-Related Considerations

1. Are provisions proposed to prevent or minimize disturbance to ducks during their flightless molting period?

2. Has the need of ducks for molting and staging areas been considered in planning for the proposed activity?

3. Are provisions proposed to prevent or minimize disturbance to nesting and brood-rearing habitat?

4. Are provisions proposed to avoid or minimize disturbance to important feeding areas used by ducks? See the life history and distribution and abundance sections of the Alaska Habitat Management Guides for information on feeding areas.

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

1. Burning. Burning of vegetation for agricultural purposes altered or eliminated nesting cover to the extent that nesting success was reduced.

   a. Vegetation composition, change to less preferred or useable species, or successional stage

      General guideline. Avoid burning vegetation that is used by ducks for nesting cover, particularly during or just prior to the nesting period (derived from Dwyer 1970, Fritzell 1975). (Note: See the duck life history section in the Alaska Habitat Management Guides for nesting chronology.)

   b. Vegetation damage/destruction due to fire or induced parasitism

      See a. above for appropriate guideline.

2. Chemical application. References discussed impacts of pesticides and herbicides to ducks. These impacts included concentration of pesticides and herbicides within duck tissues and eggs, reduced hatching success and duckling survival, damage to and changes in nesting cover, and damage to aquatic vegetation used by ducks for food from agricultural runoff.

   a. Aquatic vegetation, destruction or change in composition

      General guideline. Avoid the use of agricultural chemicals without appropriate safeguards and techniques to prevent contaminated runoff from entering watercourses and adversely affecting aquatic vegetation used by ducks (derived from Tiner 1984).

   b. Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

      General guideline. Avoid spraying herbicides or pesticides in habitat used by ducks, if these substances could be directly or indirectly ingested by ducks (derived from Dindal 1970, Vangilder and Peterle 1983).

   c. Vegetation composition, change to less preferred or useable species or successional stage

      General guideline. See a. and b. above for appropriate guideline.

d. Vegetation damage/destruction due to air pollution or contact with petroleum products or chemicals

See a. above for appropriate guideline.

3. Clearing and tree harvest. Two references discussed clearing of nesting habitat. One reference discussed clearing herbicides and the other clearing by mechanical methods.

a. Vegetation composition, change to less preferred or useable species or successional stage

(1) General guideline. Avoid clearing vegetation used by ducks (derived from Dwernychuck and Boag 1973, Sopuck et al. 1979).

(2) Specific guideline. Minimize changes in vegetation composition of habitat used by ducks for nesting, particularly changes from areas dominated by broad-leafed plants to areas dominated by grasses (derived from Dwernychuck and Boag 1973).

b. Vegetation damage/destruction due to air pollution or contact with petroleum products or other chemicals

See a.(1) above for appropriate guideline.

c. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

See a.(1) above for appropriate guideline.

4. Draining. Impacts of draining on ducks and their habitat included entrapment and subsequent drowning of ducks in drainage structures, drainage of pothole wetlands to expand farmlands, adverse effects to invertebrates and vegetation used by ducks for food, and increased susceptibility to diseases as a result of ducks concentrating in limited areas of wetlands. Impacts associated with human-caused periodic fluctuations of water levels (e.g., drawdowns for irrigation) are included in the activity Water regulation/withdrawal/irrigation. Guidelines to minimize the impacts of inadequate cross-drainage (e.g., impoundment of water by road construction) are included under the activity Grading and plowing.

a. Aquatic vegetation, destruction or change in composition

General guideline. Avoid draining wetlands and the subsequent loss of aquatic vegetation used by ducks for food and cover (derived from Haapanen and Waaramaki 1977).

b. Entrapment in impoundments or excavations

(1) General guideline. Avoid operation of drainage structures that could entrap ducks (when ducks are present) (derived from Kopischke 1964).

(2) Specific guideline. Minimize the entrapment of ducks in drainage structures by installing barriers (e.g., screens, grates) that would prevent entry into the drainage structure (derived from Kopischke 1964).

c. Parasitism and predation, increased susceptibility to

General guideline. Avoid draining wetlands when this activity could concentrate ducks on remaining wetlands, thereby increasing their susceptibility to contracting avian diseases (derived from Tiner 1984).

d. Prey base, alteration of

General guideline. Avoid draining wetlands when such drainage could adversely affect invertebrate populations within the wetlands that are used by ducks for food (derived from Tiner 1984).

e. Terrain alteration or destruction

General guideline. Avoid draining and destruction of wetlands used by ducks (derived from Haapanen and Waaramaki 1977, Sopuck et al. 1979, Tiner 1984).

5. Drilling. One study (which was summarized by two other papers reviewed for the impacts section) found that several species of ducks were less abundant near a drill rig on land than in comparable areas without a drill rig.

Harassment

General guideline. Avoid drilling in duck habitat when this activity could cause harassment (derived from Barry and Spencer 1976). (Note: See the duck life history and distribution and abundance sections of the Alaska Habitat Management Guides for information on seasonal use of habitat and nesting, brood-rearing, and molting chronology of ducks.)

6. Filling (aquatic and wetlands) and pile-supported structures (aquatic). References discussing aquatic filling documented the complete filling of pothole wetlands during road construction and the impoundment of water (also the result of road construction) that eliminated nesting habitat for at least one species of duck. Filling of wetlands also contributed to increased mortality of ducks from disease by concentrating ducks in limited remaining wetlands.

   a. Parasitism and predation, increased susceptibility to

      General guideline. Avoid filling wetlands when this activity could concentrate ducks on remaining wetlands, thereby increasing their susceptibility of contracting avian diseases (derived from Tiner 1984).

   b. Terrain alteration or destruction

      General guideline. Avoid filling wetlands when this activity could lead to loss of important duck habitat (derived from Sopuck et al. 1979, Tiner 1984).

   c. Water level or water quality fluctuations

      General guideline. Avoid filling within duck habitat when this activity could lead to impeded surface drainage and/or creation of impoundments that eliminate important duck habitat (derived from Troy 1985).

7. Grading/plowing. Several impacts to ducks and their habitat have been documented for the activity of grading and plowing. Construction of roads has led to impoundment of water and subsequent declines of emergent plant growth. Construction of roads has also eliminated marsh-pond complexes and reduced total acreage of ponds in some areas. Plowing and cultivation of fields has caused reduction in available nesting cover along margins of wetlands, attraction of ducks to fields of grain, and concentration of ducks on remaining wetlands, thereby increasing their susceptibility to diseases.

   a. Aquatic vegetation, destruction or change in composition

      (1) General guideline. Avoid grading or plowing in duck habitat when this activity could lead to changes in the depth of water or subsequent changes in aquatic vegetation in habitat adjacent to the grading or plowing project (derived from Sopuck et al. 1979).

      (2) Specific guideline. Minimize the impoundment of water created during grading or plowing (e.g., road

construction) by installing adequate cross-drainage structures (e.g., bridges, culverts) (derived from Sopuck et al. 1979).

b. Attraction to artificial food source

(1) General guideline. Avoid establishment of grain fields in or near duck habitat to reduce the artificial attraction of ducks to the fields in search of food, unless this activity is being used to mitigate loss of wetland habitat (derived from Bellrose et al. 1945, Klebesadel and Restad 1981, Neff 1955, Sugden 1976). (Note: The establishment of grain fields specifically for ducks has been used to reduce crop depredations and as "enhancement" on state and federal wildlife refuges to counter losses of surrounding natural habitat destroyed by development activities.)

(2) Specific guidelines:

- Minimize the attraction of ducks to farm fields and their subsequent feeding on grain by not storing or spreading waste grain in fields. Storing waste grain in fields may allow contact by ducks with fungal spores on moldy grain and may increase their chances of acquiring a fungal disease (e.g., aspergillosis) (derived from Bellrose et al. 1945, Neff 1955).

- Minimize the attraction of ducks to agricultural fields by employing one or more of the following practices: growing crops that are not susceptible to damage by ducks (e.g., flaxseed or rapeseed), growing grain varieties that can be harvested earlier or without the need for ripening in swaths, leaving high stubble in fields to discourage ducks, and delaying cultivation of harvested fields until nearby susceptible crops have been harvested to allow ducks to feed on waste grain in areas where they can do no damage (derived from Sugden 1976).

c. Collision with vehicles or structures, or electrocution by powerlines

General guideline. Avoid tilling lands used by ducks for nesting (e.g., pond margins) after the nesting period has begun to avoid destruction of nests, eggs, and incubating females (derived from Higgins 1977).

d. Parasitism and predation, increased susceptibility to

General guideline. Avoid plowing and cultivating wetlands when this activity could concentrate ducks on remaining wetlands, thereby increasing their susceptibility to contracting avian diseases (derived from Tiner 1984).

e. Terrain alteration or destruction

General guideline. Avoid grading or plowing in duck habitat when this activity could lead to elimination of marshes, ponds, and other wetland areas used by ducks (derived from Sopuck et al. 1979, Tiner 1984).

f. Vegetation composition, change to less preferred or useable species or successional stages

General guideline. Avoid plowing and cultivating along margins of wetlands to minimize loss of nesting and brood-rearing cover through changes in density or species of plants present in these areas (derived from Higgins 1977).

g. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

General guideline. Avoid plowing or cultivating along margins of wetlands to minimize loss of nesting and brood-rearing cover used by ducks (derived from Sopuck et al. 1979).

h. Water level or water quality fluctuations

See a.(1) and a.(2) above for appropriate guidelines.

8. Grazing. Impacts from livestock grazing include changes in the composition of vegetation used by nesting ducks and destruction of vegetation, leading to decreased use of the grazed area for nesting and brood-rearing and decreased nesting success. Trampling of nests and the consumption of duck eggs and nests by domestic reindeer has been reported.

a. Parasitism and predation, increased susceptibility to

General guideline. Avoid grazing reindeer or other livestock in areas used for nesting by ducks to prevent trampling of nests and eggs and to prevent livestock from eating nests or eggs (derived from Nelson and Hansen 1959).

b. <u>Vegetation composition, change to less preferred or useable species or successional stage</u>

General guideline. Avoid grazing livestock within duck habitat, particularly in duck nesting areas, to prevent damage to or changes in vegetation used by ducks for nesting cover (derived from Dwyer 1970, Higgins 1977).

c. <u>Vegetation damage/destruction due to grazing by domestic or introduced animals</u>

(1) General guideline. See b. above for appropriate guideline.

(2) Specific guidelines:

° Minimize the effects of grazing on duck nesting habitat by avoiding or limiting grazing and mowing on areas managed primarily for waterfowl production (derived from Kirsch 1969).

° Minimize the effects of livestock grazing on shoreline vegetation used for cover by nesting ducks by limiting grazing periods in these areas to less than 15 cattle-days per acre per year (derived from Bue et al. 1952).

9. <u>Human disturbance</u>. Human disturbance has led to flushing of birds from nests and subsequent increases in desertion of nests and loss of eggs to predators while birds were off the nests. In one instance, ducks collided with powerlines after being flushed by people walking near the lines.

a. <u>Collision with vehicles or structures, or electrocution by powerlines</u>

General guidelines. Avoid human disturbance (humans on foot) near overhead wires when ducks are present to reduce the likelihood of flushing ducks into the wires (derived from Sopuck et al. 1979).

b. <u>Harassment</u>

(1) General guideline. Avoid human disturbance (humans on foot) in duck habitat, particularly in areas used by nesting and brood-rearing ducks (derived from Gotmark and Ahlund 1984, Johnson 1984, Strang 1980).

(2) Specific guidelines:

- Minimize loss of eggs (to predators or from thermal stress) in nests from which females have been flushed by covering the exposed eggs with down (derived from Choate 1967, Gotmark and Ahlund 1984).

- Minimize harassment of nesting ducks by restricting human visitation of barrier islands when these islands are being used by nesting ducks (Gollop et al. 1974).

c. Parasitism and predation, increased susceptibility to

See b. above for appropriate guidelines.

10. Netting. References documented entanglement and subsequent death of ducks, primarily diving ducks, in net fragments and actively fished nets.

Entanglement in fishing nets, marine or terrestrial debris, or structures

General guideline. Avoid use of gill nets in areas heavily used by molting or wintering diving ducks to minimize entanglement of ducks in nets (derived from Bartonek 1965, Schorger 1947, Stout and Cornwell 1976).

11. Processing minerals (including gravel). References described destruction of aquatic vegetation used for food by ducks from industrial discharges, entrapment of ducks in industrial waste basins, and contamination of their feathers, leading to increased wetting and eventual hypothermia.

a. Aquatic vegetation, destruction or change in composition

General guideline. Avoid processing minerals in habitat used by ducks if discharges from such processing could lead to destruction of aquatic vegetation used by ducks (derived from Tiner 1984).

b. Entrapment in impoundments or excavations

General guideline. Avoid the use and placement of uncovered industrial waste basins in areas used by ducks to minimize entrapment and death of ducks (derived from Choules et al. 1978). (See also Processing oil/gas, 12.b.)

c. Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid processing minerals in habitat used by ducks if ducks could come in contact with chemicals or products used in or generated by the processing activity (derived from Choules et al. 1978). (See also Processing oil/gas, 12.c.)

12. Processing oil/gas: References discussed entrapment and subsequent death of birds in waste and oil sludge pits, destruction of aquatic vegetation used by ducks for food, and reduced egg quality and hatching success of duck eggs contaminated by small amounts of crude and refined oil.

a. Aquatic vegetation, destruction or change in composition

General guideline. Avoid processing oil/gas in habitat used by ducks if this activity could lead to destruction of aquatic vegetation used by ducks (derived from Tiner 1984).

b. Entrapment in impoundments or excavations

General guideline. Avoid placing petrochemical facilities and exposed petroleum sludge pits in areas used by ducks (Flickinger 1981).

c. Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid processing hydrocarbons in duck habitat when this activity could lead to ingestion of or contact with petroleum, petroleum products, or chemicals and subsequent debilitation or mortality of ducks (derived from Flickinger 1981, Szaro et al. 1980).

(2) Specific guidelines:

- Minimize contact of ducks with petroleum, petroleum products, or chemicals by avoiding the use of uncovered waste or sludge basins at petroleum processing facilities (derived from Boag and Lewin 1980, Choules et al. 1978).

- Minimize contact of ducks with petroleum, petroleum products, or chemicals at uncovered waste or sludge basins by installing deterrent devices (e.g., human effigies) in and around the basins and providing a means to increase their visibility to ducks (e.g., lighting) during periods of darkness (derived from Boag and Lewin 1980).

