

1 **4.3 Fish**

2 **4.3.1 Threatened and Endangered Fish Species**

3 This section discusses the predicted, direct, environmental consequences of the Proposed Action or
4 alternatives with respect to listed salmonid species found within the action area: Puget Sound chinook
5 salmon, Hood Canal summer chum salmon, bull trout, Columbia River chinook salmon, and Columbia
6 River chum salmon. The following discussion will address these species in this order. Indirect and
7 cumulative impacts are discussed in Section 4.3.8.

8 **Puget Sound Chinook and Hood Canal Summer Chum**

9 Standards of Comparison for Puget Sound Chinook

10 The Puget Sound Chinook Salmon Evolutionarily Significant Unit (ESU) was listed as threatened in
11 1999 because the potential for these populations to become endangered in the foreseeable future was
12 believed to be high if current conditions continued (Meyer et al. 1998). Harvest is identified as one
13 factor of decline in the listing decision. The co-managers anticipate the vast majority of the harvest-
14 related mortality to listed Puget Sound chinook salmon over the duration of the Resource Management
15 Plan (RMP) will be incidental to fisheries directed at other stocks or species (NMFS 2004 [4(d)
16 determination]). Nevertheless, over the past decade, the co-managers have constrained harvest
17 mortality, severely for some populations in the ESU, to avoid escapement falling to the point of
18 instability. These harvest reductions have been in response to significant reductions in productivity and
19 capacity of chinook salmon-bearing watersheds throughout Puget Sound, largely as a result of habitat
20 degradation. The National Marine Fisheries Service (NMFS) has found these harvest actions are
21 consistent with the requirements of the Endangered Species Act (ESA) (NMFS 1999; NMFS 2001;
22 NMFS 2003; Puget Sound Treaty Tribes and Washington Department of Fish and Wildlife 2003).

23 The potential impacts of the Proposed Action or alternatives on listed Puget Sound chinook salmon are
24 quantified in terms of the projected total fisheries exploitation rate and resulting spawning escapement
25 for each population. In general terms, *exploitation rate* is the number of fish harvested from each
26 population divided by the number of fish in the population^{vi} (see Appendix C). *Spawning escapement* is
27 the estimated number of fish that return to the spawning grounds each year. For some populations,

^{vi} The total exploitation rate is technically defined as the proportion of adult chinook, from all year-classes, prior to the onset of fishing in a given year, harvested or killed incidentally as a result of fishing.

1 spawning escapement is measured in terms of those fish whose parents spawned naturally rather than in
2 hatcheries or by other artificial propagation means.

3 Survival and recovery of the Puget Sound Chinook ESU will depend, over the long term, on necessary
4 actions in other sectors, especially habitat actions, and not on harvest actions alone. There is an
5 ongoing recovery planning effort for the Puget Sound Chinook ESU. Completion of the recovery plan
6 and decisions regarding the form and timing of recovery efforts described in the recovery plan will
7 determine the kinds of harvest actions that may be necessary and appropriate in the future. Absent that
8 guidance at the time of this writing, NMFS must evaluate the proposed harvest actions by examining
9 the impacts of harvest within the current context. Therefore, NMFS has evaluated the future
10 performance of populations in the ESU under recent productivity conditions; i.e., assuming that the
11 impact of hatchery and habitat management actions remain as they are now. The actual performance of
12 the populations will vary due natural variability in freshwater and marine survival, and may also vary
13 due to actions in the habitat and hatchery sectors. For example, if habitat and hatchery actions improve
14 conditions over currently existing conditions, the current NMFS conservation standards would be
15 conservative, likely overestimating the impact that harvest actions would have on the ESU.

16 Where available, exploitation rates and spawning escapement are compared to population-specific
17 conservation standards established by the NMFS to ascertain whether fisheries will appreciably reduce
18 survival and recovery of the ESU, as required by the ESA 4(d) Rule. Conservation standards are
19 represented by rebuilding exploitation rates, critical escapement thresholds, and viable escapement
20 thresholds.

21 The rebuilding exploitation rates (RERs) represent the highest rate of harvest that will achieve the
22 following ESA conservation criteria. Over the long term (25 years), harvest at the RER level will
23 achieve: 1a) a high (80%) probability of rebuilding, or 1b) no more than a 10 percent reduction in the
24 probability of rebuilding, and 2) a very low (5%) probability of the population falling to the critical
25 threshold (see Appendix A) compared with a zero-harvest baseline. Fishing regimes that exert harvest
26 rates below the RER level, by definition, do not pose jeopardy to the ESU. Fishing regimes above the
27 RERs may also not pose jeopardy to the ESU depending on the status and distribution of the chinook
28 salmon populations throughout the ESU.

29 The *critical escapement threshold* (CET) represents a point of biological instability, below which the
30 risk of extinction increases significantly, due to declining spawning success, compensatory mortality, or
31 risk of loss of genetic integrity. This threshold is not precisely known for any population, but may be
32 estimated by risk assessment if the current productivity of a population can be estimated. Based on

1 theoretical assessment of ecological and genetic risk (McElhane et al. 2000; and NMFS 2001), a
2 generic critical threshold of 200 adults has been used for other populations for which population-
3 specific data are unavailable or insufficient to estimate productivity. *Viable escapement thresholds*
4 (VETs) in the context of this EIS analysis are a level of spawning escapement associated with
5 rebuilding to recovery, consistent with current environmental conditions. For most populations, these
6 thresholds are well below the escapement levels associated with recovery, but achieving these goals
7 under current conditions is a necessary step to eventual recovery when habitat and other conditions are
8 more favorable. Where data are available, viable escapement thresholds have been defined consistent
9 with the current productivity and capacity of spawning habitat. Where such information is not
10 available, the generic viable threshold (1,250 adults) defined by NMFS for Viable Salmonid
11 Populations (McElhany et al. 2000; NMFS 2001) is used as a reference point. By definition, these
12 thresholds offer only general guidance as to what generally represents points of stability or instability.
13 Some populations may be fairly robust at very low abundances, while chinook salmon populations in
14 large river systems may become unstable at higher abundances depending on resource location and
15 spawner density. However, without population-specific information, NMFS believes these generic
16 guidelines offer the best available information.

17 NMFS has developed specific conservation standards for 12 of the 22 populations and one management
18 unit (Nooksack early) within the Puget Sound Chinook ESU (Table 4.3-1). Nine of these 12
19 populations and one management unit have estimates of rebuilding exploitation rate (RER), critical
20 escapement threshold (CET), and viable escapement threshold (VET). Although RERs have not been
21 established for the Upper Cascade spring or Snoqualmie chinook populations, ancillary information
22 indicated that the RERs developed for other populations within their management units should be
23 protective of these populations (Susan Bishop, NMFS, April 20, 2003; and Skagit Rebuilding
24 Exploitation Rate Workgroup 2003). The remaining populations have a mixture of specific and generic
25 standards – also developed by NMFS (McElhany et al. 2000). Standards for all populations are
26 summarized in Table 4.3-1. NMFS uses all of this information to assess the status and distribution of the
27 chinook salmon populations throughout the ESU, and then to determine whether the harvest action
28 would pose jeopardy to the ESU as a whole.

29 The model used for this EIS analysis estimated fishery impacts to chinook salmon and other species in
30 Alaska, British Columbia, and *Southern U.S. Fisheries* – those occurring in Puget Sound and off the
31 Pacific coast of Washington, Oregon, and California (see Technical Appendix B). Within the Southern

1 U.S. area, more than 95 percent of the catch of species discussed here occurs within Puget Sound
2 (Pacific Salmon Commission 2002).

3 Subsection 4.3.1 compares the impacts of the Proposed Action or alternatives on Puget Sound chinook
4 under each of four scenarios as described in Subsection 4.2, Basis for Comparison of Alternatives and
5 Approach to Alternatives Analysis. Each scenario defines a different baseline condition in terms of
6 forecast abundance of Puget Sound Chinook and harvests occurring in fisheries in Canada and Alaska.

7 These different scenarios are used only to explore the range of possible impacts to chinook salmon. The
8 assumptions regarding the range of abundance and Canadian/Alaskan fisheries for coho, sockeye, pink,
9 chum, and steelhead are the same among scenarios for two reasons: 1) the purpose of the Proposed
10 Action is to manage Puget Sound chinook salmon. It does not include management objectives for other
11 species or describe how fisheries will respond to changes in abundance of those other salmon species;
12 and 2) the 1999 Pacific Salmon Treaty Chinook Annex provides the necessary information to model
13 chinook salmon impacts under higher levels of fishing than those observed in recent years, but which
14 might occur in the next few years. However, there is insufficient information to allow NMFS to model
15 how catch of salmon species other than chinook would vary in response to changes in
16 Canadian/Alaskan fisheries. Therefore, the analysis assumes abundance and Canadian/Alaskan fishery
17 impacts for non-chinook salmon species will remain similar to those experienced in recent years.

Section 4 - Environmental Consequences

Table 4.3-1. Rebuilding Exploitation Rates, and critical and viable escapement standards for listed Puget Sound chinook and Hood Canal summer chum, against which impacts of Alternatives were assessed.

Population	Rebuilding Exploitation Rate	Critical escapement	MSY, viable, or capacity escapement level
Nooksack Spring	12%		500
North Fork		200	
South Fork		200	
Skagit Summer-Fall			
Lower Skagit	49%	251	2182
Lower Sauk	51%	200	681
Upper Skagit	60%	967	7454
Skagit Spring			
Upper Cascade		170	
Upper Sauk	38%	130	330
Suitttle	41%	170	400
Stillaguamish Summer-Fall			
North Fork	32%	300	552
South Fork	24%	200	300
Snohomish Summer-Fall	18%		
Skykomish	18%	1650	3500
Snoqualmie		400	
Green	53%	835	5523
Lake Washington			
Sammamish		200	1200
Cedar		200	1200
Puyallup		200	1200
White River Spring		200	1000
Nisqually		200	1100
Mid- Hood Canal / Dosewallips		200	1250
Skokomish		200	1250
Dungeness		200	925
Elwha		200	2900
Hood Canal – Juan de Fuca Summer Chum Populations			
Hood Canal	11%	4070	
Strait of Juan de Fuca	9%	920	

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Scenario	Pre-Action Resource Status ^{vii}	
	Abundance	Harvest in Canadian/Alaskan Fisheries
Scenario A	2003	2003
Scenario B	2003	Maximum expected under the 1999-2008 Pacific Salmon Treaty Annex
Scenario C	70% of 2003	2003
Scenario D	70% of 2003	Maximum expected under the 1999-2008 Pacific Salmon Treaty Annex

2 Scenario B is considered the most likely scenario during the RMP implementation period; therefore,
 3 the analysis emphasizes this scenario. However, the performance of each alternative is compared both
 4 across the four scenarios, and with each of the other alternatives for a given scenario. For example,
 5 Alternative 2 is evaluated for Scenarios A through D. Then Alternative 2, Scenario A is compared with
 6 Alternative 1, Scenario A, and so forth.

7 Table 4.3-3 in Subsection 4.3.1.5, Summary Discussion of Alternatives, summarizes the performance
 8 of each alternative (under Scenario B) in relation to the conservation standards for those populations.
 9 Table 4.3-4 in Subsection 4.3.1.5 summarizes the impacts of Alternatives 2 through 4 relative to
 10 Alternative 1, the Proposed Action, under Scenario B. Table 4.3-5 in Subsection 4.3.1.5 summarizes
 11 performance of each alternative under all scenarios relative to conservation standards, and Table 4.3.6
 12 summarizes impacts of Alternatives 2 though 4 for all scenarios. Additional tables in this Subsection
 13 4.3.1.5 (and in Appendix B) provide more detailed information on exploitation rates, total fishery-
 14 related mortality for hatchery and natural chinook salmon (landed and non-landed), and escapement of
 15 hatchery and naturally-spawning chinook salmon.

16 Standards of Comparison for Hood Canal Summer Chum

17 There are seven summer chum salmon populations in the listed Hood Canal-Strait of Juan de Fuca
 18 summer chum ESU. NMFS has determined that over the long term, fisheries exploitation rates should
 19 be constrained to an average of 10.9 percent or less for Hood Canal component salmon and 9 percent or
 20 less for Strait of Juan de Fuca component of the Hood Canal/Strait of Juan de Fuca ESU. This standard

^{vii} Represents preseason projections of 2003 fisheries and abundance.

1 allows that, in any one year, exploitation rates may vary from 3 to 15 percent for the Hood Canal
2 component, and from 3 to 12 percent for the Strait of Juan de Fuca component. Fisheries should result
3 in appropriate distribution of escapement among the various populations in each region, and should not
4 otherwise impede the survival and recovery of the ESU (NMFS 2000). For summer chum, exploitation
5 rates are expressed as total catch (in all fisheries) as a proportion of the sum of catch and escapement.
6 However, returns to the Quilcene River (whose run is dominated by a large summer chum hatchery
7 program) are excluded from the exploitation rate calculation. Critical escapement goals have also been
8 designated: 4,070 for the Hood Canal summer chum region, and 920 for the Strait of Juan de Fuca
9 region.

10 **Bull Trout, and Columbia River Chinook and Chum Salmon**

11 A small number of anadromous char, presumed to be bull trout, are caught in freshwater sport fisheries
12 and may be caught in near-shore salmon net fisheries primarily in northern Puget Sound. Listed
13 Columbia River-origin chinook and chum salmon are infrequently caught in Puget Sound (personal
14 communication via e-mail from Dell Simmons, NMFS, to Susan Bishop, NMFS Sustainable Fisheries
15 Division, December 2002).

16 Fishery closures under Alternative 2, 3 or 4 would slightly reduce the rare catch of these species that
17 might occur under Alternative 1, but neither the Proposed Action nor the Alternatives would exert a
18 measurable impact on these species under any of the harvest management scenarios. Therefore, bull
19 trout and the Columbia River ESUs will not be discussed further in this document.

20 **Metrics for Comparison of Impacts**

21 The Proposed Action (Alternative 1) serves as the baseline against which the other alternatives are
22 measured. The magnitude of the impacts of Alternatives 2, 3, or 4 relative to the baseline are classified
23 as follows:

Term	When the impact varies by:
None	Not measurable, rare, infrequent
Low	Less than 10 percent
Moderate	10 percent to 30 percent
Substantial	More than 30 percent

24 Although it is useful and necessary to provide some system of metrics against which to assess the
25 effects of the Proposed Action or alternatives, the complexity of salmon life history means that the
26 magnitude of changes in effect may not translate into realized benefits or risks to the populations of the

1 same magnitude. Therefore, it is important to note that there are several limitations to the application of
2 these metrics to fish that should be taken into account in interpreting the results of applying these
3 metrics. First, substantial increases in spawning escapements may not result in commensurate increases
4 in the progeny of those spawners. The objective for salmon fisheries management is to constrain
5 fishing mortality to the extent necessary to optimize the production of subsequent generations. The
6 *productivity* of salmon populations, often defined in terms of the number of recruits produced per
7 female spawner, increases over a range of escapement, then reaches a plateau or declines at higher
8 levels of escapement due to density-dependent survival; i.e., too many spawners for the available
9 habitat, or too many juvenile salmon for the available food in the river. The escapement level
10 corresponding to the point of optimum productivity varies widely among individual populations due to
11 the accessible area of suitable spawning and rearing habitat within a river system, and the very complex
12 array of physical and biological factors that influence the annual survival of salmon eggs and juveniles
13 through their freshwater life history. However, the influence of these physical and biological factors
14 varies greatly from year to year, so that were fisheries management to achieve optimum escapement
15 consistently from year to year, the actual production from those spawners would still vary widely. The
16 marine environment exerts even greater influence on the number of juvenile salmon that reach
17 adulthood. Consequently, this Environmental Impact Statement can compare the predicted escapement
18 for populations against specific or general escapement standards, but cannot accurately project the
19 resulting abundance of subsequent generations of adult salmon. Also, changes in risk relative to
20 achievement of the Rebuilding Exploitation Rates may not be the same as changes in risk measured by
21 changes in escapement. That is, the changes in achieving the Rebuilding Exploitation Rates are likely
22 to be more beneficial or adverse relative to recovery than changes in escapement.

23 It should also be noted that changes in exploitation rates are expressed in the discussion below as the
24 difference – in percentage points – between two rates, whereas changes in escapement are expressed as
25 the percent difference between two values. For example, if the exploitation rate for Nooksack early
26 chinook is 20 percent under Alternative 1 and 15 percent under Alternative 2, the change is 5
27 percentage points (20% minus 15% = 5%). If the escapement of Nooksack early chinook changes from
28 200 under Alternative 1 to 250 under Alternative 2, the change is 25 percent ([250 minus 200] divided
29 by 200).

30 **4.3.1.1 Alternative 1 – Proposed Action/Status Quo**

31 Alternative 1 (the Proposed Action) is the alternative that most closely resembles recent historical
32 harvest management plans. Its implementation is predicted to result in exploitation rates below

1 rebuilding exploitation rate (RER) ceilings for five of the nine populations and one management unit
2 that have RER standards. With the exception of the Nooksack early management unit, escapements
3 under this alternative are predicted to exceed critical thresholds for all populations under all scenarios,
4 in most cases by substantial margins. Viable escapement thresholds (VETs) are predicted to be met or
5 exceeded for nine of the 18 populations and one management unit that have VET standards.

6 **Summary of Scenario Differences**

7 Under Alternative 1, Scenarios A, C, or D, representing conditions similar to 2003 (A); decreased
8 forecast abundance (C); or decreased forecast abundance with maximized Canadian/Alaskan fisheries
9 (D), the predicted Southern U.S. catch from listed Puget Sound populations is 106 percent, 74 percent,
10 and 71 percent respectively of that under Scenario B (see Table 4.3-2 in Subsection 4.3.1.5, Summary
11 Discussion of Alternatives). Catch of other species is discussed in Subsection 4.3.2, Basis for
12 Comparison of Alternatives and Approach to Alternatives Analysis.

13 Exploitation rates under Alternative 1, Scenarios A, C, and D are predicted to vary from those under
14 Alternative 1, Scenario B, by 1 to 5 percent. Exploitation rates for the Nooksack population, which
15 exceeded RER ceilings under Alternative 1, Scenario B, also are predicted to exceed RER ceilings
16 under Scenarios A, C, or D by margins of 8 to 14 percent. Exploitation rates for the Skykomish River
17 chinook salmon population are also predicted to exceed the RER ceiling under all scenarios by margins
18 of 1 percent to 5 percent. Exploitation rates for the Lower Skagit River fall and Lower Sauk River
19 summer chinook populations, which were not predicted to meet RER ceilings under Alternative 1,
20 Scenario B, were below the ceiling under Alternative 1, Scenarios A or C, by 1 to 3 percent, and above
21 the RER ceiling under Scenario D by 5 to 7 percent. The exploitation rate for the Green River fall
22 chinook population is predicted to exceed the RER ceiling under Alternative 1, Scenario A, by 9
23 percent, but is predicted to be 4 to 5 percent below the ceiling under Scenarios C or D (see Table 4.3-5
24 and Table 4.3-7a through Table 4.3-7d in Subsection 4.3.1.5).

25 Except for the Nooksack early populations, all populations that met CETs under Alternative 1, Scenario
26 B, are predicted to meet them under Scenarios B, C, or D, as well. The North Fork Nooksack River
27 early chinook salmon population is not predicted to meet CETs in any scenario under Alternative 1.
28 The South Fork Nooksack population is not predicted to meet its CET under Scenarios C or D. The
29 Upper Skagit River summer chinook population, which was predicted to meet its VET goal under
30 Alternative 1, Scenario B, was also predicted to meet it under Alternative 1, Scenario A, but to fall
31 slightly below goal under Alternative 1, Scenarios C or D. This was also true for the South Fork
32 Stillaguamish fall population. Other populations that would meet or exceed VET goals under Scenario

1 B would meet or exceed them under the other scenarios, and those that were predicted to fall below
2 goal under Scenario B also did so under the other scenarios (see Table 4.3-5 in Subsection 4.3.1.5).

3 **Impacts to Puget Sound Chinook Populations**

4 Under Alternative 1, Scenario B (high abundance and Canadian/Alaskan fisheries at the maximum
5 allowed by treaty), the fishery model projected Southern U.S. catches of 52,720 chinook from
6 naturally-spawning Puget Sound populations, and 1,663 chum from listed Hood Canal/Strait of Juan de
7 Fuca summer populations. An additional 81,570 chinook from hatcheries and streams outside the
8 action area are predicted to be caught (see Table 4.3-2 in Subsection 4.3.1.5).

9 Under Alternative 1, Scenario B, exploitation rates are predicted to be below their RERs for five of the
10 nine populations and one management unit for which RERs have been derived (see Table 4.3-3 in
11 Subsection 4.3.1.5). Exploitation rates are predicted by the fisheries model to exceed RER standards for
12 the Nooksack early management unit by 13 percentage points, despite the fact that the Southern U.S.
13 exploitation rate is predicted to be only 7 percentage points. The Lower Skagit River population is
14 predicted to exceed its RER ceiling by 6 percentage points, the Lower Sauk River population by 4
15 percentage points, the Skykomish River population by 4 percentage points, and the Green River
16 chinook salmon population by 10 percentage points. However, owing to peculiarities associated with
17 the 2003 base year data for the Skagit summer/fall chinook salmon populations, it is likely that the
18 model predicts higher exploitation rates than may actually occur ^{viii} during implementation of the
19 Proposed Action (NMFS 2004 [4(d) determination]). It is also important to note that for the Skagit
20 River summer-fall chinook populations, the predicted Southern U.S. exploitation rate (16%) accounted
21 for less than one-fourth of the total predicted exploitation rate (55%) (see Table 4.3-3 and detail Table
22 4.3-7b in Subsection 4.3.1.5). The model predicted that exploitation rates for six populations would fall
23 below RER ceilings under Alternative 1, Scenario B, by margins of 5 to 13 percentage points. These
24 include exploitation rates for the upper Skagit, Upper Sauk and Suiattle chinook populations (11% and
25 14%, respectively, below the RER ceiling), the North Fork Stillaguamish and the South Fork
26 Stillaguamish chinook populations (13% and 5%, respectively, below the RER ceiling) (see Table 4.3-
27 7b in Subsection 4.3.1.5). The model predicted that, under Alternative 1, Scenario A, exploitation rates

^{viii} Anomalous age structure and the presence of pink salmon fisheries in 2003 make the estimates of exploitation rates liberal, The Southern United States exploitation rates are more likely to be similar to recent years; i.e., 6 to 18 percent

1 for two additional populations – the lower Skagit fall and Lower Sauk summer populations – would
2 fall below their RER ceilings (1% and 3%, respectively) (see Table 4.3-7a in Subsection 4.3.1.5).

3 The majority of harvest for the Nooksack early and Skagit summer/fall occurs in Canadian fisheries.
4 The RER for the Nooksack early chinook management unit is predicted to be exceeded even without
5 Southern U.S. fishing. For the Nooksack early chinook management unit, harvest mortality in Southern
6 U.S. fisheries is predicted to increase the probability of falling below its CET by 21 percentage points
7 and decrease the probability of rebuilding by 6 percentage points, measured over 25 years. For the
8 Skagit summer/fall chinook salmon populations, harvest mortality in Southern U.S. fisheries is
9 predicted to keep the probability of falling below its CET below 5 percentage points and decrease the
10 probability of rebuilding by 26 percentage points, measured over 25 years. It should be noted that these
11 are probably maximum estimates since the calculations are based on low marine survival assumptions,
12 and recent information indicates that marine survival may be improving. Both the Skagit River
13 summer/fall populations are currently above their VETs and have shown increasing trends in
14 escapement.

15 Under Alternative 1, Scenario B, only the North Fork Nooksack chinook salmon population is
16 predicted to not meet its CET. For most other populations, escapements are predicted to exceed critical
17 thresholds by more than 100 percent. Escapement is predicted to exceed the viable escapement
18 threshold for nine populations, including: Upper Skagit River, Upper Sauk River, Suiattle River, North
19 Fork Stillaguamish and South Fork Stillaguamish, Green River, White River, Puyallup River, and
20 Nisqually River. Escapement under Alternative 1, Scenario B, is predicted to be below the VET for 10
21 chinook populations and one management unit, including: Nooksack River early, Lower Skagit River,
22 Lower Sauk River, Skykomish River, Sammamish River, Cedar River, Mid-Hood Canal, Skokomish,
23 Dungeness, and Elwha chinook salmon populations (see Table 4.3-3 in Subsection 4.3.1.5).

24 In summary, implementation of Alternative 1 (the Proposed Action), Scenario B, is predicted to result
25 in exploitation rates below RER ceilings for five of the nine populations and one management unit with
26 RER standards. Critical escapement thresholds are predicted to be exceeded for all populations except
27 the Nooksack early management unit, in most cases by substantial margins. Viable escapement
28 thresholds are predicted to be met or exceeded for nine of the 18 populations and one management unit
29 with thresholds, including Upper Skagit; Upper Sauk and Suiattle, North Fork and South Fork
30 Stillaguamish, Green River, Puyallup, White, and Nisqually River chinook salmon populations (see
31 Table 4.3-5 and Tables 4.3-7a through 4.3-7d in Subsection 4.3.1.5).

1 The Puget Sound Technical Recovery Team (TRT) has identified five distinct geographic/life history
2 regions in the Puget Sound Chinook Salmon ESU: the Strait of Georgia, North Puget Sound, South
3 Puget Sound, Hood Canal, and Strait of Juan de Fuca. Current TRT guidance recommends that a
4 recovered ESU would have two to four low-risk populations within each region, representative of the
5 range of life histories within each of the regions. Under Alternative 1, the Nooksack early management
6 unit that makes up the Strait of Georgia region is predicted to exceed its RER; five of the eight^{ix} North
7 Puget Sound populations are predicted to meet their RER and/or exceed the VETs; four of the six
8 South Puget Sound populations are predicted to exceed their VETs; and none of the populations in the
9 Strait of Georgia, Hood Canal, or Strait of Juan de Fuca regions are predicted to exceed their VETs.
10 Except for the North Fork Nooksack chinook population, all populations in all regions are predicted to
11 exceed their CETs.

12 NMFS is currently evaluating Alternative 1, as proposed by the co-managers in the Puget Sound
13 Chinook Management Plan, under the ESA 4(d) Rule. Taking into account the distribution of
14 population status throughout the ESU and other relevant factors, NMFS has preliminarily concluded
15 that Alternative 1 would not appreciably reduce the likelihood of survival and recovery of the ESU
16 (NMFS *in press*).

17 **Impacts to Hood Canal and Strait of Juan de Fuca Summer Chum**

18 The fisheries modeled under Alternative 1 (the Proposed Action) are predicted to result in a Southern
19 U.S. catch of 141 Hood Canal and 12 Strait of Juan de Fuca summer chum salmon (excluding those
20 from the Quilcene management unit, which are managed for an escapement goal and treated separately
21 under the Summer Chum Salmon Conservation Initiative). The exploitation rates (including Canadian
22 catch) are predicted to be 2 percent for the Hood Canal region and 0.4 percent for the Strait of Juan de
23 Fuca region, well below the long-term goals of the Summer Chum Salmon Conservation Initiative of
24 10.9 percent for Hood Canal summer and 9 percent for Strait of Juan de Fuca summer chum
25 (Washington Department of Fish and Wildlife and Point-No-Point Treaty Tribes, Summer Chum
26 Salmon Conservation Initiative, April 2000). The predicted escapement of 11,454 Hood Canal summer
27 chum and 6,955 Strait of Juan de Fuca summer chum exceeds the critical escapement goals for these
28 regions by 181 percent and 656 percent, respectively (see Table 4.3-7a in Subsection 4.3.1.5).

^{ix} There are ten populations in the North Puget Sound Region, but only eight currently have identified management standards.

1 **4.3.1.2 Alternative 2 – Escapement Goal Management at the Management Unit Level**

2 Alternative 2 represents a more restrictive fishing regime than Alternative 1, especially for populations
3 in North Puget Sound. With three notable exceptions (discussed below), escapements are predicted to
4 be higher for most populations compared to Alternative 1.

