CHAPTER 2 – ALTERNATIVE DESCRIPTIONS

INTRODUCTION

Chapter 2 contains a description of a no action alternative and three action alternatives the Forest Service is considering for the Port Townsend Water Supply Special Use Permit EA, including how the alternatives were developed. A summary comparison of the effects of each alternative on the key issues is presented in order to provide a clear basis for choosing among the alternatives. Detailed information about the direct, indirect, and cumulative effects of the alternatives on the issues, and other environmental considerations, is provided in Chapter 3.

The description of alternatives includes specific actions and assumptions that are necessary for the environmental analysis. Actions that may occur as a result of other projects and activities not directly associated with the proposed action are identified and evaluated as indirect or cumulative effects.

ALTERNATIVE DEVELOPMENT PROCESS

The interdisciplinary team based the development of alternatives on the key project issues identified during scoping, the purpose and need for the proposed action, and the requirements and guidelines for completing environmental assessments for NEPA documents. NEPA requires the evaluation of a no action alternative and a reasonable range of alternatives that address the issues and the purpose and need of the project.

An interdisciplinary team meeting was held on May 12, 2003 to discuss the project issues, provide a forum for an interdisciplinary discussion of the interaction between resources, and to identify project alternatives for analysis in the environmental assessment. The discussion at this meeting resulted in the alternatives that are described below.

Alternatives Considered in Detail

The interdisciplinary team identified how the key issues could be addressed by a range of different alternatives within the scope of the project as defined by the proposed action and purpose and need, and within the scope of the authority of the Forest Service decision maker. The four alternatives described below are evaluated in this EA, and represent a range of possible actions considered for this project.

No Action Alternative

The National Environmental Policy Act (NEPA) requires analysis of a no action alternative. This alternative makes no formal decision or action regarding the Special Use Permits. The existing Special Use Permits would not be renewed and the project facilities would remain in place, operating without an updated permit. This alternative would result in the unpermitted occupation and use of the National Forest System Lands for the diversion facilities and transmission pipeline for the City of Port Townsend water supply system. Selection of this alternative would require an additional decision-making process regarding the use of the permit areas. The City would continue to divert their full water right from both rivers and use the diversion facilities.

Non-reissuance of the Special Use Permits Alternative

This alternative results in a decision to not reissue the Special Use Permits for the project facilities. This decision would result in the total loss of water supply to the City of Port Townsend. Several scoping comments indicated that the Forest Service should exercise this decision in order to protect endangered fish species. This decision would represent one end of the range of decision-making authority held by the Forest Service regarding the Special Use Permits.

For analysis purposes, the implementation of this alternative required the interdisciplinary team to make several assumptions regarding the water supply system and the City's civic responsibilities for providing water to its current water users. The basic principle the interdisciplinary team followed was that the City would not forgo providing water to their users, and that alternative means to supply the water would be implemented in the quickest and most cost effective manner. The assumptions the interdisciplinary team identified that would guide the analysis of this alternative are described below. These assumptions are necessary to identify the potential effects of this alternative on the physical, biological, and social resources of the area.

- The City of Port Townsend may have to halt the diversion of water from the Big Quilcene River. Relocating the point of diversion downstream off of federal land would require approval of several permitting agencies and would result in a substantial cost to construct a new diversion and pipeline, as well as operational costs to pump the water to a point connecting to the existing transmission pipeline and storage reservoirs. Without the Big Quilcene River water, the total supply of water would no longer be adequate to operate the paper mill.
- The City of Port Townsend could possibly move the Little Quilcene River point of diversion downstream to remove it from federal land.
    - The relocated diversion point on the Little Quilcene River would require the City to establish a land use agreement with the private landowner immediately adjacent to the National Forest Land.
    - A new diversion point on the Little Quilcene River would be close to the existing transmission pipeline facilities, requiring the construction of a short segment of pipeline to connect to the existing water storage and transmission facilities. Relocation of the diversion would likely necessitate pumping to continue using the Lords Lake reservoir.
    - The construction of a new diversion would require approval of a number of permits and the modification of the existing water right permit for a change in the location of diversion.

Continuation of Existing Permit Conditions Alternative

This alternative would renew the three Special Use Permits for the City of Port Townsend water supply diversion facilities, transmission pipeline, and maintenance facilities for a period of 20 years. The operation and management of the water diversion facilities, and management of the permit area lands would continue as in the recent past.