13. Sewage disposal: Pollution by sewage treatment plants caused losses of aquatic vegetation used by ducks for food.

Aquatic vegetation, destruction or change in composition

General guideline. Avoid discharging sewage treatment plant effluent to waters containing vegetation used by ducks for food (derived from Tiner 1984).

14. Solid waste disposal: References described the attraction of ducks to moldy ensilage that was disposed of on a farm field and that precipitated an outbreak of aspergillosis; and the indirect transmission of fowl cholera to ducks from dead chickens that were discarded at an open garbage dump.

a. Attraction to artificial food source

General guideline. Avoid disposing waste animal feed or other products on farm fields unless immediate burial of the waste is practiced to minimize attraction of ducks (derived from Neff 1955).

b. Introduced wild or domestic species, competition with or disease transmission from

General guideline. Avoid disposing diseased dead fowl at open dumps to minimize the indirect transmission of diseases to ducks (derived from Rosen and Bischoff 1950).

15. Transport of oil/gas/water - land: Experimental studies that investigated the effects of crude oil and other hydrocarbons on ducks and their eggs reported impacts that included altered metabolic functions and damage to plumage in adults, decreased hatching success of eggs, and decreased survival in ducklings. Experimental oil spills in shallow ponds caused reductions of invertebrate populations used by ducks for food.

a. Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid transporting oil or gas by land within duck habitat when this activity could lead to debilitation or mortality of ducks through ingestion of or contact with spilled oil or gas (derived from, e.g., Albers and Gay 1982, Lambert et al. 1982).

b. Prey base, alteration of

General guideline. Avoid spilling oil into waterbodies that could adversely affect populations of aquatic invertebrates that are used by ducks for food (derived from Abraham 1975).

16. Transport of oil/gas/water - water: References reviewed documented mortality of sea ducks from oil spills at sea and the results of experimental studies wherein crude oil was applied to ducks and duck eggs. Impacts of the experimental studies included altered metabolic functions and damage to plumage in adults, decreased hatching success of eggs, and decreased survival in ducklings.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid transporting oil or gas by water in areas used by ducks when this activity could lead to ingestion of or contact with spilled petroleum or petroleum products and subsequent debilitation or mortality of ducks (derived from Lemmetyinen 1966, Leppakoski 1973).

(2) Specific guidelines:

- Minimize the effects of vessel petroleum or chemical spills on ducks by requiring that ships carrying oil or other floating petroleum products or toxic floating compounds be equipped with spill containment devices (derived from Leppakoski 1973).

- Minimize the effects of petroleum or chemical spills in water on ducks by avoiding the use of emulsifiers and, to the extent possible, by using mechanical means to remove spilled floating compounds (derived from Leppakoski 1973).

17. Transport of personnel/equipment/material - air: Harassment from low-flying aircraft was the most common impact documented and caused reduced use of areas, flushing, and altered patterns of behavior. Collision by ducks with aircraft was also recorded.

a. Collision with vehicles or structures, or electrocution by powerlines

General guideline. Avoid operation of aircraft in areas heavily used by ducks to minimize the risks of collisions between ducks and aircraft (derived from Stout and Cornwell 1976).

b. Harassment

(1) General guideline. Avoid aircraft operations on lakes and over habitat used by ducks when this activity could lead to harassment (derived from, e.g., Campbell 1984, Gollop et al. 1974, Ward and Sharp 1974).

(2) Specific guidelines:

- Minimize harassment of nesting ducks from aircraft overflights by maintaining a minimum of 460 m (1,500 ft) above ground level (AGL) for helicopters and 152 m (500 ft) AGL for fixed-wing aircraft (Gollop et al. 1974).

- Minimize harassment of ducks by minimizing the number of aircraft flights over duck nesting habitat (Gollop et al. 1974).

- Minimize overflights of breeding ducks to reduce the possibility that repeated exposure to aircraft disturbance could lower tolerance levels of ducks to aircraft disturbance (derived from Gollop et al. 1974).

- Minimize harassment of ducks from aircraft overflights during September and October by maintaining a minimum altitude of 152 m (500 ft) (derived from Campbell 1984).

- Minimize harassment of molting seaducks from helicopter overflights by maintaining a minimum altitude of 305 m (1,000 ft) and a minimum distance of 1.6 km (1.0 mi) from the ducks (derived from Gollop et al. 1974, Ward and Sharp 1974, Wright and Fancy 1980).

18. Transport of personnel/equipment/material - land: References discussed harassment of and collisions with ducks by air cushion vehicles and collisions of ducks with overhead wires and automobiles.

(a) Collision with vehicles or structures, or electrocution by powerlines

(1) General guideline. Avoid operation and placement of land transportation systems in duck habitat to reduce

collisions between ducks and powerlines or vehicles (derived from, e.g., Anderson 1978, Sargeant 1981, Slaney and Co. 1973, Sopuck et al. 1979).

(2) Specific guidelines:

° Minimize the potential for collisions between ducks and transmission wires or towers by siting transmission lines inland from the coast to avoid coastal duck movements. Also, design transmission lines to minimize the potential for collisions during darkness or bad weather (Bristol Bay Cooperative Management Plan 1984, draft final EIS, cited in Alaska Habitat Management Guides - Southwest Region, Guidance (Note: This existing guideline was developed for a land management plan and although deemed suitable for inclusion here, may or may not be based on documented impact information.)

° Minimize the potential for collisions between ducks and automobiles by routing roads through areas other than wetlands used by ducks (particularly nesting ducks) (derived from Sargeant 1981).

b. Harassment

(1) General guideline. Avoid operation of air cushion vehicles in duck habitat to avoid harassment of ducks (derived from Slaney and Co. 1973).

(2) Specific guideline. Minimize harassment of ducks during operation of air cushion vehicles by maintaining a minimum distance of 228 m (750 ft) from dabbling ducks, and 1,200 m (3,900 ft) from diving ducks (derived from Slaney and Co. 1973). (Note: See the ducks life history and distribution and abundance sections of the Alaska Habitat Management Guides to determine the likelihood of the presence of either dabbling or diving ducks in specific habitats.)

19. Transport of personnel/equipment/material - water: References discussed impacts of waterborne transportation to ducks that included death of ducks from collisions with ships and death from ingestion of or contact with oil spilled from ships. Vessel traffic also caused harassment (flight) of ducks when they were approached by airboats and boats and reduced use of areas frequently traversed by boats.

a. Collision with vehicles or structures, or electrocution by powerlines

General guideline. Avoid operation of bright lights on watercraft at night to avoid attracting birds in areas where collisions between ducks and vessels could occur (derived from Dick and Donaldson 1978).

b. Harassment

(1) General guideline. Avoid operation of watercraft in areas where harassment of ducks could occur (derived from Barry and Spencer 1976, Campbell 1984, Sopuck et al. 1979).

(2) Specific guideline. During autumn, minimize harassment of ducks by airboats by maintaining a minimum distance of 400 m (¼ mi) between ducks and airboats (derived from Campbell 1984).

c. Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

See Transport of oil/gas/water - water, 16., for appropriate guidelines.

20. Water regulation/withdrawal/irrigation: Several impacts resulting from water regulation/withdrawal/irrigation have been documented. Impacts included changes in or loss of aquatic vegetation used by ducks because of changes in mean levels of water, increased rates of predation on ducks or their eggs when nesting islands are connected to the shore during drawdowns for irrigation, and inundation of nests and nesting areas. Changes in levels of water caused changes in the number or loss of access to invertebrate and mollusc prey items and emergent vegetation, drying or flooding of wetland areas, and shifts of successional stages (e.g., wetlands to shrubs or forest).

a. Aquatic vegetation, destruction or change in composition

General guideline. Avoid altering water levels in duck habitat when this activity could lead to loss or reduction of vegetation used by ducks for food or cover (derived from Sopuck et al. 1979).

b. Parasitism and predation, increased susceptibility to

General guideline. Avoid drawdowns of waterbodies containing islands used by nesting ducks when such drawdowns could create bridges between the islands and the shore and lead to increased predation on nesting ducks and their eggs (derived from Sopuck et al. 1979). (See also Draining, 4.c., or Filling - aquatic, 6.c., for appropriate guidelines)

c. Prey base, alteration of

General guideline. Avoid altering water levels when this activity could lead to reductions in numbers of or reduced access to invertebrate prey species used by ducks for food (derived from Sopuck et al. 1979).

d. Terrain alteration or destruction

General guideline. Avoid inundation or permanent drying of habitat used by ducks for nesting, feeding, or loafing (derived from Nieman and Dirschl 1973, Sopuck et al. 1979, Tiner 1984).

e. Vegetation composition, change to less preferred or useable species or successional stage

General guideline. Avoid alteration of water levels in duck habitat that could cause changes in shoreline vegetation that could lead to reduced use of this habitat by ducks (derived from Nieman and Dirschl 1973, Sopuck et al. 1979).

f. Water level or water quality fluctuations

General guideline. Avoid causing fluctuations in water level or water quality that could lead to reduced use of habitat by ducks (derived from Nieman and Dirschl 1973, Sopuck et al. 1979, Tiner 1984).

17. Geese

Table 1. Impacts Associated With Each Activity - Geese

Impacts / Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove	?		?			?	?			?									?				?							
Aquatic vegetation, destruction or change	?		?	?		?	?			?		?	?		?			?	?	?	?	?	?		?	?				?
Attraction to artificial food source												X	?									?								
Barriers to movement, physical and behavioral												?																X		
Collision with vehicles or structures												?		?													X	X	?	
Entanglement in fishing nets, debris																														
Entrapment in impoundments or excavations						?													?	?										
Harassment, active or passive	X				X			X				X		X											X		X	X	X	
Harvest, change in level																														
Introduced wild/domestic species, competition												?	?	?								?								
Morbidity/mortality by ingestion of petroleum				X										?				?	?	X		?			?	?			?	
Parasitism/predation, increased susceptibility					?	?				?		?	X	X													X	?	X	X
Prey base, alteration of																														
Shock waves (increase in hydrostatic pressure)																														
Terrain alteration or destruction			?		?	?	?			?		?										?								X
Veg. composition, change to less preferred		?	?	?	?	?	?			?		?	?																	X
Veg. damage/destruction due to air pollution				?	?													?	?	?	?							?	?	
Veg. damage/destruction due to fire/parasitism		?																												
Veg. damage/destruction due to grazing													?																	
Veg. damage/destruction due to erosion					?					X	?	?										?								
Water level or water quality fluctuations			?			?	?			X		?									?									X

X - Documented impact (see text).
? - Potential impact.

17. GEESE - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Has the preference of geese to nest on islands been considered in planning for the proposed activity? (Note: See the goose life history and distribution and abundance sections of the Alaska Habitat Management Guides for information on seasonal use of habitat, and nesting, brood-rearing, and molting chronology of geese.)

2. Has the use by geese of specific brood-rearing areas separate from nesting areas been considered in planning for the proposed activity?

3. Have measures been proposed to prevent or minimize disturbance to geese on fall staging areas where they obtain the necessary energy reserves prior to migrating to wintering areas?

4. Are provisions proposed to prevent or minimize disturbance to geese during their flightless period in traditional molting areas?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar

conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

In order to account for the limited distribution of snow geese in Arctic Alaska and the species' apparent high reactivity to certain types of disturbance, additional guidelines are presented that are unique to snow geese breeding and staging situations in Arctic Alaska (see 8.a., 11.b., 12.a., and 12.c. below).

1. Blasting. One reference reported that noise from blasting for reservoir preparation contributed to decreased nesting success in a population of Canada geese. Another reference reported snow geese exhibiting alert reactions to construction blasting 13 km (8 mi) distant.

    Harassment

    (1) General guideline. Avoid blasting near goose nesting areas when geese are present (derived from Gibson and Buss 1972).

    The following guideline applies to breeding snow geese in Arctic Alaska.

    (2) Specific guideline. Minimize harassment of breeding snow geese by avoiding construction blasting within 13 km (8 mi) of incubating and brood-rearing snow geese (derived from Envirosphere Company 1986).

2. Chemical application. References discuss impacts of pesticides and herbicides applied to vegetation used by geese for food. Impacts to geese include death, debilitation of enzyme systems, and decreased nesting success.

    Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

    (1) General guideline. Avoid use of pesticides or herbicides that are toxic to geese in habitat used by geese (derived from, e.g., Blus et al. 1979, Flickinger 1979, White et al. 1982, Zinkl et al. 1978).

    (2) Specific guidelines:

    - Minimize impacts to geese from the use of pesticides and herbicides by using chemicals that have a low level of toxicity to geese and that degrade rapidly to nontoxic compounds after application (derived from Blus et al. 1979, Flickinger 1979, White et al. 1982, Zinkl et al. 1978).

- Minimize the exposure of geese to chemically treated crop seed by using treated seed only where necessary and by using methods of cultivation that decrease the availability of grain to geese (derived from Blus et al. 1979).

3. Clearing and tree harvest. One reference attributed the desertion of several Canada goose nests to noise from clearing orchards and farms prior to reservoir filling.

Harassment

General guideline. Avoid clearing in or near goose habitat when geese are present (derived from Culbertson et al. 1971).

4. Drilling. One study (that was summarized by two other papers reviewed for the impacts section) found that geese were less abundant near a drill rig on land than in more distant comparable areas.

Harassment

General guideline. Avoid drilling in goose habitat when this activity could cause harassment to geese (derived from Barry and Spencer 1976).

5. Filling (aquatic and wetlands) and pile-supported structures (aquatic). One reference found that water impounded by the construction of a road effectively eliminated and reduced habitat quality for breeding white-fronted geese. Another reference reported filling of snow goose brood-rearing areas with gravel and consequent loss of use of the area by geese.

a. Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay

General guideline. Avoid filling wetlands when this activity could lead to direct loss of habitat from material overlay (derived from Envirosphere 1986, Troy 1985).

b. Water level or quality fluctuations

General guideline. Avoid filling wetlands when this activity could lead to impeded surface drainage and/or creation of impoundments that eliminate goose breeding habitat (derived from Troy 1985).