5 **Summary of Scenario Differences**

6 Under Alternative 2, Scenarios A, C, or D, representing conditions similar to 2003 (A); decreased
7 forecast abundance (C); or decreased forecast abundance with maximized Alaskan and Canadian
8 fisheries (D), Southern U.S. catch of naturally-spawning chinook salmon is predicted to be 123 percent,
9 71 percent, and 69 percent respectively of that under Scenario B. Catch of other species is discussed in
10 Subsection 4.3.2, Basis for Comparison of Alternatives and Approach to Alternatives Analysis.

11 Exploitation rates for the Nooksack early chinook management unit, the North Fork Stillaguamish
12 population, and the South Fork Stillaguamish population, which are predicted to exceed RER ceilings
13 under Alternative 2, Scenario B, are also predicted to exceed RER ceilings under Scenarios A, C, or D.
14 Exploitation rates for the Skykomish River and Green River populations are predicted to exceed the
15 RER ceilings under Scenarios A or B, but are predicted to be below the RER ceilings for Scenarios C
16 or D. Escapements for Alternative 2, Scenario A, are predicted to be generally lower than escapements
17 under Alternative 2, Scenario B and escapements under Alternative 2, Scenarios C or D are predicted to
18 be generally higher (see Table 4.3-5 and Tables 4.3-8a through 4.3-8d in Subsection 4.3.1.5).
19 Nevertheless, populations (other than the Nooksack River population) predicted to meet CETs under
20 Scenario B are also predicted to meet CETs under Scenarios A, C, or D, as well. The South Fork
21 Stillaguamish population is not predicted to meet its CET in any scenario under Alternative 2.
22 Populations predicted to meet or exceed VET goals under Alternative 2, Scenario B, are also predicted
23 to meet or exceed them under Alternative 2, Scenario A. With one exception, (Lower Sauk River),
24 populations predicted to meet or exceed VETs under Alternative 2, Scenario B, would meet or exceed
25 VETs under Alternative 2, Scenarios C or D (see Table 4.3-5 and Tables 4.3-8a through 4.3-8d in
26 Subsection 4.3.1.5).

1 **Comparison of Alternative 2 (Escapement Goal Management at the Management Unit Level) to**
2 **the Proposed Action**

3 **Impacts to Puget Sound Chinook Populations**

4 Under Alternative 2, Scenario B (high abundance and Canadian/Alaskan fisheries at the maximum
5 allowed by treaty), the fishery model projected Southern U.S. catches of 42,793 chinook from
6 naturally-spawning chinook Puget Sound chinook populations, or 11,743 fewer than with Alternative 1,
7 Scenario B. It is predicted that an additional 36,074 chinook salmon from hatcheries and from streams
8 outside the action area would be caught, which is 75,857 fewer than under Alternative 1, Scenario B
9 (see Table 4.3-2 in Subsection 4.3.1.5).

10 Under Alternative 2, Scenario B, the total exploitation rate for the Nooksack early management unit is
11 predicted to exceed its RER ceiling by 7 percentage points, despite the fact that the Southern U.S.
12 exploitation rate is predicted to be only 1 percent. The exploitation rate for the North Fork
13 Stillaguamish population is predicted to exceed the RER ceiling by 35 percentage points, the South
14 Fork Stillaguamish population by 43 percentage points, the Skykomish River population by 5
15 percentage points, and the Green River population by 3 percentage points. Modeled exploitation rates
16 for the five other populations with RERs range from 8 to 25 percentage points less than their RER
17 ceilings. Escapements under Alternative 2, Scenario B, are predicted to exceed the CET for all
18 populations except the North Fork Nooksack and South Fork Stillaguamish populations. In all but five
19 cases (South Fork Nooksack, Skykomish, Sammamish, Cedar and Dungeness populations),
20 escapements are predicted to exceed critical thresholds by more than 100 percent. Escapement under
21 Alternative 2, Scenario B is predicted to meet or exceed VET for 9 of the 18 populations and one
22 management unit for which VETs have been established, including: the Lower Sauk River, Upper
23 Skagit River, Upper Sauk River, Suiattle River, White River, North Fork Stillaguamish, Green-
24 Duwamish, Puyallup River and Nisqually River populations. Modeling results indicate that viable
25 escapement thresholds would not be met for the 10 other populations and one management unit with
26 Alternative 2, Scenario B (see Table 4.3-3 and Table 4.3-8b in Subsection 4.3.1.5).

27 For the Nooksack early management unit, model results indicate that the RER would be exceeded even
28 without salmon fishing in Southern U.S. waters. For the Nooksack early chinook management unit, the
29 probability of falling below its CET due to Southern U.S. fishing-related mortality is predicted to
30 increase by 1 percentage point, and the probability of rebuilding is predicted to decrease by 1
31 percentage point, measured over 25 years.

1 Relative to Alternative 1, Scenario B, implementing Alternative 2, Scenario B, is predicted to result in
2 low to moderate reductions in exploitation rates for nine Puget Sound chinook populations and one
3 management unit, with resulting increases in spawning escapement. Impacts to these populations would
4 be classed as beneficial and of low to moderate magnitude. Under Alternative 2, Scenario B, chinook
5 salmon spawning escapements are predicted to decrease in the North and South Forks of the
6 Stillaguamish, the Skykomish and Snoqualmie Rivers, and in the Puyallup, White and Nisqually
7 Rivers. Impacts are predicted to be substantially negative for the North Fork Stillaguamish, the South
8 Fork Stillaguamish, the Puyallup and the White River populations. Impacts to populations in the
9 Skykomish, Snoqualmie and Nisqually Rivers are predicted to be negative but low. For the South Fork
10 Stillaguamish population, the decreased escapements are predicted to be approximately 32 percent
11 below the VET. Despite the predicted decrease in spawning escapement in the Puyallup, White, and
12 Nisqually Rivers, these populations are all expected to meet or exceed VETs under Alternative 2,
13 Scenario B. Escapements for the Green, Sammamish, Cedar, and Skokomish River populations are
14 predicted to change by less than 1 percent relative to Alternative 1, Scenario B. These impacts are
15 considered immeasurable. The pattern of impacts from applying Alternative 2 under Scenarios A, C, or
16 D is predicted to be similar to its application under Alternative 2, Scenario B. In most cases, the type of
17 impact (beneficial or negative) under Alternative 2, Scenario B, would be the same under Scenarios A,
18 C, or D. However, as can be seen from Table 4.3-6 in Subsection 4.3.1.5, there is a tendency for the
19 magnitude of beneficial impacts to increase and negative impacts to decrease going from Scenario B to
20 Scenarios C or D. See Tables 4.3-8a-1 and 4.3-8d-2 in Subsection 4.3.1.5 for additional detail.

21 In summary, because Alternative 2 represents a more restrictive fishing regime than Alternative 1
22 (especially for populations in North Puget Sound), escapements are predicted to be higher for most
23 populations compared to Alternative 1, Scenario B (see Tables 4.3-4 through 4.3-6 in Subsection
24 4.3.1.5). The notable exceptions are predicted to be escapements to the North and South Fork
25 Stillaguamish, the Skykomish, and Snoqualmie populations where exploitation rates are predicted to be
26 higher and escapements lower than under Alternative 1, Scenario B. The increased exploitation would
27 result from the additional harvest opportunity available in Tulalip Bay (Marine Catch Area 8D) and the
28 Stillaguamish River under Alternative 2 that is not anticipated to occur under Alternative 1.

29 The TRT has identified five distinct geographic/life history regions in the Puget Sound Chinook
30 Salmon Evolutionarily Significant Unit: the Strait of Georgia, North Puget Sound, South Puget Sound,
31 Hood Canal, and the Strait of Juan de Fuca. Current TRT guidance recommends that a recovered ESU
32 would have two to four low-risk populations within each region, representative of the range of life

1 histories within each of the regions. Under Alternative 2, the Nooksack early management unit that
2 makes up the Strait of Georgia region is predicted to exceed its RER; six of the eight^x North Puget
3 Sound populations are predicted to meet their RER and/or exceed the VETs; four of the six South
4 Puget Sound populations are predicted to exceed their VETs; and none of the populations in the Strait
5 of Georgia, Hood Canal, or the Strait of Juan de Fuca regions are predicted to exceed their VETs.
6 Except for the North Fork Nooksack (Strait of Georgia) and South Fork Stillaguamish (North Puget
7 Sound) chinook populations, all populations in all regions are predicted to exceed their CETs.

8 **Impacts to Hood Canal and Strait of Juan de Fuca Summer Chum Salmon**

9 Because virtually all marine salmon fisheries would be closed under Alternative 2, incidental impacts
10 to summer chum predicted to occur under Alternative 1 would be eliminated, and the catch of Hood
11 Canal and Strait of Juan de Fuca summer chum salmon is predicted to be zero. Consequently, the
12 exploitation rate is predicted to decrease to less than 1 percent (including Canadian fishery impacts),
13 and escapement increase by approximately 76 percent. The exploitation rate standards – 10.9 percent
14 for populations in the Hood Canal region, and 9 percent for populations in the Strait of Juan de Fuca
15 region – are predicted to be achieved. The changes in exploitation rate and escapement would be
16 classified as a substantial, beneficial effect. Impacts under Alternative 2, Scenarios A, C, and D were
17 the same as under Alternative 2, Scenario B (see Tables 4.3-8a and 4.3.8b in Subsection 4.3.1.5).

18 **4.3.1.3 Alternative 3 – Escapement Goal Management at the Population Level**

19 Alternative 3 represents a more restrictive fishing regime than Alternative 1 or Alternative 2, especially
20 for populations in North Puget Sound. Escapements in North Puget Sound watersheds are predicted to
21 be higher under Alternative 3 compared to Alternative 1. For all but two South Puget Sound chinook
22 salmon populations (Puyallup River and White River), changes relative to Alternative 1 are predicted to
23 be minimal.

24 **Summary of Scenario Differences**

25 Under Alternative 3, Scenarios A, C, or D, representing conditions similar to 2003 (A); decreased
26 forecast abundance (C); or decreased forecast abundance with maximized Canadian/Alaskan fisheries
27 (D), Southern U.S. catch of naturally-spawning Puget Sound chinook salmon is predicted to be 107
28 percent, 53 percent, and 49 percent, respectively, of that under Alternative 3, Scenario B. Catch of

^x There are ten populations in the North Puget Sound Region, but only eight currently have identified management standards.

1 other species is discussed in Subsection 4.3.2, Basis for Comparison of Alternatives and Approach to
2 Alternatives Analysis.

3 It is predicted that critical escapement thresholds would be met for all populations except the North
4 Fork Nooksack chinook population under Alternative 3, Scenario A. Under Alternative 3, Scenarios C
5 or D, it is predicted that CETs would be met for all populations except the Nooksack early chinook
6 population. With the exception of the Lower Sauk population (20 to 25% below VET under Scenarios
7 C or D), it is predicted that VETs would be met for the same populations under Alternative 3, Scenarios
8 A, C, or D as they were under Alternative 3, Scenario B (see Table 4.3-5 and Tables 4.3-9a through
9 4.3-9d in Subsection 4.3.1.5).

10 **Comparison of Alternative 3 to Alternative 1 (Proposed Action)**

11 Impacts to Puget Sound Chinook Populations

12 Under Alternative 3, Scenario B (high abundance and Canadian/Alaskan fisheries at the maximum
13 allowed by treaty), the Southern U.S. catch of chinook salmon from naturally-spawning Puget Sound
14 populations is predicted to be 39,231, or 6,018 fewer than with Alternative 1, Scenario B. An additional
15 30,201 chinook salmon from hatcheries and from streams outside the action area are predicted to be
16 landed, which is 81,730 fewer than with Alternative 1, Scenario B. The catch of listed Hood
17 Canal/Strait of Juan de Fuca summer chum is predicted to be zero, or 1,663 fewer than with Alternative
18 1, Scenario B. Catch of other species is discussed in Subsection 4.3.2, Basis for Comparison of
19 Alternatives and Approach to Alternatives Analysis. See Table 4.3-9a through 4.3-9d in Subsection
20 4.3.1.5 for a detailed listing of fishery-related impacts to individual populations of Puget Sound
21 chinook and Hood Canal summer chum salmon.

22 Under Alternative 3, Scenario B, RERs are predicted to be met except for the Nooksack early chinook
23 management unit and the Green River chinook population, and in these cases, exploitation rates are
24 predicted to exceed the RER ceilings by 7 percentage points and 3 percentage points, respectively. As
25 with Alternative 2, it should be noted that the Southern U.S. exploitation rate for the Nooksack early
26 management unit is predicted to be only 1 percent while the total exploitation rate is predicted to be 19
27 percent. For the other populations in this group, predicted exploitation rates range from 8 to 25
28 percentage points below the RER ceilings. Critical escapement thresholds are predicted to be exceeded
29 for all populations except the North Fork Nooksack population, in most cases by margins well over 100
30 percent. Escapements are predicted to exceed VETs for ten populations. Notably, the VET for the
31 South Fork Stillaguamish population is predicted to be met with Alternative 3, Scenario B, whereas it is

1 not under Alternative 2, Scenario B. Those populations that are not predicted to exceed VETs under
2 Alternative 3, Scenario B, include Nooksack early, Lower Skagit, Skykomish, Dungeness, Elwha,
3 Sammamish, Cedar, Mid-Hood Canal, and Skokomish chinook salmon populations (see Table 4.3-5
4 and Tables 4.3-9a-1 through 4.3-9d-2 in Subsection 4.3.1.5).

5 For the Nooksack early management unit, model results predict that the RER would be exceeded even
6 without salmon fishing in Southern U.S. waters. For the Nooksack early chinook management unit, the
7 probability of falling below its CET due to Southern U.S. fishing-related mortality is predicted to
8 increase by 1 percentage point, and the probability of rebuilding is predicted to decrease by 1
9 percentage point, measured over 25 years.

10 Because Alternative 3 is very similar to Alternative 2, the impacts of its implementation relative to
11 Alternative 1 would be nearly identical to those described for Alternative 2 (see Tables 4.3-3 and 4.3-4
12 in Subsection 4.3.1.5). The notable exception would be in the Stillaguamish watershed, where
13 application of Alternative 3 is predicted to result in a small reduction in exploitation rate and low
14 beneficial impacts to spawning escapement for populations within the Stillaguamish and Snohomish
15 management units. Under Alternative 3, the South Fork Stillaguamish population is predicted to meet
16 its CET under all scenarios, whereas it is not predicted to meet its CET under Alternative 2 for any
17 scenario. Relative to Alternative 1, Scenario B, impacts associated with the application of Alternative
18 3, Scenario B, would be beneficial and of low to moderate impact for 14 populations, substantially
19 negative for two populations (Puyallup and White River), and of a low negative magnitude for one
20 population (Nisqually River). Model results of the effects of Alternative 3 on the Green, Sammamish,
21 and Cedar River chinook salmon populations were less than 1 percent and therefore classed as
22 immeasurable. For Scenarios A, C, or D, predicted impacts (relative to Alternative 1 Scenarios A, C, or
23 D) would be nearly identical to those under Scenario B. Although small changes in escapement (Cedar,
24 Sammamish and Skokomish populations) shifted impacts from low negative, to low beneficial, or no to
25 low impact in some cases, the actual percentage changes were very small (see Table 4.3-4, Table 4.3-6,
26 and Tables 4.3-9a-2 through 4.3-9d-2 in Subsection 4.3.1.5).

27 In summary, Alternative 3 represents a more restrictive fishing regime than Alternative 1 or Alternative
28 2, especially for populations in North Puget Sound; therefore, it is predicted that escapements in North
29 Puget Sound watersheds would be higher compared to Alternative 1. For all but two South Puget
30 Sound populations (Puyallup River and White River), changes relative to Alternative 1 are predicted to
31 be minimal (see Tables 4.3-4 and 4.3-5 in Subsection 4.3.1.5).

1 The TRT has identified five distinct geographic/life history regions in the Puget Sound Chinook
2 Salmon ESU: the Strait of Georgia, North Puget Sound, South Puget Sound, Hood Canal, and the Strait
3 of Juan de Fuca. Current TRT guidance recommends that a recovered ESU would have two to four
4 low-risk populations within each region, representative of the range of life histories within each of the
5 regions. Under Alternative 3, the Nooksack early management unit that makes up the Strait of Georgia
6 region is predicted to exceed its RER; all eight^{xi} North Puget Sound populations are predicted to meet
7 their RER and/or exceed the VETs; four of the six South Puget Sound populations are predicted to
8 exceed their VETs; and none of the populations in the Strait of Georgia Strait, Hood Canal, or the Strait
9 of Juan de Fuca regions are predicted to exceed their VETs. Except for the North Fork Nooksack
10 chinook population, all populations in all regions are predicted to exceed their CETs.

11 Impacts to Hood Canal and Strait of Juan de Fuca Summer Chum

12 Under Alternative 3, there would be no summer chum harvested in Puget Sound fisheries. Therefore,
13 the consequences would be the same as those described for Alternative 2.

14 **4.3.1.4 Alternative 4 – No Action/No Authorized Take**

15 Alternative 4, the most restrictive of the harvest management alternatives, is predicted to reduce catch
16 and increase escapement of all populations of naturally-spawning Puget Sound chinook salmon relative
17 to Alternative 1.

18 Summary or Scenario Differences

19 Under Alternative 4, Scenarios A, C, or D, representing conditions similar to 2003 (A); decreased
20 forecast abundance (C); or decreased forecast abundance with maximized Canadian/Alaskan fisheries
21 (D), Southern U.S. catch of naturally-spawning chinook is predicted to be 99 percent, 73 percent, and
22 73 percent, respectively, of that with Alternative 3, Scenario B. Catch of other species is discussed in
23 Subsection 4.3.2, Basis of Comparison of Alternatives and Approach to Alternatives Analysis.

24 Modeled escapement patterns under Alternative 4, Scenarios A, C, or D were similar to those under
25 Alternative 4, Scenario B. Decreased abundance under Scenarios C or D would result in predicted
26 escapement for the Nooksack early populations falling below their CETs under Scenarios C or D,
27 whereas escapement was above CET for Scenarios A or B for the North Fork Nooksack population.

^{xi} There are ten populations in the North Puget Sound Region, but only eight currently have identified management standards.

1 Decreased abundance under Scenarios C or D would result in predicted escapement for the Lower
2 Skagit population falling below its VET in Scenarios C or D, whereas it exceeded VET in Scenarios A
3 and B (see Table 4.3-5 and Tables 4.3-10a-1 through 4.3-10d-1 in Subsection 4.3.1.5).

4 **Comparison of Alternative 4 to Alternative 1 (Proposed Action)**

5 **Impacts to Puget Sound Chinook Populations**

6 Under Alternative 4, Scenario B (high abundance and Canadian/Alaskan fisheries at the maximum
7 allowed by treaty), the catch of Puget Sound chinook from naturally-spawning chinook populations is
8 predicted to be 6,289 fish, or 46,648 fewer than with Alternative 1, Scenario B. The total chinook catch
9 predicted under Alternative 4, Scenario B, is 150,891 fewer than with Alternative 1, Scenario B (see
10 Table 4.3-2 in Subsection 4.3.1.5).

11 Catch of other species is discussed in Subsection 4.3.2, Basis for Comparison of Alternatives and
12 Approach to Alternatives Analysis. See Tables 4.3-10a through 4.3-10db in Subsection 4.3.1.5 for a
13 detailed listing of fishery-related impacts to individual populations of Puget Sound chinook and Hood
14 Canal summer chum salmon.

15 Population-specific impacts of Alternative 4 under Scenario B, are predicted to be nearly identical to
16 those of Alternative 2 or 3, Scenario B. Under Alternative 4, Scenario B, exploitation rates are
17 predicted to be less than RER standards for all populations except in the Nooksack early management
18 unit. Critical escapement thresholds are predicted to be exceeded for all populations except the North
19 Fork Nooksack population. Viable escapement thresholds are predicted to be met or exceeded for the
20 Lower Sauk, Upper Skagit, North Fork Stillaguamish, Upper Sauk, Suiattle, White River, the South
21 Fork Stillaguamish, Green-Duwamish, Puyallup, Nisqually, and Skokomish chinook salmon
22 populations (see Table 4.3-3 and Table 4.3-10b in Subsection 4.3.1.5).

23 For the Nooksack early management unit, the RER would be exceeded even without salmon fishing in
24 Southern U.S. waters. For the Nooksack early chinook management unit, the probability of falling
25 below its CET due to Southern U.S. fishing-related mortality is predicted to increase by 1 percentage
26 point and the probability of rebuilding is predicted to decrease by 1 percentage point, measured over 25
27 years.

28 Alternative 4, the most restrictive of the alternatives, is predicted to reduce catch and increase
29 escapement of all populations of naturally-spawning Puget Sound chinook salmon relative to
30 Alternative 1. Increases in escapement are predicted to result in beneficial impacts of low to moderate

1 magnitude for 16 of the 22 populations, and substantial beneficial impacts for four other populations.
2 The four populations predicted to have substantial increases in spawning escapement under Alternative
3 4 relative to Alternative 1 are the Green, Puyallup, Nisqually, and Skokomish chinook salmon
4 populations. Modeled spawning escapements for these populations predict exceedance of the VET by
5 84 percent, 163 percent, 196 percent, and 90 percent, respectively (see Table 4.3-4 and Table 4.3-10a-2
6 in Subsection 4.3.1.5). However, to some extent, the beneficial impact of increased escapement might
7 be moderated by capacity of the extant habitats to support additional spawners and their progeny.

8 As would be expected, impacts associated with the application of Alternative 4 under Scenarios A, C,
9 or D relative to Alternative 1, Scenarios A, C, or D, were similar in type and, in most cases, magnitude,
10 to the impacts modeled under Scenario B. Two notable exceptions were the Green River and Puyallup
11 River populations where substantial beneficial impacts were indicated under Scenarios A or B, but only
12 moderately beneficial impacts under Scenarios C or D (lower abundance conditions). For the Cedar and
13 Sammamish River populations, impacts are predicted to range from low and beneficial (Alternative 4,
14 Scenario A or B) to low and adverse (Alternative 4, Scenarios C or D), compared to the same scenarios
15 under Alternative 1. However, the actual change in numbers of fish in escapement is predicted to be no
16 more than 1 percent (see Table 4.3-4 and Tables 4.3-10a-2 through 4.3-10d-2 in Subsection 4.3.1.5).

17 In summary, Alternative 4 represents the most restrictive fishing regime and would result in low to
18 substantial increases in spawning escapement relative to Alternative 1. These increases would not
19 necessarily result in beneficial impacts to all populations. (See discussion below.)

20 The TRT has identified five distinct geographic/life history regions in the Puget Sound Chinook
21 Salmon ESU: the Strait of Georgia, North Puget Sound, South Puget Sound, Hood Canal, and the Strait
22 of Juan de Fuca. Current TRT guidance recommends that a recovered ESU would have two to four
23 low-risk populations within each region, representative of the range of life histories within each of the
24 regions. Under Alternative 4, the Nooksack early populations that make up the Strait of Georgia region
25 are predicted to exceed its RER; all eight^{xii} North Puget Sound populations are predicted to meet their
26 RER and/or exceed the VETs; four of the six South Puget Sound populations are predicted to exceed
27 their VETs; one of the two populations in the Hood Canal region is predicted to exceed its VET; and
28 none of the populations in the Strait of Georgia or the Strait of Juan de Fuca regions are predicted to

^{xii} There are ten populations in the North Puget Sound Region, but only eight currently have identified management standards.

1 exceed their VETs. Except for the North Fork Nooksack chinook population, all populations in all
2 regions are predicted to exceed their CETs.

3 Impacts to Hood Canal and Strait of Juan de Fuca Summer Chum

4 Under Alternative 4, the catch from listed Hood Canal and Strait of Juan de Fuca summer chum salmon
5 populations is predicted to be zero, compared to 141 under Alternative 1. Therefore, the consequences
6 would be the same as those described for Alternative 2 or 3.

7 **4.3.1.5 Summary Discussion of Alternatives**

8 Under Alternative 1, the Proposed Action, RERs are predicted to be met under nearly all scenarios and
9 within nearly all populations except the Nooksack early chinook management unit, and the Skykomish
10 summer population. While the Skykomish summer population is predicted to meet the RER standard
11 under most other alternatives and scenarios, the Nooksack early management unit is not predicted to
12 meet its RER goal under any alternative or scenario. Failure of the Nooksack early populations to meet
13 RERs and, in most instances, CETs, can be attributed to the fact that a high proportion of impacts to
14 this population occur in fisheries outside of Puget Sound, not within the jurisdiction of the Resource
15 Management Plan. Another notable exception is predicted for the Green River population. However,
16 unlike the Nooksack population, the Green River population, despite exceeding RER ceilings under
17 several alternative/scenario combinations, is predicted to meet or exceed its VET in all cases.

18 Critical escapement goals are predicted to be met for all populations under Alternative 1 except the
19 North Fork Nooksack chinook salmon population, the South Fork Nooksack population under the
20 lower abundance scenarios, and the South Fork Stillaguamish fall population under any scenario. The
21 North Fork Nooksack population is not predicted to meet its CET under any alternative or scenario.
22 Seventy percent or more of the fishing-related mortality on the Nooksack early chinook population
23 occurs as a result of Canadian/Alaskan fisheries. Catch in fisheries covered by the Resource
24 Management Plan is predicted to be at most 36 fish; thus, there is likely to be little difference in the
25 impact of any alternative.

26 Under Alternative 1, performance relative to VETs is predicted to vary considerably for the different
27 populations. What would be consistent, however, is that certain populations are predicted to not meet
28 VETs under most, if not all alternatives and scenarios. These include the Nooksack early, Lower
29 Skagit, Skykomish, Sammamish, Cedar, Mid-Hood Canal, Skokomish, Dungeness, and Elwha River
30 populations.

1 As noted previously, increasingly restrictive alternatives generally result in increased spawning
2 escapement. Thus, application of Alternatives 2 through 4 appear to have a beneficial impact on most
3 populations relative to Alternative 1. However, while spawning escapement provides a useful basis for
4 comparing alternatives, the intricacy of salmon life histories must be taken into account in interpreting
5 the model results.

6 First, substantial increases in spawning escapements may not result in commensurate increases in the
7 progeny of those chinook salmon spawners. The objective for salmon fisheries management is to
8 constrain fishing mortality to the extent necessary to optimize the production of subsequent
9 generations. The productivity of salmon populations, often defined in terms of the number of recruits
10 produced per female spawner, increases over a range of escapement, then reaches a plateau or declines
11 at higher levels of escapement due to density-dependent survival; i.e., too many spawners for the
12 available habitat, or too many juvenile salmon for the available food in the river. The escapement level
13 corresponding to the point of optimum productivity varies widely among individual populations due to
14 the accessible area of suitable spawning and rearing habitat within a river system, and the very complex
15 array of physical and biological factors that influence the annual survival of salmon eggs and juveniles
16 through their freshwater life history. However, the influence of these physical and biological factors
17 varies greatly from year to year, so that were fisheries management to achieve optimum escapement
18 consistently from year to year, the actual production from those spawners would still vary widely. The
19 marine environment exerts even greater influence on the number of juvenile salmon that reach
20 adulthood. Consequently, this Environmental Impact Statement can compare the predicted escapement
21 for populations against specific or general escapement standards, but cannot accurately project the
22 resulting abundance of subsequent generations of adult salmon. In addition, changes in risk relative to
23 achievement of the RERs may not be the same as changes in risk measured by changes in escapement.
24 That is, the changes in achieving the RERs are likely to be more beneficial or adverse relative to
25 recovery than changes in escapement.

26 The harvest standards for the Hood Canal and Strait of Juan de Fuca Summer Chum Evolutionarily
27 Significant Unit are predicted to be met under any alternative.

Section 4 - Environmental Consequences

Table 4.3-2. Predicted Southern U.S. catch of Puget Sound chinook populations under Alternatives 1-4 and Scenarios A-D.