This alternative would address issues raised by the City of Port Townsend to operate and maintain the diversion facilities as they have in the past. The interdisciplinary team assumed the City would continue to implement its voluntary maintenance of a 27 cfs instream flow in the Big Quilcene River.

Applicable standards identified in the 2005 Record of Decision for the Pacific Northwest Region Invasive Plant Program – Preventing and Managing Invasive Plants FEIS (Appendix 1-3 to 1-6) would be incorporated into the Special Use Permits.

Modified Permit Conditions Alternative

This alternative would renew the three Special Use Permits for the City of Port Townsend water supply diversion facilities, transmission pipeline, and maintenance facilities for a period of 20 years. Additional conditions would be placed on the permits to provide supplementary protection, mitigation, or enhancement (PME) to sensitive resources. Additional PME measures for the permits include; (1) a requirement that the City of Port Townsend maintain an instream flow in the Big Quilcene River of 27 cfs below the diversion dam at R.M. 9.4 when the natural flow above the diversion exceeds 27 cfs, and (2) that the Operation and Maintenance Plan which is attached to the permits would include a road maintenance plan and a monitoring plan. The monitoring plan would follow the monitoring framework described in the NMFS's November 14, 2006 Biological Opinion (Appendix B of this document).

Applicable standards identified in the 2005 Record of Decision for the Pacific Northwest Region Invasive Plant Program – Preventing and Managing Invasive Plants FEIS (Appendix 1-3 to 1-6) would be incorporated into the Special Use Permits. A condition to the permits would be as follows: The City of Port Townsend is responsible for monitoring and treatment of existing invasive plants in the project area, and incorporate prevention measures to avoid the spread of invasive plants in any future ground disturbing activities. This condition would be noted in the Forest Service standard invasive plant permit clause.

This alternative would address issues raised by federal agencies for the improved management of the water supply diversion and provide additional protection to sensitive fish species.

Alternatives Considered but Dismissed from Further Analysis

Several alternatives discussed by the project team were dismissed from further analysis. These alternatives were dismissed from further analysis as described below.

New Water Storage Sites Alternative

This alternative would evaluate the effects of developing and using new water storage sites within the area traversed by the existing water transmission line between Lords Lake and the City of Port Townsend. A feasibility study regarding additional water storage sites was prepared by the WRIA 17 planning team as an option for augmenting stream flow in selected streams in the watershed. There would be no change in the current water rights of the City.

This alternative would address issues raised by Jefferson County and local Native American tribes regarding opportunities to increase off-stream storage. The objective of this alternative is to modify the operation of the water supply system to reduce or eliminate instream water diversions during the low flow period.

Reasons for dismissing this alternative from further analysis include cost, environmental impact and the time schedule required to develop new storage facilities would not meet the immediate needs of the primary issue of improving the current in-stream conditions for salmonids in the lower Big Quilcene River.

Increase Existing Reservoir Capacity Alternative

This alternative would evaluate the effects of expanding the existing Lords Lake water storage reservoir. The City would divert water to storage during higher flow periods and when there is unused capacity (relative to daily use) in the transmission pipeline between the diversion site and the reservoir.

This alternative would address issues raised by Jefferson County, the WRIA planning team, and local Native American tribes to evaluate opportunities for increasing off-stream water storage, thereby reducing or eliminating instream water diversions during low stream flow periods.

Reasons for dismissing this alternative from further analysis include engineering and hydrological constraints associated with the existing physical facilities. An engineering study was conducted to determine the feasibility of filling and refilling an expanded reservoir based on historical stream flow conditions, the voluntary instream flow quantity, and the transmission pipeline capacity. This study concluded that the current 27 cfs voluntary instream flow release is close to the maximum instream flow release possible without causing a significant impact on the ability to refill an expanded reservoir. The current capacity of the transmission pipeline facilities is approximately equal to the water right, thus limiting the potential excess transmission pipeline capacity available for additional storage.

New Water Right Alternative

This alternative would require the approval of a new water right at a different water source for the diversion of water during the natural low flow period of the Big Quilcene River. The new water source would be used during the low flow period to augment the existing water supply and allow water in the Big Quilcene River to remain instream.