6. Grading/plowing. References documented two impacts to geese from grading and plowing. Noise from grading activities caused desertion of nests and decreased nesting success. Geese also were attracted to cultivated grain fields to feed.

a. Attraction to artificial food source

(1) General guideline. Avoid establishment of grain fields in or near goose habitat, to reduce the artificial attraction of geese to the fields in search of food, unless this activity is being used to mitigate loss of wetland habitat (derived from Blus et al. 1984, Klebesadel and Restad 1981, Sugden 1976). (Note: The establishment of grain fields specifically for geese has been used to reduce crop depredations and as enhancement on state and federal wildlife refuges to counter losses of surrounding natural habitat destroyed by development activities.)

(2) Specific guideline. Minimize the attraction of geese to agricultural fields by employing one or more of the following practices: a) growing crops that are not susceptible to damage by geese (e.g., flaxseed or rapeseed); b) growing grain varieties that can be harvested earlier or without the need for ripening in swaths; c) leaving high stubble in fields to discourage geese; d) delaying cultivation of harvested fields until nearby susceptible crops have been harvested (to allow geese to feed on waste grain in areas where they can do no damage); and e) by using methods of cultivation that minimize the availability of seed to geese (derived from Blus et al. 1984, Sugden 1976).

b. Harassment

General guideline. Avoid grading or plowing near nesting geese when this activity could cause harassment (derived from Culbertson et al. 1971, Gibson and Buss 1971).

7. Grazing. One reference documented the introduction of foxes (for fur farming) to islands used by nesting Aleutian Canada geese and the subsequent elimination of geese from these islands.

Parasitism and predation, increased susceptibilty to

General guideline. Avoid introducing predatory species within goose nesting habitat (derived from Jones and Byrd 1979).

8. Human disturbance. Disturbance of geese by humans has caused geese to flush from nests, decreased nesting success, and increased loss of eggs and young to predators while geese were off their nests or separated from their broods. Disturbance by humans has also disrupted the activities of molting and nonbreeding geese, causing them to leave the area or to remain in alert posture for extended periods.

The responses of breeding snow geese in Arctic Alaska are sufficiently distinct from those of other species and regions that an additional set of guidelines has been written for that situation (see a. below).

a. Harassment

(1) General guideline. Avoid human disturbance (humans on foot) in goose habitat, particularly in areas used by nesting, brood-rearing, molting, or fall-staging geese (derived from, e.g., Derksen et al. 1982, Eisenhaurer and Kirkpatrick 1977, Hansen and Eberhardt 1971, MacInnes and Misra 1972).

(2) Specific guidelines.

The following guidelines apply to all regions of the state:

- Minimize harassment of geese by restricting development activities to periods when geese are absent from the area (i.e., September to May) (Derksen et al. 1982).
- Minimize harassment of geese by avoiding development activities in coastal wetlands and intertidal areas that are important fall staging areas (Derksen et al. 1982).
- Minimize harassment of geese by siting facilities, winter trails, and developments on dry upland tundra away from wet-sedge meadows and drained basins used extensively by geese (Derksen et al. 1982).

- Minimize visits to goose nests, particularly during the early egg-laying period, to minimize desertion of nests (derived from Mickelson 1975).

- Minimize harassment of nesting geese by restricting human visitation to barrier islands when these islands are being used by nesting geese (Gollop et al. 1974).

- Minimize harassment of snow geese during late summer by avoiding the approach of humans on foot to within 150 m (500 ft) (derived from Spindler 1984).

- Minimize harassment of black brant during fall migration by avoiding approach of humans on foot to within 4 km (2.5 mi) (derived from Lehnhausen and Quinlan 1981).

The following guidelines apply to breeding snow geese in Arctic Alaska:

- Minimize harassment to snow goose breeding pairs at the nest and to nonbreeding geese at this time by not approaching on foot within 200 m (650 ft) (derived from Envirosphere Company 1986).

- Minimize harassment of breeding snow geese during egg laying and incubation that could cause abandonment of nesting habitat on Howe Island by prohibiting visits to the Howe Island USGS benchmark site between 20 May and 8 July (derived from Envirosphere Company 1986).

- Minimize severe harassment (e.g., capture and handling) of snow goose brood-rearing flocks to avoid causing abandonment of brood-rearing areas (derived from Envirosphere Company 1986).

b. Parasitism and predation, increased susceptibility to

General guideline. Avoid human disturbance (humans on foot) in areas used by nesting and brood-rearing geese, to avoid flushing geese from their nests or separating adults from young and exposing the unprotected eggs or young to increased predation (derived from Eisenhaurer and Kirkpatrick 1977, MacInnes and Misra 1972, Mickelson 1975).

9. Processing oil/gas. One reference reported that six geese were found dead in a tailings pond of an oil sands extraction plant.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

(1) General guideline. Avoid processing hydrocarbons in goose habitat when this activity could lead to ingestion of or contact with petroleum, petroleum products, or chemicals, and subsequent debilitation or mortality of geese (derived from Boag and Lewin 1980).

(2) Specific guidelines:

° Minimize contact of geese with petroleum, petroleum products, or chemicals by avoiding use of uncovered waste or sludge basins at petroleum processing facilities (derived from Boag and Lewin 1980).

° Minimize contact of geese with petroleum, petroleum products, or chemicals at uncovered waste or sludge basins by installing deterrent devices (e.g., human effigies) in and around the basins and providing a means to increase their visibility to geese (e.g., lighting) during periods of darkness (derived from Boag and Lewin 1980).

10. Transport of oil/gas/water-land, ice. Two references discuss the effects of noise from a simulated natural gas compressor station on fall-staging white-fronted, Canada, and snow geese on the arctic coastal plain of the northern Yukon Territory. Reactions of snow geese included changes in direction and pattern of flight upon encountering the sound, increased distance between flocks of feeding geese and the active sound simulator, and fewer geese landing near the active simulator.

Harassment

(1) General guideline. Avoid siting gas compressor stations in areas heavily used by fall-staging geese (derived from Gollop and Davis 1974, Wiseley 1974).

(2) Specific guidelines:

° Minimize harassment to geese if compressor stations must be built within areas used by geese for staging by shutting down the stations during the goose staging period or by installing efficient muffler systems that reduce the area affected by the noise (Gollop and Davis 1974).

- Minimize harassment to geese by suspending aircraft support operations to the compressor stations during the goose staging period or by keeping such operations to a minimum (Gollop and Davis 1974).

11. Transport of personnel/equipment/material-air. Several references discuss impacts of aircraft overflights to brant and emperor, Canada, white-fronted, and snow geese. Impacts include collision with powerlines after geese were flushed by low-flying aircraft, flushing geese from nests and a subsequent increase in predation on the exposed eggs, interruption of feeding activities, the splitting of flocks, and abandonment of the area in which overflights occurred.

    The responses of breeding and staging snow geese in Arctic Alaska to aircraft are sufficiently distinct from those of other geese and in other regions that separate guidelines have been written (see b. below).

    a. Collision with vehicles or structures, or electrocution by powerlines

        General guideline. Avoid aircraft overflights of geese, particularly snow geese, when such overflights could cause geese to take flight and collide with nearby overhead wires (derived from Blokpoel and Hatch 1976).

    b. Harassment

        (1) General guideline. Avoid operation of aircraft, particularly helicopters, over habitat used by geese (derived from Derksen et al. 1979, Gollop et al. 1974, Salter and Davis 1974).

        (2) Specific guidelines:

        - Minimize harassment of geese by using fixed-wing aircraft instead of helicopters for flights over habitat occupied by geese (derived from Davis and Wiseley 1974, Gollop et al. 1974, Sellers 1979).

        - Minimize harassment of molting geese (brant, Canada, white-fronted, and snow geese) by requiring small aircraft to maintain a minimum altitude of 1,525 m (5,000 ft) over habitat used by molting geese (Derksen et al. 1979).

        - Minimize harassment of nesting black brant by maintaining minimum altitudes of 152 m (500 ft) for overflights by fixed-wing aircraft and 457 m (1,500 ft) for overflights by helicopters (Gollop et al. 1974).

- Minimize harassment of geese by avoiding repeated overflights or circling by aircraft, particularly helicopters (derived from Gollop et al. 1974, Woodward-Clyde Consultants 1982).

- Minimize harassment by routing aircraft a minimum of 1.6 km (1 mi) from fall-staging emperor and cackling Canada geese (derived from Timm 1980).

The following guidelines apply to breeding snow geese in Arctic Alaska:

- Minimize harassment of breeding snow geese at Howe and Duck islands (Sagavanirktok River delta-Prudhoe Bay area) by avoiding flights within 1.6 km (1 mi) of these islands between 25 May and 7 July (Welling and Johnson 1982). Necessary overflights of these islands should be conducted above 500 m (1,650 ft) (Welling and Johnson 1982).

- Minimize harassment of breeding geese during egg laying and incubation that could cause abandonment of nesting habitat on Howe Island by prohibiting visits to the Howe Island USGS benchmark site with helicopters between 20 May and 8 July (derived from Envirosphere Company 1986).

- Minimize harassment of brood-rearing and molting snow geese in the Sagavanirktok River delta by routing helicopter flight paths to avoid flightless geese by a minimum of 1.6 km (1.0 mi) and 500 m (1,650 ft) agl (derived from Envirosphere Company 1986, Welling and Johnson 1982).

The following guidelines apply to staging snow geese in Arctic Alaska.

- Minimize harassment of fall-staging snow geese by scheduling necessary repetitive aircraft and helicopter overflights to minimize the interval between overflights (preferably to 1/2 hr intervals as opposed to 2 hr intervals) (derived from Davis and Wiseley 1974).

- Minimize harassment of fall-staging snow geese by routing aircraft away from areas of heavy concentrations of snow geese (derived from Salter and Davis 1974).

- ° Minimize harassment of fall-staging snow geese by avoiding aircraft overflights at altitudes less than 3,050 m (10,000 ft) and within 14.6 km (9 mi) of snow geese (derived from Salter and Davis 1974).

- ° Minimize harassment of fall-staging snow geese (through reduced lateral dispersion of sound from the aircraft) by conducting necessary aircraft flights near geese at altitudes of less than 30 m (100 ft) (derived from Spindler 1984).

c. <u>Parasitism and predation, increased susceptibility to</u>

General guideline. Avoid flying over nesting geese to reduce flushing geese from nests and thereby exposing the unattended eggs and disturbed adults to increased avian or mammalian predation (derived from Barry and Spencer 1976, Derksen et al. 1982).

12. <u>Transport of personnel/equipment/material - land</u>. References documented collisions of geese with powerlines, harassment of geese by hovercraft and trucks, leading to disruption of behavior of incubating and brood-rearing geese and to abandonment of nesting habitat and vehicular traffic restricting the movements of flightless geese attempting to cross a road.

a. <u>Barriers to movement, physical and behavioral</u>

The following guideline applies to <u>breeding</u> snow geese in Arctic Alaska.

General guideline. Avoid construction of roads and continuous operation of vehicles on roads traversing snow goose brood-rearing habitat, to avoid creating a barrier that prevents or hinders the movement of broods between brood-rearing areas (derived Envirosphere Company 1986, Hampton and Joyce 1985).

b. <u>Collision with vehicles or structures, or electrocution by powerlines</u>

(1) General guideline. Avoid the placement of overhead wires and support structures within habitat used by geese (derived from Sopuck et al. 1979).

(2) Specific guideline. Minimize collisions of geese with overhead transmission wires or towers by siting

transmission lines inland from the coast to avoid coastal goose movements (Bristol Bay Cooperative Management Plan 1984, draft final EIS, cited in Alaska Habitat Management Guides in the Southwest Region, Guidance). (Note: This existing guideline was developed for a land management plan and although deemed suitable for inclusion here, may or may not be based on documented impact information.)

c. Harassment

(1) General guideline. Avoid operation of vehicles, including hovercraft, within habitat used by geese when geese are present (derived from Culbertson et al. 1971, Hampton and Joyce 1985, Slaney and Co. 1973).

(2) Specific guideline. Minimize harassment of geese by hovercraft by maintaining a minimum distance of 1,200 m (3,900 ft) from geese (derived from Slaney and Co. 1973).

The following guidelines apply to breeding snow geese in Arctic Alaska.

- Minimize harassment of nesting snow geese and possible abandonment of nesting areas by minimizing vehicle traffic on roads within 1.6 km (1.0 mi) of nesting areas (derived from Envirosphere 1986).

- Minimize harassment of brood-rearing snow geese by avoiding operation of vehicles within 1.0 km (0.6 mi) of geese (derived from Envirosphere 1986).

13. Transport of personnel/equipment/material - water. References described harassment of geese by the operation of small boats and airboats, separation of young from adults by boats causing increased rates of predation on young, and inadvertent introduction of predators on ships that visit islands used by geese for nesting.

a. Harassment

(1) General guideline. Avoid operation of small boats in areas used by geese when geese are present (derived from Hampton and Joyce 1985, Mickelson 1975, Owens 1977).

(2) Specific guideline. Minimize harassment of resident fall-staging geese in autumn by airboats by maintaining a minimum distance of 125 m (400 ft) from geese (derived from Campbell 1984).

b. Parasitism and predation, increased susceptibility to

(1) General guideline. Avoid operation of watercraft in areas used by geese when increases in predation on geese could occur as a result of the operation of watercraft (derived from Jones and Byrd 1979, Mickelson 1975).

(2) Specific guidelines:

° Minimize reduction of goose populations by avoiding the introduction of predators of geese (derived from Jones and Byrd 1979).

° Minimize separation of goslings from adult geese and consequent increased rates of avian predation on goslings by avoiding the operation of boats near broods of geese (derived from Mickelson 1975).

14. Water regulation/withdrawal/irrigation. References discussed inundation and erosion of island nest sites used by geese upon completion and operation of hydroelectric dams. Changes in levels of water also changed the composition of vegetation to species that were less preferred by geese. Drawdown of impoundments used for irrigation also allowed easier access of mammalian predators to islands used by nesting geese, causing increased predation on these nests.

a. Parasitism and predation, increased susceptibility to

General guideline. Avoid drawdown of waterbodies containing islands used for nesting by geese when such activity could connect the islands and the mainland, thereby facilitating mammalian predation on nesting geese or their eggs (derived from Sopuck et al. 1979).

b. Terrain alteration or destruction

General guideline. Avoid water regulation/withdrawal/irrigation within habitat used by geese when this activity could lead to temporary or permanent inundation of islands and wetland habitat or drying of wetlands or waterbodies that adversely affects the use of this habitat by geese (derived from, e.g., Bowhay 1972, Fielder and Perleberg 1983, Gibson and Buss 1972, Nieman and Dirschl 1973).

c. Vegetation composition, change to less preferred or useable species, or successional stage

General guideline. Avoid alteration of water levels in habitat used by geese that could cause changes in composition of vegetation to species that are less preferred by geese (derived from Bowhay 1972).

d. Water level or water quality fluctuations

General guideline. Avoid causing fluctuations in water level or water quality that could lead to reduced use of habitat by geese (derived from, e.g., Bowhay 1972, Hanson and Eberhardt 1971, McCabe 1979).