		Scenario A	Scenario B	Scenario C	Scenario D
Natural	Alternative 1	55,512	45,249	32,256	31,238
Other		110,994	111,931	83,808	81,058
Total		166,506	157,180	116,064	112,296
Natural	Alternative 2	45,249	42,793	21,614	19,667
Other		81,570	36,074	21,753	19,354
Total		126,819	78,867	43,367	39,021
Natural	Alternative 3	41,931	39,231	20,785	18,885
Other		65,565	30,201	21,753	19,354
Total		107,496	69,432	42,538	38,239
Natural	Alternative 4	6,233	6,289	4,597	4,619
Other					
Total		6,233	6,289	4,597	4,619

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-3. Performance of Alternatives 1 through 4 under Scenario B relative to rebuilding exploitation rate, critical escapement threshold, and viable escapement threshold standards.

	Performance Relative to Rebuilding Exploitation Rate				Performance Relative to Critical Escapement Threshold				Performance Relative to Viable Escapement Threshold			
	A-1	A-2	A-3	A-4	A-1	A-2	A-3	A-4	A-1	A-2	A-3	A-4
Nooksack Early*	N	N	N	N					N	N	N	N
North Fork					N	N	N	N	NA	NA	NA	NA
South Fork					Y	Y	Y	Y	NA	NA	NA	NA
Skagit Summer-Fall*												
Lower Skagit Fall	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	N
Lower Sauk Summer	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Upper Skagit Summer	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Skagit Spring*												
Upper Cascade	NA	NA	NA	NA	Y	Y	Y	Y				
Upper Sauk	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Suiattle	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Stillaguamish Summer-Fall*												
North Fork Summer	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
South Fork Fall	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y
Snohomish Summer-Fall*												
Skykomish Summer	N	N	Y	Y	Y	Y	Y	Y	N	N	N	N
Snoqualmie Fall	NA	NA	NA	NA	Y	Y	Y	Y	NA	NA	NA	NA
Green-Duwamish Fall*	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Lake Washington Fall												
Sammamish	NA	NA	NA	NA	Y	Y	Y	Y	N	N	N	N
Cedar	NA	NA	NA	NA	Y	Y	Y	Y	N	N	N	N
Puyallup Fall	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y
White River Spring	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y
Nisqually Fall	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y
Mid- Hood Canal Fall	NA	NA	NA	NA	Y	Y	Y	Y	N	N	N	N
Skokomish Fall	NA	NA	NA	NA	Y	Y	Y	Y	N	N	N	Y
Dungeness Summer	NA	NA	NA	NA	Y	Y	Y	Y	N	N	N	N
Elwha Summer	NA	NA	NA	NA	Y	Y	Y	Y	N	N	N	N

Y	Meets or exceeds goal.
N	Does not meet goal.
NA	Standard not applicable.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-4 Summary of impacts of Alternatives 2-4 relative to the proposed action under Scenario B

	Alternative 2 Compared to Alternative 1		Alternative 3 Compared to Alternative 1		Alternative 4 Compared to Alternative 1	
	Type	Extent	Type	Extent	Type	Extent
Nooksack Early	B	M	B	M	B	M
Lower Skagit Fall	B	M	B	M	B	M
Lower Sauk Summer	B	M	B	M	B	M
Upper Skagit Summer	B	M	B	M	B	M
Upper Cascade Spring	B	L	B	L	B	L
Upper Sauk Spring	B	L	B	L	B	L
Suiattle Spring	B	L	B	L	B	L
NF Stillaguamish Summer	N	S	B	L	B	L
SF Stillaguamish Fall	N	S	B	L	B	L
Skykomish Summer	N	L	B	M	B	M
Snoqualmie Fall	N	L	B	M	B	M
Green-Duwamish Fall	0	0	0	0	B	S
Sammamish Fall	0	0	0	0	0	0
Cedar Fall	0	0	0	0	0	0
Puyallup Fall	N	S	N	S	B	S
White River Spring	N	S	N	S	B	M
Nisqually Fall	N	L	N	L	B	S
Mid-Hood Canal Fall	B	L	B	L	B	L
Skokomish Fall	0	0	0	0	B	S
Dungeness Summer	B	L	B	L	B	L
Elwha Summer	B	L	B	L	B	L

Impact Type		Impact Magnitude			
Beneficial	<table border="1"><tr><td>B</td></tr></table>	B	Low (<10%)	<table border="1"><tr><td>L</td></tr></table>	L
B					
L					
Negative	<table border="1"><tr><td>N</td></tr></table>	N	Moderate (10%-30%)	<table border="1"><tr><td>M</td></tr></table>	M
N					
M					
None (not measurable)	<table border="1"><tr><td>0</td></tr></table>	0	Substantial (>30%)	<table border="1"><tr><td>S</td></tr></table>	S
0					
S					
		Not Measurable (<1%)	<table border="1"><tr><td>0</td></tr></table>	0	
0					

Section 4 - Environmental Consequences

Table 4.3-5. Performance of Alternatives 1 through 4 under Scenarios A-D relative to rebuilding exploitation rate, critical escapement threshold, and viable escapement threshold standards.

	Rebuilding Exploitation Rate												Critical Escapement Threshold												Viable Escapement Threshold																			
	Alternative 1			Alternative 2			Alternative 3			Alternative 4			Alternative 1			Alternative 2			Alternative 3			Alternative 4			Alternative 1			Alternative 2			Alternative 3			Alternative 4										
	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D
Nooksack Early*	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N													N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
North Fork													N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
South Fork													Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Skagit Summer-Fall*																													N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Lower Skagit Fall	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Lower Sauk Summer	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N
Upper Skagit Summer	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y				
Skagit Spring*																																												
Upper Cascade	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																
Upper Sauk	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				
Suiattle	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				
Stillaguamish Summer-Fall*																													Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				
North Fork Summer	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				
South Fork Fall	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	Y	Y	Y	Y				
Snohomish Summer-Fall*																																												
Skykomish Summer	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N				
Snoqualmie Fall	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Green-Duwamish Fall*	Y	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				
Lake Washington Fall																																												
Sammamish	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N				
Cedar	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N				
Puyallup Fall	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				
White River Spring	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				
Nisqually Fall	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				
Mid-Hood Canal Fall	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N				
Skokomish Fall	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	Y	Y	Y	Y				
Dungeness Summer	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N				
Elwha Summer	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N				

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-6 Summary of impacts of alternatives 2-4 relative to the proposed action under scenarios 1-4.

	Alternative 2 Compared to Alternative 1								Alternative 3 Compared to Alternative 1								Alternative 4 Compared to Alternative 1							
	Scenario A		Scenario B		Scenario C		Scenario D		Scenario A		Scenario B		Scenario C		Scenario D		Scenario A		Scenario B		Scenario C		Scenario D	
	Type	Extent	Type	Extent	Type	Extent	Type	Extent	Type	Extent	Type	Extent	Type	Extent	Type	Extent	Type	Extent	Type	Extent	Type	Extent	Type	Extent
Nooksack Early	B	L	B	M	B	L	B	M	B	L	B	M	B	L	B	M	B	L	B	M	B	L	B	M
Lower Skagit Fall	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M
Lower Sauk Summer	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M
Upper Skagit Summer	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M
Upper Cascade Spring	B	L	B	L	B	M	B	M	B	L	B	L	B	M	B	M	B	L	B	L	B	M	B	M
Upper Sauk Spring	B	L	B	L	B	M	B	M	B	L	B	L	B	M	B	M	B	L	B	L	B	M	B	M
Suiattle Spring	B	L	B	L	B	M	B	M	B	L	B	L	B	M	B	M	B	L	B	L	B	M	B	M
NF Stillaguamish Summer	N	S	N	S	N	S	N	S	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L
SF Stillaguamish Fall	N	S	N	S	N	S	N	S	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L
Skykomish Summer	N	L	N	L	B	L	B	L	B	L	B	M	B	L	B	L	B	L	B	M	B	L	B	L
Snoqualmie Fall	N	L	N	L	B	L	B	L	B	L	B	M	B	L	B	L	B	L	B	M	B	L	B	L
Green-Duwamish Fall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B	S	B	S	B	M	B	M
Sammamish Fall	B	L	0	0	N	L	N	L	B	L	0	0	N	L	N	L	B	L	0	0	N	L	N	L
Cedar Fall	B	L	0	0	N	L	N	L	B	L	0	0	N	L	N	L	B	L	0	0	N	L	N	L
Puyallup Fall	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	B	S	B	S	B	M	B	M
White River Spring	N	S	N	S	N	L	N	L	N	S	N	S	N	L	N	L	B	M	B	M	B	M	B	M
Nisqually Fall	N	L	N	L	N	L	N	L	N	L	N	L	N	L	N	L	B	S	B	S	B	S	B	S
Mid-Hood Canal Fall	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L
Skokomish Fall	B	L	0	0	N	L	N	L	B	L	0	0	N	L	N	L	B	S	B	S	B	S	B	S
Dungeness Summer	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L
Elwha Summer	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L

Impact Type

B	Beneficial
N	Negative
0	Not Measurable

Impact Extent

L	Low (<10%)
M	Moderate (10%-30%)
S	Substantial (>30%)
0	Not Measurable (<1%)

Table 4.3-7a Performance of Alternative 1 (Proposed Action) under Scenario A relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 1 Scenario A				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Escapement Goal ³
Nooksack Early*	20%	7%	37	388	8%		-22%
North Fork				171		-15%	
South Fork				217		9%	
Skagit Summer-Fall*	48%	18%	3,894	11,633			
Lower Skagit Fall				1,247	-1%	397%	-43%
Lower Sauk Summer				620	-3%	210%	-9%
Upper Skagit Summer				9,765	-12%	910%	31%
Skagit Spring*	23%	23%	570	1,921			
Upper Cascade				563		231%	
Upper Sauk				647	-15%	398%	96%
Suiattle				712	-18%	319%	78%
Stillaguamish Summer-Fall	17%	11%	313	2,322			
North Fork Summer				1,892	-15%	531%	243%
South Fork Fall				430	-7%	115%	43%
Snohomish Summer-Fall	19%	18%	2,325	5,073			
Skykomish Summer				2,604	-18%	58%	-26%
Snoqualmie Fall				2,469		517%	
Green-Duwamish Fall*	62%	51%	15,901	5,819	9%	597%	5%
Lake Washington Fall		20%					
Sammamish	31%		86	305		53%	-76%
Cedar	31%		87	305		53%	-75%
Puyallup Fall	49%	39%	5,024	2,392		1096%	99%
White River Spring	20%	19%	356	1,468		634%	47%
Nisqually Fall	76%	68%	17,425	1,106		453%	1%
Mid- Hood Canal Fall	26%	13%	95	531		166%	-58%
Skokomish Fall	63%	50%	9,372	1,211		506%	-3%
Dungeness Summer	22%	5%	15	352		76%	-62%
Elwha Summer	22%	5%	98	2,125		963%	-27%
All Chinook from Listed Populations			55,599	36,951			
Hood Canal and Strait of Juan de Fuca Summer Chum					Performance vs Recovery Standards		
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold		
Hood Canal	2%	1,651	7,437	-9%	83%		
Juan de Fuca	0.4%	12	6,955	-9%	656%		
All Summer Chum		1,663	14,392				

* Populations with specific NMFS-developed standards

¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))

² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))

³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))

⁴ Excludes Quilcene River population.

█ Indicates exploitation rate or escapement does not meet standard.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-7b Performance of Alternative 1 (Proposed Action) under Scenario B relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 1 Scenario B				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Escapement Goal ³
Nooksack Early*	25%	8%	38	365	13%		-27%
North Fork				161		-20%	
South Fork				204		2%	
Skagit Summer-Fall*	55%	16%	3,737	11,029			
Lower Skagit Fall				1,183	6%	371%	-46%
Lower Sauk Summer				588	4%	194%	-14%
Upper Skagit Summer				9,258	-5%	857%	24%
Skagit Spring*	27%	23%	567	1,845			
Upper Cascade				541		218%	
Upper Sauk				622	-11%	378%	88%
Suiattle				684	-14%	302%	71%
Stillaguamish Summer-Fall	19%	11%	314	2,281			
North Fork Summer				1,859	-13%	520%	237%
South Fork Fall				422	-5%	111%	41%
Snohomish Summer-Fall	22%	18%	2,286	4,901			
Skykomish Summer				2,516	-18%	52%	-28%
Snoqualmie Fall				2,385		496%	
Green-Duwamish Fall*	63%	47%	15,103	5,816	10%	597%	5%
Lake Washington Fall		20%					
Sammamish	35%		86	294		47%	-76%
Cedar	35%		85	294		47%	-76%
Puyallup Fall	50%	35%	4,623	2,419		1110%	102%
White River Spring	20%	18%	323	1,459		630%	46%
Nisqually Fall	76%	65%	16,929	1,126		463%	2%
Mid- Hood Canal Fall	32%	13%	94	504		152%	-60%
Skokomish Fall	63%	44%	8,509	1,237		519%	-1%
Dungeness Summer	27%	5%	15	336		68%	-64%
Elwha Summer	28%	5%	97	2,031		916%	-30%
All Chinook from Listed Populations			52,806	35,937			
Hood Canal and Strait of Juan de Fuca Summer Chum					Performance vs Recovery Standards		
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold		
Hood Canal	2%	1,651	7,437	-9%	83%		
Juan de Fuca	0.4%	12	6,955	-9%	656%		
All Summer Chum		1,663	14,392				

* Populations with specific NMFS-developed standards

¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))

² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))

³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))

⁴ Excludes Quilcene River population.

█ Indicates exploitation rate or escapement does not meet standard.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-7c Performance of Alternative 1 (Proposed Action) under Scenario C relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 1 Scenario C				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Escapement Goal ³
Nooksack Early*	20%	7%	26	278	8%		-44%
North Fork				122		-39%	
South Fork				156		-22%	
Skagit Summer-Fall*	49%	18%	2,778	8,033			
Lower Skagit Fall				861	0%	243%	-61%
Lower Sauk Summer				428	-2%	114%	-37%
Upper Skagit Summer				6,743	-11%	597%	-10%
Skagit Spring*	23%	23%	393	1,331			
Upper Cascade				390		129%	
Upper Sauk				449	-15%	245%	36%
Suiattle				493	-18%	190%	23%
Stillaguamish Summer-Fall	17%	12%	225	1,620			
North Fork Summer				1,320	-15%	340%	139%
South Fork Fall				300	-7%	50%	0%
Snohomish Summer-Fall	20%	18%	1,633	3,543			
Skykomish Summer				1,819	-18%	10%	-48%
Snoqualmie Fall				1,724		331%	
Green-Duwamish Fall*	49%	39%	9,185	5,801	-4%	595%	5%
Lake Washington Fall		23%					
Sammamish	33%		72	223		12%	-82%
Cedar	33%		72	223		12%	-81%
Puyallup Fall	50%	39%	3,772	1,798		799%	50%
White River Spring	20%	19%	243	1,011		406%	1%
Nisqually Fall	64%	56%	9,544	1,119		460%	2%
Mid- Hood Canal Fall	26%	12%	65	367		84%	-71%
Skokomish Fall	45%	31%	4,166	1,239		520%	-1%
Dungeness Summer	22%	5%	12	245		23%	-74%
Elwha Summer	23%	5%	70	1,480		640%	-49%
All Chinook from Listed Populations			32,256	28,311			
Hood Canal and Strait of Juan de Fuca Summer Chum				Performance vs Recovery Standards			
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold		
Hood Canal	2%	1,651	7,437	-9%	83%		
Juan de Fuca	0.4%	12	6,955	-9%	656%		
All Summer Chum		1,663	14,392				

* Populations with specific NMFS-developed standards

¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))

² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))

³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))

⁴ Excludes Quilcene River population.

█ Indicates exploitation rate or escapement does not meet standard.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-7d Performance of Alternative 1 (Proposed Action) under Scenario D relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 1 Scenario D				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Escapement Goal ³
Nooksack Early*	26%	7%	27	252	14%		-50%
North Fork				111		-45%	
South Fork				141		-29%	
Skagit Summer-Fall*	56%	16%	2,698	7,551			
Lower Skagit Fall				810	7%	223%	-63%
Lower Sauk Summer				403	5%	101%	-41%
Upper Skagit Summer				6,339	-4%	556%	-15%
Skagit Spring*	28%	24%	415	1,270			
Upper Cascade				372		119%	
Upper Sauk				428	-10%	229%	30%
Suiattle				471	-13%	177%	18%
Stillaguamish Summer-Fall	20%	12%	239	1,584			
North Fork Summer				1,291	-12%	330%	134%
South Fork Fall				293	-4%	47%	-2%
Snohomish Summer-Fall	23%	18%	1,685	3,399			
Skykomish Summer				1,745	-18%	6%	-50%
Snoqualmie Fall				1,654		314%	
Green-Duwamish Fall*	51%	36%	8,768	5,802	-2%	595%	5%
Lake Washington Fall		22%					
Sammamish	38%		73	214		7%	-83%
Cedar	38%		74	214		7%	-82%
Puyallup Fall	50%	35%	3,464	1,834		817%	53%
White River Spring	20%	17%	219	1,011		406%	1%
Nisqually Fall	66%	53%	9,714	1,109		455%	1%
Mid- Hood Canal Fall	34%	12%	67	344		72%	-72%
Skokomish Fall	48%	26%	3,712	1,225		513%	-2%
Dungeness Summer	29%	5%	12	231		16%	-75%
Elwha Summer	30%	5%	71	1,395		598%	-52%
All Chinook from Listed Populations			31,238	27,435			
Hood Canal and Strait of Juan de Fuca Summer Chum					Performance vs Recovery Standards		
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold		
Hood Canal	2%	1,651	7,437	-9%	83%		
Juan de Fuca	0.4%	12	6,955	-9%	656%		
All Summer Chum		1,663	14,392				

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

█ Indicates exploitation rate or escapement does not meet standard.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-8a-1 Performance of Alternative 2 (Escapement Goal Management at Management Unit Level) under Scenario A relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 2 Scenario A				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Escapement Goal ³
Nooksack Early*	14%	1%	8	422	2%	6%	-16%
North Fork				186		-7%	
South Fork				236		18%	
Skagit Summer-Fall*	32%	1%	147	14,656			
Lower Skagit Fall				1,571	-17%	526%	-28%
Lower Sauk Summer				782	-19%	291%	15%
Upper Skagit Summer				12,303	-28%	1172%	65%
Skagit Spring*	12%	3%	73	2,073			
Upper Cascade				607		257%	
Upper Sauk				699	-26%	437%	112%
Suittale				768	-29%	352%	92%
Stillaguamish Summer-Fall	66%	60%	1,614	903			
North Fork Summer				736	34%	145%	33%
South Fork Fall				167	42%	-16%	-44%
Snohomish Summer-Fall	22%	21%	2,606	4,634			
Skykomish Summer				2,379	-18%	44%	-32%
Snoqualmie Fall				2,255		464%	
Green-Duwamish Fall*	55%	42%	11,312	5,800	2%	595%	5%
Lake Washington Fall		5%					
Sammamish	18%		18	307		54%	-75%
Cedar	18%		18	307		54%	-74%
Puyallup Fall	70%	57%	6,271	1,200		500%	0%
White River Spring	46%	46%	434	1,000		400%	0%
Nisqually Fall	72%	63%	14,375	1,100		450%	0%
Mid- Hood Canal Fall	19%	5%	39	552		176%	-56%
Skokomish Fall	60%	46%	8,334	1,218		509%	-3%
Dungeness Summer	19%	1%	3	360		80%	-61%
Elwha Summer	19%	1%	16	2,172		986%	-25%
All Chinook from Listed Populations			45,268	36,704			
Hood Canal and Strait of Juan de Fuca Summer Chum				Performance vs Recovery Standards			
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold		
Hood Canal	0%	0	13,105	-11%	222%		
Juan de Fuca	0.2%	0	6,985	-9%	659%		
All Summer Chum		0	20,090				

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

█ Indicates exploitation rate or escapement does not meet standard.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-8a-2 Performance of Alternative 2 (Escapement Goal Management at Management Unit Level) under Scenario A relative to Alternative 1 Scenario A (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario A					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early*	-6%	-29	34	9%		
North Fork			15	9%	Beneficial	Low
South Fork			19	9%	Beneficial	Low
Skagit Summer-Fall*	-16%	-3,747	3,023	26%		
Lower Skagit Fall			324	26%	Beneficial	Moderate
Lower Sauk Summer			161	26%	Beneficial	Moderate
Upper Skagit Summer			2,538	26%	Beneficial	Moderate
Skagit Spring*	-11%	-497	152	8%	Beneficial	Low
Upper Cascade			45	8%	Beneficial	Low
Upper Sauk			51	8%	Beneficial	Low
Suittale			56	8%	Beneficial	Low
Stillaguamish Summer-Fall	49%	1,301	-1,419	-61%		
North Fork Summer			-1,156	-61%	Negative	Substantial
South Fork Fall			-263	-61%	Negative	Substantial
Snohomish Summer-Fall	3%	281	-439	-9%		
Skykomish Summer			-225	-9%	Negative	Low
Snoqualmie Fall			-214	-9%	Negative	Low
Green-Duwamish Fall*	-7%	-4,589	-19	-0.3%	None	None
Lake Washington Fall						
Sammamish	-13%	-68	2	1%	Beneficial	Low
Cedar	-13%	-69	2	1%	Beneficial	Low
Puyallup Fall	21%	1,247	-1,192	-50%	Negative	Substantial
White River Spring	26%	78	-468	-32%	Negative	Substantial
Nisqually Fall	-4%	-3,050	-6	-1%	Negative	Low
Mid- Hood Canal Fall	-7%	-56	21	4%	Beneficial	Low
Skokomish Fall	-3%	-1,038	7	1%	Beneficial	Low
Dungeness Summer	-3%	-12	8	2%	Beneficial	Low
Elwha Summer	-3%	-82	47	2%	Beneficial	Low
Impacts Relative to Alternative A Scenario A						
Summer Chum	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	% Change in Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	267%	Beneficial	Substantial
Juan de Fuca	0%	-12	30	1%	Beneficial	Low

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-8b-1 Performance of Alternative 2 (Escapement Goal Management at Management Unit Level) under Scenario B relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 2 Scenario B				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Escapement Goal ³
Nooksack Early*	19%	1%	9	412	7%		-18%
North Fork				181		-9%	
South Fork				231		15%	
Skagit Summer-Fall*	41%	1%	147	13,935			
Lower Skagit Fall				1,494	-8%	495%	-32%
Lower Sauk Summer				743	-10%	272%	9%
Upper Skagit Summer				11,698	-19%	1110%	57%
Skagit Spring*	16%	3%	74	2,009			
Upper Cascade				589		246%	
Upper Sauk				677	-22%	421%	105%
Suiattle				745	-25%	338%	86%
Stillaguamish Summer-Fall	67%	59%	1,591	904			
North Fork Summer				737	35%	146%	33%
South Fork Fall				167	43%	-16%	-44%
Snohomish Summer-Fall	23%	19%	2,347	4,603			
Skykomish Summer				2,363	-18%	43%	-32%
Snoqualmie Fall				2,240		460%	
Green-Duwamish Fall*	56%	38%	10,526	5,800	3%	595%	5%
Lake Washington Fall		5%					
Sammamish	23%		37	295		48%	-76%
Cedar	23%		18	295		48%	-75%
Puyallup Fall	71%	53%	5,990	1,200		500%	0%
White River Spring	46%	44%	414	1,000		400%	0%
Nisqually Fall	73%	60%	14,010	1,100		450%	0%
Mid- Hood Canal Fall	25%	5%	39	527		164%	-58%
Skokomish Fall	61%	40%	7,612	1,231		516%	-2%
Dungeness Summer	24%	1%	3	344		72%	-63%
Elwha Summer	24%	1%	16	2,079		940%	-28%
All Chinook from Listed Populations			42,833	35,734			
Hood Canal and Strait of Juan de Fuca Summer Chum				Performance vs Recovery Standards			
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold		
Hood Canal	0%	0	13,105	-11%	222%		
Juan de Fuca	0.2%	0	6,985	-9%	659%		
All Summer Chum		0	20,090				

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference ((predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

█ Indicates exploitation rate or escapement does not meet standard.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-8b-2 Performance of Alternative 2 (Escapement Goal Management at Management Unit Level) under Scenario B relative to Alternative 1 Scenario B (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario B					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early*	-6%	-29	47	13%	Beneficial	Moderate
North Fork			21	13%	Beneficial	Moderate
South Fork			26	13%	Beneficial	Moderate
Skagit Summer-Fall*	-14%	-3,590	2,906	26%	Beneficial	Moderate
Lower Skagit Fall			312	26%	Beneficial	Moderate
Lower Sauk Summer			155	26%	Beneficial	Moderate
Upper Skagit Summer			2,439	26%	Beneficial	Moderate
Skagit Spring*	-11%	-493	164	9%	Beneficial	Low
Upper Cascade			48	9%	Beneficial	Low
Upper Sauk			55	9%	Beneficial	Low
Suiattle			61	9%	Beneficial	Low
Stillaguamish Summer-Fall	48%	1,277	-1,377	-60%	Negative	Substantial
North Fork Summer			-1,122	-60%	Negative	Substantial
South Fork Fall			-255	-60%	Negative	Substantial
Snohomish Summer-Fall	1%	61	-298	-6%	Negative	Low
Skykomish Summer			-153	-6%	Negative	Low
Snoqualmie Fall			-145	-6%	Negative	Low
Green-Duwamish Fall*	-7%	-4,577	-16	-0.3%	None	None
Lake Washington Fall						
Sammamish	-12%	-49	1	0%	None	None
Cedar	-12%	-67	1	0%	None	None
Puyallup Fall	21%	1,367	-1,219	-50%	Negative	Substantial
White River Spring	26%	91	-459	-31%	Negative	Substantial
Nisqually Fall	-3%	-2,919	-26	-2%	Negative	Low
Mid- Hood Canal Fall	-7%	-55	23	5%	Beneficial	Low
Skokomish Fall	-2%	-897	-6	0%	None	None
Dungeness Summer	-3%	-12	8	2%	Beneficial	Low
Elwha Summer	-4%	-81	48	2%	Beneficial	Low

Impacts Relative to Alternative 1 Scenario B						
Summer Chum	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	% Change in Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	279%	Beneficial	Substantial
Juan de Fuca	0%	-12	30	1%	Beneficial	Low

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-8c-1 Performance of Alternative 2 (Escapement Goal Management at Management Unit Level) under Scenario C relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 2 Scenario C				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Escapement Goal ³
Nooksack Early*	14%	1%	6	304	2%		-39%
North Fork South Fork				134 170		-33% -15%	
Skagit Summer-Fall*	33%	1%	105	10,215			
Lower Skagit Fall				1,095	-16%	336%	-50%
Lower Sauk Summer				545	-18%	172%	-20%
Upper Skagit Summer				8,575	-27%	787%	15%
Skagit Spring*	12%	3%	53	1,460			
Upper Cascade				428		152%	
Upper Sauk				492	-26%	278%	49%
Suiattle				541	-29%	218%	35%
Stillaguamish Summer-Fall	52%	46%	864	909			
North Fork Summer				741	20%	147%	34%
South Fork Fall				168	28%	-16%	-44%
Snohomish Summer-Fall	10%	3%	244	3,875			
Skykomish Summer				1,989	-18%	21%	-43%
Snoqualmie Fall				1,886		372%	
Green-Duwamish Fall*	36%	23%	4,403	5,800	-17%	595%	5%
Lake Washington Fall		5%					
Sammamish	19%		28	214		7%	-83%
Cedar	19%		13	214		7%	-82%
Puyallup Fall	57%	44%	3,703	1,200		500%	0%
White River Spring	23%	23%	156	1,000		400%	0%
Nisqually Fall	61%	51%	8,324	1,100		450%	0%
Mid- Hood Canal Fall	20%	5%	29	385		93%	-69%
Skokomish Fall	43%	29%	3,701	1,221		511%	-2%
Dungeness Summer	19%	1%	2	251		26%	-73%
Elwha Summer	19%	1%	11	1,516		658%	-48%
All Chinook from Listed Populations			21,642	29,664			
Hood Canal and Strait of Juan de Fuca Summer Chum				Performance vs Recovery Standards			
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold		
Hood Canal	0%	0	13,105	-11%	222%		
Juan de Fuca	0.2%	0	6,985	-9%	659%		
All Summer Chum		0	20,090				