Scoping comments did not identify a specific need for a new water source. The interdisciplinary team discussed this alternative as a possible solution to address existing instream flow issues.

Reasons for dismissing this alternative from further analysis include the City's withdrawal in 1998 of a pending water right application for the Dosewallips River. The water right application for the Dosewallips River was submitted in 1956 and was withdrawn without a decision regarding approval. Issues that resulted in withdrawing this water right application included the expected ESA listing of summer chum, the depressed stocks of winter steelhead and pink salmon, the Department of Ecology's proposed restrictions on withdrawals during the low flow period and the requirement that all major avenues of conservation needed to be pursued by the City and the Mill before issuing new rights. Additional reasons for eliminating this alternative include the cost of developing the water supply facilities.

There are no other surface water sources with adequate volume in proximity to Port Townsend to be considered economically feasible. The time schedule required to develop new facilities would also not meet the immediate needs of the primary issue of improving the current instream conditions for salmonids in the lower Big Quilcene River.

Desalination Facility Alternative

This alternative would involve the construction of a desalination facility within or adjacent to the City of Port Townsend to provide the entire water needs of the City.

Scoping comments did not identify a specific need for a desalination facility to provide a new water source for the City. The interdisciplinary team discussed this alternative as a possible solution to address existing instream flow issues.

Reasons for dismissing this alternative from further analysis include the high cost and long time frame associated with the construction of a desalination facility. The cost of water from desalination is estimated at $3.00 – $3.50/thousand gallons, including construction costs. The time schedule required to develop a desalination facility would also not meet the immediate needs of the primary issue of improving the current instream conditions for salmonids in the lower Big Quilcene River.

Groundwater Alternative

This alternative would replace the City's existing surface water diversions with a ground water supply system.

Scoping comments did not identify a specific need for a groundwater supply system to provide a new water source for the City. The interdisciplinary team discussed this alternative as a possible solution to address existing instream flow issues.

Reasons for dismissing this alternative from further analysis include the lack of sufficient rainfall and groundwater recharge within the local area. An estimate of the annual ground water recharge for the entire Quimper peninsula surrounding Port Townsend is only 12.4 cfs. The annual ground water recharge rate for the adjacent Chimacum Creek sub basin is estimated at 25.8 cfs. It would require multiple wells in several sub basins of eastern Jefferson County to provide enough water for the City and paper mill. The costs for multiple wells, transmission pipelines, and treatment facilities would not be financially feasible. The time schedule required to develop a groundwater supply system would also not meet the immediate needs of the primary issue of improving the current instream conditions for salmonids in the lower Big Quilcene River.

Removal of Fisheries Barrier at Big Quilcene River Diversion

This alternative would remove the barrier to upstream fish migration that serves as the diversion dam for the Port Townsend water supply intake structure, thus eliminating the diversion of water from the Big Quilcene River at the current location. This alternative would return natural stream passage conditions to resident salmonids on the Big Quilcene River at the current diversion site. This alternative would result in the loss of the City's capability to divert water from the Big Quilcene River.

Reasons for dismissing this alternative from further analysis include cost, engineering and hydrological constraints associated with other diversion locations, and the time schedule required to develop an alternative water source and associated infrastructure. The loss of this water source would effectively limit the ability of the City to provide an adequate supply of water for the operation of the paper mill. There are no other surface water sources with adequate volume in proximity to Port Townsend, available to replace this water supply diversion, that are considered economically feasible.

Forest Service Preferred Alternative

Comparing the benefits and adverse effects of each alternative against the issues, and the purpose and need for the project, the Forest Service has identified the Modified Permit Conditions Alternative as

the Preferred Alternative in this Environmental Assessment. The final selection of an alternative will be made by the Forest Supervisor in the Decision Notice and Finding of No Significant Impact.

COMPARISON OF ALTERNATIVES BY ISSUE

This section contains a comparison of the way each alternative affects the key issues identified during scoping. The comparison is based on both qualitative and quantitative measures of outputs and effects, and is summarized in Table 2-1.

Issue 1: Hydrology

The diversion of water from the Big Quilcene and Little Quilcene Rivers for the City of Port Townsend municipal water supply represents a change in the natural hydrology of these rivers and is an indirect effect of the reissuance of the special use permits. The potential impact to the rivers is greatest during the summer when natural flows are near their lowest, and the percent of water that is diverted from the river is greatest. The change in hydrology may impact aquatic and riparian resources, and species that are dependant upon the aquatic environment.