18. Seabirds

Table 1. Impacts Associated With Each Activity - Seabirds

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove	?		?				?			?												?								
Aquatic vegetation, destruction or change	?		?	?			?			?					?			?	?	?	?	?			?	?			?	
Attraction to artificial food source	?													?		X						X								
Barriers to movement, physical and behavioral																														
Collision with vehicles or structures								?														X					X		X	
Entanglement in fishing nets, debris																X						X								
Entrapment in impoundments or excavations																														
Harassment, active or passive	?						?	?		?		?		X													X	?	?	
Harvest, change in level																														
Introduced wild/domestic species, competition																														
Morbidity/mortality by ingestion of petroleum				X				?										?	X	X	X				X	X			X	
Parasitism/predation, increased susceptibility													X	X													X	?	?	
Prey base, alteration of			?				?	?		?					?	?		?	?	?	?				?	?			?	
Shock waves (increase in hydrostatic pressure)	X																													
Terrain alteration or destruction	?									?	?	?	X									?								
Veg. composition, change to less preferred				?	?					?			?																	
Veg. damage/destruction due to air pollution				?														?	?	?								?	?	
Veg. damage/destruction due to fire/parasitism		?																												
Veg. damage/destruction due to grazing													X																	
Veg. damage/destruction due to erosion					?						?		?																	
Water level or water quality fluctuations			?				?			?								?			?									

X - Documented impact (see text).
? - Potential impact.

18. SEABIRDS - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Are provisions proposed to avoid or minimize damage to or destruction of cliffs and barrier islands used by nesting seabirds or areas in which burrow-nesting species may dig their nest holes? (Note: See the distribution and abundance section of the Alaska Habitat Management Guides - Southcentral Region for locations of seabird nesting.)

2. Has the vulnerability of ground-nesting seabirds on islands to introduced predators been considered for those activities that may introduce, either accidentally or intentionally, animals capable of preying on seabirds, their eggs, or their young?

3. Has the low reproductive potential (e.g., a small clutch size or a long period to reproductive maturity) of the seabird species in the area of the proposed activity been considered for activities that may interfere with or reduce the nesting success of seabirds?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar

conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

1. Blasting. One reference discussed mortality of seabirds from underwater blasting.

    Shock waves (increase in hydrostatic pressure)

    (1) General guideline. Avoid blasting in seabird habitat, particularly in feeding areas, when seabirds are present (derived from Cooper 1982).

    (2) Specific guidelines:

    - Minimize impacts of blasting to seabirds by scheduling underwater blasts when few birds are in the area (derived from Cooper 1982).

    - Minimize impacts of blasting to seabirds by scheduling only one blast per day or, at a minimum, by timing the blasts such that birds attracted to the fish killed by the earlier blast will have sufficient time to leave the new blast area (derived from Cooper 1982).

    - Minimize impacts of blasting to seabirds by patrolling the area of the blast by boat in conjunction with scaring techniques (e.g., gunfire, underwater acoustics) to drive birds away from the area prior to the blasting (derived from Cooper 1982).

2. Chemical application. Runoff containing organochlorines that eventually made its way to seabird habitat caused elevated levels of organochlorines in seabird tissues, eggshell thinning, and reduced viability of embryos.

    Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

    General guideline. Avoid application of chemicals in seabird habitat or in areas where runoff containing chemicals could reach seabird habitat if mortality or morbidity of seabirds could result from direct ingestion of these chemicals or ingestion of contaminated food items (derived from Ohlendorf et al. 1978).

3. Grazing. Livestock introduced onto islands have grazed and trampled vegetation in nesting areas of burrowing seabirds and have initiated landslides that have buried burrows and rendered slopes unuseable by burrowing seabirds. Fox fur farming was documented as a source of increased predation on seabirds.

   a. Parasitism and predation, increased susceptibility to

      General guideline. Avoid fox fur farming (or raising other fur-bearing predators of seabirds) in habitat used by seabirds, particularly ground-nesting or burrowing seabirds (derived from Jones and Byrd 1979).

   b. Terrain alteration or destruction

      General guideline. Avoid grazing livestock in areas used for nesting by burrowing seabirds to prevent trampling of burrows, disruption of vegetation, and erosion of slopes used by burrowing seabirds for nest sites (derived from Jones and Byrd 1979).

   c. Vegetation damage/destruction due to grazing by domestic or introduced animals

      See b. above for appropriate guideline.

4. Human disturbance. References (dealing primarily with gulls) documented nest abandonment, flushing of adults from nests, and increased predation by gulls on exposed eggs and chicks when humans approached and ventured into nesting areas.

   a. Harassment

      (1) General guideline. Avoid harassment of gulls and other seabirds, particularly during the breeding season (derived from, e.g., Ellison and Cleary 1978, Gillett et al. 1975, Robert and Ralph 1975).

      (2) Specific guidelines:

         ° Minimize harassment to seabirds by restricting human visitation to areas used by breeding seabirds, particularly during nest initiation, incubation, and early chick rearing (derived from, e.g., Ellison and Cleary 1978, Gollop et al. 1974, Lehnhausen and Quinlan 1981).

         ° Minimize harassment of nesting gulls by maintaining a distance of 100 m (330 ft) from the nests (derived from Murphy and Hoover 1981).

b. Parasitism and predation, increased susceptibility to

General guideline. See a. above for appropriate guidelines that will also minimize predation on seabird eggs and chicks while the adults are harassed off the nest.

5. Netting. References discussed entanglement of seabirds in actively fished and lost nets and the attraction of seabirds to net-entangled organisms (e.g., fish).

a. Attraction to an artificial food source

General guideline. Avoid using nets or discarding damaged nets in areas used by feeding seabirds, to minimize attracting seabirds to organisms (e.g., fish) entangled in the nets (derived from DeGange and Newby 1980).

b. Entanglement in fishing nets, marine or terrestrial debris, or structures

General guideline. Avoid using nets or discarding damaged net in areas used by seabirds, to minimize entanglement of birds in the net (derived from Ainley et al. 1981, DeGange and Newby 1980, King et al. 1979).

6. Processing minerals (including gravel). Chemical and heavy metal (e.g., mercury) contamination of marine waters from effluent and spills from metals processing was reported to cause elevated levels of metals in tissues and eggs of seabirds and decreased viability of embryos.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid processing minerals in or near seabird habitat if this activity could cause mortality or morbidity from ingestion of chemicals or heavy metals (derived from Ohlendorf et al. 1978).

7. Processing oil/gas. Impacts to seabirds from petroleum processing (e.g., processing effluent, petrochemical spills) included eggshell thinning, decreased viability of embryos, and elevated levels of organochlorine compounds in tissues. Experimental dosing of seabirds with oil caused blood and endocrine disorders and reduced weight gain.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid processing oil, gas, or petrochemicals in or near seabird habitat if this activity could cause mortality or morbidity from ingestion of oil, petroleum products, or petrochemicals (derived from Ohlendorf et al. 1978).

8. Sewage disposal. Sewage waste water containing hydrocarbons, organochlorines, and heavy metals was a source of contamination of seabird habitat that ultimately affected egg shell thickness and egg viability and elevated levels of contaminants in seabird tissue.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid disposal of sewage containing hydrocarbons, organochlorines, or heavy metals in or near seabird habitat, to minimize ingestion of compounds debilitating or lethal to seabirds (derived from Ohlendorf et al. 1978).

9. Solid waste disposal. References discussed the attraction of gulls to garbage dumps, recreation areas, airports, or other areas where garbage was improperly handled or stored. Gulls were also found entangled in discarded plastic beverage carriers.

a. Attraction to an artificial food source

(1) General guideline. To minimize the attraction of gulls, prohibit establishing or operating garbage dumps in areas where gulls are present (derived from Solman 1978).

(2) Specific guideline. Minimize the availability of garbage to gulls by rapidly burying or preferably incinerating the garbage and by maintaining proper collection and storage procedures prior to incineration (derived from Solman 1978).

b. Collision with vehicles or structures, or electrocution by powerlines

General guideline. Avoid collisions between seabirds and aircraft by siting airports away from areas used by seabirds and by siting developments that could attract seabirds (e.g., gulls to dumps, shopping center parking lots) such that birds flying to these areas from roosting or loafing sites would not fly over airports or approach or departure routes (derived from Solman 1978).

c. Entanglement in fishing nets, marine or terrestrial debris or structures

General guideline. Avoid disposal of materials that could entangle seabirds in seabird habitat (derived from Paul 1984).

10. Transport of oil/gas/water - land. Experimental dosing of seabirds with oil caused blood and endocrine disorders and reduced weight gain.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid transporting oil or gas in or near seabird habitat, to minimize contact with or ingestion of petroleum by seabirds (derived from, e.g., McEwan 1980, Peakall et al. 1980, 1981).

11. Transport of oil/gas/water - water. Experimental studies of seabirds dosed with crude oil indicated blood and endocrine disorders and reduced weight gain. Oiling of seabirds in marine oil spills caused extensive mortality and debilitation of birds on many occasions.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum, products, or chemicals

General guideline. Avoid transporting petroleum or petroleum products by water in seabird habitat to minimize mortality or debilitation of seabirds from contact with or ingestion of spilled oil or refined products (derived from, e.g., Levy 1980, Ohlendorf et al. 1978).

12. Transport of personnel/equipment/material - air. References documented collisions between seabirds and aircraft, flushing of nesting and nonbreeding seabirds by low-flying aircraft, and the introduction of predators (i.e., rats) that escaped aircraft cargo holds onto islands used by seabirds.

a. Collision with vehicles or structures, or electrocution by powerlines

General guideline. Avoid siting airports in areas used by seabirds or routing aircraft approach and departure routes over nesting, loafing, and feeding areas or through travel routes used by seabirds, to minimize collisions between seabirds and aircraft (derived from Solman 1978).

b. Harassment

General guideline. Avoid harassment of seabirds by minimizing the number of flights over seabird colonies and by maintaining a minimum altitude of 500 m (1,500 ft) for helicopters and 152 m (500 ft) for fixed-wing aircraft during unavoidable overflights (derived from Gollop et al. 1974).

c. Parasitism and predation, increased susceptibility to

General guideline. Avoid introductions of predators of seabirds or their eggs via aircraft cargo holds to nesting habitat used by seabirds (derived from Jones and Byrd 1979).

13. Transport of personnel/equipment/material - water. References documented collisions of seabirds with ships, harassment of nesting birds by ships closely approaching nesting colonies, oiling of seabirds from vessel fuel oil spills, and introduction of predators to islands in cargo transported by ship.

a. Collision with vehicles or structures, or electrocution by powerlines

General guideline. Avoid operation of bright lights on watercraft at night to avoid attracting seabirds in areas where collisions between seabirds and vessels could occur (derived from Dick and Donaldson 1978).

b. Harassment

General guideline. Avoid operating watercraft within 75 m (235 ft) of gull nesting islands to minimize harassment (derived from Murphy and Hoover 1981).

c. Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid operation of watercraft near seabird colonies, to minimize the potential for oil spills that could adversely affect seabirds in these areas (derived from Barrett 1979, Handel 1979).

d. Parasitism and predation, increased susceptibility to

General guideline. Avoid transporting cargo that contains predators of seabirds via ship to habitat, particularly nesting islands, used by seabirds (derived from Jones and Byrd 1979).

19. Trumpeter Swan

Table 1. Impacts Associated With Each Activity - Trumpeter swan

Impacts \ Activity	Blasting	Burning	Channelizing waterways	Chemical application	Clearing and tree harvest	Draining	Dredging	Drilling	Fencing	Filling and pile-supported structures (aquatic)	Filling (terrestrial)	Grading/plowing	Grazing	Human disturbance	Log storage/transport	Netting	Processing geothermal energy	Processing lumber/kraft/pulp	Processing minerals (including gravel)	Processing oil/gas	Sewage disposal	Solid waste disposal	Stream crossing - fords	Stream crossing - structures	Transport of oil/gas/water - land,ice	Transport of oil/gas/water - water	Transport of personnel/equipment/material - air	Transport of personnel/equipment/material - land,ice	Transport of personnel/equipment/material - water	Water regulation/withdrawal/irrigation
Aquatic substrate materials, add or remove	?		?			?	?			?									?				?							
Aquatic vegetation, destruction or change	?		?	?		?	?			?		?	?		?			?	?	?	?	?	?		?	?				?
Attraction to artificial food source												?	X									?								
Barriers to movement, physical and behavioral												?																?		
Collision with vehicles or structures									X																		X	X	?	
Entanglement in fishing nets, debris																														
Entrapment in impoundments or excavations																			?	?										
Harassment, active or passive	?							X				X		X											X		X	X	X	
Harvest, change in level																														
Introduced wild/domestic species, competition														?								?								
Morbidity/mortality by ingestion of petroleum				?										?				?	X	?		X			?	?				
Parasitism/predation, increased susceptibility						?				?		?	?	X													?	X	X	?
Prey base, alteration of																														
Shock waves (increase in hydrostatic pressure)																														
Terrain alteration or destruction			?		?	?	?			?		?										?								?
Veg. composition, change to less preferred			?	?	?	?	?			?		?																		?
Veg. damage/destruction due to air pollution				?														?	?	?	?							?	?	
Veg. damage/destruction due to fire/parasitism		?																												
Veg. damage/destruction due to grazing													?																	
Veg. damage/destruction due to erosion					?					?		?										?								
Water level or water quality fluctuations			?			?	?			?		?									?									?

X - Documented impact (see text).
? - Potential impact.

19. TRUMPETER SWAN - GUIDELINES

This section consists of guidelines derived from references to documented impacts that have been discussed in the companion volume, Impacts of Land and Water Use on Wildlife and Their Habitat and on Human Use of Fish and Wildlife. Only those activities and impact categories for which documented impacts have been located are included here. Table 1 is a quick index to the impacts and activities for which documentation has been located. The guidelines are organized by impact category under each activity. For a complete list of activities and impact categories, see appendices E and F, respectively.