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

█ Indicates exploitation rate or escapement does not meet standard.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-8c-2 Performance of Alternative 2 (Escapement Goal Management at Management Unit Level) under Scenario C relative to Alternative 1 Scenario C (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario A					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early*	-6%	-20	26	9%		
North Fork South Fork			11 15	9% 9%	Beneficial	Low
Skagit Summer-Fall*	-16%	-2,673	2,182	27%		
Lower Skagit Fall			234	27%	Beneficial	Moderate
Lower Sauk Summer			116	27%	Beneficial	Moderate
Upper Skagit Summer			1,832	27%	Beneficial	Moderate
Skagit Spring*	-11%	-340	129	10%	Beneficial	Moderate
Upper Cascade			38	10%	Beneficial	Moderate
Upper Sauk			43	10%	Beneficial	Moderate
Suiattle			48	10%	Beneficial	Moderate
Stillaguamish Summer-Fall	35%	639	-711	-44%		
North Fork Summer			-579	-44%	Negative	Substantial
South Fork Fall			-132	-44%	Negative	Substantial
Snohomish Summer-Fall	-10%	-1,389	332	9%		
Skykomish Summer			170	9%	Beneficial	Low
Snoqualmie Fall			162	9%	Beneficial	Low
Green-Duwamish Fall*	-13%	-4,782	-1	0.0%	None	None
Lake Washington Fall						
Sammamish	-14%	-45	-9	-4%	Negative	Low
Cedar	-14%	-59	-9	-4%	Negative	Low
Puyallup Fall	7%	-69	-598	-33%	Negative	Substantial
White River Spring	3%	-87	-11	-1%	Negative	Low
Nisqually Fall	-3%	-1,220	-19	-2%	Negative	Low
Mid- Hood Canal Fall	-6%	-36	18	5%	Beneficial	Low
Skokomish Fall	-2%	-465	-18	-1%	Negative	Low
Dungeness Summer	-3%	-10	6	2%	Beneficial	Low
Elwha Summer	-4%	-59	36	2%	Beneficial	Low
Summer Chum						
Impacts Relative to Alternative A Scenario A						
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	% Change Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	383%	Beneficial	Substantial
Juan de Fuca	0%	-12	30	2%	Beneficial	Low

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-8d-1 Performance of Alternative 2 (Escapement Goal Management at Management Unit Level) under Scenario D relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 2 Scenario D				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Escapement Goal ³
Nooksack Early*	20%	1%	6	285	8%		-43%
North Fork				125		-37%	
South Fork				160		-20%	
Skagit Summer-Fall*	43%	1%	105	9,625			
Lower Skagit Fall				1,032	-6%	311%	-53%
Lower Sauk Summer				513	-8%	157%	-25%
Upper Skagit Summer				8,080	-17%	736%	8%
Skagit Spring*	17%	3%	54	1,395		140%	
Upper Cascade				409		262%	42%
Upper Sauk				470	-21%	204%	29%
Suittle				517	-24%		
Stillaguamish Summer-	52%	43%	817	919			
North Fork Summer				749	20%	150%	36%
South Fork Fall				170	28%	-15%	-43%
Snohomish Summer-Fal	13%	3%	248	3,720			
Skykomish Summer				1,909	-18%	16%	-45%
Snoqualmie Fall				1,811		353%	
Green-Duwamish Fall*	38%	18%	3,685	5,800	-15%	595%	5%
Lake Washington Fall		5%					
Sammamish	25%		13	204		2%	-84%
Cedar	25%		13	204		2%	-83%
Puyallup Fall	59%	39%	3,449	1,200		500%	0%
White River Spring	22%	20%	137	1,000		400%	0%
Nisqually Fall	62%	47%	7,998	1,100		450%	0%
Mid- Hood Canal Fall	28%	5%	29	361		81%	-71%
Skokomish Fall	46%	23%	3,113	1,215		508%	-3%
Dungeness Summer	26%	1%	2	237		19%	-74%
Elwha Summer	26%	1%	11	1,431		616%	-51%
All Chinook from Listed Populations			19,680	28,696			

Hood Canal and Strait of Juan de Fuca Summer Chum		Performance vs Recovery Standards			
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold
Hood Canal	0%	0	13,105	-11%	222%
Juan de Fuca	0.2%	0	6,985	-9%	659%
All Summer Chum		0	20,090		

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-8d-2 Performance of Alternative 2 (Escapement Goal Management at Management Unit Level) under Scenario D relative to Alternative 1 Scenario D (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario A					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early*	-6%	-21	33	13%		
North Fork			15	13%	Beneficial	Moderate
South Fork			18	13%	Beneficial	Moderate
Skagit Summer-Fall*	-13%	-2,593	2,074	27%		
Lower Skagit Fall			222	27%	Beneficial	Moderate
Lower Sauk Summer			111	27%	Beneficial	Moderate
Upper Skagit Summer			1,741	27%	Beneficial	Moderate
Skagit Spring*	-11%	-361	125	10%	Beneficial	Moderate
Upper Cascade			37	10%	Beneficial	Moderate
Upper Sauk			42	10%	Beneficial	Moderate
Suittle			46	10%	Beneficial	Moderate
Stillaguamish Summer-	32%	578	-665	-42%		
North Fork Summer			-542	-42%	Negative	Substantial
South Fork Fall			-123	-42%	Negative	Substantial
Snohomish Summer-Fal	-10%	-1,437	321	9%		
Skykomish Summer			165	9%	Beneficial	Low
Snoqualmie Fall			156	9%	Beneficial	Low
Green-Duwamish Fall*	-13%	-5,083	-2	0.0%	None	None
Lake Washington Fall						
Sammamish	-13%	-60	-10	-5%	Negative	Low
Cedar	-13%	-61	-10	-5%	Negative	Low
Puyallup Fall	9%	-15	-634	-35%	Negative	Substantial
White River Spring	2%	-82	-11	-1%	Negative	Low
Nisqually Fall	-4%	-1,716	-9	-1%	Negative	Low
Mid- Hood Canal Fall	-6%	-38	17	5%	Beneficial	Low
Skokomish Fall	-2%	-599	-10	-1%	Negative	Low
Dungeness Summer	-3%	-10	6	3%	Beneficial	Low
Elwha Summer	-4%	-60	36	3%	Beneficial	Low

Summer Chum		Impacts Relative to Alternative A Scenario A				
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	% Change in Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	406%	Beneficial	Substantial
Juan de Fuca	0%	-12	30	2%	Beneficial	Low

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-9a-1 Performance of Alternative 3 (Escapement Goal Management at Population Level) under Scenario A relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 3 Scenario A				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Goal ³
Nooksack Early*	14%	1%	8	422	2%		-16%
North Fork				186		-7%	
South Fork				236		18%	
Skagit Summer-Fall*	32%	1%	147	14,656			
Lower Skagit Fall				1,571	-17%	526%	-28%
Lower Sauk Summer				782	-19%	291%	15%
Upper Skagit Summer				12,303	-28%	1172%	65%
Skagit Spring*	12%	3%	71	2,074			
Upper Cascade				608		257%	
Upper Sauk				699	-26%	438%	112%
Suitttle				769	-29%	352%	92%
Stillaguamish Summer-Fa	8%	2%	47	2,468			
North Fork Summer				2,011	-24%	570%	264%
South Fork Fall				457	-16%	128%	52%
Snohomish Summer-Fall*	10%	4%	857	5,475			
Skykomish Summer				2,810	-18%	70%	-20%
Snoqualmie Fall				2,665		566%	
Green-Duwamish Fall*	55%	42%	11,312	5,800	2%	595%	5%
Lake Washington Fall		5%					
Sammamish	18%		18	307		54%	-75%
Cedar	18%		18	307		54%	-74%
Puyallup Fall	70%	57%	6,271	1,200		500%	0%
White River Spring	46%	46%	434	1,000		400%	0%
Nisqually Fall	72%	63%	14,375	1,100		450%	0%
Mid- Hood Canal Fall	19%	5%	39	552		176%	-56%
Skokomish Fall	60%	46%	8,333	1,218		509%	-3%
Dungeness Summer	19%	1%	3	360		80%	-61%
Elwha Summer	19%	1%	16	2,172		986%	-25%
All Chinook from Listed Populations			41,949	39,111			

Hood Canal and Strait of Juan de Fuca Summer Chum				Performance vs Recovery Standards	
	Wild Exploitation Rate ¹	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold
Hood Canal	0%	0	13,105	-11%	222%
Juan de Fuca	0.4%	12	6,955	-9%	656%
All Summer Chum			12	20,060	

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-9a-2 Performance of Alternative 3 (Escapement Goal Management at Population Level) under Scenario A relative to Alternative 1 Scenario A (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario A					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early*	-6%	-29	34	9%		
North Fork			15	9%	Beneficial	Low
South Fork			19	9%	Beneficial	Low
Skagit Summer-Fall*	-16%	-3,747	3,023	26%		
Lower Skagit Fall			324	26%	Beneficial	Moderate
Lower Sauk Summer			161	26%	Beneficial	Moderate
Upper Skagit Summer			2,538	26%	Beneficial	Moderate
Skagit Spring*	-11%	-499	153	8%		
Upper Cascade			45	8%	Beneficial	Low
Upper Sauk			52	8%	Beneficial	Low
Suitttle			57	8%	Beneficial	Low
Stillaguamish Summer-Fa	-9%	-266	146	6%		
North Fork Summer			119	6%	Beneficial	Low
South Fork Fall			27	6%	Beneficial	Low
Snohomish Summer-Fall*	-9%	-1,468	402	8%		
Skykomish Summer			206	8%	Beneficial	Low
Snoqualmie Fall			196	8%	Beneficial	Low
Green-Duwamish Fall*	-7%	-4,589	-19	-0.3%	None	None
Lake Washington Fall						
Sammamish	-13%	-68	2	1%	Beneficial	Low
Cedar	-13%	-69	2	1%	Beneficial	Low
Puyallup Fall	21%	1,247	-1,192	-50%	Negative	Substantial
White River Spring	26%	78	-468	-32%	Negative	Substantial
Nisqually Fall	-4%	-3,050	-6	-1%	Negative	Low
Mid- Hood Canal Fall	-7%	-56	21	4%	Beneficial	Low
Skokomish Fall	-3%	-1,039	7	1%	Beneficial	Low
Dungeness Summer	-3%	-12	8	2%	Beneficial	Low
Elwha Summer	-3%	-82	47	2%	Beneficial	Low

Summer Chum						
Impacts Relative to Alternative A Scenario A						
	Wild Exploitation Rate ¹	Southern U.S. Catch	Natural Escapement	% Change Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	267%	Beneficial	Substantial
Juan de Fuca	0%	0	0	0%	Beneficial	None

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-9b-1 Performance of Alternative 3 (Escapement Goal Management at Population Level) under Scenario B relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 3 Scenario B				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Goal ³
Nooksack Early*	19%	1%	9	412	7%		-18%
North Fork				181		-9%	
South Fork				231		15%	
Skagit Summer-Fall*	41%	1%	147	13,935			
Lower Skagit Fall				1,494	-8%	495%	-32%
Lower Sauk Summer				743	-10%	272%	9%
Upper Skagit Summer				11,698	-19%	1110%	57%
Skagit Spring*	16%	3%	72	2,010			
Upper Cascade				589		246%	
Upper Sauk				677	-22%	421%	105%
Suiattle				745	-25%	338%	86%
Stillaguamish Summer-Fa	10%	2%	48	2,446			
North Fork Summer				1,993	-22%	564%	261%
South Fork Fall				453	-14%	126%	51%
Snohomish Summer-Fall*	12%	3%	328	5,368			
Skykomish Summer				2,755	-18%	67%	-21%
Snoqualmie Fall				2,613		553%	
Green-Duwamish Fall*	56%	38%	10,526	5,800	3%	595%	5%
Lake Washington Fall		5%					
Sammamish	23%		37	295		48%	-76%
Cedar	23%		18	295		48%	-75%
Puyallup Fall	71%	53%	5,990	1,200		500%	0%
White River Spring	46%	44%	414	1,000		400%	0%
Nisqually Fall	73%	60%	14,010	1,100		450%	0%
Mid- Hood Canal Fall	25%	5%	39	527		164%	-58%
Skokomish Fall	61%	40%	7,611	1,231		516%	-2%
Dungeness Summer	24%	1%	3	344		72%	-63%
Elwha Summer	24%	1%	16	2,079		940%	-28%
All Chinook from Listed Populations			39,268	38,042			

Hood Canal and Strait of Juan de Fuca Summer Chum	Performance vs Recovery Standards				
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold
Hood Canal	0%	0	13,105	-11%	222%
Juan de Fuca	0.2%	0	6,985	-9%	659%
All Summer Chum		0	20,090		

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-9b-2 Performance of Alternative 3 (Escapement Goal Management at Population Level) under Scenario B relative to Alternative 1 Scenario B (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario B					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early*	-6%	-29	47	13%		
North Fork			21	13%	Beneficial	Moderate
South Fork			26	13%	Beneficial	Moderate
Skagit Summer-Fall*	-14%	-3,590	2,906	26%		
Lower Skagit Fall			312	26%	Beneficial	Moderate
Lower Sauk Summer			155	26%	Beneficial	Moderate
Upper Skagit Summer			2,439	26%	Beneficial	Moderate
Skagit Spring*	-11%	-495	165	9%	Beneficial	Low
Upper Cascade			48	9%	Beneficial	Low
Upper Sauk			56	9%	Beneficial	Low
Suiattle			61	9%	Beneficial	Low
Stillaguamish Summer-Fa	-9%	-266	165	7%		
North Fork Summer			134	7%	Beneficial	Low
South Fork Fall			31	7%	Beneficial	Low
Snohomish Summer-Fall*	-10%	-1,958	467	10%		
Skykomish Summer			240	10%	Beneficial	Moderate
Snoqualmie Fall			227	10%	Beneficial	Moderate
Green-Duwamish Fall*	-7%	-4,577	-16	-0.3%	None	None
Lake Washington Fall						
Sammamish	-12%	-49	1	0%	None	None
Cedar	-12%	-67	1	0%	None	None
Puyallup Fall	21%	1,367	-1,219	-50%	Negative	Substantial
White River Spring	26%	91	-459	-31%	Negative	Substantial
Nisqually Fall	-3%	-2,919	-26	-2%	Negative	Low
Mid- Hood Canal Fall	-7%	-55	23	5%	Beneficial	Low
Skokomish Fall	-2%	-898	-6	0%	None	None
Dungeness Summer	-3%	-12	8	2%	Beneficial	Low
Elwha Summer	-4%	-81	48	2%	Beneficial	Low

Summer Chum	Impacts Relative to Alternative A Scenario B					
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	% Change in Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	279%	Beneficial	Substantial
Juan de Fuca	0%	-12	30	1%	Beneficial	Low

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-9c-1 Performance of Alternative 3 (Escapement Goal Management at Population Level) under Scenario C relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative C Scenario C				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Goal ³
Nooksack Early* North Fork South Fork	14%	1%	6	304 134 170	2%	-33%	-39%
Skagit Summer-Fall* Lower Skagit Fall Lower Sauk Summer Upper Skagit Summer	33%	1%	105	10,215 1,095 545 8,575	-16% -18% -27%	336% 172% 787%	-50% -20% 15%
Skagit Spring* Upper Cascade Upper Sauk Suittie	12%	3%	53	1,460 428 492 541	-26% -29%	152% 278% 218%	49% 35%
Stillaguamish Summer-Fa North Fork Summer South Fork Fall	8%	2%	35	1,738 1,416 322	-24% -16%	372% 61%	157% 7%
Snohomish Summer-Fall* Skykomish Summer Snoqualmie Fall	10%	3%	244	3,875 1,989 1,886	-18%	21% 372%	-43%
Green-Duwamish Fall* Lake Washington Fall Sammamish Cedar	36%	23% 5%	4,403	5,800	-17%	595%	5%
Puyallup Fall White River Spring Nisqually Fall Mid- Hood Canal Fall Skokomish Fall Dungeness Summer Elwha Summer	57% 23% 61% 20% 43% 19% 19%	44% 23% 51% 5% 29% 1% 1%	3,703 156 8,324 29 3,701 2 11	1,200 1,000 1,100 385 1,221 251 1,516		500% 400% 450% 93% 511% 26% 658%	0% 0% 0% -69% -2% -73% -48%
All Chinook from Listed Populations			20,813	30,493			
Hood Canal and Strait of Juan de Fuca Summer Chum				Performance vs Recovery Standards			
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold		
Hood Canal	0%	0	13,105	-11%	222%		
Juan de Fuca	0.2%	0	6,985	-9%	659%		
All Summer Chum			0	20,090			

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference ((predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

█ Indicates exploitation rate or escapement does not meet standard.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-9c-2 Performance of Alternative 3 (Escapement Goal Management at Population Level) under Scenario C relative to Alternative 1 Scenario C (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario A					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early* North Fork South Fork	-6%	-20	26 11 15	9% 9% 9%	Beneficial	Low
Skagit Summer-Fall* Lower Skagit Fall Lower Sauk Summer Upper Skagit Summer	-16%	-2,673	2,182 234 116 1,832	27% 27% 27% 27%	Beneficial	Moderate
Skagit Spring* Upper Cascade Upper Sauk Suittie	-11%	-340	129 38 43 48	10% 10% 10% 10%	Beneficial	Moderate
Stillaguamish Summer-Fa North Fork Summer South Fork Fall	-9%	-190	118 96 22	7% 7% 7%	Beneficial	Low
Snohomish Summer-Fall* Skykomish Summer Snoqualmie Fall	-10%	-1,389	332 170 162	9% 9% 9%	Beneficial	Low
Green-Duwamish Fall* Lake Washington Fall Sammamish Cedar	-13%	-4,782	-1	0.0%	None	None
Puyallup Fall White River Spring Nisqually Fall Mid- Hood Canal Fall Skokomish Fall Dungeness Summer Elwha Summer	7% 3% -3% -6% -2% -3% -4%	-69 -87 -1,220 -36 -465 -10 -59	-598 -11 -19 18 -18 6 36	-33% -1% -2% 5% -1% 2% 2%	Negative	Substantial

Impacts Relative to Alternative A Scenario A						
Summer Chum	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	% Change Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	383%	Beneficial	Substantial
Juan de Fuca	0%	-12	30	2%	Beneficial	Low

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-9d-1 Performance of Alternative 3 (Escapement Goal Management at Population Level) under Scenario D relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 3 Scenario D				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Goal ³
Nooksack Early*	20%	1%	6	285	8%		-43%
North Fork				125		-37%	
South Fork				160		-20%	
Skagit Summer-Fall*	43%	1%	105	9,625			
Lower Skagit Fall				1,032	-6%	311%	-53%
Lower Sauk Summer				513	-8%	157%	-25%
Upper Skagit Summer				8,080	-17%	736%	8%
Skagit Spring*	17%	3%	54	1,395			
Upper Cascade				409		140%	
Upper Sauk				470	-21%	262%	42%
Suitttle				517	-24%	204%	29%
Stillaguamish Summer-Fa	11%	2%	35	1,702			
North Fork Summer				1,387	-21%	362%	151%
South Fork Fall				315	-13%	57%	5%
Snohomish Summer-Fall*	13%	3%	248	3,720			
Skykomish Summer				1,909	-18%	16%	-45%
Snoqualmie Fall				1,811		353%	
Green-Duwamish Fall*	38%	18%	3,685	5,800	-15%	595%	5%
Lake Washington Fall		5%					
Sammamish	25%		28	204		2%	-84%
Cedar	25%		13	204		2%	-83%
Puyallup Fall	59%	39%	3,449	1,200		500%	0%
White River Spring	22%	20%	137	1,000		400%	0%
Nisqually Fall	62%	47%	7,998	1,100		450%	0%
Mid- Hood Canal Fall	28%	5%	29	361		81%	-71%
Skokomish Fall	46%	23%	3,113	1,215		508%	-3%
Dungeness Summer	26%	1%	2	237		19%	-74%
Elwha Summer	26%	1%	11	1,431		616%	-51%
All Chinook from Listed Populations			18,913	29,479			
Hood Canal and Strait of Juan de Fuca Summer Chum				Performance vs Recovery Standards			
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold		
Hood Canal	0%	0	13,105	-11%	222%		
Juan de Fuca	0.2%	0	6,985	-9%	659%		
All Summer Chum		0	20,090				

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference ((predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

█ Indicates exploitation rate or escapement does not meet standard.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-9d-2 Performance of Alternative 3 (Escapement Goal Management at Population Level) under Scenario D relative to Alternative 1 Scenario D (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario A					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early*	-6%	-21	33	13%	Beneficial	Moderate
North Fork			15	13%		
South Fork			18	13%		
Skagit Summer-Fall*	-13%	-2,593	2,074	27%	Beneficial	Moderate
Lower Skagit Fall			222	27%		
Lower Sauk Summer			111	27%		
Upper Skagit Summer			1,741	27%		
Skagit Spring*	-11%	-361	125	10%	Beneficial	Moderate
Upper Cascade			37	10%		
Upper Sauk			42	10%		
Suitttle			46	10%		
Stillaguamish Summer-Fa	-9%	-204	118	7%	Beneficial	Low
North Fork Summer			96	7%		
South Fork Fall			22	7%		
Snohomish Summer-Fall*	-10%	-1,437	321	9%	Beneficial	Low
Skykomish Summer			165	9%		
Snoqualmie Fall			156	9%		
Green-Duwamish Fall*	-13%	-5,083	-2	0.0%	None	None
Lake Washington Fall						
Sammamish	-13%	-45	-10	-5%	Negative	Low
Cedar	-13%	-61	-10	-5%	Negative	Low
Puyallup Fall	9%	-15	-634	-35%	Negative	Substantial
White River Spring	2%	-82	-11	-1%	Negative	Low
Nisqually Fall	-4%	-1,716	-9	-1%	Negative	Low
Mid- Hood Canal Fall	-6%	-38	17	5%	Beneficial	Low
Skokomish Fall	-2%	-599	-10	-1%	Negative	Low
Dungeness Summer	-3%	-10	6	3%	Beneficial	Low
Elwha Summer	-4%	-60	36	3%	Beneficial	Low
Summer Chum						
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	% Change Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	406%	Beneficial	Substantial
Juan de Fuca	0%	-12	30	2%	Beneficial	Low

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-10a-1 Performance of Alternative 4 (No Fishing) under Scenario A relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 4 Scenario A				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Goal ³
Nooksack Early*	14%	1%	8	422	2%		-16%
North Fork				186		-7%	
South Fork				236		18%	
Skagit Summer-Fall*	32%	1%	147	14,656			
Lower Skagit Fall				1,571	-17%	526%	-28%
Lower Sauk Summer				782	-19%	291%	15%
Upper Skagit Summer				12,303	-28%	1172%	65%
Skagit Spring*	12%	3%	71	2,074			
Upper Cascade				608		257%	
Upper Sauk				699	-26%	438%	112%
Suitttle				769	-29%	352%	92%
Stillaguamish Summer-Fa	8%	2%	47	2,468			
North Fork Summer				2,011	-24%	570%	264%
South Fork Fall				457	-16%	128%	52%
Snohomish Summer-Fall*	9%	3%	329	5,504			
Skykomish Summer				2,825	-18%	71%	-19%
Snoqualmie Fall				2,679		570%	
Green-Duwamish Fall*	18%	5%	1,675	10,558	-35%	1164%	91%
Lake Washington Fall							
Sammamish	18%	5%	37	307		54%	-75%
Cedar	18%		18	307		54%	-74%
Puyallup Fall	18%	5%	629	3,286		1543%	174%
White River Spring	2%	1%	18	1,831		816%	83%
Nisqually Fall	16%	7%	2,142	3,338		1569%	203%
Mid- Hood Canal Fall	19%	5%	39	552		176%	-56%
Skokomish Fall	19%	5%	1,054	2,482		1141%	99%
Dungeness Summer	19%	1%	3	360		80%	-61%
Elwha Summer	19%	1%	16	2,172		986%	-25%
All Chinook from Listed Populations			6,233	50,317			
Hood Canal and Strait of Juan de Fuca Summer Chum				Performance vs Recovery Standards			
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold		
Hood Canal	0%	0	13,105	-11%	222%		
Juan de Fuca	0.2%	0	6,985	-9%	659%		
All Summer Chum			0	20,090			

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

[Grey Box] Indicates exploitation rate or escapement does not meet standard.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-10a-2 Performance of Alternative 4 (No Fishing) under Scenario A relative to Alternative 1 Scenario A (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario A					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early*	-6%	-29	34	9%		
North Fork			15	9%	Beneficial	Low
South Fork			19	9%	Beneficial	Low
Skagit Summer-Fall*	-16%	-3,747	3,023	26%	Beneficial	Moderate
Lower Skagit Fall			324	26%	Beneficial	Moderate
Lower Sauk Summer			161	26%	Beneficial	Moderate
Upper Skagit Summer			2,538	26%	Beneficial	Moderate
Skagit Spring*	-11%	-499	153	8%	Beneficial	Low
Upper Cascade			45	8%	Beneficial	Low
Upper Sauk			52	8%	Beneficial	Low
Suitttle			57	8%	Beneficial	Low
Stillaguamish Summer-Fa	-9%	-266	146	6%	Beneficial	Low
North Fork Summer			119	6%	Beneficial	Low
South Fork Fall			27	6%	Beneficial	Low
Snohomish Summer-Fall*	-10%	-1,996	431	8%	Beneficial	Low
Skykomish Summer			221	8%	Beneficial	Low
Snoqualmie Fall			210	8%	Beneficial	Low
Green-Duwamish Fall*	-44%	-14,226	4,739	81.4%	Beneficial	Substantial
Lake Washington Fall						
Sammamish	-13%	-49	2	1%	Beneficial	Low
Cedar	-13%	-69	2	1%	Beneficial	Low
Puyallup Fall	-31%	-4,395	894	37%	Beneficial	Substantial
White River Spring	-18%	-338	363	25%	Beneficial	Moderate
Nisqually Fall	-60%	-15,283	2,232	202%	Beneficial	Substantial
Mid- Hood Canal Fall	-7%	-56	21	4%	Beneficial	Low
Skokomish Fall	-44%	-8,318	1,271	105%	Beneficial	Substantial
Dungeness Summer	-3%	-12	8	2%	Beneficial	Low
Elwha Summer	-3%	-82	47	2%	Beneficial	Low
Summer Chum						
Impacts Relative to Alternative A Scenario A						
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	% Change Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	267%	Beneficial	Substantial
Juan de Fuca	0%	-12	30	1%	Beneficial	0%

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-10b-1 Performance of Alternative 4 (No Fishing) under Scenario B relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 4 Scenario B				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement Goal ³
Nooksack Early*	19%	1%	9	412	7%		-18%
North Fork				181		-9%	
South Fork				231		15%	
Skagit Summer-Fall*	41%	1%	147	13,935			
Lower Skagit Fall				1,494	-8%	495%	-32%
Lower Sauk Summer				743	-10%	272%	9%
Upper Skagit Summer				11,698	-19%	1110%	57%
Skagit Spring*	16%	3%	72	2,010			
Upper Cascade				589		246%	
Upper Sauk				677	-22%	421%	105%
Suitttle				745	-25%	338%	86%
Stillaguamish Summer-Fa	10%	2%	48	2,446			
North Fork Summer				1,993	-22%	564%	261%
South Fork Fall				453	-14%	126%	51%
Snohomish Summer-Fall*	12%	3%	328	5,368			
Skykomish Summer				2,755	-18%	67%	-21%
Snoqualmie Fall				2,613		553%	
Green-Duwamish Fall*	23%	5%	1,684	10,153	-30%	1116%	84%
Lake Washington Fall							
Sammamish	23%	5%	37	295		48%	-76%
Cedar	23%		18	295		48%	-75%
Puyallup Fall	23%	5%	633	3,160		1480%	163%
White River Spring	3%	1%	18	1,792		796%	79%
Nisqually Fall	21%	7%	2,183	3,261		1531%	196%
Mid- Hood Canal Fall	25%	5%	39	527		164%	-58%
Skokomish Fall	25%	5%	1,054	2,370		1085%	90%
Dungeness Summer	24%	1%	3	344		72%	-63%
Elwha Summer	24%	1%	16	2,079		940%	-28%
All Chinook from Listed Populations			6,289	48,447			