Analysis of the alternatives describes the affect of operating the diversion facilities on five hydrological characteristics; timing, frequency, rate of change, magnitude, and duration. Implementation of the no action, continuation of existing permit conditions, and modified permit conditions alternatives would result in no change to any of the five hydrological parameters in either the Big Quilcene or Little Quilcene River.

Implementation of the non-reissuance of the special use permits alternative would result in no change in the five hydrological parameters for the Little Quilcene River. However, the rate of change, magnitude, and duration of flow parameters would return to natural conditions for the Big Quilcene River under this alternative, as a result of removing the diversion facilities. The amount of increase in magnitude and duration in the Big Quilcene River would be approximately equal to the average annual diversion amount of 18 cfs.

Issue 2: Fisheries

The diversion of water from the Big Quilcene and Little Quilcene Rivers results in a change in some of the natural hydrological characteristics of both rivers as described under Issue 1: Hydrology, which affects water quantity downstream. Hydrologic alteration has the greatest potential to impact fisheries by affecting aquatic habitat quantity and water temperature. Impacts to fisheries caused by water diversion are considered indirect effects because the three Special Use Permits are independent of the City's State issued water rights.

The comparison of alternatives for this issue describes the direct affects of facility presence and maintenance on fish migration and fish habitat, and indirect effects of water diversion on fish habitat quantity, fish migration, and water temperature effects on fish.

Direct Effects

Implementation of the no action, continuation of existing permit conditions, and modified permit conditions alternatives would not result in any new facilities or changes to the physical nature of either diversion. Therefore, these three alternatives would maintain existing conditions and would have no additional effect on fisheries above that which occurs under existing conditions. The relocation of the Little Quilcene diversion under the non-reissuance of the special use permits

alternative would essentially maintain existing conditions in the Little Quilcene River and would have the same direct effects on fisheries as the other three alternatives. However, the removal of the Big Quilcene diversion under the non-reissuance of the special use permits alternative would improve upstream resident fish passage since no upstream passage facility currently exists, nor is an upstream fish passage facility proposed under the other three alternatives.

Both diversions allow natural bed load movement downstream, and neither facility provides short or long-term water storage; therefore, fish habitat maintenance through natural sediment transport would continue at both diversion sites under all alternatives. Vegetation management and routine road and facility maintenance would continue as conducted under existing conditions under all alternatives. The effect of the existing project facilities, operations, and maintenance on fish habitat and fish migration is described in Chapter 4 Environmental Consequences section of this EA and in the Biological Assessment (Appendix A, Section 4.2).

Indirect Effects

Implementation of all alternatives would not result in any change in water diversion or any hydrologic parameters in the Little Quilcene River. The diversion of water would continue to limit fish habitat quantity, as occurs under existing conditions. The existing water temperature regime in the Little Quilcene River would continue to be within the life history range for salmonid populations that reside in the watershed under all alternatives. Fish migration effects in the lower portion of the Little Quilcene River would be the same as occurs under existing conditions. The effect of the existing project operations on fish habitat quantity and fish migration, and water temperature effects on fish are described in Chapter 4 Environmental Consequences section of this EA and in the Biological Assessment (Appendix A, Section 4.3).

The no action, continuation of existing permit conditions, and modified permit conditions alternatives would have the same indirect effects on fisheries in the Big Quilcene River, as described above for the Little Quilcene River, except the modified permit conditions alternative would ensure maintenance of the current hydrologic regime. Implementation of the non-reissuance of the special use permits alternative would eliminate the municipal diversion effects on the Big Quilcene River as diversion elsewhere would probably be impractical. Ceasing diversion on the Big Quilcene River would increase the quantity of fish habitat, which may increase fish production, although the extent to which increased habitat may increase fish production is not known.

Issue 3: Water Quality

The thermal regime in the Big Quilcene and Little Quilcene Rivers below the diversions under the no action, continuation of the existing permit conditions, and the modified permit conditions alternative would likely remain within the water quality criteria and continue to follow a similar diurnal and seasonal trend as existing conditions. The water temperature regime in the lower Big Quilcene River could potentially exceed state water quality criteria during warm summer months in July and August. The existing data indicated that the highest exceedence would likely to be approximately 2°C above the State criteria during warm periods in an extreme dry year condition.