A. Species-related Considerations

1. Are provisions proposed to prevent or minimize disturbance to trumpeter swans during nesting and brood-rearing (i.e., periods during which swans are sensitive to disturbance)? (Note: See the life history section of the Alaska Habitat Management Guides for information on nesting and brood-rearing chronology.)

2. Are provisions proposed to prevent or minimize disturbance to trumpeter swans during their flightless molting period?

3. Has the preference of trumpeter swans for small shallow ponds and lakes for nesting and brood-rearing sites been considered in planning for the proposed activity?

B. Guidelines

Citations after each guideline refer to annotated references in the companion impacts volume. Where the term "derived from" appears in a citation, it indicates that the stated guideline was deduced from a particular reference or number of references but that the reference source(s) did not explicitly formulate the guideline. The term "derived from, e.g.," indicates that only a few references were selected from a large number of references providing similar information. Citations without the two aforementioned terms indicate that the guideline is either a direct paraphrase of the source or contains a substantial amount of information (including specific units of measure, in some cases) from the original reference. In instances in which different references discuss identical impacts under similar conditions but mention different units of measure (e.g., aircraft elevations, species flight distances, obstruction heights, percentage of forest cover), we selected the units of measure that were most protective of the wildlife species or its habitat use.

1. Drilling. One reference reported fewer tundra swans within 2.5 km (1.5 mi) of a drilling rig than in a distant area without a drilling rig. Swans that nested near the rig moved their brood away from the nest site after hatching.

   Harassment

   (1) General guideline. Avoid drilling in swan habitat when this activity could cause harassment of swans (derived from Barry and Spencer 1976).

   (2) Specific guideline. Minimize harassment of nesting swans by not drilling within 2.5 km (1.5 mi) of nest sites (derived from Barry and Spencer 1976).

2. Fencing. One reference reported that at least one trumpeter swan collided with a fence and subsequently died.

   Collision with vehicles or structures, or electrocution by powerlines

   General guideline. Avoid constructing fences in trumpeter swan habitat to avoid collisions of swans with fences (derived from Banko 1960).

3. Grading/plowing. One reference reported abandonment of a nest site by a pair of trumpeter swans after a road was constructed to their lake.

   Harassment

   General guideline. Avoid constructing roads to waterbodies used by nesting and brood-rearing trumpeter swans that could lead to increased levels of human activity and harassment of swans (derived from Richey 1981).

4. Grazing. One reference reported that wintering trumpeter swans used dairy pastures as feeding sites.

   Attraction to an artificial food source

   General guideline. Avoid establishing pastures adjacent to or in areas used by wintering trumpeter swans to minimize conflicts between farmers and swans (derived from McKelvey 1979).

5. Human disturbance. References documented abandonment of nesting sites and brood-rearing areas, separation of cygnets from adults,

and increased mortality of cygnets following harassment-induced overland movements from their natal ponds.

a. Harassment

(1) General guideline. Avoid harassment of trumpeter swans, particularly during nesting and brood-rearing periods, to avoid causing abandonment of nests and brood-rearing areas (derived from, e.g., Hansen et al. 1971, Richey 1981, Shepherd 1962, Timm 1981).

(2) Specific guidelines:

- Minimize residential and commercial development on or near waterbodies suitable for nesting and brood-rearing by swans to minimize abandonment of habitat by swans (derived from Bangs et al. 1982, Richey 1981, Timm 1981).

- Minimize harassment of swans by providing a minimum separation of 0.8 km (0.5 mi) between waterbodies used by nesting and brood-rearing trumpeter swans and waterbodies along which cabin construction may be permitted (derived from Timm 1981).

b. Parasitism and predation, increased susceptibility to

General guideline. Avoid harassment of trumpeter swans that could lead to the separation of cygnets from adults (derived from Hansen et al. 1971, McKelvey et al. 1983).

6. Processing minerals (including gravel). One reference documented the death of whistling swans from heavy metals poisoning. Waste products from mines and smelters contaminated substrate and vegetation that was later ingested by the swans.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid processing minerals in or upstream of areas used by trumpeter swans if products from the processing could cause morbidity or mortality if ingested in food or water by swans (derived from Chupp and Dalke 1964).

7. Solid waste disposal. Whistling swans died from ingestion of food and water contaminated with heavy metals from mine and smelter tailings.

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

General guideline. Avoid disposal of mine or smelter tailings in trumpeter swan habitat if contamination of vegetation or water ingested by swans could occur that could lead to morbidity or mortality of swans (derived from Chupp and Dalke 1964).

8. Transport of oil/gas/water - land. During autumn, sound from a gas compressor sound simulator caused tundra swans to break flight formations, flare, and gain altitude.

Harassment

(1) General guideline. Avoid siting gas compressor stations in habitat used by trumpeter swans (derived from Wiseley 1974).

(2) Specific guideline. Minimize harassment of swans by installing efficient muffler systems that reduce the area affected by the noise generated by the compressor station (derived from Wiseley 1974).

9. Transport of personnel/equipment/material - air. References documented collisions of swans with aircraft, flushing of swans from their nests by low-flying aircraft, and abandonment of lakes used by swans after repeated floatplane operation on these lakes.

a. Collision with vehicles or structures, or electrocution by powerlines

General guideline. Avoid operation of floatplanes on waterbodies near nesting trumpeter swans, to avoid collisions between the aircraft and adult swans defending their nest site (derived from Hansen et al. 1971).

b. Harassment

(1) General guideline. Avoid low-altitude aircraft operations in trumpeter swan habitat when swans are present (derived from, e.g., Hansen et al. 1971, Renken et al. 1983, Timm 1981).

(2) Specific guideline. Minimize operation of floatplanes on waterbodies used by nesting and brood-rearing trumpeter swans to minimize harassment and abandonment of nest sites (derived from, e.g., Renken et al. 1983, Shepherd 1962, Timm 1981).

10. Transport of personnel/equipment/material - land. References documented collisions of swans with overhead wires, abandonment of nesting sites following vehicular operations near nests, flushing of tundra swans by hovercraft operations, and greater mortality of cygnets in areas in which human activity is frequent.

a. Collision with vehicles or structures, or electrocution by powerlines

General guideline. Avoid placement of overhead wires in trumpeter swan habitat (derived from Banko 1960, Sopuck et al. 1979).

b. Harassment

(1) General guideline. Avoid operation of vehicles in trumpeter swan habitat, particularly near brood-rearing and nesting sites (derived from Hansen et al. 1971, Richey 1981, Timm 1981).

(2) Specific guideline. Minimize harassment of swans during operation of hovercraft by maintaining a minimum distance of 825 m (2,700 ft) from the swans (derived from Slaney and Co. 1973).

c. Parasitism and predation, increased susceptibility to

General guideline. Avoid operation of vehicles in trumpeter swan habitat during brood-rearing, to reduce disturbance that could lead to cygnet mortality (derived from Hansen et al. 1971).

11. Transport of personnel/equipment/material - water: References documented harassment of nesting and brood-rearing swans by boats and increased cygnet mortality in areas of frequent human activity.

a. Harassment

General guideline. Avoid operation of watercraft in trumpeter swan habitat, particularly during nesting and brood-rearing (derived from Barry and Spencer 1976, Hansen et al. 1971, Richey 1981).

b. Parasitism and predation, increased susceptibility to

General guideline. Avoid operation of watercraft in trumpeter swan habitat during brood-rearing, to reduce disturbance that could lead to cygnet mortality (derived from Hansen et al. 1971).

Introduction

Approach

Developing effective guidelines for the protection of human use of fish and wildlife resources from impacts due to land or water use activities requires a thorough and accurate determination and cataloging of all existing human uses that occur in the affected area, an assessment of the probable impact of proposed land use activities on these uses, a direction for mitigation of impacts to human uses, and good documentation of the data and sources consulted when determining the probable impact on human use. The following procedure has been developed to accomplish these tasks and to insure that land and water use decisions affecting human use of fish and wildlife will be made only after careful review of all relevant data. The approach of using a procedure, or checklist, rather than that of preparing specific guidelines (as, for example, the wildlife guidelines) reflects the ability and necessity to acquire impacts information from the affected user group during the preparation of human use guidelines.

Organization

The organization of this section is similar to that of the wildlife section. The first portion consists of a list of "considerations"--i.e., items concerning human use of fish and wildlife that should be kept in mind when preparing guidelines. The human use considerations listed here should be supplemented with the general and activity-specific considerations in appendices E and F, respectively. The second portion of the procedure is to determine if an impact from a proposed project is likely to occur. Information supplied by the user groups, as well as information from the human use portion of the companion impacts volume and other sources, is required in order to decide if an impact is likely to occur. The third portion is a set of guidelines, including a series of alternatives that could be implemented if the general guideline cannot be followed. These guidelines are organized similarly to those of the wildlife guidelines--that is, the general intent is to avoid the impact, but if that is impossible, several specific measures to minimize the impact are then suggested.

Although this procedure relies heavily on information gathered directly from the user groups, other information sources are also required. In particular, impacts information from the companion impacts volume, as well as human use narratives and maps from other Alaska Habitat Management Guide volumes should be consulted.

HUMAN USE OF FISH AND WILDLIFE - GUIDELINES

A. Considerations

1. Consider the effect of the proposed action on human uses of fish and wildlife:

   a. Does proposed action occur on or near lands or waters where uses of fish and wildlife resources are documented?

      Yes______ No______ Uncertain______ (If uncertain, provide direction for obtaining information: needed research, further review of existing data, additional document review or consultation, etc.)

      If yes or uncertain, specify: species used, user group, and months when use occurs.

      <u>Species</u> <u>User group/months used/source</u>

      (1) Freshwater fish (list all):

      (2) Marine fish (list all):

      (3) Large game (list all):

      (4) Small game (list all):

      (5) Furbearers (list all):

      (6) Birds, waterfowl (list all):

      (7) Invertebrates, other (list all):

   b. Which communities and user groups may be affected by the proposed action?

      (1) Communities with subsistence uses on or near lands affected by proposed action (list all).

         <u>Name of community</u> <u>Community size</u>

      (2) Major user groups, origins (list all).

         <u>User group/size</u> <u>Home area or community</u>

(3) Data sources (list those consulted).

c. Considering all species used and user groups listed in a. (above), what has been the level of harvest and effort over past 20 years?

(1) Provide best available data.

(2) Data sources (list those consulted).

d. Considering all species used and user groups listed in a. (above), what have been the main uses of resources? (List all.)

(1) Species used/user group — Use code

(2) Data sources (list those consulted).

Use code:

1. Personal use (specify all uses)
2. Nonconsumptive use (specify all uses)
3. Sport fishing (specify all uses)
4. Sport hunting (specify all uses)
5. Subsistence (specify all uses)

e. Considering all species used and user groups listed in a. (above), what has been the value of harvest? No data should be indicated "ND." (List all by type of use.)

(1) Species used/user group — Value

(2) Data sources (list those consulted).

f. Does proposed action occur near fish camps, trapping camps, hunting camps, other camps or harvest and use locations, or public campsites, boat ramps, trailheads, etc?

Yes______ No______ Uncertain______(If uncertain, provide direction for obtaining information: needed research, further review of existing data, additional document review or consultation, etc.)

If yes or uncertain, describe on map and specify species and camps, harvest and use locations?

(1) Species (list) — Camp, H/U Location

(2) Data sources (list those consulted).

g. Considering species and resources listed in a. (above), does the proposed action create impacts to species that may decrease harvest opportunity? Specify impact. (See species impacts volumes.)

Yes______ No______ Uncertain______(If uncertain, provide direction for obtaining information: needed research, further review of existing data, additional document review or consultation, etc.)

(1) If yes or uncertain, specify habitat and species abundance changes; see species impact/guidance sections.

(2) Data sources (list those consulted).

h. Considering species and resources listed in a. (above), does the proposed action increase the number of people living in, working in, or passing through an area used for resource harvesting? Will the proposed action increase the number of people competing for resources? Specify likely impact.

Yes______ No______ Uncertain______ (If uncertain, provide direction for obtaining information: needed research, further review of existing data, additional document review or consultation, etc.)

(1) If yes or uncertain, specify population changes, species likely to be affected.

(2) Data sources (list those consulted).

i. Considering the resources listed in a. (above), will the proposed action cause changes in land classification or ownership which may affect access to resources?

Yes______ No______ Uncertain______ (If uncertain, provide direction for obtaining information: needed research, further review of existing data, additional document review or consultation, etc.)

(1) If yes or uncertain, specify expected changes and uses affected.

(2) Data sources (list those consulted).

j. Considering the resources listed in a. (above), will the proposed action change access routes used to reach resource use areas or to transport harvest?

Yes_____ No_____ Uncertain_____ (If uncertain, provide direction for obtaining information: needed research, further review of existing data, additional document review or consultation, etc.)

(1) If yes or uncertain, specify changes and uses affected.

(2) Data sources (list those consulted).

k. Considering the resources listed in a. (above), will the proposed action interfere with harvest due to gear loss, displacement of users from other areas, or other factors?

Yes_____ No_____ Uncertain_____ (If uncertain, provide direction for obtaining information: needed research, further review of existing data, additional document review or consultation, etc.)

(1) If yes or uncertain, specify changes and uses affected.

(2) Data sources (list those consulted).

2. Consider the availability of other lands or waters that could be used for the proposed action:

a. Are there other lands or waters that could be used for the proposed action? (See applicants statements and review.)

Yes_____ No_____ Uncertain_____ (If uncertain, provide direction for obtaining information to applicant.)

(1) Specify alternative lands and waters.

(2) Data sources (list those consulted).

b. Are the lands or waters listed in a. (above) available within timeframe of proposed action?

Yes_____ No_____ Uncertain_____ (If uncertain, provide direction for obtaining information to applicant.)

(1) Detail.

(2) Data sources (list those consulted).

c. Are the lands or waters listed in a. (above) in appropriate ownership or management for the proposed action?

Yes_____ No_____ Uncertain_____ (If uncertain, provide direction for obtaining information to applicant.)

(1) Detail.

(2) Data sources (list those consulted).

d. Are the lands or waters listed in a. (above) designated for uses that preclude the proposed action?

Yes_____ No_____ Uncertain______ (If uncertain, provide direction for obtaining information to applicant.)

(1) Detail.

(2) Data sources (list those consulted).

3. Summary of sources consulted (provide full listing):

a. Source Reports (provide full reference).

b. Map Collections.

c. Persons Consulted (title, organization).

d. Other.