Hood Canal and Strait of Juan de Fuca Summer Chum	Performance vs Recovery Standards				
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold
Hood Canal	0%	0	13,105	-11%	222%
Juan de Fuca	0.2%	0	6,985	-9%	659%
All Summer Chum		0	20,090		

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference ((predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-10b-2 Performance of Alternative 4 (No Fishing) under Scenario B relative to Alternative 1 Scenario B (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario B					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early*	-6%	-29	47	13%		
North Fork			21	13%	Beneficial	Moderate
South Fork			26	13%	Beneficial	Moderate
Skagit Summer-Fall*	-14%	-3,590	2,906	26%		
Lower Skagit Fall			312	26%	Beneficial	Moderate
Lower Sauk Summer			155	26%	Beneficial	Moderate
Upper Skagit Summer			2,439	26%	Beneficial	Moderate
Skagit Spring*	-11%	-495	165	9%		
Upper Cascade			48	9%	Beneficial	Low
Upper Sauk			56	9%	Beneficial	Low
Suitttle			61	9%	Beneficial	Low
Stillaguamish Summer-Fa	-9%	-266	165	7%		
North Fork Summer			134	7%	Beneficial	Low
South Fork Fall			31	7%	Beneficial	Low
Snohomish Summer-Fall*	-10%	-1,958	467	10%		
Skykomish Summer			240	10%	Beneficial	Moderate
Snoqualmie Fall			227	10%	Beneficial	Moderate
Green-Duwamish Fall*	-40%	-13,419	4,337	74.6%	Beneficial	Substantial
Lake Washington Fall						
Sammamish	-12%	-49	1	0%	None	None
Cedar	-12%	-67	1	0%	None	None
Puyallup Fall	-27%	-3,990	741	31%	Beneficial	Substantial
White River Spring	-17%	-305	333	23%	Beneficial	Moderate
Nisqually Fall	-55%	-14,746	2,135	190%	Beneficial	Substantial
Mid- Hood Canal Fall	-7%	-55	23	5%	Beneficial	Low
Skokomish Fall	-38%	-7,455	1,133	92%	Beneficial	Substantial
Dungeness Summer	-3%	-12	8	2%	Beneficial	Low
Elwha Summer	-4%	-81	48	2%	Beneficial	Low

Summer Chum	Impacts Relative to Alternative 1 Scenario B					
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	% Change Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	279%	Beneficial	Substantial
Juan de Fuca	0%	-12	30	1%	Beneficial	0%

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-10c-1 Performance of Alternative 4 (No Fishing) under Scenario C relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 4 Scenario C				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Goal ³
Nooksack Early*	14%	1%	6	304	2%		-39%
North Fork				134		-33%	
South Fork				170		-15%	
Skagit Summer-Fall*	33%	1%	105	10,215			
Lower Skagit Fall				1,095	-16%	336%	-50%
Lower Sauk Summer				545	-18%	172%	-20%
Upper Skagit Summer				8,575	-27%	787%	15%
Skagit Spring*	12%	3%	53	1,460			
Upper Cascade				428		152%	
Upper Sauk				492	-26%	278%	49%
Suitttle				541	-29%	218%	35%
Stillaguamish Summer-Fa	8%	2%	35	1,738			
North Fork Summer				1,416	-24%	372%	157%
South Fork Fall				322	-16%	61%	7%
Snohomish Summer-Fall*	10%	3%	244	3,875			
Skykomish Summer				1,989	-18%	21%	-43%
Snoqualmie Fall				1,886		372%	
Green-Duwamish Fall*	19%	5%	1,228	7,367	-34%	782%	33%
Lake Washington Fall		5%					
Sammamish	19%		27	214		7%	-83%
Cedar	19%		13	214		7%	-82%
Puyallup Fall	19%	5%	461	2,293		1047%	91%
White River Spring	2%	1%	14	1,283		542%	28%
Nisqually Fall	17%	8%	1,600	2,330		1065%	112%
Mid- Hood Canal Fall	20%	5%	29	385		93%	-69%
Skokomish Fall	20%	5%	769	1,730		765%	38%
Dungeness Summer	19%	1%	2	251		26%	-73%
Elwha Summer	19%	1%	11	1,516		658%	-48%
All Chinook from Listed Populations			4,597	35,175			

Hood Canal and Strait of Juan de Fuca Summer Chum				Performance vs Recovery Standards	
	Wild Exploitation Rate ¹	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold
Hood Canal	0%	0	13,105	-11%	222%
Juan de Fuca	0.2%	0	6,985	-9%	659%
All Summer Chum	0	0	20,090		

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-10c-2 Performance of Alternative 4 (No Fishing) under Scenario C relative to Alternative 1 Scenario C (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario C					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early*	-6%	-20	26	9%		
North Fork			11	9%	Beneficial	Low
South Fork			15	9%	Beneficial	Low
Skagit Summer-Fall*	-16%	-2,673	2,182	27%	Beneficial	Moderate
Lower Skagit Fall			234	27%	Beneficial	Moderate
Lower Sauk Summer			116	27%	Beneficial	Moderate
Upper Skagit Summer			1,832	27%	Beneficial	Moderate
Skagit Spring*	-11%	-340	129	10%	Beneficial	Moderate
Upper Cascade			38	10%	Beneficial	Moderate
Upper Sauk			43	10%	Beneficial	Moderate
Suitttle			48	10%	Beneficial	Moderate
Stillaguamish Summer-Fa	-9%	-190	118	7%	Beneficial	Low
North Fork Summer			96	7%	Beneficial	Low
South Fork Fall			22	7%	Beneficial	Low
Snohomish Summer-Fall*	-10%	-1,389	332	9%	Beneficial	Low
Skykomish Summer			170	9%	Beneficial	Low
Snoqualmie Fall			162	9%	Beneficial	Low
Green-Duwamish Fall*	-30%	-7,957	1,566	27.0%	Beneficial	Moderate
Lake Washington Fall						
Sammamish	-14%	-45	-9	-4%	Negative	Low
Cedar	-14%	-59	-9	-4%	Negative	Low
Puyallup Fall	-31%	-3,311	495	28%	Beneficial	Moderate
White River Spring	-18%	-229	272	27%	Beneficial	Moderate
Nisqually Fall	-47%	-7,944	1,211	108%	Beneficial	Substantial
Mid- Hood Canal Fall	-6%	-36	18	5%	Beneficial	Low
Skokomish Fall	-25%	-3,397	491	40%	Beneficial	Substantial
Dungeness Summer	-3%	-10	6	2%	Beneficial	Low
Elwha Summer	-4%	-59	36	2%	Beneficial	Low

Summer Chum						Impacts Relative to Alternative 1 Scenario C							
	Wild Exploitation Rate ¹	Southern U.S. Catch	Natural Escapement	% Change Escapement	Type of Impact	Magnitude of Impact		Wild Exploitation Rate ¹	Southern U.S. Catch	Natural Escapement	% Change Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	383%	Beneficial	Substantial							
Juan de Fuca	0%	-12	30	2%	Beneficial	0%							

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-10d-1 Performance of Alternative 4 (No Fishing) under Scenario D relative to NMFS recovery standards, viable salmonid population guidelines, and current condition escapement goals for listed Puget Sound chinook and Hood Canal-Strait of Juan de Fuca summer chum salmon.

Puget Sound Chinook	Alternative 4 Scenario D				Performance vs. Recovery Standards		
	Wild Exploitation Rate	Southern U.S. Wild Exploitation Rate	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate ¹	Critical Escapement Threshold ²	Viable Escapement or Goal ³
Nooksack Early* North Fork	20%	1%	6	285	8%		-43%
South Fork				125		-37%	
				160		-20%	
Skagit Summer-Fall* Lower Skagit Fall	43%	1%	105	9,625	-6%	311%	-53%
Lower Sauk Summer				1,032	-8%	157%	-25%
Upper Skagit Summer				513	-17%	736%	8%
				8,080			
Skagit Spring* Upper Cascade	17%	3%	54	1,395		140%	
Upper Sauk				409	-21%	262%	42%
Suiattle				470	-24%	204%	29%
				517			
Stillaguamish Summer-Fa North Fork Summer	11%	2%	35	1,702	-21%	362%	151%
South Fork Fall				1,387	-13%	57%	5%
				315			
Snohomish Summer-Fall* Skykomish Summer	13%	3%	244	3,720	-18%	16%	-45%
Snoqualmie Fall				1,909		353%	
				1,811			
Green-Duwamish Fall* Lake Washington Fall	25%	5%	1,232	7,006	-28%	739%	27%
Sammamish	25%	5%				2%	-84%
Cedar	25%		13	204		2%	-83%
			13	204			
Puyallup Fall	25%	5%	463	2,180		990%	82%
White River Spring	3%	1%	14	1,246		523%	25%
Nisqually Fall	23%	8%	1,630	2,264		1032%	106%
Mid- Hood Canal Fall	28%	5%	29	361		81%	-71%
Skokomish Fall	28%	5%	767	1,622		711%	30%
Dungeness Summer	26%	1%	2	237		19%	-74%
Elwha Summer	26%	1%	11	1,431		616%	-51%
All Chinook from Listed Populations			4,619	33,482			

Hood Canal and Strait of Juan de Fuca Summer Chum	Performance vs Recovery Standards				
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	Rebuilding Exploitation Rate	Critical Escapement Threshold
Hood Canal	0%	0	13,105	-11%	222%
Juan de Fuca	0.2%	0	6,985	-9%	659%
All Summer Chum		0	20,090		

* Populations with specific NMFS-developed standards
¹ Calculated as difference of rates ((predicted wild exploitation rate - recovery exploitation rate))
² Calculated as percent of difference ((predicted escapement-critical escapement threshold ÷ critical escapement threshold))
³ Calculated as percent of difference (predicted escapement-viable escapement threshold ÷ viable escapement threshold))
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Table 4.3-10d-2 Performance of Alternative 4 (No Fishing) under Scenario D relative to Alternative 1 Scenario D (Proposed Action).

Puget Sound Chinook	Impacts Relative to Alternative 1 Scenario D					
	Change in Wild Exploitation Rate ¹	Change in Southern U.S. Catch ¹	Change in Natural Escapement ¹	% Change in Natural Escapement ²	Type of Impact	Magnitude of Impact
Nooksack Early* North Fork	-6%	-21	33	13%		
South Fork			15	13%	Beneficial	Moderate
			18	13%	Beneficial	Moderate
Skagit Summer-Fall* Lower Skagit Fall	-13%	-2,593	2,074	27%		
Lower Sauk Summer			222	27%	Beneficial	Moderate
Upper Skagit Summer			111	27%	Beneficial	Moderate
			1,741	27%	Beneficial	Moderate
Skagit Spring* Upper Cascade	-11%	-361	125	10%	Beneficial	Moderate
Upper Sauk			37	10%	Beneficial	Moderate
Suiattle			42	10%	Beneficial	Moderate
			46	10%	Beneficial	Moderate
Stillaguamish Summer-Fa North Fork Summer	-9%	-204	118	7%		
South Fork Fall			96	7%	Beneficial	Low
			22	7%	Beneficial	Low
Snohomish Summer-Fall* Skykomish Summer	-10%	-1,441	321	9%		
Snoqualmie Fall			165	9%	Beneficial	Low
			156	9%	Beneficial	Low
Green-Duwamish Fall* Lake Washington Fall	-26%	-7,536	1,204	20.8%	Beneficial	Moderate
Sammamish	-13%	-60	-10	-5%	Negative	Low
Cedar	-13%	-61	-10	-5%	Negative	Low
Puyallup Fall	-25%	-3,001	346	19%	Beneficial	Moderate
White River Spring	-17%	-205	235	23%	Beneficial	Moderate
Nisqually Fall	-43%	-8,084	1,155	104%	Beneficial	Substantial
Mid- Hood Canal Fall	-6%	-38	17	5%	Beneficial	Low
Skokomish Fall	-20%	-2,945	397	32%	Beneficial	Substantial
Dungeness Summer	-3%	-10	6	3%	Beneficial	Low
Elwha Summer	-4%	-60	36	3%	Beneficial	Low

Summer Chum	Impacts Relative to Alternative 1 Scenario D					
	Wild Exploitation Rate ⁴	Southern U.S. Catch	Natural Escapement	% Change Escapement	Type of Impact	Magnitude of Impact
Hood Canal	-2%	-1,651	5,668	406%	Beneficial	Substantial
Juan de Fuca	0%	-12	30	2%	Beneficial	0%

* Populations with specific NMFS-developed standards
¹ Alternative 1 - Alternative 2
² (Alternative 1 - Alternative 2) ÷ Alternative 1
³ See explanation of impact metrics.
⁴ Excludes Quilcene River population.

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

1 **4.3.2 Unlisted Salmonid Species**

2 Puget Sound populations of coho, sockeye, pink, chum salmon, and steelhead would also be affected
3 by the Proposed Action or alternatives considered in this Environmental Impact Statement. As noted in
4 Section 3.3, Fish: Affected Environment, chinook and coho salmon from Washington and Oregon
5 coastal populations are infrequently taken in Puget Sound fisheries, and therefore would not be
6 measurably affected. The co-managers aggregate populations of sockeye, coho, pink, chum salmon,
7 and steelhead into seven management units: the Nooksack-Samish, Skagit, Stillaguamish, and
8 Snohomish River management units in North Puget Sound; the South Sound management unit, which
9 includes streams south of the Snohomish; the Hood Canal management unit; and the Strait of Juan de
10 Fuca management unit. The two sockeye salmon management units – the Skagit (Baker) River and
11 South Puget Sound (Cedar River) – are managed to achieve escapement goals. Coho salmon harvest is
12 managed to not exceed exploitation rate ceilings specific to each management unit. These exploitation
13 rate ceilings would be set annually according to the forecast abundance of each management unit, and
14 appropriate to the productivity level implied by the forecast. Pink and chum salmon fisheries are
15 managed to achieve escapement goals for each management unit. Since these coho, chum, sockeye,
16 pink salmon, and steelhead populations are unlisted populations, NMFS has not set Endangered
17 Species Act standards for them. The standards of performance referred to in this Environmental Impact
18 Statement are the exploitation rate ceilings, or escapement goals established by the co-managers
19 beginning with the 2001 management year.

20 The alternatives considered all assume that river fisheries could remain open from December through
21 March when adult chinook salmon are absent from Puget Sound streams. More than 95 percent of the
22 net harvest of steelhead occurs during this period. The model employed in the analysis is able to
23 account for the relatively small changes in tribal harvest that would occur in late summer and fall
24 fisheries when chinook salmon and summer steelhead presence overlaps. Under Alternative 2 or 3,
25 catch in these fisheries would be reduced relative to Alternative 1. Because such a large part of
26 steelhead harvest occurs between December and March, the effect on catch and escapement of
27 steelhead under Alternative 2 or 3 relative to Alternative 1 would be a low to moderately beneficial
28 impact.

29 It is important to note that, in the modeling for this impact analysis, the abundance of species other than
30 chinook salmon within the action area was held constant with the base period; that is, the “scenarios”
31 used to simulate variability in abundance and fishing regimes outside the action area were not applied
32 for these species.

1 **4.3.2.1 Alternative 1 – Proposed Action/Status Quo**

2 Impacts to Unlisted Puget Sound Salmon Populations

3 Under Alternative 1, the modeled total Southern U.S. catch of unlisted salmon species originating from
4 Puget Sound is predicted to be 476,794 coho salmon, 92,850 sockeye salmon, 419,957 pink salmon,
5 and 715,235 fall and winter chum salmon.

6 Under Alternative 1, escapement of naturally-spawning coho salmon is predicted to be 326,114 fish. As
7 shown in Table 4.3-11, it is predicted that the co-managers' exploitation rate goals would be met under
8 Alternative 1 for all Puget Sound coho salmon management units by margins ranging from 13 to 27
9 percent. An exploitation rate ceiling has not been established for South Puget Sound coho salmon, but
10 the exploitation rate achieved under Alternative 1 would balance natural spawning capacity and
11 hatchery program objectives.

12 Under Alternative 1, the escapement of Baker River sockeye salmon is predicted to exceed the goal by
13 almost 300 percent. A recreational and tribal fishery for Cedar River sockeye salmon was modeled
14 under Alternative 1 with a predicted total catch of 92,600 sockeye. Under this Alternative, escapement
15 is predicted to be 17 percent below the goal for the Cedar River (Table 4.3-11).

16 The escapement of naturally-spawning pink salmon to streams in the seven management units is
17 predicted to be 897,976 fish. Under Alternative 1, escapements of pink salmon are predicted to exceed
18 the goal by a substantial margin for the Nooksack, Skagit, and Snohomish River pink salmon
19 management units, and are predicted to be substantially below the goals for South Puget Sound and
20 Hood Canal. A pink salmon escapement goal is not available for the Strait of Juan de Fuca
21 management unit.

Section 4 - Environmental Consequences

Table 4.3-11 Performance of Alternative 1 (Proposed Action) relative to exploitation rate objectives or escapement goals for coho, sockeye, pink, and fall-winter chum salmon.

						Performance vs Standards	
	Wild Exploitation Rate	Exploit. Rate Objective	Southern U.S. Catch	Natural Escapement	Escapement Goal	Exploitation Rate	Escapement
Coho							
Nooksack/Samish	50%	75%	41,215	8,182		-25%	
Skagit	37%	60%	42,493	73,624		-23%	
Stillaguamish	37%	50%	12,069	24,017		-13%	
Snohomish	33%	60%	76,720	136,873		-27%	
South Sound	55%		246,383	47,086			
Hood Canal	42%	65%	42,909	19,012		-23%	
Juan de Fuca	14%	40%	15,005	17,320		-26%	
All Coho			476,794	326,114			
Sockeye							
Skagit			250	11,823	3,000		294%
South Sound			92,600	291,916	350,000		-17%
All Sockeye			92,850	303,739			
Pink							
Nooksack/Samish	7%		7,184	91,988	50,000		84%
Skagit	30%		184,614	430,792	330,000		31%
Stillaguamish	36%		90,690	164,000	155,000		6%
Snohomish	37%		101,193	173,000	120,000		44%
South Sound	9%		1,319	13,283	25,000		-47%
Hood Canal	39%		33,467	20,065	125,000		-84%
Juan de Fuca	35%		1,490	4,848			
All Pink			419,957	897,976			
Fall Chum							
Nooksack/Samish	56%		54,738	35,610	20,800		71%
Skagit	9%		4,253	42,237	40,000		6%
Stillaguamish	59%		21,577	14,400	13,100		10%
Snohomish	51%		54,284	17,600	10,200		73%
South Sound	68%		361,258	150,923	64,350		135%
Hood Canal	49%		218,987	50,382	39,900		26%
Juan de Fuca	7%		137	2,585	3,600		-28%
All Fall Chum			715,234	313,737			

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

1 Escapement of naturally-spawning fall and winter chum salmon to streams in the seven management
2 units under Alternative 1 is predicted to be 313,737 fish. Under Alternative 1, escapement is predicted
3 to meet the co-managers' escapement goals by substantial margins for the Nooksack, Snohomish,
4 South Puget Sound, and Hood Canal chum salmon management units, and by low margins for the
5 Skagit and Stillaguamish management units. Escapement of naturally-spawning fall and winter chum
6 salmon is predicted to be substantially less than the goal for the Strait of Juan de Fuca Management
7 Unit (see Table 4.3-11).

8 **4.3.2.2 Alternative 2 – Escapement Goal Management at the Management Unit Level**

9 Impacts to Unlisted Puget Sound Salmon Populations and Comparison to Alternative 1

10 Under Alternative 2, the modeled total Southern U.S. catch of unlisted salmon species originating from
11 Puget Sound is predicted to be 197,691 coho salmon, zero sockeye salmon, 115,732 pink salmon, and
12 152,384 fall and winter chum salmon.

13 As shown in Table 4.3-12a, the co-managers' exploitation rate goals are predicted to be met under
14 Alternative 2 for all Puget Sound coho salmon management units by margins ranging from 26 to 62
15 percent. Exploitation rates on naturally-spawning coho salmon are predicted to be substantially lower
16 than with Alternative 1, by margins ranging from 24 to 56 percent, while coho escapement is predicted
17 to increase substantially, by margins ranging from 9 to 74 percent (see Table 4.3-12b).

18 With Alternative 2, Cedar River sockeye salmon fisheries would be closed, with the result that
19 escapement is predicted to increase by approximately 92,600 fish, bringing escapement to slightly over
20 the goal of 300,000. Catch of Baker River sockeye is predicted to be zero. The predicted increase in
21 Cedar River sockeye salmon escapement of approximately 24 percent would constitute a moderate
22 beneficial impact. The increased escapement of Baker River sockeye salmon would constitute a small
23 (low) beneficial impact relative to Alternative 1. Harvest of Puget Sound pink salmon is predicted to
24 decline by more than 339,000 compared to Alternative 1. Spawning escapement to the Nooksack and
25 South Puget Sound management units is predicted to increase by a small margin and by a substantial
26 margin (ranging from 22 to 58 percent) to the Skagit, Stillaguamish, Snohomish, Hood Canal, and
27 Strait of Juan de Fuca units (Table 4.3-12b). As with Alternative 1, escapements are not predicted to
28 meet the escapement goals for the South Sound and Hood Canal management units.

Section 4 - Environmental Consequences

Table 4.3-12a Performance of Alternative 2 relative to exploitation rate objectives or escapement goals for coho, sockeye, pink, and fall-winter chum salmon.

						Performance vs Standards:	
	Wild Exploitation Rate	Exploit. Rate Objective	Southern U.S. Catch	Natural Escapement	Escapement Goal	Exploitation Rate	Escapement
Coho							
Nooksack/Samish	13%	75%	7,386	14,272		-62%	
Skagit	6%	60%	5,019	109,887		-54%	
Stillaguamish	24%	50%	8,024	28,689		-26%	
Snohomish	19%	60%	47,594	165,820		-41%	
South Sound	33%		115,245	69,945			
Hood Canal	12%	65%	7,931	28,533		-53%	
Juan de Fuca	6%	40%	6,492	18,819		-34%	
All Coho			197,691	435,965			
Sockeye							
Skagit	0%		0	12,073	3,000		302%
South Sound	0%		0	362,292	350,000		4%
All Sockeye			0	237,256			
Pink							
Nooksack/Samish	0%		0	99,172	50,000		98%
Skagit	0%		0	615,406	330,000		86%
Stillaguamish	21%		54,331	200,360	155,000		29%
Snohomish	0%		34,800	274,192	120,000		128%
South Sound	4%		600	13,999	25,000		-44%
Hood Canal	16%		26,001	27,556	125,000		-78%
Juan de Fuca	15%		0	6,338			
All Pink			115,732	1,237,023			
Fall Chum							
Nooksack/Samish	1%		1,090	79,482	20,800		282%
Skagit	1%		252	46,071	40,000		15%
Stillaguamish	2%		852	34,194	13,100		161%
Snohomish	0%		239	35,583	10,200		249%
South Sound	16%		83,501	399,761	64,350		521%
Hood Canal	4%		66,448	95,473	39,900		139%
Juan de Fuca	2%		2	2,722	3,600		-24%
All Fall Chum			152,384	693,286			

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-12b Performance of Alternative 2 (Escapement goal management at the management unit level) relative to Alternative 1 for coho, sockeye, pink, and chum salmon.

	Changes Relative to Alternative 1					Type of Impact	Magnitude of Impact
	Wild Exploitation Rate	Southern U.S.Catch	Total Mortality	Natural Escapement	% Change Escapement		
Coho							
Nooksack/Samish	-37%	(33829)	(6,151)	6,090	74%	beneficial	substantial
Skagit	-31%	(37474)	(36,580)	36,263	49%	beneficial	substantial
Stillaguamish	-13%	(4045)	(4,782)	4,672	19%	beneficial	substantial
Snohomish	-14%	(29126)	(29,567)	28,947	21%	beneficial	substantial
South Sound	-22%	(131138)	(23,503)	22,859	49%	beneficial	substantial
Hood Canal	-30%	(34978)	(9,662)	9,521	50%	beneficial	substantial
Juan de Fuca	-8%	(8513)	(1,529)	1,499	9%	beneficial	low
All Coho		(279103)	(111774)	109851	34%		
Sockeye							
Skagit		(250)		250			
South Sound		(92600)		70,376			
All Sockeye		(92850)		250			
Pink							
Nooksack/Samish		(7184)	(7,184)	7,184	8%	beneficial	low
Skagit		(184614)	(184,611)	184,614	43%	beneficial	substantial
Stillaguamish		(36359)	(36,359)	36,360	22%	beneficial	substantial
Snohomish		(66393)	(101,192)	101,192	58%	beneficial	substantial
South Sound		(719)	(716)	716	5%	beneficial	low
Hood Canal		(7466)	(7,491)	7,491	37%	beneficial	substantial
Juan de Fuca		(1490)	(1,490)	1,490	31%	beneficial	substantial
All Pink		(304225)	(339043)	339047	38%		
Fall Chum							
Nooksack/Samish		(53648)	(43,872)	43,872	123%	beneficial	substantial
Skagit		(4001)	(3,834)	3,834	9%	beneficial	low
Stillaguamish		(20725)	(19,789)	19,794	137%	beneficial	substantial
Snohomish		(54045)	(17,983)	17,983	102%	beneficial	substantial
South Sound		(277757)	(248,838)	248,838	165%	beneficial	substantial
Hood Canal		(152539)	(45,091)	45,091	89%	beneficial	substantial
Juan de Fuca		(135)	(137)	137	5%	beneficial	low
All Fall Chum		(562,850)	(379,544)	379,549	121%		

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2002

1 Escapement of most naturally-spawning fall and winter chum salmon management units is predicted to
2 increase by more than 100 percent compared to Alternative 1. As with Alternative 1, chum salmon
3 escapement is predicted to meet the co-managers' escapement goals by substantial margins in all but
4 the Skagit and Strait of Juan de Fuca chum salmon management units. The increase in escapement for
5 the Skagit management unit is predicted to be low compared to Alternative 1, and the Strait of Juan de
6 Fuca management unit is not predicted to meet its escapement goal.

7 Based on the expected increases in escapement of naturally-spawning fish that are predicted to occur
8 under Alternative 2 relative to Alternative 1, the impacts of Alternative 2 to populations in the two
9 sockeye salmon management units would be beneficial, but low. Impacts to all other populations of
10 coho, fall and winter chum, and pink salmon are predicted to be moderately to substantially beneficial.
11 However, as explained previously, for populations where escapements exceed current goals by
12 substantial margins, the potential for density-dependent decreases in productivity due to competition
13 for mates, food, or territory would be heightened; therefore, natural production by these populations is
14 unlikely to increase in direct proportion to the predicted increase in spawning escapement.

15 **4.3.2.3 Alternative 3 – Escapement Goal Management at the Population Level With Terminal**
16 **Fisheries Only**

17 Impacts to Unlisted Puget Sound Salmon Populations

18 Under Alternative 3, the modeled total Southern U.S. catch of unlisted salmon species originating from
19 Puget Sound is predicted to be 157,753 coho salmon, zero sockeye salmon, 26,601 pink salmon, and
20 151,578 fall and winter chum salmon.