Under the non-reissuance of the special use permit alternative, the temperature regime in the Little Quilcene River would remain within the state water quality criteria and follow a diurnal and seasonal trend similar to existing conditions. The daily maximum water temperatures in the Big Quilcene

River from mid-July to mid-September at RM 4.4 would be reduced by about 0.3° to 0.7°C, and reductions of up to 1°C could occur. However, the changes in water temperatures would be less in reaches below RM 4.4 due to changes in stream channel morphology, and are expected to be reduced by less than 0.5°C in the reach accessible to anadromous salmonids (i.e., below RM 2.8).

Issue 4: Water Supply

The diversion of water from the Big Quilcene and Little Quilcene Rivers represents 100 percent of the total water supply and demand for the City of Port Townsend. Renewal of the Special Use Permit for the diversion facilities would allow the City to continue to provide residential, commercial, and industrial customers with a reliable, cost effective, and uninterrupted supply of water.

Implementation of the no action, continuation of the existing permit conditions, and the modified permit conditions alternative would result in no change to the water supply for the City of Port Townsend. However the modified permit conditions alternative would limit the City's flexibility to meet water demand during low flow periods. Implementation of the non-reissuance of the special use permits alternative would result in a substantial decrease in the water supply for the City. This change is attributed to the removal of water diversion facilities on the Big Quilcene River, which account for greater than 80 percent of the current water supply.

Table 2-1. Comparison of Alternatives by Resource Area

Resource Area	No Action Alternative	Non-reissuance of the Special Use Permits Alternative	Continuation of Existing Permit Conditions Alternative	Modified Permit Conditions Alternative
Hydrology	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.	Maintain existing conditions in the Little Quilcene River. Return to natural conditions in the Big Quilcene River with an expected increase in magnitude and duration of flows of approximately the average annual diversion amount of 18 cfs.	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.	Mandatory minimum instream flow for the Big Quilcene River would be an improvement over existing baseline conditions. Maintain existing conditions in the Little Quilcene River.
Fisheries	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.	Maintain existing conditions in Little Quilcene. Increased fish habitat in the lower Big Quilcene River and removal of upstream resident fish passage barrier.	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.	Mandatory minimum instream flow for the Big Quilcene River would be an improvement over existing baseline conditions. Maintain existing conditions in the Little Quilcene River.

Water Quality	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.	Maintain existing conditions in the Little Quilcene River. Reduction of the water temperature in the Big Quilcene, although likely less than 1°C.	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.	Mandatory minimum instream flow for the Big Quilcene River would be an improvement over existing baseline conditions. Maintain existing conditions in the Little Quilcene River.
Water Supply	Maintain existing water supply from the Big Quilcene and Little Quilcene Rivers.	Maintain existing water supply from the Little Quilcene River. There would be a loss of all water supply historically provided by the Big Quilcene River.	Maintain existing water supply from the Big Quilcene and Little Quilcene Rivers.	Maintain existing water supply from the Big Quilcene and Little Quilcene Rivers. Mandatory 27 cfs would limit the City's flexibility to meet the water demand.
Geology and Soils	No change in geology and soil resources.	No change in geology and soil resources.	No change in geology and soil resources.	No change in geology and soil resources.
Vegetation	Increase in existing invasive plant infestations over time.	Riparian vegetation would be improved if the Big Quilcene River diversion access road was removed. Increase in existing invasive plant infestations over time.	Prevention of invasive plant spread and treatment of existing infestations would result in eradication and control of invasive plants and improved watershed conditions.	Prevention of invasive plant spread and treatment of existing infestations would result in eradication and control of invasive plants and improved watershed conditions.
Wildlife	No change in wildlife resources.	No change in wildlife resources.	No change in wildlife resources.	No change in wildlife resources.
TES Fish Species	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.	Maintain existing conditions in the Little Quilcene River. Increased fish habitat in the lower Big Quilcene River and removal of upstream resident fish passage barrier.	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.	Mandatory minimum instream flow for the Big Quilcene River would be an improvement over existing baseline conditions. Maintain existing conditions in the Little Quilcene River.