B. Impact Determination

Considering the above data and impacts documented in the human use impacts section, the proposed action has been found to have the following probable effects on human use of fish and wildlife resources:

Probable Effect on Human Uses of Fish and Wildlife

	Impact on use	No impact on use
1. Activity near camps/ harvesting locations.		
2. Increased competition.		
3. Change in access to resources.		
4. Change in land classification.		
5. Other.		

6. Impacts to species distribution or abundance (refer to species impacts or guidance volumes).

C. Guidelines

1. Recommendations for public meetings and hearings. If, based on consideration of data outlined above, a proposed action is likely to result in an impact to human use of fish and wildlife, it is recommended that public meetings or hearings in affected communities and with affected user groups be held prior to final impact evaluation. The purpose of these meetings and hearings will be to verify the level and importance of the impact and solicit public participation in the decision-making process.

   Public meetings and hearings should be held with existing representative institutions in potentially affected communities and with affected user groups. City Councils, Indian Reorganization Act Tribal Councils, and other community organizations are the appropriate local bodies to be used to facilitate representative public participation.

2. Guidelines. If findings from a thorough examination of considerations listed above and from public meetings or hearings confirm that the proposed action will likely cause an impact on human use of fish and wildlife, the following should apply.

   a. In order to avoid impacts on human use of fish and wildlife, the proposed action should be opposed if there are no feasible alternative locations or seasons in which such impacts would not occur.

   b. If avoiding the action is not feasible, the impacts of the action should be minimized by recommending or implementing the following:

      (1) Alternatives for reducing impact to seasonal camps and other harvest and use locations

      (2) Alternatives for reducing habitat changes that may reduce species abundance and decrease harvest opportunity

      (3) Alternatives for reducing people living in, working in, or passing through area

      (4) Alternatives for reducing people competing for resources

      (5) Alternatives for reducing disturbance, roads, noise, etc., that may affect distribution of species

      (6) Alternatives for reducing land classification and ownership changes

(7) Alternatives for reducing changes in access routes to use areas.

Appendices

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B. General Considerations

The following are considerations that are not unique to a particular species or a particular type of activity and that should be taken into account when one desires to prepare or modify a guideline or recommendation in response to a specific proposal.

A. What is the distribution and abundance of the species in question in the area of the proposed activity? (See the individual species distribution and abundance narratives and maps.)

B. Does the species use the area in question year-round or seasonally?

C. Within the area of the proposed land use/development type, are there areas where important species life functions or relatively higher or lower habitat values occur?

D. What is the availability of the species habitat outside the proposed area of the land use/development type that is similar to the species habitat inside the proposed area?

E. What is the species tolerance or reaction to disturbance?

F. What is the frequency, intensity, and duration of the proposed land use? (e.g., intermittent winter seismic surveys a week long involving a crew of 10 people and three vehicles or 10-hr-per-day operations once each month)?

G. What activities are to be undertaken (or are normally associated with) the type of development? (See the Land Use x Activity matrix in the Impacts volume.)

H. Are less environmentally damaging procedures, techniques, or equipment useable to minimize impacts to fish and wildlife?

I. Should studies be proposed to fill existing data that pertain to the land use/development types in the area of concern?

C. Activity-related Considerations

The following are considerations that are unique to each separate type of activity and that should be taken into account when one is preparing or modifying a recommendation or guideline in response to a specific development proposal.

A. Blasting

1. Will the blasting occur on land or in water or both?

2. Will the charges be detonated on the surface or subsurface? At what depth if subsurface?

3. What is the magnitude of the proposed blasting (charge size, delay, and total amount for each shot)?

4. What will be the frequency of detonation and for how long a period will the blasting activity be undertaken?

5. What type of equipment will be used (e.g., airguns vs. explosives)?

B. Burning

1. What will be the size of the proposed burn?

2. What habitat types (e.g. shrub land, mature upland conifer forest, stunted black spruce bog) will be burned?

3. What will be the fuel and weather conditions and predicted intensity of the burn?

4. Have adequate provision been made to control the burn?

C. Channelizing Waterways

1. Will channelization be accomplished by construction of dikes or by excavation of channels?

2. What terrestrial habitat type (e.g., riparian shrub, sedge-grass meadow, unvegetated gravel bar) will be covered or removed?

3. Will the channel connect existing waterbodies (e.g., pond to a stream) that may result in a change to the current fish or wildlife species composition (e.g., provide access to a different species, such as northern pike, to a land-locked lake)?

4. Will the channelization require mechanical bank stabilization measures (e.g., riprap, sheet piling)?

5. Will the channelization result in water conditions that will restrict the movement of aquatic species?

6. Will there be adequate provisions to prevent erosion?

D. Chemical Application

1. What is the type, method of application (e.g., aerial spraying, ground spraying, addition to water source) and concentration of the applied chemical?

2. In what season will the chemical be applied?

3. How persistent (long-lasting) is the chemical in the physical and biological environment?

4. What is the effect of the chemical on nontarget organism?

5. Can the chemical spread to nontarget areas?

E. Clearing and Tree Harvest

1. What type of clearing (e.g., clear-cut, selective-cut) will be used?

2. How large will the total area and individual cutting units within the total area be?

3. Will the cut trees be removed (e.g., as in logging) or stockpiled in berms (e.g., agricultural clearing)?

4. What method of disposal will be used for slash?

5. Will the shape of the cuts maximize the perimeter length (i.e., to create maximum "edge")?

6. What will be the degree of disturbance of soil and understory vegetation?

F. Draining

1. What method will be used to remove water from the drained location (e.g., by-pass pumping, ditches)?

2. What will be the effect of relocation of the water on adjacent habitat?

G. Dredging

1. What types of equipment will be used (e.g., suction dredge, clamshell, backhoe)? How will these affect the natural substrate?

2. How deep will the proposed dredging be?

3. What methods will be used to minimize sedimentation (e.g., silt curtains, onshore disposal of cuttings)?

4. How will the dredge spoil be disposed (see also Solid Waste Disposal)?

H. Drilling

1. Will drilling be by large, stationary rig (e.g., exploratory well, drill ship) or by small, mobile rig (e.g., Nodwell)?

2. Will "mudpits" or associated disposal facilities be required?

3. During what season will the drilling occur?

4. In aquatic or marine systems, what methods will be used to prevent siltation or release of toxic chemicals?

I. Fencing

1. What type and amount of fencing will be used (e.g., woven-wire, spruce pole, snow fence)?

2. Is the fence to be permanent or temporary? If temporary, during what season?

3. Will the fence inhibit movements of wildlife species?

J. Filling (Aquatic and Wetlands)

1. What type of material (e.g., riprap, gravel, concrete) will be used for fill?

2. What are the slope and dimensions of the fill (e.g., wide, gradually sloping vs. steep and narrow)?

3. Will water-quality parameters (e.g., temperature, salinity, dissolved oxygen) be changed?

4. Will the fill inhibit movements of aquatic species?

K. Filling

1. What type of material (e.g., gravel, soil, trees) will be used for fill?

2. Are there adequate provisions for maintaining surface and subsurface flow of water?

3. Are there adequate provisions to stabilize the fill from erosion?

L. Grading and Plowing

1. Are there adequate provisions for prevention of water and wind erosion?

2. Will the plowed area consist of small units surrounded by natural vegetation, or large units?

3. Will the graded area be replanted with native vegetation? Exotic vegetation? No vegetation?

4. Are there adequate provisions for maintaining surface and subsurface flow of water?

M. Grazing

1. What type of livestock will be used?

2. What will be the season and duration of grazing?

3. Will artificial food sources (e.g., salt blocks, haystacks) be included?

4. Are there adequate provisions to prevent the transmission of diseases and/or parasites to native wildlife species?

N. Human Disturbance

1. What will be the frequency, magnitude, and seasonality of the disturbance?

O. Log Storage/Transport

1. What type of loading facilities will be used?

2. What type of transport facilities (e.g., balloons, trucks, rafts) will be used?

3. Have adequate provisions been included to prevent bark accumulation in the marine environment?

P. Netting

1. What length, mesh size, and type of nets will be used?

Q. Processing Geothermal Energy

1. Have adequate provisions been included to prevent thermal pollution of waterbodies used by fish and wildlife?

R. Processing Lumber, Kraft, or Pulp

1. Are adequate provisions for water and air treatment included?

2. What provision have been included to prevent loss or spills of toxic processing chemicals?

S. Processing Minerals

1. Are adequate provisions included for the prevention of water and air pollution?

2. Have adequate provisions been included to prevent loss or spills of toxic processing chemicals?

(See also Solid Waste Disposal)

T. Processing of Oil/Gas

1. Are adequate provisions included for the prevention of air and water pollution?

2. Have adequate provisions been included to prevent loss or spills of toxic processing chemicals?

U. Sewage Disposal

1. Are adequate provisions for containment and treatment of sewage provided?

2. What will be the method of disposal of sludge?

V. Solid Waste Disposal

1. Are adequate provisions for the prevention of air and water pollution provided?

2. Is the disposal site located in an area where it may attract animals? If so, what provisions are included to prohibit access by wildlife?

3. What provisions are included to prevent the transmission of disease and/or parasites to native wildlife from pests (e.g., rats, insects) associated with disposals such as land fills?

W. Stream Crossings - Fords

1. What provisions have been made to prevent bank and bottom erosion?

2. What types of equipment (e.g., pickups, belly-dumps) will use the fords?

X. Stream Crossings - Structures

1. Will the structure cause a restriction of the stream's flow?

2. What methods will be used to stabilize the structure?

3. Will the structure be in place seasonally or year-round?

Y. Transport of Oil/Gas/Water - Land

1. What method of transport will be used (e.g., pipeline, tank truck)?

2. What provisions are included to prevent oil spills?

3. What provision are included to provide free passage of wildlife?

4. What provisions are included to prevent thermal erosion due to heated pipelines?

Z. Transport of Oil/Gas/Water - Water

1. What type of transport will be used (e.g., ship, subsea pipeline)?

2. Will the type of transport affect natural ice conditions (e.g., icebreakers)?

3. Will adequate provisions be included to prevent oil spills?

AA. Transport of Personnel/Equipment/Material - Air

1. What type of aircraft will be used?

2. What will be the frequency, duration, and altitude of the flights?

BB. Transport of Personnel/Equipment/Material - Land

1. What types of vehicles are to be used (e.g., trucks, rolligons, bulldozers, hovercraft)?

2. Will vehicles be restricted to existing roads or will off-road travel be required? Will vehicles operate on frozen or unfrozen ground?

3. What are the number and frequency of travel of vehicles to be operated in a particular area?

4. What is the potential for animals to visit road surfaces to eat ice-melting minerals or chemicals?

CC. Transport of Personnel/Equipment/Materials - Water

1. What type of water craft will be used?

2. What will be the frequency and duration of use?

3. Will the type of transport affect natural ice conditions (e.g., icebreakers)?

DD. Water Regulation/Withdrawal/Irrigation

1. What will be the effect of water removal on the natural hydraulics of the waterbody?

2. What will be the seasonality and duration of use?

3. What are the provisions for prevention of degradation of water quality after use?

4. What will be the effect of relocation of water on adjacent habitat?

5. Will water levels in impoundments remain stable? If not, during what seasons will fluctuations occur?

D. Land and Water Uses and Development Types

Commercial fishing*
Fire management
Geothermal energy development
Grain and hay farming
Harbors and shoreline structures
Offshore prospecting and mining
Oil and gas development
Pipelines
Placer mining
Red meat and dairy farming
Seafood processing
Settlement
Silviculture and timber processing
Strip and open pit mining
Transmission corridors
Transport--air, rail, and road
Underground mining
Water development

*Impacts to nontarget species, such as marine mammals and seabirds, only.

E. List of Activities *

Blasting
Burning
Channelizing waterways
Chemical application
Clearing and tree harvest
Draining
Dredging
Drilling
Fencing
Filling and pile-supported structures (aquatic and wetland habitats)
Filling (terrestrial)
Grading/plowing
Grazing
Human disturbance
Log storage/transport
Netting
Processing geothermal energy
Processing lumber/kraft/pulp
Processing minerals (including gravel)
Processing oil/gas
Sewage disposal
Solid waste disposal
Stream crossing - fords
Stream crossing - structures
Transport of oil/gas/water - land, ice
Transport of oil/gas/water - water
Transport of personnel/equipment/material - air
Transport of personnel/equipment/material - land, ice
Transport of personnel/equipment/material - water
Water regulation/withdrawal/irrigation

* For definitions, see appendix G

F. Wildlife Impacts Categories

Aquatic substrate materials, addition or removal

Aquatic vegetation, destruction or change in composition

Attraction to artificial food source

Barriers to movement, physical and behavioral

Collision with vehicles or structures or electrocution by powerlines

Entanglement in fishing nets, marine or terrestrial debris, or structures

Entrapment in impoundments or excavations

Harassment, active (e.g. intentional hazing, chasing) or passive (e.g., construction or vehicle noise, human scent)

Harvest, change in level

Introduced wild or domestic species, competition with or disease transmission from

Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals

Parasitism and predation, increased susceptibility to

Prey base, alteration of (<u>Note</u>: this category is restricted to specific impacts that have been <u>documented</u> to affect individual prey species not discussed in the regional volumes of the Alaska Habitat Management Guides)

Shock waves (increase in hydrostatic pressure)

Terrain alteration or destruction (e.g., raptor cliffs)

Vegetation composition, change to less preferred or useable species or successional stage

Vegetation damage/destruction due to air pollution (e.g., acid rain, SO_2) or contact with petroleum products or chemicals (e.g., herbicides)*

Vegetation damage/destruction due to fire or induced parasitism (e.g., bark bettle infestation)*

Vegetation damage/destruction due to grazing by domestic or introduced animals*

Vegetation damage/destruction due to hydraulic or thermal erosion or deposition, mechanical removal, or material overlay*

Water level or water quality fluctuations (including change in drainage patterns, long-term change in water levels)

* Discussion is limited to those plant species/associations that are important to the wildlife species in question and that are specifically mentioned in a reference to impacts on the wildlife species in question.