21 As shown in Table 4.3-13a, the co-managers' exploitation rate goals are predicted to be met under
22 Alternative 2 for all Puget Sound coho salmon management units by margins ranging from 34 to 62
23 percent. Exploitation rates on naturally-spawning coho salmon are predicted to be substantially lower
24 than with Alternative 1, by margins ranging from 8 to 37 percent, while coho escapement is predicted
25 to increase substantially, by margins ranging from 9 to 74 percent (see Table 4.3-13a).

Section 4 - Environmental Consequences

Table 4.3-13a Performance of Alternative 3 relative to exploitation rate objectives or escapement goals for coho, sockeye, pink, and fall-winter chum salmon.

						Performance vs Standards	
	Wild Exploitation Rate	Exploit. Rate Objective	Southern U.S. Catch	Natural Escapement	Escapement Goal	Exploitation Rate	Escapement
Coho							
Nooksack/Samish	13%	75%	7,386	14,272		-62%	
Skagit	6%	60%	5,019	109,887		-54%	
Stillaguamish	8%	50%	1,908	34,840		-42%	
Snohomish	8%	60%	13,772	187,066		-52%	
South Sound	33%		115,245	69,945			
Hood Canal	12%	65%	7,931	28,533		-53%	
Juan de Fuca	6%	40%	6,492	18,819		-34%	
All Coho			157,753	463,362			
Sockeye							
Skagit	0%		0	12,073	3,000		302%
South Sound	0%		0	224,422	350,000		-36%
All Sockeye				236,495			
Pink							
Nooksack/Samish	0%		0	99,172	50,000		98%
Skagit	0%		0	615,406	330,000		86%
Stillaguamish	0%		0	254,690	155,000		64%
Snohomish	0%		0	274,193	120,000		128%
South Sound	4%		600	13,999	25,000		-44%
Hood Canal	16%		26,001	27,556	125,000		-78%
Juan de Fuca	15%		0	6,338			
All Pink			26,601	1,291,354			
Fall Chum							
Nooksack/Samish	1%		1,090	79,482	20,800		282%
Skagit	1%		252	46,071	40,000		15%
Stillaguamish	0%		46	34,964	13,100		167%
Snohomish	0%		239	35,583	10,200		249%
South Sound	16%		83,501	399,761	64,350		521%
Hood Canal	4%		66,448	95,473	39,900		139%
Juan de Fuca	2%		2	2,722	3,600		-24%
All Fall Chum			151,578	694,056			

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

1 With Alternative 3, Cedar River sockeye salmon fisheries would be closed and escapement is predicted
2 to increase by approximately 92,600 fish, bringing escapement to slightly over the goal of 300,000
3 (Table 4.3-13a). Catch of Baker River sockeye is predicted to be zero. The predicted increase in Cedar
4 River sockeye escapement by approximately 24 percent would constitute a moderate beneficial impact.
5 The increased escapement of Baker River sockeye would constitute a small (low) beneficial impact
6 relative to Alternative 1 (Table 4.3-13b). Modeled harvest of Puget Sound pink salmon are predicted to
7 decline by more than 393,000 compared to Alternative 1. Spawning escapement is predicted to increase
8 by a small margin in the Skagit and South Puget Sound management units, and by a substantial margin
9 (ranging from 89 to 143 percent) in other management units. As with Alternative 1, pink salmon
10 escapements are not predicted to meet the escapement goals for the South Sound and Hood Canal
11 management units.

12 Escapement of most naturally-spawning fall and winter chum salmon management units is predicted to
13 increase by more than 100 percent compared to Alternative 1 (Table 4.3-13a). As with Alternative 1,
14 chum salmon escapement is predicted to meet the co-managers' escapement goals by substantial
15 margins in all but the Skagit and Strait of Juan de Fuca management units. The increase in escapement
16 for the Skagit management unit is predicted to be low compared to Alternative 1, and the Strait of Juan
17 de Fuca management unit is not predicted to meet its escapement goal (Table 4.3-13b).

18 Based on the predicted increases in escapement of naturally-spawning fish that would occur under
19 Alternative 3 relative to Alternative 1, the impacts of Alternative 3 on populations in the two sockeye
20 salmon management units would be beneficial, but low. Impacts to all other populations of coho
21 salmon, fall-winter chum salmon, and pink salmon would be moderately to substantially beneficial.
22 However, as explained previously, for populations where escapements exceed current goals by
23 substantial margins, the potential for density-dependent declines in productivity based on competition
24 for mates, food or territory would be heightened, with the result that natural production by these
25 populations is unlikely to increase proportionate to the predicted increase in spawning escapement.

Section 4 - Environmental Consequences

Table 4.3-13b Performance of Alternative 3 (Escapement goal management at the population level) relative to Alternative 1 for coho, sockeye, pink, and chum salmon.

	Changes Relative to Alternative 1					Type of Impact	Magnitude of Impact
	Wild Exploitation Rate	Southern U.S.Catch	Total Mortality	Natural Escapement	% Change Escapement		
Coho							
Nooksack/Samish	-37%	(33829)	(6,151)	6,090	74%	beneficial	substantial
Skagit	-31%	(37474)	(36,580)	36,263	49%	beneficial	substantial
Stillaguamish	-29%	(10161)	(10,969)	10,823	45%	beneficial	substantial
Snohomish	-25%	(62948)	(51,002)	50,193	37%	beneficial	substantial
South Sound	-22%	(131138)	(23,503)	22,859	49%	beneficial	substantial
Hood Canal	-30%	(34978)	(9,662)	9,521	50%	beneficial	substantial
Juan de Fuca	-8%	(8513)	(1,529)	1,499	9%	beneficial	low
All Coho		(319041)	(139396)	137248	42%		
Sockeye							
Skagit		(250)		250			
South Sound		(92600)		(67,494)			
All Sockeye		(92850)		250			
Pink							
Nooksack/Samish		(7184)	(7,184)	7,184	8%	beneficial	low
Skagit		(184614)	(184,611)	184,614	43%	beneficial	substantial
Stillaguamish		(90690)	(90,690)	90,690	55%	beneficial	substantial
Snohomish		(101193)	(101,192)	101,193	58%	beneficial	substantial
South Sound		(719)	(716)	716	5%	beneficial	low
Hood Canal		(7466)	(7,491)	7,491	37%	beneficial	substantial
Juan de Fuca		(1490)	(1,490)	1,490	31%	beneficial	substantial
All Pink		(393356)	(393374)	393378	44%		
Fall Chum							
Nooksack/Samish		(53648)	(43,872)	43,872	123%	beneficial	substantial
Skagit		(4001)	(3,834)	3,834	9%	beneficial	low
Stillaguamish		(21531)	(20,564)	20,564	143%	beneficial	substantial
Snohomish		(54045)	(17,983)	17,983	102%	beneficial	substantial
South Sound		(277757)	(248,838)	248,838	165%	beneficial	substantial
Hood Canal		(152539)	(45,091)	45,091	89%	beneficial	substantial
Juan de Fuca		(135)	(137)	137	5%	beneficial	low
All Fall Chum		(563,656)	(380,319)	380,319	121%		

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2002

1 **4.3.2.4 Alternative 4 – No Action/No Authorized Take**

2 Impacts to Unlisted Puget Sound Salmon Populations

3 Under Alternative 4, the modeled Southern U.S. catch of unlisted salmon species originating from
4 Puget Sound is 70,260 coho salmon, zero sockeye salmon, 6,459 pink salmon, and 38,877 fall and
5 winter chum salmon. The predicted catch would be the same under all scenarios.

6 Under Alternative 4, the No Authorized Take alternative, catch of unlisted salmonids would be limited
7 to terminal areas when naturally-spawning chinook salmon are absent. The effect of Alternative 4 is
8 predicted to be a further reduction in catch and exploitation rates, with further increases in escapement
9 of both natural- and hatchery-origin salmonids compared to Alternative 2 or 3. The exploitation rates
10 on coho salmon populations are predicted to decline to 6 to 8 percent. These rates are predicted to be
11 lower than with Alternative 1 by substantial margins (25 to 49%) (Table 4.3-14b). Spawning
12 escapement is predicted to increase substantially (by 168,000 for all management units) relative to
13 Alternative 1. Exploitation rate goals are predicted to be met for all management units, by margins
14 ranging from 34 to 68 percent (see Table 4.3-14a). With Alternative 4, Cedar River sockeye salmon
15 fisheries would be closed and escapement is predicted to increase by approximately 92,600 fish,
16 bringing escapement to slightly more than the goal of 300,000. Baker River sockeye salmon catch is
17 predicted to be zero. The predicted increase in Cedar River sockeye escapement by approximately 24
18 percent would constitute a moderate beneficial impact. The increased escapement of Baker River
19 sockeye would constitute a small (low) beneficial impact relative to Alternative 1.

20 Under Alternative 4, exploitation rates in Puget Sound fisheries for pink salmon are predicted to be
21 zero for the Nooksack, Skagit, Stillaguamish, Snohomish, and South Puget Sound management units.
22 Spawning escapement is predicted to increase by a low amount for the Nooksack and South Sound
23 management units, and substantially for the Skagit, Stillaguamish, Snohomish, Hood Canal, and Strait
24 of Juan de Fuca management units, compared to the outcome of Alternative 1 (Table 4.3-14b). As with
25 Alternative 2 or 3, it is predicted that escapement goals for pink salmon would be substantially
26 exceeded. Also as with Alternative 2 or 3, although escapements would increase for the South Puget
27 Sound and Hood Canal pink salmon management units, the escapement goals still would not be met.

Section 4 - Environmental Consequences

Table 4.3-14a Performance of Alternative 4 relative to exploitation rate objectives or escapement goals for coho, sockeye, pink, and fall-winter chum salmon.

						Performance vs Standards	
	Wild Exploitation Rate	Exploit. Rate Objective	Southern U.S. Catch	Natural Escapement	Escapement Goal	Exploitation Rate	Escapement
Coho							
Nooksack/Samish	7%	75%	2,463	15,305		-68%	
Skagit	6%	60%	6,409	110,022		-54%	
Stillaguamish	8%	50%	5,205	34,840		-42%	
Snohomish	8%	60%	1,910	187,066		-52%	
South Sound	6%		13,784	97,804			
Hood Canal	7%	65%	33,886	30,345		-58%	
Juan de Fuca	6%	40%	6,603	18,819		-34%	
All Coho			70,260	494,201			
Sockeye							
Skagit	0%		0	12,073	3,000		302%
South Sound	0%		0	224,422	350,000		-36%
All Sockeye				236,495			
Pink							
Nooksack/Samish	0%		0	99,172	50,000		98%
Skagit	0%		0	615,406	330,000		86%
Stillaguamish	0%		0	254,690	155,000		64%
Snohomish	0%		0	274,193	120,000		128%
South Sound				14,596	25,000		-42%
Hood Canal	10%		6,459	47,387	125,000		-62%
Juan de Fuca	15%		0	6,338			
All Pink			6,459	1,311,782			
Fall Chum							
Nooksack/Samish	1%		1,066	79,501	20,800		282%
Skagit	1%		252	46,071	40,000		15%
Stillaguamish	0%		46	34,964	13,100		167%
Snohomish	0%		239	35,583	10,200		249%
South Sound	7%		36,912	441,499	64,350		586%
Hood Canal			360	99,621	39,900		150%
Juan de Fuca	2%		2	2,722	3,600		-24%
All Fall Chum			38,877	739,961			

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2003.

Section 4 - Environmental Consequences

Table 4.3-14b Performance of Alternative 4 (No Fishing) relative to Alternative 1 for coho, sockeye, pink, and chum salmon.

	Changes Relative to Alternative 1					Type of Impact	Magnitude of Impact
	Wild Exploitation Rate	Southern U.S.Catch	Total Mortality	Natural Escapement	% Change Escapement		
Coho							
Nooksack/Samish	-43%	(38752)	(7,185)	7,123	87%	beneficial	substantial
Skagit	-31%	(36084)	(36,715)	36,398	49%	beneficial	substantial
Stillaguamish	-29%	(6864)	(10,969)	10,823	45%	beneficial	substantial
Snohomish	-25%	(74810)	(51,002)	50,193	37%	beneficial	substantial
South Sound	-49%	(232599)	(51,361)	50,718	108%	beneficial	substantial
Hood Canal	-35%	(9023)	(11,473)	11,333	60%	beneficial	substantial
Juan de Fuca	-8%	(8402)	(1,529)	1,499	9%	beneficial	low
All Coho		(406534)	(170234)	168087	52%		
Sockeye							
Skagit		(250)		250			
South Sound		(92600)		(67,494)			
All Sockeye		(92850)		250			
Pink							
Nooksack/Samish		(7184)	(7,184)	7,184	8%	beneficial	low
Skagit		(184614)	(184,611)	184,614	43%	beneficial	substantial
Stillaguamish		(90690)	(90,690)	90,690	55%	beneficial	substantial
Snohomish		(101193)	(101,192)	101,193	58%	beneficial	substantial
South Sound		(1319)	(1,313)	1,313	10%	beneficial	low
Hood Canal		(27008)	(7,597)	27,322	136%	beneficial	substantial
Juan de Fuca		(1490)	(1,490)	1,490	31%	beneficial	substantial
All Pink		(413498)	(394077)	413806	46%		
Fall Chum							
Nooksack/Samish		(53672)	(43,891)	43,891	123%	beneficial	substantial
Skagit		(4001)	(3,834)	3,834	9%	beneficial	low
Stillaguamish		(21531)	(20,564)	20,564	143%	beneficial	substantial
Snohomish		(54045)	(17,983)	17,983	102%	beneficial	substantial
South Sound		(324346)	(290,576)	290,576	193%	beneficial	substantial
Hood Canal		(218627)	(49,240)	49,239	98%	beneficial	substantial
Juan de Fuca		(135)	(137)	137	5%	beneficial	low
All Fall Chum		(676,357)	(426,225)	426,224	136%		

Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, December 2002

1 Fall and winter chum salmon harvest under Alternative 4 is predicted to be about 39,000, a decrease
2 relative to Alternative 1 of 676,357. Escapements of naturally-spawning fall and winter chum salmon
3 are predicted to increase substantially – by 426,224 fish under Alternative 4, or more than 100 percent
4 of the escapement goals for the Nooksack, Stillaguamish, Snohomish, Mid-Hood Canal, and South
5 Puget Sound units. However, it is predicted that the escapement goal for the Strait of Juan de Fuca unit,
6 for which the run size entering Puget Sound is predicted to be below the escapement goal, would not be
7 achieved (see Table 4.3-14b).

8 Based on the predicted increases in escapement of naturally-spawning fish that would occur under
9 Alternative 4 relative to Alternative 1, the impact of Alternative 4 on escapements of sockeye salmon,
10 Nooksack-Samish and South Sound pink salmon, and Skagit and Strait of Juan de Fuca chum salmon
11 are predicted to be beneficial, but of low magnitude. Impacts to all other populations of coho, fall-
12 winter chum, and pink salmon are predicted to be substantially beneficial. However, as discussed
13 above, escapement far in excess of current escapement goals raises the potential of intra- and inter-
14 specific density-dependent reductions in productivity due to competition for mates, food or territory.
15 For many coho salmon management units, exploitation rate objectives are based on stock recruit
16 functions which would predict that large increases in escapement would not result in substantial
17 increases in progeny (personal communication via e-mail from William Beattie, Northwest Indian
18 Fisheries Commission, Conservation Management Coordinator, to The William Douglas Company,
19 February 17, 2004).

20 **4.3.3 Non-Salmonid Fish Species**

21 Unlisted non-salmonid fish species potentially affected by the Proposed Action include the groundfish
22 and forage fish species discussed in Subsections 3.3.3, Non-Salmonid Fishes (Groundfish): Affected
23 Environment, and 3.3.4, Forage Species (Pacific Herring, Sandlance, Smelt): Affected Environment.
24 Impacts of the Proposed Action or alternatives to groundfish species would result from changes in the
25 incidental catch of these species in marine salmon fisheries. Impacts to forage fish species would be
26 related to possible changes in the predator-prey relationship resulting from changes in the marine
27 abundance of salmon.

28 According to Palsson (2002), marine salmon anglers take approximately 0.65 groundfish per trip.
29 Therefore, with Alternative 1, the incidental catch of groundfish species in sport salmon fisheries is
30 predicted to be approximately 241,765 groundfish, based on the area-wide average catch per trip.
31 Species comprising the recreational catch include Pacific halibut, other flatfish, lingcod, rockfish

1 (*Sebastes spp.*), Pacific cod, and dogfish, but the species composition of groundfish caught incidentally
2 during salmon fishing has not been quantified. Under Alternative 1, it is likely that sportfishing effort
3 would vary somewhat under the different scenarios, but it is difficult to predict how that variability
4 would affect the incidental catch of groundfish.

5 Under Alternative 2, 3, or 4 there would be no marine sport fisheries in Puget Sound, so incidental
6 catch of groundfish would be reduced by 100 percent with either of these alternatives. As discussed in
7 Subsection 3.3.3, commercial fisheries targeting salmon attempt to avoid incidental harvest of
8 groundfish species, and landings of groundfish species in commercial salmon fisheries are rarely
9 reported.

10 Under Alternative 2, most commercial salmon fisheries in marine areas would be closed (the marine
11 fisheries that would occur under Alternative 2 are nearshore using beach seines or set gillnets and
12 therefore are anticipated to have a negligible impact on groundfish), and under Alternative 3 or 4, all
13 commercial salmon fisheries in marine areas would be closed. Therefore, incidental catch of groundfish
14 under either of these alternatives would be eliminated relative to Alternative 1. This would represent a
15 substantial beneficial impact to these species. Chinook and coho salmon are key predators of sandlance,
16 herring, and smelt, the predominant forage fish species present in Puget Sound. Sockeye, chum and
17 pink salmon, particularly as juveniles, feed predominately on small, free-swimming crustacea, but
18 adults occasionally feed on forage fish species. The direct impacts of the Proposed Action or
19 alternatives would be related to reductions in catch under Alternative 2, 3, or 4 that would potentially
20 increase predation by adult salmon on these forage fish species during the period in which fisheries
21 would otherwise take place. Other effects would be indirect in nature, and are discussed below in
22 Subsection 4.3.8, Indirect and Cumulative Effects.

23 **4.3.4 Fish Habitat**

24 The primary impacts of salmon fisheries on fish habitat occur as a result of tribal and sport fisheries in
25 river areas, and include disruptions of spawning beds by wading fishermen and boat traffic, and, to a
26 lesser extent, degradation of streamside habitat. As required by the Magnuson-Steven's Conservation
27 and Management Act, NMFS conducted an essential fish habitat (EFH) consultation on the 2003 4(d)
28 determination and concluded that Alternative 1 (the Proposed Action) would not adversely affect
29 designated EFH for chinook salmon. NMFS is currently conducting an EFH consultation on the 2004-
30 2009 4(d) determination that will be complete for the Final Environmental Impact Statement. However,
31 since the anticipated fishery structure of the Proposed Action is similar to that of the 2003 fisheries
32 Resource Management Plan, the effects on EFH are also likely to be similar. Therefore, at this time,

1 NMFS does not anticipate Alternative 1 will adversely affect designated EFH. Fisheries modeled under
2 Alternatives 2 and 3 are predicted to increase the level of fishing effort in freshwater areas and,
3 potentially, would result in a possible low adverse impact on fish habitat. Fisheries modeled under
4 Alternative 4 are predicted to decrease fishing effort in freshwater areas relative to Alternative 1, and
5 are therefore predicted to eliminate the potential impact to fish habitat from these sources and would
6 thus be considered to have a no to low beneficial impact. However, regardless of the alternative
7 considered, these effects would occur to some degree through the occurrence of fisheries other than
8 those addressed in Alternative 1 (the Proposed Action); e.g., recreational freshwater trout or steelhead
9 fisheries, that do not take listed Puget Sound salmon species.

4.3.5 Marine-Derived Nutrients from Spawning Salmon

Nutrients provided by adult salmon to freshwater systems are, at the simplest level, directly related to the biomass of spawners of all species. However, as described in the Affected Environment (Subsection 3.3.5, Marine-Derived Nutrients from Spawning Salmon), highly complex processes determine how juvenile chinook salmon and other species benefit directly and indirectly from this source of nutrients.

This subsection refers to the modeled spawning escapement of all salmon species, converted to carcass biomass predicted to result from implementation of the Proposed Action or alternative harvest management regimes, and assesses the nutrient-related effects on the production and survival of juvenile chinook. At the current state of scientific inquiry in this field, the technical tools necessary to quantify nutrient loading in any one Puget Sound river system, or the differences in growth and survival of juvenile chinook in a system that would result from different spawner abundance of all salmon species, are not available.

Nutrient loading is affected by spawner density, which varies greatly among species and river reaches, and by stream flow, water temperature, stream channel structure, and a multitude of other factors that affect carcass and nutrient availability, decomposition, and retention (see Subsection 3.3.5, Marine-Derived Nutrients from Spawning Salmon: Affected Environment).

The following analysis compares adult salmonid escapement and spawner biomass among alternatives for Scenario B, because this scenario is the most likely combination of chinook abundance and fisheries to occur over the duration of the Proposed Action. The variability in escapement associated with the other Canadian/Alaskan fishery and abundance scenarios (A, C, or D) is noted, but does not influence the relative magnitude of the potential impact of the alternatives.

It must be noted that added nutrients, above current levels, may not be desirable in all streams. The Washington Department of Ecology reports that more than 2,600 bodies of water throughout Washington are listed under Section 303(d) of the Clean Water Act as Category 5, “polluted.” For those waters, and others with lesser water quality problems, increased nutrient loads may not provide a benefit to fish and wildlife. Lackey (2003) reminds us that federal and state legislation has, for many years, focused on reducing the nutrient and toxic pollutant input associated with human development, so intentionally managing salmonids to increase nutrient input has complex implications for public policy.

1 **4.3.5.1 Alternative 1 – Proposed Action/Status Quo**

2 To compare the consequences of the Proposed Action or alternatives, the biomass of spawning salmon
3 is compared for four river systems – the Skagit River, Snohomish River, Stillaguamish River, and the
4 Green-Duwamish River. These systems offer examples that contrast the variation in total spawner
5 biomass in different systems, and the contribution of chinook salmon to total spawner biomass. For this
6 analysis, biomass was approximated from modeled escapements and average weights for each species
7 (i.e., 15 pounds for chinook, 12 pounds for chum, 6 pounds for coho, and 4 pounds for pink salmon)
8 (personal communication with Robert Hayman, Skagit Systems Cooperative, Salmon Recovery
9 Biologist, August 19, 1999). Sockeye salmon are not included in this accounting, because they spawn
10 only in the Baker River drainage of the Skagit basin and in the Cedar River (Lake Washington system),
11 and therefore are not broadly representative of the species composition in Puget Sound watersheds with
12 spawning salmon.

13 Under Alternative 1, the co-managers' proposed harvest plan, total spawner biomass is projected to
14 exceed 2.86 million pounds in the Skagit River system, 1.80 million pounds in the Snohomish River
15 system, 1.00 million pounds in the Stillaguamish River system, and 0.15 million pounds in the Green-
16 Duwamish River system (Table 4.3.5-1). In the Skagit, Stillaguamish, and Snohomish River systems,
17 chinook salmon contribute a small proportion (i.e., 4% to 7%) of the total biomass, while coho, pink,
18 and chum salmon each comprise much larger proportions. By contrast, in the Green-Duwamish River,
19 coho and chum salmon escapement is relatively low, but chinook salmon comprise 59 percent of total
20 spawner biomass. Hatchery-origin chinook salmon comprise a relatively small proportion of chinook
21 salmon escapement to the Skagit, Stillaguamish, and Snohomish River systems, but a large proportion
22 of chinook salmon escapement to the Green-Duwamish River system. Chinook spawning escapement
23 is predicted to vary from 3 percent higher to 24 percent lower than Scenario B^{xiii}, if abundance and
24 Canadian/Alaskan fisheries varies as specified in Scenarios A, C, or D. Total spawning escapement

^{xiii} Spawning escapements projected to occur under Alternative 1 may vary substantially from the example provided above for some systems in some years. In the Skagit system, for example, total spawner biomass ranged from 1.0 to 5.2 million pounds in 1998 – 2002 (personal communication with Robert Hayman, Skagit River System Cooperative, August 2003). Units for which harvest is managed under exploitation rate objectives are predicted to experience variable escapement, increasing or decreasing in direct relation to total abundance. For some units managed under escapement goals, recent experience suggests that escapement may also exceed goals depending on abundance, but less so than under exploitation rate management since all abundance above the goal is considered available for harvest.

1 would also vary with changes in overall abundance and Canadian/Alaskan fisheries harvest levels, but
2 information is not currently available to quantify the amount.

3 Table 4.3.5-1 Biomass (pounds) of spawning salmon in the Skagit, Snohomish, and Green rivers,
4 under Alternative 1.

Chinook	Coho	Pink	Chum	Total
203,310	441,744	1,723,168	506,840	2,875,061
76,089	821,238	692,000	211,200	1,800,527
87,285	42,377	0	18,111	147,773
34,830	144,102	656,000	172,800	1,007,732

5 The extent to which these escapements promote or constrain the productivity of natural chinook salmon
6 populations cannot be quantified, due to factors discussed above and the lack of basin-specific
7 empirical understanding of the relationship between escapement, nutrient loading, and salmon
8 productivity. Intuitively, any factor that increases the growth rate of juvenile chinook salmon could,
9 potentially, increase their survival through their freshwater, estuarine, and early marine life stages, but
10 this effect has not been empirically demonstrated for Puget Sound chinook. Chinook populations that
11 characteristically produce high proportions of yearling smolts will be more likely to benefit, given their
12 extended freshwater residence, as is predicted to juvenile coho salmon and steelhead, all of which
13 reside in freshwater for more than one year before smolting. However, ocean-type chinook populations,
14 and pink and chum salmon, might also benefit from increased nutrient loading, particularly if it
15 increases prey availability in estuarine areas.

16 If nutrient loading currently imposes a primary constraint on juvenile salmon survival, then the
17 consequences of Alternative 1 are predicted to maintain the status quo in this regard. Nutrient-related
18 constraint of productivity rests on the assumption that the preferred prey of juvenile coho salmon is
19 limited by current nutrient loading such that, at some point in their early life history, the growth and
20 survival of juvenile salmon is reduced under current conditions. This hypothesis is supported by
21 numerous studies that consistently show increased growth rates among juvenile coho and steelhead
22 when carcass loading is increased (Bilby et al. 1998; and Wipfli et al. 1999).

23 If habitat conditions or other physical and biotic factors currently limit survival, maintaining recent
24 escapements will have little or no effect on chinook productivity. For example, circumstantial evidence
25 suggests this is the case in the Skagit River. The magnitude of peak river flow during the chinook

1 incubation period, presumably due to increased risk of scour and sediment deposition in spawning
2 areas, has correlated very closely with Age-0 chinook smolt production (Seiler et al. 2002 and 2000).
3 There is no odd-even year pattern of chinook smolt abundance or survival rate, as is predicted to be
4 expected if the observed variation in pink salmon carcass loading affected chinook survival. Though
5 such an effect is predicted to be statistically difficult to detect, given the overwhelming influence of
6 incubation period flow, there is no significant correlation between chinook salmon smolt abundance
7 and escapement of other species, even when the effects of flow are taken into account (personal
8 communication with Robert Hayman, Skagit River System Cooperative, Salmon Recovery Planner,
9 August 19, 1999).

10 This hypothesis will continue to be tested when the productivity of systems in which salmon
11 escapement has recently increased substantially is reassessed. Under Alternative 1, such monitoring is
12 required, and adjustment of management objectives is mandated, if studies determine that the
13 productivity of chinook or other salmon species is nutrient-limited.