TES Botanical Species	No effect on sensitive fungi, lichens, mosses, or Endangered or sensitive vascular plants.	No effect on sensitive fungi, lichens, mosses, or Endangered or sensitive vascular plants.	No effect on sensitive fungi, lichens, mosses, or Endangered or sensitive vascular plants.	No effect on sensitive fungi, lichens, mosses, or Endangered or sensitive vascular plants.
Floodplain and Wetlands	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.	Maintain existing conditions in the Little Quilcene River. Increased flows in the Big Quilcene River as a result of diversion removal.	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.	Maintain existing conditions in the Big Quilcene and Little Quilcene Rivers.
Socioeconomics	Maintain existing socioeconomic conditions in the Port Townsend community.	Probable closure of Paper Mill due to lack of water as a result of the removal of the Big Quilcene River Diversion.	Maintain existing socioeconomic conditions in the Port Townsend community.	Maintain existing socioeconomic conditions in the Port Townsend community. Mandatory 27 cfs flow could result in additional conservation measures and potential adverse effect on paper mill operations.
Recreation and Scenic Resources	No change in recreation and scenic resources.	Reduced access to the Big Quilcene River if the Big Quilcene diversion access road was removed. No change in recreation and scenic resources in the Little Quilcene River.	No change in recreation and scenic resources.	No change in recreation and scenic resources.
Heritage and Cultural Resources	No change in heritage and cultural resources.	No change in heritage and cultural resources.	No change in heritage and cultural resources.	No change in heritage and cultural resources.
Transportation and Access Management	No change in transportation and access management.	Probably removal of Big Quilcene diversion access road. No change in transportation and access management to the Little Quilcene River.	No change in transportation and access management.	Roads accessing diversion sites would be maintained by the City of Port Townsend.
Lands and Land Use	No change in lands and land use.	No change in lands and land use.	No change in lands and land use.	No change in lands and land use.

CUMULATIVE EFFECTS

Cumulative effects are the incremental impact upon a resource that result from the interaction of two or more individual actions. There are two types of cumulative effects that could occur on this project, and are described in this document: (1) the incremental effect of two different resource actions occurring within a proposed alternative, and (2) the incremental effect resulting from a

project action and a non-project action. Each type of cumulative effect must consider past, present, and reasonably foreseeable future actions (temporal component), and actions that may be separated by distance (spatial component) if there is the potential for incremental effects.

Based on the analysis presented in the Environmental Consequences section of the EA, resource specific studies, and agency and public comments, the level of detail of cumulative effects analysis is greatest with respect to direct project effects, with broader basin-wide impacts analyzed more qualitatively.

Cumulative Effects Resulting from Project Actions

Two or more project actions that result in a cumulative effect are addressed as a direct or indirect project effect, and are described for each alternative in the environmental consequences chapter.

Cumulative Effects between Project and non-Project Actions

Cumulative effects can also occur when the effects of project related actions interact with non-project actions occurring in the same geographic area. The non-project effects may occur at differing temporal scopes than the project action, such as persisting effects from past actions, or effects that may result from reasonably foreseeable future actions. Non-project actions can include other federal, state, local government or private industry activities, or management and policy decisions relating to social or resource management.

Non-project Action/Effect	+	Project Action/Effect	=	Incremental or Cumulative Physical, Biological, or Social Effect

Non-Project Actions Contributing to Cumulative Effects

Non-project actions that were considered as potentially contributing to the cumulative effects of the City of Port Townsend Special Use Permit renewal are listed below. These policies, projects, and actions may possibly interact with resources and project actions evaluated in this EA to create a cumulative effect upon a resource.

- Change (increase) in recreation usage in the watershed.
- Quilcene National Fish Hatchery Projects.
  a. Discontinuation of the summer chum supplementation program.
  b. Normal hatchery operations.
  c. Bank stabilization projects
- Installation of gravel traps for sediment management by the County.
- Road maintenance practices (by all agencies / landowners).
- Road decommissioning (primarily by the Forest Service).
- Modifications to the river levees.
- Timber management practices in the watershed.
- Long-term population change (increase).
- Recreational and commercial fisheries harvesting.
- Bank stabilization projects (other than the Hatchery project).
- Climate change and ocean warming (e.g., La Niña, El Niño).