G. Definitions of Activities

Blasting

Blasting refers to the use of high explosives (e.g., dynamite, TNT, ammonium nitrate, plastic explosives) to excavate material (e.g., rock, ice, soil, or tree stumps) or the use of explosives or nonexplosive devices (e.g., airguns, vibroseis) to create a shock wave sufficient to be monitored by geophones (on land) or hydrophones (in water). Airguns use compressed air to create a shock wave for seismic work in water. "Vibroseis" uses a small gas explosion to create a shock wave for seismic work on land. Blasting is often used during the exploratory phase (e.g., seismic exploration during oil/gas development or mining) and/or the construction phase (e.g., tunnel excavation or riprap production during highway construction, pipeline ditch excavation in rock or frozen substrate) of many kinds of development. Most high explosive blasting on land requires drilling. See the activity of Drilling for impacts from seismic and construction drilling.

Typical impacts:

- Harassment noise of explosions, equipment
- Entrapment (e.g., in blasted ditches, quarries)
- Mechanical destruction of vegetation
- Death or injury from shock waves (e.g., to marine mammals or seabirds from underwater blast)
- Changes in sedimentation rates, turbidity, suspended solids

Burning

Burning refers to the controlled use of fire in a predetermined area for the purpose of returning or maintaining vegetation at an early successional stage (i.e., at a stage where grasses, shrubs, and saplings are the predominant forms of vegetation). Major uses of controlled burns include inhibition of woody plant growth for the purpose of maintaining open land cover, manipulation of wildlife habitat to improve the food and shelter requirements of targeted species (e.g., moose), reduction of wildfire hazards, and disposal of slash from cutover areas.

Typical impacts:

- Harassment

- Vegetation damage/destruction due to fire
- Changes in water temperature, dissolved oxygen, or pH (e.g., due to runoff from burned areas or destruction of riparian vegetation)
- Changes in biological oxygen demand, nutrient loading in surface waters
- Changes in sedimentation rates, turbidity, and suspended solids levels in surface waters
- Barriers to movement because animals avoid large areas without cover

Channelizing Waterways

Channelizing waterways refers to the modification of an existing stream, river, canal, or other flowing watercourse for the purpose of realigning the flow of water. Channelizing generally results in the physical alteration of bottom substrate, channel geometry, or configuration. Modifications generally include one or more of the following: 1) widening or deepening the channel, 2) installing structures (e.g., dikes or bank stabilization structures), 3) removing structures (e.g., snags or large debris), 4) eliminating channel meanders, 5) creating uniform substrate conditions, or 6) creating a new stream channel (e.g., diversion ditches for irrigation or for other purposes). Closely associated activities not included under channelizing are the excavation of substrate materials for the purpose of maintaining water transportation routes and boat harbors (see Dredging), the installation of dikes, gabions, jetties, etc., in estuarine environments (see Filling and pile-supported structures [Aquatic and Wetland Habitats]), construction of low-water crossings (see Stream Crossings - Fords), and creating ditches in wetlands or shallow lakes for the purpose of draining them (see Draining).

<u>Typical impacts</u>:

- Changes in substrate composition
- Barriers to movement
- Vegetation damage or destruction due to mechanical removal
- Changes in flow or water level
- Harassment
- Changes in water temperature (e.g., reduction of stream cover)
- Changes in sedimentation rates, turbidity, suspended solids

Chemical Application

Chemical application refers to the purposeful spreading or placing of any chemically active substance upon lands or waters or within or around structures. Agriculture and silviculture account for the majority of chemical applications to land and water, although highway maintenance is also important. Substances that markedly change the physical properties of that to which they are applied (e.g., carbon black or salt on ice or snow) are also included, as is storage of chemicals. Chemicals used to kill vegetation (herbicides) are also included in this activity. Petroleum and its fractions and products are included (e.g., oiling of roads for dust control), except for spills, which are included under the headings of Processing of oil/gas or Transport of oil/gas/water - land, ice. Other chemical applications, which are excluded here, include industrial pollution of air and water (considered under the Processing of lumber, kraft, and pulp; Processing of minerals; and Processing of oil/gas), and disposal of chemicals in solid waste or sewage (considered under Solid waste disposal or Sewage disposal).

Typical impacts:

° Attraction of wildlife to artificial food source (e.g., ungulates to road salt or urea fertilizer)

° Changes in biological oxygen demand (BOD), nutrient loading (e.g., fertilizer)

° Changes in chemical composition of water (e.g., herbicides, pesticides)

° Changes in terrestrial or aquatic vegetation, including algae (e.g., eutrophication)

° Morbidity or mortality due to ingestion of or contact with petroleum, petroleum products, or other chemicals (e.g., raptors, from chlorinated hydrocarbons)

° Vegetation damage or destruction due to contact with petroleum, petroleum products, or chemicals (e.g., road salt)

Clearing and Tree Harvest

Clearing and tree harvest refers to the removal of trees or other vegetation, either partially or entirely, by mechanical means. Skidding logs within cutting areas is included in this activity. Clear-cutting and selective tree harvest is often associated with other activities such as construction of access roads and timber-processing facilities, (see the activity categories Grading and plowing, and Processing lumber, kraft, or pulp). Clearing of vegetation prior to new construction projects such as roads is included in Clearing and tree harvest, but maintenance clearing of corridors for pipelines, electric power transmission lines, railroads, and highway rights-of-way by mechanical means is included in the activity category Transport of personnel/equipment/material by land, ice. The use of herbicides to clear vegetation is included in the activity category of Chemical application.

Typical impacts:

- Barriers to movement (e.g., slash piles and downed trees)
- Change in harvest level (e.g., increase due to improved access)
- Changes in dissolved oxygen (DO), pH, salinity, temperature (e.g., increased sunlight penetration to streams)
- Changes in flow or water level (e.g., accelerated runoff)
- Changes in terrestrial or aquatic vegetation, including algae
- Entanglement in terrestrial debris (e.g., slash)
- Harassment (e.g., from noise of machinery and people)
- Vegetation damage or destruction due to mechanical removal, contact with chemicals, or hydraulic or thermal erosion or deposition
- Vegetation composition, change to less preferred or useable species or successional stages

Draining

Draining refers to the intentional reduction of water content from shallow ponds or soils. Water content generally is reduced by recontouring (also see the activity of Grading/plowing) the surface area of concern and/or introducing highly porous soil materials to the area that will facilitate water flow away from the site. Open ditches or covered gravel trenches designed to accommodate gravitational flow ("french drains") are common techniques employed in drainage operations. Drainage of wet soil areas generally is undertaken when a land use is planned in a chronically wet area (e.g., draining wetlands to increase land available for farming).

Typical impacts:

- Harrassment
- Vegetation composition change to a less preferred or useable species (e.g., from wetland to upland vegetation)

- Water level or water quality fluctuations in surface waters

- Changes in sedimentation rates, turbidity, and suspended solids in surface waters

Dredging

Dredging refers to excavation within aquatic or wetland habitats. Dredging is often conducted in relation to shoreline alteration projects, site preparation and/or maintenance of ports, harbors, and marine transportation routes, and for the purposes of sand and gravel extraction from aquatic habitats, gravel extraction from floodplains, and extraction of borrow or fill materials. Examples of equipment used for dredging include suction dredges, backhoes, bucketlines, clam shovels, and draglines. Dredging of canals for transport, irrigation, or channelizing of waterways is included in the activity category Channelizing waterways. Excavation of terrestrial habitat <u>adjacent</u> to aquatic habitat (e.g., for road construction) is included in the activity categories of Grading and plowing and Blasting. Such excavation during placer mining is considered in Processing of minerals. Dredging of ditches for the purpose of draining a marsh or shallow lake is included in Draining.

<u>Typical impacts</u>:

- Changes in substrate composition

- Vegetation damage or destruction due to mechanical removal or material overlay

- Changes in sedimentation rates, turbidity, suspended solids

- Changes in chemical composition of water

- Changes in flow or water level (e.g., wetlands)

Drilling

Drilling refers to the use of a portable drill mounted on a mobile vehicle (e.g., ship, Nodwell, truck) or a stationary drill assemblage that is usually supported on a gravel, ice, or concrete pad or steel platform and that is employed to drill into the earth's surface to prepare shot holes for blasting, sample the substrate (soil, rock, ice, or water), or extract liquified material (e.g., oil, gas, steam, water). Shothole drilling, substrate sampling, road construction, and seismic exploration are usually conducted from portable equipment and often are part of the exploratory phase of several types of development. Oil, gas, and geothermal exploratory and production drilling are often conducted from stationary pads. Stationary drilling rigs often are accompanied by auxiliary facilities such as drilling towers, pits to store recirculating drilling mud, pipe and drill stem storage areas, and occasionally camps for the drill crew.

Typical impacts:

- Harassment

- Interference with intraspecies communication (e.g., offshore drilling)

- Morbidity or mortality due to ingestion of petroleum products or chemicals (e.g., some drilling mud compounds)

- Vegetation damage due to mechanical removal

- Changes is chemical composition of water (e.g., heavy metals)

- Changes in sedimentation rates, turbidity, suspended solids

Fencing

Fencing refers to the construction and maintenance of barriers designed to prevent or inhibit the movement of humans or animals from one place to another. Structures designed as visual barriers (e.g., landscape fences, highway medians) or other barriers such as snow fences, which incidentally inhibit movement of animals, are also included. Fences extensive enough to act as barriers to wildlife are usually associated with agricultural projects or major highways.

Typical impacts:

- Barriers to movement

- Entanglement in terrestrial structures, such as wire fences

Filling and Pile-Supported Structures (Aquatic and Wetland Habitats)

Aquatic filling refers to the deposition or placement of material (e.g., gravel, rock, soil, concrete, wood, steel) into aquatic and wetland habitats for the purpose of making the habitat suitable for constructing various types of structures or water impoundments. Examples of structures include buildings, drilling islands, breakwaters, jetties, groins, bulkheads, revetments, dikes, and causeways. Filling also includes pile-supported structures, such as bridges, piers, and docks. Filling of aquatic and wetland habitats during the construction phase of various types of water impoundments is included here (e.g., hydroelectric dams, wastewater treatment, water cooling ponds, or ponds used for aquacultural purposes). After impoundments have been constructed and are being filled with water, they are considered under the activity category of Water regulation/withdrawal/irrigation. Deposition of fill, including nonsewage waste and drilling muds, for the purpose of disposal is not included here (see Solid waste disposal) except in cases where waste materials are used for preparation of sites for construction of the structures indicated above.

Typical impacts:

- Physical barriers to movement
- Changes in substrate composition
- Changes in the chemical composition of water
- Changes in flow or water level, entrapment
- Changes in sedimentation rates, turbidity, suspended solids
- Changes in dissolved oxygen, temperature, pH, salinity

Filling (Terrestrial)

Filling refers to the intentional addition of soil, rock, or other material to a defined land area. Filling normally is undertaken to improve land surface features for a selected land use such as construction of roads, pipelines, or building complexes. This activity does not include filling in open-water areas and wetlands or disposal of spoil or other solid wastes. These activities are discussed under the activity categories of Filling and pile-supported structures (Aquatic and Wetland Habitats), and Solid waste disposal, respectively. Spoil, however, that is used specifically to fill an area for some defined purpose, is included here.

Typical impacts:

- Harrassment
- Vegetation damage/destruction due to mechanical removal or material overlay
- Water level and quality fluctuations (e.g., ponding of sheet runoff uphill from the fill)
- Terrain alteration or destruction

Grading and Plowing

Grading and plowing are interrelated activities that involve the alteration or disruption of terrestrial substrates. Plowing is an agricultural practice and involves breaking and turning of soil such that the vegetative cover is eliminated and the root or moss mat is disrupted. Growing of agricultural crops such as grains or vegetables is also included in this activity. Grading includes the disruption of substrate strata beneath the soil surface and may result in the alteration of the contours of land by movement of soil, subsoil, or other substrate within a localized area. Typical equipment used for grading includes scrapers, bulldozers, backhoes, draglines, or clam shovels. Grading is used during several developmental activities, including road construction and maintenance, preparation of sites for building structures, and surface mining. Grading usually involves some filling as well as excavating, but if extensive filling is involved, the activity categories of Filling (aquatic and wetland habitats) and pile-supported structures (aquatic), Filling (terrestrial), or Solid waste disposal should be consulted instead. Grading that facilitates drainage by removing excess soil water is considered under the activity category of Draining. The removal of soil or substrates in floodplains and wetlands is considered under the activity category of Dredging.

Typical impacts:

- Barriers to movement (e.g., large openings lacking cover)
- Changes in flow or water level
- Changes in sedimentation rates, turbidity, suspended solids (e.g., runoff from hydraulic erosion or fugitive dust)
- Changes in substrate composition and location
- Entrapment in excavations
- Harassment
- Terrain alteration or destruction
- Vegetation damage or destruction due to mechanical removal or material overlay

Grazing

Grazing refers to the introduction of animals onto lands for the purpose of feeding on the vegetation. The land may provide all or a portion of the feed, for a few days or throughout the year. Other activities often associated with open range or improved pasture grazing that should be referred to when considering the impacts of grazing include Fencing, Chemical application, Clearing and tree harvest, Grading and plowing, and Water regulation/withdrawal/irrigation.

<u>Typical impacts</u>:

- Changes in biological oxygen demand (BOD), nutrient loading (e.g., from grazed areas with an accumulation of livestock manure)
- Changes in flow or water level
- Changes in substrate composition and location (e.g., stream bank breakdown and accelerated erosion)
- Changes in sedimentation rates, turbidity, suspended solids
- Attraction to artificial food source (e.g., bears to cattle)
- Competition with introduced species (e.g., for food or space)
- Disease transmission from domestic animals (including parasites)
- Vegetation composition change to less preferred or useable species
- Vegetation damage or destruction due to grazing by domestic animals

Human Disturbance

Human disturbance refers to the human disruption of or interference with fish and wildlife producing stress that may be detrimental to the affected organism. This category does not include interference with or disturbance of fish or wildlife by motorized vehicles used for recreation or development activities or by construction. Some extremely sensitive species may be adversely affected by a single encounter with a solitary human or small group of humans (e.g., hikers); however, the primary concerns regarding human disturbance involve situations where repeated disturbance occurs, either by individuals or small groups of people or by solitary events involving large numbers of people. Also included here is sensory disturbance (e.g., noise, odor) of animals that is caused by presence of dwellings (e.g., subdivisions) or settlement in remote areas.

<u>Typical impacts</u>:

- Harassment (e.g., active chasing, presence in sensitive wildlife habitat, noise, human scent)
- Attraction to artificial food sources (e.g., feeding carnivores)

- Increased susceptibility to predation (e.g., separation of adults from young or nest)

Log Storage and Transport

Log storage and transport refers to intermediate activities that occur after trees are harvested from the land but before logs are processed. These activities include log dumping, on-water and dry land sorting, booming, barge loading and dumping, upland and water-floatation storage, and transportation by rafting. Construction and maintenance of logging roads is included under the activity category of Grading and plowing.