14 **4.3.5.2 Alternative 2 – Escapement Goal Management at the Management Unit Level**

15 Under Alternative 2, Scenario B, total salmon spawner biomass is predicted to be 3.91 million pounds
16 in the Skagit River (36% higher than with Alternative 1), 1.84 million pounds in the Snohomish system
17 (2% higher than with Alternative 1), 1.40 million pounds in the Stillaguamish River system (39%
18 higher than with Alternative 1), and 0.20 million pounds in the Green-Duwamish River system (34%
19 higher than with Alternative 1) (Table 4.3.5-2).

20 Assuming no scouring floods and sufficient carcass retention time, a broader distribution of carcasses
21 throughout the river system might enhance primary and secondary local productivity. Detailed analysis
22 of spawner distribution is not available for this assessment; however, it may be possible that the
23 predominant abundance of pink and chum spawners is predicted to be sufficient to supply the nutrients
24 essential to the production of salmon prey species. This assumes that the carcasses are retained, and
25 that marine-derived nutrients drive production of prey in habitat that is utilized by juvenile chinook
26 salmon. However, presence of carcasses, and resultant higher productivity, might be inhibited by other
27 habitat factors, such as incubation period flows or the availability of suitable spawning or rearing
28 habitat. If, on the other hand, habitat is not limiting, Alternative 2 could have a beneficial effect on
29 nutrient loading and subsequent production. Therefore, although spawner biomass is predicted to be
30 substantially higher with Alternative 2 compared to Alternative 1 for all of the four of the example
31 systems, it is not possible for these reasons to predict the difference in effects on the productivity of
32 chinook salmon or other species.

1 Table 4.3.5-2 Biomass (pounds) of spawning salmon in the Skagit, Snohomish, and Green rivers,
 2 under Alternative 2.

Chinook	Coho	Pink	Chum	Total
250,956	659,322	2,461,623	552,851	3,924,752
82,123	1,122,396	1,096,771	426,993	2,728,284
87,000	62,951	0	47,971	197,922
37,020	209,040	1,018,762	419,565	1,684,387

3 For chinook salmon populations that would be managed under exploitation rate objectives with
 4 Alternative 1 (i.e., the Skagit, Stillaguamish, and Snohomish management units), changing to
 5 escapement goal management is predicted to result in more stable numbers of spawners, provided that
 6 these goals were consistently achieved. This outcome is predicted to depend on accurate forecasting
 7 methods and low management error (see Subsection 4.3.8, Indirect and Cumulative Effects). The
 8 objectives for populations for which harvest is already managed to achieve escapement goals is
 9 predicted to not change with Alternative 2, but under the Puget Sound chinook abundance scenarios
 10 considered by this review, escapement goal management is predicted to virtually preclude marine
 11 harvest. Spawning escapement relative to Alternative 1 is predicted to increase as a result, particularly
 12 where terminal fisheries could not completely harvest the surplus of all species.

13 **4.3.5.3 Alternative 3 – Escapement Goal Management at the Population Level with Terminal**
 14 **Fisheries Only**

15 The spawning biomass for all species of salmon, and resultant nutrient loading, is predicted to increase
 16 substantially relative to Alternative 1, if Alternative 3 were implemented. Under Alternative 3, total
 17 biomass of spawning salmon is predicted to be 36 percent higher in the Skagit River system, 52 percent
 18 higher in the Snohomish River system, 67 percent higher in the Stillaguamish River system, and 34
 19 percent higher in the Green-Duwamish River system, relative to Alternative 1 (Table 4.3.5-3). As with
 20 Alternative 2, the contribution of chinook salmon to total nutrient loading is predicted to be slightly
 21 less than with Alternative 1, because the virtual closure of all marine-area fisheries is predicted to result
 22 in proportionately greater escapement of other species.

23 The effect of the projected increase in total salmon escapement on the productivity of chinook or other
 24 salmon species in these example systems, or within the Puget Sound ESU in general, cannot be
 25 quantified with current information due to the degree of variability in the environmental factors
 26 discussed above. As described above, juvenile chinook salmon with extended freshwater rearing

1 (particularly those that smolt as yearlings) are predicted to be more likely to benefit from Alternative 3.
 2 But the nutrient loading (i.e., carcass density) thresholds necessary to support optimal primary and
 3 secondary productivity have not been determined for any Puget Sound basin. Therefore, the
 4 consequences to individual populations of implementing Alternative 3 are unknown, and are predicted
 5 to vary among different river systems. Also, if current habitat conditions create a primary constraint on
 6 system capacity and productivity, any beneficial effects of increased spawner abundance and nutrient
 7 loading may be offset by increased competition for suitable spawning habitat, redd superimposition, or
 8 overcrowding of rearing habitat. If, on the other hand, habitat is not limiting, Alternative 3 could have a
 9 beneficial effect on nutrient loading and subsequent production. Therefore, although spawner biomass
 10 is predicted to be substantially higher compared to Alternative 1 for all four of the example systems, it
 11 is not possible for these reasons to predict the difference in effects on the productivity of chinook
 12 salmon or other species.

13 Table 4.3.5-3 Biomass (pounds) of spawning salmon in the Skagit, Snohomish, and Green rivers,
 14 under Alternative 3.

Chinook	Coho	Pink	Chum	Total
250,937	659,322	2,461,623	552,851	3,924,734
69,514	244,914	1,096,771	426,993	1,838,192
87,000	62,951	0	47,971	197,922

13,545	172,134	801,439	410,333	1,397,452
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15 **4.3.5.4 Alternative 4 – No Action/No Authorized Take**

16 Preclusion of all fisheries that harvest listed chinook salmon, as envisioned under Alternative 4, is
 17 predicted to result in substantially higher spawning escapement of all salmon species, and possibly
 18 substantially higher nutrient loading than is predicted to occur with Alternative 1. Total spawner
 19 biomass is predicted to be 37 percent higher in the Skagit River system, 52 percent higher in the
 20 Snohomish River system, 67 percent higher in the Stillaguamish River system, and 98 percent higher in
 21 the Green-Duwamish River system, compared to Alternative 1 (Table 4.3.5-4).

22 As noted in the preceding discussion, the effects of higher spawner biomass cannot be assumed to
 23 increase the productivity of chinook or other salmon species. Increases in productivity are predicted to
 24 be expected where nutrient input now limits prey availability, with consequent effect on the growth and
 25 survival of juvenile salmon. Increase in survival is predicted to only be realized if other habitat
 26 constraints on survival were addressed. Competition for suitable spawning areas, and other density-

1 dependent factors may also counteract the potential nutrient-related benefit to growth and survival of
2 juvenile chinook salmon. Therefore, although spawner biomass is predicted to be substantially higher
3 with Alternative 4 compared to Alternative 1 for all four of the example systems, it is not possible for
4 these reasons to predict the difference in effects on the productivity of chinook salmon or other species.

5 Table 4.3.5-4 Biomass (pounds) of spawning salmon in the Skagit, Snohomish, and Green rivers,
6 under Alternative 4.

Chinook	Coho	Pink	Chum	Total
250,956	660,132	2,461,623	552,851	3,925,562
82,562	1,122,396	1,096,771	426,993	2,728,723
158,370	88,024	0	52,980	299,374

37,020	209,040	1,018,762	419,565	1,684,387
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1 **4.3.6 Selectivity on Biological Characteristics of Salmon**

2 Puget Sound fisheries regimes would vary substantially between the Proposed Action and alternatives
3 considered in this Environmental Assessment, with respect to their selective effects on target species.
4 This section qualitatively compares their effects, focusing on chinook salmon since that is the subject
5 of the Proposed Action. It must be stated at the outset that a quantitative or theoretical analysis of the
6 selective effects of current or historical fishing regimes has not been done in Puget Sound, except on a
7 limited basis (Hard 2004). As described in the Affected Environment (Subsection 3.3.7), long-time
8 series of data describing the age composition and size of chinook salmon in catch and on the spawning
9 grounds exist for many Puget Sound chinook salmon populations. However, the quality of the data vary
10 greatly from population to population. Better data generally exist for returns to hatcheries. The causes
11 for observed variation or trends in these biological characteristics are highly complex and confounded
12 with each other. The influence of fisheries selectivity on variation and trends cannot be isolated from
13 environmental and other causes. Furthermore, historical data reflect a constantly-changing fishing
14 regime in fisheries inside and outside of Washington, particularly during the last decade (1991–2001).
15 The selective effects of historically higher fishing pressure, for all gear types, are likely to have
16 declined substantially as exploitation rates on Puget Sound chinook salmon have fallen (PSIT and
17 Washington Department of Fish and Wildlife 2004). The relative harvest rates exerted by different gear
18 types, and the distribution of effort by different gear types, have changed dramatically over the last 30
19 years. Furthermore, fishing regimes like those envisioned under Alternative 2 or 3 have never existed
20 in Puget Sound, so their effects are necessarily a matter of conjecture.

21 Review of the scientific literature (discussed in Subsection 3.3.7) suggests that Puget Sound fisheries
22 would exert some degree of selectivity on the size- or age-composition of chinook salmon, but
23 available data do not indicate any changes or trends in the age composition of catch or escapement over
24 the last several decades. Hard (2004) concluded that selective effects over a 25 year period would be
25 negligible or low at harvest rates less than approximately 40 percent. Exploitation rates on most
26 chinook salmon populations associated with Puget Sound fisheries during the 2004–2009 fishing
27 seasons are projected to fall well below this level in fishing regimes examined in this Environmental
28 Impact Statement.

29 Since the pattern of exploitation rates across alternatives is similar for each scenario and cannot be
30 quantitatively related to changes in size or age except on a very gross scale, the results have been
31 combined across scenarios and are presented only by alternative for the purposes of the selective
32 effects discussion.

1 **4.3.6.1 Alternative 1 – Proposed Action/Status Quo**

2 The Proposed Action represents a diverse spatial and temporal array of commercial net and recreational
3 hook-and-line fisheries in marine and freshwater areas of Puget Sound. Some net fisheries would
4 operate in the Strait of Juan de Fuca, Rosario Strait, and the Strait of Georgia, where stocks originating
5 in Puget Sound and British Columbia commingle. These fisheries target sockeye, pink, and chum
6 salmon, and harvest relatively few chinook salmon. Non-treaty purse seine vessels are required to
7 release chinook salmon, and seines are designed to reduce the catch of immature chinook. In aggregate,
8 these fisheries are likely to exert relatively low selective effects on chinook salmon.

9 Gillnet fisheries predominate commercial harvest of chinook salmon in other marine and freshwater
10 areas in Puget Sound; e.g., Bellingham Bay/Samish Bay, Skagit Bay/Saratoga Passage, Port
11 Susan/Possession Sound, central and south Puget Sound, and Hood Canal. The selectivity of gillnet
12 gear is directly related to the mesh size, which is commonly expressed as the stretched diagonal
13 dimension. Fishing regulations specify the mesh dimension for each gillnet fishery; different mesh
14 sizes are specified for each target species. Chinook-directed gillnet fisheries typically use 6½-inch
15 mesh, which is ineffective in capturing the smallest and largest size classes of chinook salmon. Pink-
16 and coho-directed salmon fisheries typically use smaller mesh (e.g., 5-inch), which captures fewer
17 large chinook, and a larger number of smaller chinook salmon. Capture efficiency is also affected by
18 many other factors, including ambient light, water clarity, net design (hanging), and current. The size-
19 or age-composition of chinook salmon before and after they encounter a net fishery has not been
20 experimentally compared in Puget Sound, so the vulnerability of different ages or sizes of chinook
21 salmon has not been quantified.

22 Each year, Puget Sound fisheries during the 2004–2009 fishing seasons will harvest varying
23 proportions of five cohorts of chinook salmon (i.e., Age-2, 3, 4, 5, and 6 fish). During that period,
24 Puget Sound fisheries will affect the dominant age classes of five brood cycles (brood years
25 2001–2005). As discussed in Subsection 3.3.7, the majority of harvest will be of Age-3 to Age-5 fish,
26 with Age-4 fish comprising the largest proportion. The primary concern is that Puget Sound fisheries
27 might remove a large proportion of older, larger chinook salmon, or chinook that, if not harvested,
28 would be larger and older at maturity, and that depleted of these age and size classes, spawners that
29 escape fisheries would be less productive. However, the magnitude of the immediate effect on the
30 cohorts of a population that are vulnerable to fishing in a given year will depend on fishing pressure
31 (exploitation rate) and how the fishing season is structured. Under Alternative 1, annual exploitation
32 rates would range from 17 to 76 percent on Puget Sound chinook management units depending on the

1 scenario; rates would be below 40 percent for 10 of the 15 management units (Table 4.3.6.1-1).
2 Southern U.S. exploitation rates would range from 5 to 68 percent depending on the scenario and
3 management unit; rates would be below 40 percent for twelve of the fifteen management units (Table
4 4.3.6.1-1). For most natural units, then, under Alternative 1, two-thirds of the management units would
5 experience total exploitation rates below the level where selective effects might occur (Hard 2004).
6 Only three management units (Green-Duwamish, Nisqually and Skokomish) would experience
7 exploitation rates above this level directly as a result of southern U.S. fisheries (primarily in Puget
8 Sound) (Table 4.3.6.1-2). Commercial fisheries would not operate continuously through the fishing
9 season. In most fishing areas, commercial openings would be scheduled for one to three days per week.
10 This *pulsed* schedule is designed to distribute harvest mortality and escapement across the entire
11 migration timing of the population(s) present in that area. Recreational fisheries would generally open
12 for longer periods, though effort is expected to be much higher on weekends and holidays. Recreational
13 fisheries that target immature chinook salmon in the winter and spring (November through April)
14 would be open for intermittent month-long periods (i.e., they would not operate continuously for 6
15 months).

16 If the Alternative 1 fisheries regime were implemented for the 2004–2009 management years, it would
17 exert minor changes to the age and size composition of most Puget Sound chinook salmon populations
18 that, absent fishing, would spawn naturally. Each year, the fishery will influence the age and size
19 composition of spawners in that year, and in three or four subsequent years (i.e., when the youngest
20 cohort contributing to that year’s fishery matures). As a result, fisheries implemented under Alternative
21 1 during the 2004–2009 fishing seasons would affect the dominant age classes of five brood cycles
22 (brood years 2001–2005). Similarly, the composition of spawners in 2004–2006 will have already been
23 influenced by fisheries prior to 2004. If, as some studies assert, the productivity of a given population
24 is, under adverse freshwater conditions, more dependent on the higher fecundity and spawning success
25 (i.e., number of fertilized eggs per female) of older, larger fish, then the productivity of the period
26 2004–2009 broods might be lower as a result of fishing. Data are not available to estimate the
27 magnitude of the short-term effect (i.e., the reduction in recruits per spawner for, say, the 2004 brood)
28 for any of the affected broods, nor has it been estimated empirically for any previous brood year. Smolt
29 production is strongly influenced by complex environmental factors, and is particularly sensitive to the
30 magnitude of high flows during the incubation season (Seiler et al 2000). Though redds constructed by
31 older or larger females may be somewhat less vulnerable to high flow, the reduction in productivity
32 implied by a slightly lower proportion of older spawners cannot be estimated in the face of high
33 uncertainty about flow conditions that will prevail in the winters of 2004–2010.

1 Further circumstantial evidence suggests that the long-term selective effects of fisheries are predicted
2 to be minor, if not undetectable. The average fecundity of mature Skagit River summer chinook salmon
3 has not declined from 1973 to the present (Orrell 1976; and SSC 2002). The age composition of Skagit
4 River summer/fall chinook salmon harvested in the terminal area has varied widely over the last 30
5 years, particularly with respect to the proportions of Age-3 and Age-4 fish, but there is no declining
6 trend in the contribution of Age-5 fish, which has averaged 15 percent (Henderson and Hayman 2002;
7 and R. Hayman, Skagit Systems Cooperative December 9, 2002, personal communication). As
8 described in Subsection 3.3.7, no decline in average age has been detected for other Puget Sound
9 chinook salmon populations for which data are available (Figure 3.3.7-2), including the Green-
10 Duwaumish which commonly experienced fishery exploitation rates of 60 to 70 percent through the
11 early 1990s. Declining total exploitation rates on most natural chinook salmon stocks in Puget Sound in
12 the last ten years (1991–2001) from averages of 70 to 90 percent to averages of 30 to 50 percent, due in
13 part to decline in exploitation rates in Puget Sound fisheries, would suggest that selective pressure has
14 also been reduced.

15 In light of the information presented above, implementation of Alternative 1 is predicted to have a no to
16 low negative effect on size and age as a result of the size-selective effects of fishing.

1 Table 4.3.6.1-1. Range of expected total exploitation rates by Puget Sound chinook management unit
 2 during the period 2004–2009. Exploitation rates greater than 0.4 are shaded.

Puget Sound Chinook (Management Unit/Population)	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum
Dungeness Spring	0.22	0.29	0.19	0.26	0.19	0.26	0.19	0.26
Western Strait-Hoko	0.23	0.30	0.19	0.26	0.19	0.26	0.19	0.26
Elwha	0.22	0.30	0.19	0.26	0.19	0.26	0.19	0.26
Nooksack Spring	0.20	0.26	0.14	0.20	0.14	0.20	0.14	0.20
Skagit								
Spring	0.23	0.28	0.12	0.17	0.12	0.17	0.12	0.17
Upper Sauk								
Suiattle								
Upper Cascade								
Summer/Fall	0.48	0.56	0.32	0.43	0.32	0.43	0.32	0.43
Lower Sauk								
Upper Skagit								
Lower Skagit								
Stillaguamish	0.17	0.20	0.52	0.67	0.08	0.11	0.08	0.11
Snohomish	0.19	0.23	0.10	0.23	0.10	0.13	0.09	0.13
Lake Washington	0.31	0.38	0.18	0.25	0.18	0.25	0.18	0.25
Green-Duwamish	0.49	0.63	0.36	0.56	0.36	0.56	0.18	0.25
Puyallup	0.49	0.50	0.57	0.71	0.57	0.71	0.18	0.25
Nisqually	0.64	0.76	0.61	0.73	0.61	0.73	0.16	0.23
White Spring	0.20	0.20	0.22	0.46	0.22	0.46	0.02	0.03
Mid-Canal	0.26	0.34	0.19	0.28	0.19	0.28	0.19	0.28
Skokomish	0.45	0.63	0.43	0.61	0.43	0.61	0.19	0.28

3
 4 Table 4.3.6.1-2. Range of expected southern U.S. exploitation rates by Puget Sound chinook
 5 management unit during the period 2004–2009. Exploitation rates greater than 0.4 are
 6 shaded.

Puget Sound Chinook (Management Unit/Population)	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum
Dungeness Spring	0.05	0.05	0.01	0.01	0.01	0.01	0.01	0.01
Western Strait-Hoko	0.05	0.05	0.01	0.01	0.01	0.01	0.01	0.01
Elwha	0.05	0.05	0.01	0.01	0.01	0.01	0.01	0.01
Nooksack Spring	0.07	0.07	0.01	0.01	0.01	0.01	0.01	0.01
Skagit								
Spring	0.14	0.15	0.02	0.02	0.02	0.02	0.02	0.02
Upper Sauk								
Suiattle								
Upper Cascade								
Summer/Fall	0.16	0.18	0.00	0.01	0.00	0.01	0.00	0.01
Lower Sauk								
Upper Skagit								
Lower Skagit								
Stillaguamish	0.11	0.12	0.43	0.60	0.02	0.02	0.02	0.02
Snohomish	0.13	0.14	0.03	0.16	0.10	0.13	0.03	0.03
Lake Washington (Cedar River)	0.20	0.23	0.05	0.05	0.05	0.05	0.05	0.05
Green-Duwamish	0.36	0.51	0.18	0.42	0.18	0.42	0.05	0.05
Puyallup	0.35	0.39	0.39	0.57	0.39	0.57	0.05	0.05
Nisqually	0.53	0.68	0.47	0.63	0.47	0.63	0.07	0.08
White Spring	0.17	0.19	0.20	0.46	0.20	0.46	0.01	0.01
Mid-Canal	0.12	0.13	0.05	0.05	0.05	0.05	0.05	0.05
Skokomish	0.26	0.50	0.23	0.46	0.23	0.46	0.05	0.05

4.3.6.2 Alternative 2 – Escapement Goal Management at the Management Unit Level

Implementation of Alternative 3 for the 2004–2009 management years would preclude marine net and recreational fisheries in Puget Sound except for a small marine net fishery in Tulalip Bay, and substantially reduce exploitation rates on most chinook salmon natural management units. The size-selective effects of pre-terminal net fisheries predicted to occur under Alternative 1, would not occur. Except for the limited Tulalip Bay fishery, gillnet fishery effects would be confined to those associated with in-river fisheries, and further confined to fisheries directed at other species in most rivers. The selective effects of recreational fisheries, which with Alternative 1 would operate under a 22-inch minimum size restriction, would also be eliminated.

The consequences of implementing Alternative 2, however, cannot be quantified in terms of a change in the age- or size-composition of chinook spawners during the period 2004–2009. Though exploitation rates would be lower for most populations relative to Alternative 1, these would be declines from already-low rates for most populations in the ESU. In addition, although overall, rates would be lower than under Alternative 1, exploitation rates would generally be greater than 40 percent for many of the same management units noted under Alternative 1. The range of exploitation rates for two additional management units (White River [upper end of range only] and Stillaguamish) are anticipated to exceed 40 percent, significantly greater than the rates anticipated under Alternative 1. Seven management units could exceed 40 percent exploitation rate as compared with five management units under Alternative 1, although the lower end of the range for the Skagit summer/fall and Green-Duwamish management units would be below 40 percent under Alternative 2 (Table 4.3.6.1-1). Six management units would be expected to exceed 40 percent exploitation in southern U.S. fisheries compared with three under Alternative 1 (Table 4.3.6.1-2). However, where exploitation rates would be lower than under Alternative 1, it is reasonable to expect that the proportion of older and larger fish in the escapement in many rivers would increase slightly; i.e., decreasing selective effects. On the other hand, the shift to terminal-area fishing could increase the use of selective gear types; i.e., gillnets and hook-and-line recreational gear, and the greater number of management units anticipated to exceed 40 percent exploitation could mean an increase in selective effects compared with Alternative 1. For these reasons, there is too much uncertainty to predict the effects of implementing Alternative 2 on selective fishing effects.

1 **4.3.6.3 Alternative 3 – Escapement Goal Management at the Population Level with Terminal**
2 **Fisheries Only**

3 Implementation of Alternative 3 for the 2004–2009 management years would preclude marine net and
4 recreational fisheries in Puget Sound, and substantially reduce exploitation rates on most chinook
5 salmon natural populations. The size-selective effects of pre-terminal net fisheries predicted to occur
6 under Alternative 1, would not be occur under Alternative 3. Gillnet fishery effects would be confined
7 to those associated with in-river fisheries, and further confined to fisheries directed at other species in
8 most rivers. The selective effects of marine recreational fisheries, which with Alternative 1 would
9 operate under a 22-inch minimum size restriction, would also be eliminated.

10 Since, except for the Tulalip Bay and Stillaguamish fisheries in Alternative 2, the fisheries under
11 Alternative 3 would be identical to those under Alternative 2, it is also anticipated that the selective
12 fishing effects would be similar. Under Alternative 3, 6 management units out of 15 would be
13 anticipated to exceed 40 percent exploitation rate, as compared with five under Alternative 1 and seven
14 under Alternative 2. Five management units would be anticipated to exceed 40 percent exploitation rate
15 in southern U.S. fisheries as compared with three under Alternative 1 and six under Alternative 2. For
16 the reasons described under Alternative 2, there is too much uncertainty to predict the effects of
17 implementing Alternative 3 on selective fishing effects.

18 **4.3.6.4 Alternative 4 – No Action/No Authorized Take**

19 The closing of all fisheries that involve any take of listed Puget Sound chinook salmon would
20 substantially lower exploitation rates on all populations relative to Alternative 1, and would eliminate
21 any size- and age-selective effects associated with Puget Sound gillnet and recreational fisheries. The
22 short-term consequences would include a substantial increase in escapement to all chinook salmon-
23 producing rivers, and there would likely be some increase in proportions of ages and size represented in
24 the spawning population. Given that size-selective effects have not been observed in Puget Sound
25 chinook salmon, and decreases in exploitation rates would, in most cases, be from levels that are
26 anticipated to cause low levels of size-selective effects at most, implementation of Alternative 3 is
27 predicted to have no to low beneficial effects compared to Alternative 1.

1 **4.3.7 Hatchery-Related Fishery Effects On Salmon: Straying and Overfishing**

2 As discussed in Subsection 3.3.7 of this Environmental Impact Statement, there are two hatchery-
3 related effects to natural-origin salmon associated with fishing. The first is straying of hatchery-origin
4 fish that are not caught, onto the spawning grounds where they may interact with natural populations
5 potentially leading to a decrease in overall natural population productivity. Since not all hatchery fish
6 return to the hatchery, any increases in hatchery returns could be expected to increase the probability
7 for higher numbers of hatchery fish spawning in the wild. The much greater escapements of hatchery
8 coho and chum salmon could exacerbate inter-species predation, competition and genetic diversity
9 effects in some areas. The second hatchery-related effect is the potential to overfish natural populations
10 while pursuing harvestable hatchery-origin fish. One of the purposes of the Proposed Action is to create
11 opportunities to harvest commingled populations, including hatchery-raised chinook, while providing
12 an adequate level of protection to natural chinook salmon populations. In attempting to maximize
13 harvest of hatchery fish, the commingled natural fish could be overharvested; i.e., harvested at a rate
14 that is not sustainable based on the underlying productivity of the natural population. The potential
15 effects on Puget Sound chinook salmon populations from overfishing are discussed in Section 4.3.1,
16 which quantifies the impacts of the Proposed Action and alternatives in terms of exploitation rate and
17 escapement of natural Puget Sound chinook populations. These effects will not be discussed further
18 here.

19 Estimated escapement patterns for chinook salmon under the Proposed Action or alternatives for
20 purposes of evaluating the two potential hatchery-related effects on natural-origin salmon are presented
21 in Tables 4.3.7-1 through 4.3.7-5 by scenario. Potential contribution of hatchery-origin chinook salmon
22 adults to the naturally-spawning population is presented in Table 4.3.7-7. Estimated escapement
23 patterns for coho and chum are presented in Tables 4.3.7-8 and 4.3.7-9. The model runs on which these
24 numbers are based are found in Appendix B. These are the Puget Sound salmon species with the largest
25 hatchery production, and therefore the species with the greatest potential for hatchery-related effects.
26 Puget Sound hatchery production of pink and sockeye salmon is relatively small by comparison.
27 Results for chinook salmon are presented by alternative and scenario, with the discussion of
28 comparison among alternatives focused on Scenario B, since that is the most likely to occur during
29 implementation of the Proposed Action (see Subsection 4.2, Basis for Comparison of Alternatives and
30 Approach to Alternatives Analysis, for background discussion.)

1 **4.3.7.1 Straying of Hatchery Chinook**

2 Under the alternatives analyzed, hatchery escapement would vary in concert with natural escapement.
3 Alternative 4 (No Authorized Take/Status Quo) is predicted to result in the highest escapement levels,
4 for both hatchery- and naturally-spawning chinook, regardless of scenario. In most cases, Alternative 1
5 is predicted to result in the lowest overall hatchery escapement levels, and the lowest natural
6 escapement for the Strait of Juan de Fuca, North Puget Sound, and Hood Canal populations (Table
7 4.3.7-1). Total natural chinook escapement is predicted to show no to low changes (-6% to +3%) under
8 Alternatives 2 or 3 compared with Alternative 1, and low to moderate changes in total hatchery
9 escapement, with the direction of change depending on the scenario. Compared with Alternative 1,
10 Alternative 4 is predicted to result in substantial increases in total natural escapement of chinook
11 salmon when abundance is similar to that in 2003 (Scenarios A or B), and moderate increases in
12 escapement when abundance is low (Scenarios C or D). Hatchery escapements under Alternative 4 are
13 predicted to substantially increase under all scenarios (62 to 89%) (Table 4.3.7-1).

Section 4 – Environmental Consequences

1 Table 4.3.7-1. Comparisons of hatchery- and naturally-spawning chinook salmon escapement with the
 2 Proposed Action or alternatives by scenario. Substantial differences (greater than 30%)
 3 in escapement from Alternative 1 are shaded.