Typical impacts:

- Changes in dissolved oxygen, pH, and temperature of the waters
- Changes in substrate composition
- Vegetation damage or destruction due to material overlay (e.g., logs)
- Harassment
- Changes in biological oxygen demand (e.g., woody debris)
- Changes in vegetation (e.g., reduction of stream cover)
- Increased susceptibility to human harvest
- Changes in vegetation composition (aquatic)

Netting

Netting refers to the placement of nets (e.g., drift and set gill nets, bottom trawls, purse seines) in waters for the purpose of catching fish. The effects of human harvest of fish with nets for purposes of sport, commercial, or subsistence use are not considered here. Only those aspects of netting involving discarded or lost nets or net fragments are considered here.

Typical impacts:

- Entanglement (e.g., seabirds, marine mammals)
- Barriers to movement
- Attraction to an artificial food source (e.g., to fish or birds caught in the net)

Processing Geothermal Energy

Processing geothermal energy refers to the capture and use of heat energy from sources beneath the earth's surface, usually in the form of steam or hot water. Primary uses of geothermal energy are generation of electricity, space heating, and industrial processing. This definition excludes drilling operations, which are discussed under the activity of Drilling.

Typical impacts:

° Harrassment

° Barriers to movement (e.g., pipelines)

° Changes in harvest levels (e.g., improved access and increased presence of man)

° Changes in chemical composition of surface waters

° Changes in water temperature, dissolved oxygen, and pH.

Processing Lumber, Kraft, or Pulp

Processing lumber, kraft, or pulp refers to the conversion of cut timber into lumber, pulp, paper, or paper-board products. This activity excludes the felling, transport, or storage of timber, which are defined under the activity headings of Clearing and tree harvest, and Log storage and transport, respectively.

Typical impacts:

° Harrassment

° Changes in water temperature, dissolved oxygen, and pH (e.g., due to mill effluent)

° Changes in biological oxygen demand, nutrient loading (e.g., due to mill effluent)

° Changes in aquatic substrate composition

° Changes in algae and plant composition in surface waters

° Addition of toxic chemicals to surface waters (e.g., sulfites from pulp mills)

° Inducement of impingement or entrainment of fish and fish eggs

- Changes in turbidity and suspended solids in surface waters

- Barriers to movement

Processing of Minerals

Processing of minerals refers to the storage, sorting, milling, crushing, washing, sluicing, concentrating, smelting, and refining of gravel and minerals such as coal, gold, molybdenum, lead, and zinc. The impacts from tailings and waste rock disposal are included under the activity of Solid waste disposal. The extraction of minerals is included in the activities of Grading and plowing, Dredging, and Blasting.

Typical impacts:

- Harassment (e.g., noise)

- Morbidity or mortality due to ingestion or contact with chemicals (e.g., cyanide and other processing chemicals)

- Vegetation damage/destruction due to air pollution (e.g., toxic fumes from smelters), contact with chemicals (e.g., spillage of toxic processing chemicals or byproducts) and material overlay (e.g., ore storage)

- Changes in chemical composition of water (e.g., heavy metals, toxic chemicals)

Processing of Oil/Gas

Processing of oil/gas refers to the refinement or treatment of crude oil or gas for use by industry and consumers. Included in this activity are the production of oil-and gas-derived substances such as plastics and petrochemicals. The transportation of crude and refined products to and from the processing facilities is included in the activity headings of Transport of oil/gas/water - land, ice and Transport of oil/gas/water - water.

Typical impacts:

- Harassment (e.g., noise)

- Morbidity or mortality due to ingestion of petroleum or petroleum products (e.g., oil and chemical spills, plastic particles)

- Changes in chemical composition of water

- Vegetation damage/destruction due to air pollution or contact with petroleum, petroleum products, or chemicals

Sewage Disposal

Sewage disposal refers to the means by which human wastes are collected and treated. Various methods of disposal are commonly employed. They range from an out-house system involving a ground collection pit and no additional treatment to sophisticated state-of-the-art methods that involve a network of collection lines and pump stations that deliver the wastes to treatment plants that provide tertiary treatment. See the activity heading Solid waste disposal for the definition and a listing of typical potential impacts from disposal of other forms of solid wastes (e.g., seafood-processing wastes or mine tailings).

<u>Typical impacts</u>:

- Changes in biological oxygen demand and nutrient loading in surface waters
- Changes in turbidity and suspended solids levels in surface waters
- Changes in dissolved oxygen levels, temperatures, and salinity in surface waters
- Addition of toxic chemicals to surface waters
- Changes in aquatic substrate composition
- Changes in flow or water level in surface waters
- Changes in vegetation composition (aquatic)

Solid Waste Disposal

Solid waste disposal refers to the disposal of unuseable or unneeded materials. Major sources of solid waste include seafood processing, drilling mud and cuttings, dredge spoils, garbage, overburden, debris, abandoned cars, and contained liquid or semisolid materials (organic or mineral). Effluent wastes that result directly from processing lumber, minerals, or oil and gas are included under the activity categories Processing of lumber/kraft/pulp, Processing of minerals, and Processing of oil/gas, respectively. Waste material used as fill material for construction projects is considered under the activity headings of Filling and pile-supported structures (aquatic and wetland habitats) and Filling (terrestrial). Impacts of discarded or lost nets are discussed under Netting.

<u>Typical impacts:</u>

- Attraction to artificial food source (e.g., garbage)
- Barriers to movement (e.g., mine tailings)
- Changes in biological oxygen demand (BOD), nutrient loading (e.g., seafood waste)
- Changes in chemical composition of water (e.g., leachates)
- Changes in flow or water level (e.g., accelerated runoff)
- Changes in substrate composition or location (e.g., mine tailings)
- Morbidity or mortality due to ingestion of or contact with chemicals
- Disease transmission from domestic animals (e.g., diseased carcasses)
- Entrapment in excavations (e.g., land fills)
- Harassment
- Terrain alteration or destruction
- Vegetation damage or destruction due to mechanical removal or material overlay

Stream Crossings - Fords

The activity of fording streams refers to the movement of vehicles, including wheeled, tracked, and skid-mounted assemblies, across a flowing watercourse at a low-water crossing. Impacts from filling (e.g., during construction of a crossing pad) are included under the activity headings of Filling and pile-supported structures (aquatic and wetland habitats), and Grading and plowing. Impacts from stream diversion (e.g., during construction of a crossing pad) are included under the activity heading of Channelizing waterways.

<u>Typical impacts:</u>

- Changes in sedimentation rates, turbidity, suspended solids (e.g. erosion of streambanks, or during construction of crossing pad)
- Changes in substrate composition (e.g., compaction from traffic)

- Changes in flow or water level (e.g., if a crossing pad is constructed)

- Changes in vegetation (e.g., primarily in riparian areas at crossing point)

Stream Crossings - Structures

Stream crossing with structures refers to the construction and operation of single or multiple span bridges or the installation of culverts in order to traverse a flowing watercourse. Placement of pipelines or cables beneath streams is included under the activity headings of Transport of oil/gas/water - Land, ice and Transport of personneleEquipment/material - land, ice.

For lists of impacts associated with structured stream crossings during construction, see the activity headings of Blasting, Grading/plowing, Channelizing waterways, Drilling, Filling and pile-supported structures (aquatic and wetland habitats), and Water regulation/withdrawal/irrigation.

Typical impacts:

- Changes in sedimentation rates, turbidity, suspended solids (e.g., erosion of banks)

- Changes in substrate composition and location (e.g., scour and erosion of streambed)

- Physical barrier to movement (e.g., debris blockage)

- Changes in flow or water level (e.g., velocity barriers, excessively shallow water, pools at downstream end of culverts)

- Shock waves (e.g., during construction phase)

- Increased susceptibility to harvest or predation

Transport of Oil/Gas/Water-Land and Ice

Transport of oil, gas, and water by land refers to the movement of these materials on, above, or buried beneath the land surface and over ice. Pipelines are a commonly used method for transport, although railroads, tanker trucks, and aqueducts (water) are also used. Also included are pumping stations, gathering lines, and other production facilities. Impacts associated with pumping water for irrigation purposes are included under the activity heading of Water regulation/withdrawal/irrigation. Impacts of transport through ice, such as by ice-breaking tankers, are included under the activity heading of Transport of oil/gas/water--water.

Typical impacts:

- Barriers to movement
- Harassment (e.g., noise from pumping or compressor stations)
- Morbidity or mortality due to ingestion or contact with petroleum or petroleum products
- Vegetation damage/destruction due to contact with petroleum or petroleum products
- Changes in chemical composition of water (e.g., oil spills)

Transport of Oil/Gas/Water - Water

Transport of oil, gas, or water by water is defined as the transport of these liquid materials across or under water by pipeline, vessel, or barge, including loading and unloading liquid cargo by piping and lightering, and through ice by ice-breaking ships.

Typical impacts:

- Morbidity or mortality due to contact with or ingestion of petroleum and petroleum products
- Harassment
- Changes in substrate composition (e.g., pipeline construction)
- Changes in chemical composition of water (e.g., oil spills, dispersants)

Transport of Personnel/Equipment/Material - Air

Transport of personnel, equipment, and material by air refers to the movement of these items by helicopter, airplane, blimps, and balloons. Helicopters and airplanes are commonly used for support of seismic exploration, oil and mineral exploration, construction, and development, and fire management. Balloons and blimps are often used for logging in sensitive areas.

Typical impacts:

- Collision with aircraft
- Harassment (e.g., hazing, noise)
- Introduction of non-native species (e.g., rats, mice, flies)

Transport of Personnel/Equipment/Material - Land and Ice

Transport of personnel, equipment, and material by land refers to automobile, truck, rail, hovercraft, snowmachine, and all-terrain vehicle transportation of people, equipment, and material. This category also includes the transmission of electrical power and telephone messages over transmission lines. This activity incorporates transportation of people and equipment even when associated with the construction or operation of systems included in other categories (e.g., pipelines). Transportation of petroleum and petroleum products by tanker trucks or by rail car is included in the activity category of Transport of oil/gas/water - land, ice. Transport of equipment or material through ice, such as by ice-breaking ships, is included under the activity heading of Transport of personnel/equipment/material--water.

Typical impacts:

- Attraction to an artificial food source (e.g., food stored in unattended vehicles)
- Barriers to movement (e.g. above-ground pipelines with insufficient clearance for passage of large mammals)
- Collision with vehicles
- Electrocution (e.g., contact with powerlines)
- Entanglement in debris (e.g., such as downed powerlines)
- Harassment (e.g., chasing, noise)
- Introduction of non-native species (e.g., rats, mice, flies)

Transport of Personnel/Equipment/Material - Water

This activity refers to transport over or through water by vessel or barge, or submarine. Pipelines and bridges are discussed under the activity headings of Stream Crossings - structures, Transport of personnel/equipment/material - land,ice, and Transport of oil/gas/water -

land and water. Transport over ice roads is discussed under Transport of personnel/equipment/material--land,ice.

Typical impacts:

- Morbidity or mortality due to contact with chemicals
- Changes in noise level
- Changes in chemical composition of water (e.g., bilge pumping, leaching of toxic materials)
- Collision with vehicles (e.g., seabirds attracted to ship lights)
- Harassment
- Interference with interspecies communication (e.g., marine mammals)
- Introduction of non-native species (e.g., rats, flies, mice)

Water Regulation/Withdrawal/Irrigation

Water regulation/withdrawal/irrigation refers to the alteration of the flow and/or the appropriation of water from a stream, lake, or subsurface aquifer by active (pumps) or passive (gravity) measures. Regulation of water is primarily associated with hydroelectric and flood control projects. Irrigation for agricultural crops or to enhance productivity of native vegetation generally withdraws water from a system by way of pumps or dams. The use of diversion ditches to redirect flow from existing stream channels for irrigation or other uses is considered under the category of Channelizing waterways. Active pumping is the method used by the majority of development practices (e.g., placer mining, powerplant cooling, dust control, municipal and industrial uses). Construction and operation of canals for the purpose of transport is covered under the activity category of Channelizing waterways, whereas the maintenance of water transportation routes is included under the activity category of Dredging.

Typical impacts:

- Aquatic substrate alteration
- Barriers to movement (e.g., large impoundments, steep-sided ditches, dams)
- Entrapment in excavations or impoundments
- Changes in flow or water level

- Changes in chemical composition of water (e.g., agricultural runoff)
- Impingement or entrainment
- Vegetation composition change to less preferred or useable species
- Changes in temperature (e.g., waste cooling water)
- Changes in sedimentation rates, turbidity, suspended solids

H. List of Abbreviations

ACMP	Alaska Coastal Management Program
ADCED	Alaska Department of Commerce and Economic Development
ADCRA	Alaska Department of Community and Regional Affairs
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADL	Alaska Department of Labor
ADNR	Alaska Department of Natural Resources
ADR	Alaska Department of Revenue
AEIDC	Arctic Environmental Information and Data Center
AOU	American Ornithological Union
BBCMP	Bristol Bay Cooperative Management Plan
BLM	Bureau of Land Management
CFEC	Commercial Fisheries Entry Commission
CIRPT	Cook Inlet Regional Planning Team
EPA	Environmental Protection Agency
EPS	Environmental Protection Service (Canada)
ERL	Environmental Research Laboratory
FAO	Food and Agriculture Organization of the United Nations
GMS	Game Management Subunit
GMU	Game Management Unit
IMS	Institute of Marine Science
INPFC	International North Pacific Fisheries Commission
IPHC	International Pacific Halibut Commission
IUCN	International Union of Conservation of Nature and Natural Resources
ISEGR	Institute of Social, Economic and Government Research
LCI	Lower Cook Inlet
MMS	Mineral Management Service
NEGOA	Northeast Gulf of Alaska
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
NPS	National Park Service

NWAFC	Northwest and Alaska Fisheries Center
NWR	National Wildlife Refuge
OCSEAP	Outer Continental Shelf Environmental Assessment Program
OMPA	Office of Marine Pollution Assessment
PWS	Prince William Sound
PWSRPT	Prince William Sound Regional Fisheries Planning Team
UCI	Upper Cook Inlet
USDC	United States Department of Commerce
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USDL	United States Department of Labor
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service