CHINOOK	Scenario A						Scenario B					
	Comparisons to the Proposed Action						Comparisons to the Proposed Action					
	Natural Escapement			Hatchery Escapement			Natural Escapement			Hatchery Escapement		
	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1
Juan de Fuca												
Dungeness Spring	2%	2%	2%				2%	2%	2%			
Western Strait-Hoko	3%	3%	3%				3%	3%	3%			
Elwha	2%	2%	2%				2%	2%	2%			
Regional Average	2%	2%	2%				3%	3%	3%			
North Sound												
Nooksack Spring	9%	9%	9%				13%	13%	13%			
Nooksack/Samish summer-fall				237%	237%	0%				1%	1%	1%
Skagit												
Spring	8%	8%	8%	8%	8%	8%	9%	9%	9%	9%	9%	9%
Summer/Fall	26%	26%	26%				26%	26%	26%			
Stillaguamish	-61%	6%	6%				-60%	7%	7%			
Snohomish	-9%	8%	9%	-12%	8%	19%	-6%	10%	10%	-9%	20%	20%
Tulalip Tribal Hatchery				99%	7974%	7974%				101%	7990%	7990%
Regional Average	-5%	11%	12%	78%	85%	9%	-4%	13%	13%	0%	10%	10%
South Sound												
Lake Washington (Cedar River)	1%	1%	1%	18%	18%	18%	0%	0%	0%	19%	19%	19%
Green-Duwamish	0%	0%	81%	19%	19%	116%	0%	0%	75%	19%	19%	109%
Puyallup	-50%	-50%	37%	-53%	-53%	99%	-50%	-50%	31%	-54%	-54%	86%
Nisqually	-1%	-1%	202%	0%	0%	204%	-2%	-2%	190%	-2%	-2%	191%
White Spring	-32%	-32%	25%				-31%	-31%	23%			
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes				31%	31%	42%				29%	29%	40%
Regional Average	-16%	-16%	69%	3%	3%	96%	-17%	-17%	64%	2%	2%	89%
Hood Canal												
Mid-Canal	4%	4%	4%				5%	5%	5%			
Skokomish	1%	1%	105%	1%	1%	100%	0%	0%	92%	0%	0%	88%
Hoodsport H, Dewato, Union, & Tahuya tribs.	6%	6%	6%	-67%	-67%	237%	6%	6%	6%	-66%	-66%	235%
Regional Average	2%	2%	54%	26%	26%	77%	2%	2%	48%	26%	26%	77%
Average	-6%	0%	33%	17%	19%	89%	-5%	0%	31%	-9%	-6%	84%

CHINOOK	Scenario C						Scenario D					
	Comparisons to the Proposed Action						Comparisons to the Proposed Action					
	Natural Escapement			Hatchery Escapement			Natural Escapement			Hatchery Escapement		
	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1
Juan de Fuca												
Dungeness Spring	2%	2%	2%				3%	3%	3%			
Western Strait-Hoko	3%	3%	3%				4%	4%	4%			
Elwha	2%	2%	2%				3%	3%	3%			
Regional Average	3%	3%	3%				3%	3%	3%			
North Sound												
Nooksack Spring	9%	9%	9%				13%	13%	13%			
Nooksack/Samish summer-fall				0%	0%	0%				121%	121%	1%
Skagit												
Spring	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Summer/Fall	27%	27%	27%				27%	27%	27%			
Stillaguamish	-44%	7%	7%				-42%	7%	7%			
Snohomish	9%	9%	9%	20%	20%	20%	9%	9%	9%	20%	20%	20%
Tulalip Tribal Hatchery				9517%	9517%	9517%				9484%	9484%	9484%
Regional Average	2%	13%	13%	10%	10%	10%	4%	13%	13%	50%	50%	10%
South Sound												
Lake Washington (Cedar River)	-4%	-4%	-4%	0%	0%	0%	-5%	-5%	-5%	24%	24%	24%
Green-Duwamish	0%	0%	27%	31%	31%	66%	0%	0%	21%	33%	33%	61%
Puyallup	-33%	-33%	28%	-26%	-26%	120%	-35%	-35%	19%	-30%	-30%	96%
Nisqually	-2%	-2%	108%	-1%	-1%	109%	-1%	-1%	104%	0%	0%	105%
White Spring	-1%	-1%	27%				-1%	-1%	23%			
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes				44%	44%	55%				46%	46%	57%
Regional Average	-8%	-8%	37%	9%	9%	70%	-8%	-8%	32%	15%	15%	69%
Hood Canal												
Mid-Canal	5%	5%	5%				5%	5%	5%			
Skokomish	-1%	-1%	40%	-1%	-1%	38%	-1%	-1%	32%	-1%	-1%	32%
Hoodsport H, Dewato, Union, & Tahuya tribs.	6%	6%	6%	-56%	-56%	212%	6%	6%	6%	-54%	-54%	207%
Regional Average	2%	2%	22%	26%	26%	77%	2%	2%	19%	26%	26%	77%
Average	-1%	3%	19%	-3%	-3%	64%	0%	3%	18%	14%	14%	62%

4 Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team,
 5 November 2004.
 6

Section 4 – Environmental Consequences

1 Table 4.3.7-2. Comparisons of hatchery- and naturally-spawning chinook salmon escapement with the Proposed Action or alternatives under
 2 Scenario A. Substantial differences (greater than 30%) in escapement from Alternative 1 are shaded. Substantial differences
 3 (greater than 30%) in escapement from Alternative 1 are shaded.

CHINOOK	Alternative 1 - Proposed Action		Alternative 2 - Escapement Goal/Manag. Unit Level		Alternative 3 - Escapement Goal/Pop Level/Terminal Only		Alternative 4 - No Listed Take		Comparisons to the Proposed Action							
	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Natural Escapment			Hatchery Escapement				
									Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1		
Juan de Fuca																
Dungeness Spring	--	352	--	360	--	360	--	360	2%	2%	2%					
Western Strait-Hoko	--	785	--	807	--	807	--	807	3%	3%	3%					
Elwha	--	2,125	--	2,172	--	2,172	--	2,172	2%	2%	2%					
Regional Average									2%	2%	2%					
North Sound																
Nooksack Spring	--	388	--	422	--	422	--	422	9%	9%	9%					
Nooksack/Samish summer-fall	10,044	--	33,887	--	33,887	--	10,083	--				237%	237%	0%		
Skagit																
Spring	1,136	1,921	1,229	2,073	1,230	2,074	1,230	2,074	8%	8%	8%	8%	8%	8%	8%	8%
Summer/Fall	118	11,633	147	14,656	147	14,656	147	14,656	26%	26%	26%					
Stillaguamish	--	2,322	--	903	--	2,468	--	2,468	-61%	6%	6%					
Snohomish	4,564	5,073	4,024	4,634	4,933	5,475	5,432	5,504	-9%	8%	9%	-12%	8%	19%		
Tulalip Tribal Hatchery	98	--	195	--	7,906	--	7,906	--				99%	7974%	7974%		
Regional Average									-5%	11%	12%	78%	85%	9%		
South Sound																
Lake Washington (w Cedar River index)	4,632	305	5,448	307	5,449	307	5,449	307	1%	1%	1%	18%	18%	18%		
Green-Duwamish	5,016	5,819	5,948	5,800	5,948	5,800	10,827	10,558	0%	0%	81%	19%	19%	116%		
Puyallup	2,338	2,392	1,100	1,200	1,100	1,200	4,656	3,286	-50%	-50%	37%	-53%	-53%	99%		
Nisqually	4,911	1,106	4,913	1,100	4,913	1,100	14,908	3,338	-1%	-1%	202%	0%	0%	204%		
White Spring	--	1,468	--	1,000	--	1,000	--	1,831	-32%	-32%	25%					
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes	29,528	--	38,545	--	38,547	--	41,786	--				31%	31%	42%		
Regional Average									-16%	-16%	69%	3%	3%	96%		
Hood Canal																
Mid-Canal	--	531	--	552	--	552	--	552	4%	4%	4%					
Skokomish	6,104	1,211	6,174	1,218	6,175	1,218	12,214	2,482	1%	1%	105%	1%	1%	100%		
Hoodsport H, Dewato, Union, Tahuya trib	5,594	591	1,851	625	1,851	625	18,833	625	6%	6%	6%	-67%	-67%	237%		
Regional Average									2%	2%	54%	26%	26%	77%		
Total	109,447	42,438			138,057	37,627	195,999	55,708	Ave	-6%	0%	22%	17%	19%	89%	

4 Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, March 2003 and November 2004.
 5

Section 4 – Environmental Consequences

1 Table 4.3.7-3. Comparisons of hatchery- and naturally-spawning chinook salmon escapement with the Proposed Action or alternatives under
 2 Scenario B. Substantial differences (greater than 30%) in escapement from Alternative 1 are shaded. Substantial differences
 3 (greater than 30%) in escapement from Alternative 1 are shaded.

CHINOOK	Alternative 1 - Proposed Action		Alternative 2 - Escapement Goal/Manag. Unit Level		Alternative 3 - Escapement Goal/Pop Level/Terminal Only		Alternative 4 - No Listed Take		Comparisons to the Proposed Action							
	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Natural Escapement			Hatchery Escapement				
									Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1		
Juan de Fuca																
Dungeness Spring	--	336	--	344	--	344	--	344		2%	2%	2%				
Western Strait-Hoko	--	750	--	772	--	772	--	772		3%	3%	3%				
Elwha	--	2,031	--	2,079	--	2,079	--	2,079		2%	2%	2%				
Regional Average										3%	3%	3%				
North Sound																
Nooksack Spring	--	365	--	412	--	412	--	412		13%	13%	13%				
Nooksack/Samish summer-fall	9,855	--	9,906	--	9,906	--	9,906	--					1%	1%	1%	
Skagit																
Spring	1,088	1,845	1,188	2,009	1,189	2,010	1,189	2,010		9%	9%	9%	9%	9%	9%	
Summer/Fall	110	11,029	139	13,935	139	13,935	139	13,935		26%	26%	26%				
Stillaguamish	--	2,281	--	904	--	2,446	--	2,446		-60%	7%	7%				
Snohomish	4,342	4,901	3,947	4,603	5,203	5,368	5,203	5,368		-6%	10%	10%	-9%	20%	20%	
Tulalip Tribal Hatchery	96	--	192	--	7,730	--	7,730	--					101%	7990%	7990%	
Regional Average										-4%	13%	13%	0%	10%	10%	
South Sound																
Lake Washington (w Cedar River index)	4,449	294	5,273	295	5,274	295	5,274	295		0%	0%	0%	19%	19%	19%	
Green-Duwamish	5,019	5,816	5,982	5,800	5,981	5,800	10,470	10,153		0%	0%	75%	19%	19%	109%	
Puyallup	2,424	2,419	1,109	1,200	1,109	1,200	4,506	3,160		-50%	-50%	31%	-54%	-54%	86%	
Nisqually	5,007	1,126	4,920	1,100	4,920	1,100	14,587	3,261		-2%	-2%	190%	-2%	-2%	191%	
White Spring	--	1,459	--	1,000	--	1,000	--	1,792		-31%	-31%	23%				
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes	28,954	--	37,477	--	37,479	--	40,641	--					29%	29%	40%	
Regional Average										-17%	-17%	64%	2%	2%	89%	
Hood Canal																
Mid-Canal	--	504	--	527	--	527	--	527		5%	5%	5%				
Skokomish	6,213	1,237	6,220	1,231	6,221	1,231	11,662	2,370		0%	0%	92%	0%	0%	88%	
Hoodport H, Dewato, Union, Tahuya trib	5,372	562	1,850	597	1,850	597	17,983	597		6%	6%	6%	-66%	-66%	235%	
Regional Average										2%	2%	48%	26%	26%	77%	
Total	109,447	42,438			138,057	37,627	195,999	55,708	Aver	-5%	0%	22%	-9%	-6%	84%	

4 Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, March 2003 and November 2004.
 5

Section 4 – Environmental Consequences

1 Table 4.3.7-4. Comparisons of hatchery- and naturally-spawning chinook salmon escapement with the Proposed Action or alternatives under
 2 Scenario C. Substantial differences (greater than 30%) in escapement from Alternative 1 are shaded. Substantial differences
 3 (greater than 30%) in escapement from Alternative 1 are shaded.

CHINOOK	Alternative 1 - Proposed Action		Alternative 2 - Escapement Goal/Manag. Unit Level		Alternative 3 - Escapement Goal/Pop Level/Terminal Only		Alternative 4 - No Listed Take		Comparisons to the Proposed Action								
	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Natural Escapement			Hatchery Escapement					
									Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1			
Juan de Fuca																	
Dungeness Spring	--	245	--	251	--	251	--	251		2%	2%	2%					
Western Strait-Hoko	--	545	--	564	--	564	--	564		3%	3%	3%					
Elwha	--	1,480	--	1,516	--	1,516	--	1,516		2%	2%	2%					
Regional Average										3%	3%	3%					
North Sound																	
Nooksack Spring	--	278	--	304	--	304	--	304		9%	9%	9%					
Nooksack/Samish summer-fall	9,528	--	9,571	--	9,571	--	9,571	--					0%	0%	0%		
Skagit																	
Spring	788	1,331	865	1,460	865	1,460	865	1,460		10%	10%	10%	10%	10%	10%		
Summer/Fall	80	8,033	102	10,215	102	10,215	102	10,215		27%	27%	27%					
Stillaguamish	--	1,620	--	909	--	1,738	--	1,738		-44%	7%	7%					
Snohomish	3,185	3,543	3,812	3,875	3,812	3,875	3,812	3,875		9%	9%	9%	20%	20%	20%		
Tulalip Tribal Hatchery	58	--	5,531	--	5,531	--	5,531	--					9517%	9517%	9517%		
Regional Average										2%	13%	13%	10%	10%	10%		
South Sound																	
Lake Washington (w Cedar River index)	3,082	223	3,084	214	3,084	214	3,084	214		-4%	-4%	-4%	0%	0%	0%		
Green-Duwamish	4,558	5,801	5,950	5,800	5,950	5,800	7,558	7,367		0%	0%	27%	31%	31%	66%		
Puyallup	1,478	1,798	1,100	1,200	1,100	1,200	3,250	2,293		-33%	-33%	28%	-26%	-26%	120%		
Nisqually	4,972	1,119	4,914	1,100	4,914	1,100	10,408	2,330		-2%	-2%	108%	-1%	-1%	109%		
White Spring	--	1,011	--	1,000	--	1,000	--	1,283		-1%	-1%	27%					
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes	18,808	--	27,007	--	27,007	--	29,169	--					44%	44%	55%		
Regional Average										-8%	-8%	37%	9%	9%	70%		
Hood Canal																	
Mid-Canal	--	367	--	385	--	385	--	385		5%	5%	5%					
Skokomish	6,147	1,239	6,080	1,221	6,080	1,221	8,513	1,730		-1%	-1%	40%	-1%	-1%	38%		
Hoodport H, Dewato, Union, Tahuya trib	4,209	410	1,857	436	1,857	436	13,126	436		6%	6%	6%	-56%	-56%	212%		
Regional Average										2%	2%	22%	26%	26%	77%		
Total	109,447	42,438			138,057	37,627	195,999	55,708	Ave	-1%	3%	22%	-3%	-3%	64%		

4
 5
 6 Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, March 2003 and November 2004.

Section 4 – Environmental Consequences

1 Table 4.3.7-5. Comparisons of hatchery- and naturally-spawning chinook salmon escapement with the Proposed Action or alternatives under
 2 Scenario D. Substantial differences (greater than 30%) in escapement from Alternative 1 are shaded. Substantial differences
 3 (greater than 30%) in escapement from Alternative 1 are shaded.

CHINOOK	Alternative 1 - Proposed Action		Alternative 2 - Escapement Goal/Manag. Unit Level		Alternative 3 - Escapement Goal/Pop Level/Terminal Only		Alternative 4 - No Listed Take		Comparisons to the Proposed Action									
	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Natural Escapement			Hatchery Escapement						
									Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1				
Juan de Fuca																		
Dungeness Spring	--	231	--		237	--	237	--	237	3%	3%	3%						
Western Strait-Hoko	--	514	--		532	--	532	--	532	4%	4%	4%						
Elwha	--	1,395	--		1,431	--	1,431	--	1,431	3%	3%	3%						
Regional Average										3%	3%	3%						
North Sound																		
Nooksack Spring	--	252	--		285	--	285	--	285	13%	13%	13%						
Nooksack/Samish summer-fall	9,370	--	20,673	--	20,673	--	9,424	--	--				121%	121%	1%			
Skagit																		
Spring	749	1,270	825	1,395	825	1,395	825	1,395	10%	10%	10%	10%	10%	10%	10%			
Summer/Fall	75	7,551	96	9,625	96	9,625	96	9,625	27%	27%	27%							
Stillaguamish	--	1,584	--		919	--	1,702	--	1,702	-42%	7%	7%						
Snohomish	3,007	3,399	3,596	3,720	3,596	3,720	3,600	3,720	9%	9%	9%	20%	20%	20%				
Tulalip Tribal Hatchery	56	--	5,351	--	5,351	--	5,351	--	--				9484%	9484%	9484%			
Regional Average										4%	13%	13%	50%	50%	10%			
South Sound																		
Lake Washington (w Cedar River index)	2,933	214	3,648	204	3,648	204	3,648	204	-5%	-5%	-5%	24%	24%	24%				24%
Green-Duwamish	4,512	5,802	5,995	5,800	5,995	5,800	7,242	7,006	0%	0%	21%	33%	33%	61%				61%
Puyallup	1,588	1,834	1,113	1,200	1,113	1,200	3,118	2,180	-35%	-35%	19%	-30%	-30%	96%				96%
Nisqually	4,935	1,109	4,920	1,100	4,920	1,100	10,124	2,264	-1%	-1%	104%	0%	0%	105%				105%
White Spring	--	1,011	--		1,000	--	1,000	--	1,246	-1%	-1%	23%						
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes	17,893	--	26,063	--	26,063	--	28,157	--	--				46%	46%	57%			
Regional Average										-8%	-8%	32%	15%	15%	69%			
Hood Canal																		
Mid-Canal	--	344	--		361	--	361	--	361	5%	5%	5%						
Skokomish	6,069	1,225	6,038	1,215	6,038	1,215	7,983	1,622	-1%	-1%	32%	-1%	-1%	32%				32%
Hoodport H, Dewato, Union, Tahuya trib	4,010	384	1,854	408	1,854	408	12,309	408		6%	6%	6%	-54%	-54%	207%			
Regional Average										2%	2%	19%	26%	26%	77%			
Total	109,447	42,438			138,057	37,627	195,999	55,708	Ave	0%	3%	22%	14%	14%	62%			

4 Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, March 2003 and November 2004.
 5

1 Relatively small numbers of juvenile hatchery chinook are released each year into the watersheds
2 where the Nooksack spring, Skagit, Stillaguamish, White, Dungeness and Elwha chinook salmon
3 populations spawn and rear, either as indicator stocks for research (e.g., the Skagit hatchery programs),
4 or as supplementation to aid in the recovery of the naturally-spawning chinook salmon populations.
5 With the exception of the Elwha River, releases do not exceed one million juveniles each year. The
6 hatchery programs in these systems all use the native chinook salmon populations as broodstock.
7 Juvenile and adult hatchery fish from all but the Skagit programs are deemed essential for the recovery
8 of the Puget Sound Chinook ESU, and are therefore listed. Straying of Skagit hatchery-origin spawning
9 adults to natural spawning areas is insignificant because the numbers of adult fish produced by the low
10 numbers of juveniles released is not substantial. For the other hatchery programs, escapement of adult
11 fish produced through the supplementation programs that return to natural spawning areas is a primary
12 objective of the program, and therefore generally seen as having an overall beneficial effect.

13 Annual hatchery releases of more than one million juvenile chinook salmon occur in the Snohomish,
14 Lake Washington, Green-Duwamish, Puyallup, Nisqually and Skokomish watersheds. The hatchery
15 programs located in the Snohomish and Green-Duwamish watersheds propagate chinook salmon
16 derived from the native stock. Hatcheries in the Sammamish, Puyallup, Nisqually and Skokomish
17 watersheds operate where native populations are no longer believed to exist. The hatchery and wild
18 adult chinook salmon populations returning to these watersheds are indistinguishable from each other.
19 With the exception of the Snohomish watershed, the majority of the returning adults are believed to be
20 predominately first-generation, hatchery-origin fish, and any natural production is generally managed
21 for composite escapements of hatchery- and wild-origin fish. Hatchery programs in these areas have
22 been in place for 40 to 100 years. Given the stock origin of propagated fish, or the lack of native
23 chinook salmon populations in these watersheds, continued straying of hatchery-origin spawning adults
24 to natural spawning areas at present levels in these systems is unlikely to have a significant adverse
25 effect on the extant natural-origin chinook salmon populations.

26 However, to the extent that increases in the contribution of hatchery-origin adults on the natural
27 spawning grounds increase risks such as predation on naturally-produced salmon, or competition with
28 naturally-produced salmon for food, and rearing and spawning areas, a reduction in the contribution of
29 hatchery-origin adults on the natural spawning grounds would be considered a beneficial effect.
30 Information is not currently available to determine with certainty what levels of hatchery contribution
31 to naturally-spawning chinook populations in Puget Sound result in what levels of risk or benefit. State,
32 tribal and federal agencies are currently engaged in on-going cooperative efforts to develop this

1 understanding. Therefore, for the purpose of this analysis, a reduction in hatchery contribution will be
 2 considered a benefit, and the impact analysis metrics described in Subsection 4.3, Fish, will be used to
 3 describe the magnitude of change. All programs used in the analysis of the Proposed Action and
 4 alternatives would have significant hatchery contribution rates to natural spawning grounds regardless
 5 of the alternative or scenario (Table 4.3.7-9).

6 Under the alternative fishing regimes analyzed, the same factors that would cause natural escapements
 7 to increase (or decrease) would also result in higher (or lower) hatchery escapements. Since not all
 8 hatchery fish return to the hatchery, any increases in hatchery returns could be expected to increase the
 9 probability for higher numbers of hatchery fish spawning in the wild. Table 4.3.7-6 provides examples
 10 of stray rates for several key chinook salmon populations, where stray rate is defined as the proportion
 11 of the total hatchery-origin escapement not removed from the natural environment through trapping, or
 12 the number of hatchery-origin salmon that otherwise strayed from their point of release. The predicted
 13 contribution of hatchery fish to natural escapement is then computed by calculating the number of
 14 hatchery fish that would not return to the hatchery using the proportions in Table 4.3.7-6, and dividing
 15 that number by the natural escapement.

16 Table 4.3.7-6. Estimated 1996–2002 average number of hatchery-origin chinook salmon that spawn in
 17 the wild as a proportion of the hatchery-origin escapement for key Puget Sound chinook
 18 hatchery salmon populations under consideration (hatchery fish spawning in the
 19 wild/total hatchery fish returning).

Population	Average Hatchery Stray Rate (1996-2002)
Nooksack	
North Fork	.35
South Fork	.05
Snohomish	
Skykomish	.32
Snoqualmie	.09
Green-Duwamish	.40

20 Source: Puget Sound Technical Recovery Team Abundance and
 21 Productivity Tables (2003).

22 Stray rates are not yet available for other systems, pending evaluation of mass-marked hatchery-origin
 23 returns in future years. When that information is available, it will be used to assess the contribution of
 24 hatchery-origin fish to natural escapement. The results of that assessment are expected to indicate that
 25 hatchery fish stray rates for South Puget Sound and Hood Canal watersheds will be similar to or exceed
 26 that of the Green River, with proportionally greater risks of potential impacts to any natural-origin

1 chinook salmon populations. Therefore, the populations in Table 4.3.7-6 will be used as examples to
2 indicate the relative impact of the Proposed Action or alternatives.

3 **Alternative 1 – Proposed Action/Status Quo**

4 No change from current baseline conditions would result from implementation of Alternative 1.

5 Modeled scenarios for Alternative 1 showed little variation and no consistent pattern of hatchery
6 contribution rates across the three representative systems (Nooksack spring, Snohomish and Green-
7 Duwamish) (Table 4.3.7-7). For the Nooksack spring system, the modeled stray rate is predicted to be
8 the same across modeled scenarios. For the Snohomish system, the modeled stray rate is predicted to be
9 lowest under Scenario D (30% reduction in abundance with maximum Canadian/Alaskan fisheries),
10 followed by Scenario B (high abundance and maximum Canadian/Alaskan fisheries). Scenario C (30%
11 reduction in abundance with Canadian/Alaskan fisheries similar to those in 2003), and Scenario A
12 (high abundance and Canadian/Alaskan fisheries similar to those in 2003) are predicted to have the
13 same and the lowest hatchery contribution rate, respectively. The Green-Duwamish River system is
14 predicted to have the lowest stray rate under Scenario D or Scenario C, followed by Scenario B or
15 Scenario A.

16 Hatchery strays are predicted to average approximately 93 percent of total natural escapement in the
17 Nooksack spring system; 50 to 51 percent of total natural escapement in the Snohomish River system;
18 and 52 to 58 percent of total natural spawners in the Green-Duwamish River system (Puget Sound
19 Technical Recovery Team 2003).

20 Hatchery contribution rates of out-of-watershed-origin chinook salmon at these levels indicate a
21 substantial potential risk of adverse ecological and genetic effects to the indigenous natural-origin
22 populations through competition and genetic introgression, respectively. However, hatchery-origin fish
23 straying within these watersheds are predominately of native-population-origin, which is expected to
24 attenuate the potential for adverse ecological and genetic effects. In addition, Nooksack hatchery
25 chinook salmon are considered essential to the recovery of the ESU, and are therefore listed along with
26 the natural-origin fish. Given these circumstances, straying hatchery fish are expected to result in a low
27 to moderate short-term risk of adverse impact to the ability of natural populations to sustain
28 themselves. Impacts over the long-term would also be expected to be low to moderate, since
29 Alternative 1 is the baseline condition.

Section 4 – Environmental Consequences

1 Table 4.3.7-7. Hatchery contribution to natural spawning escapement by scenario and alternative for five representative Puget Sound chinook
 2 populations.

CHINOOK		Scenario A				Scenario B				Scenario C				Scenario D			
		Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4
Nooksack Spring North Fork Nooksack	Escapement to the hatchery	9,150	9,952	9,150	9,952	7,924	8,112	8,112	8,112	5,778	5,919	5,919	5,919	5,448	5,589	5,589	5,589
	strays from hatchery to grounds	3,203	3,483	3,203	3,483	2,773	2,839	2,839	2,839	2,022	2,072	2,072	2,072	1,907	1,956	1,956	1,956
	% of hatchery return to hatchery	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	total strays on grounds	4,927	5,359	4,927	5,359	4,267	4,368	4,368	4,368	3,111	3,187	3,187	3,187	2,933	3,009	3,009	3,009
South Fork Nooksack	strays from hatchery to grounds	458	498	458	498	396	406	406	406	289	296	296	296	272	279	279	279
	% of hatchery return to hatchery	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
	total strays on grounds	482	524	482	524	417	427	427	427	304	312	312	312	287	294	294	294
Snohomish Skykomish	Escapement to the hatchery	4,564	4,024	4,933	5,432	4,342	3,947	5,203	5,203	3,185	3,812	3,812	3,812	3,007	3,596	3,596	3,600
	strays from hatchery to grounds	1,461	1,288	1,579	1,738	1,389	1,263	1,665	1,665	1,019	1,220	1,220	1,220	962	1,151	1,151	1,152
	% of hatchery return to hatchery	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Snoqualmie	total strays on grounds	2,148	1,894	2,322	2,556	2,043	1,857	2,449	2,449	1,499	1,794	1,794	1,794	1,415	1,692	1,692	1,694
	strays from hatchery to grounds	411	362	444	489	391	355	468	468	287	343	343	343	271	324	324	324
	% of hatchery return to hatchery	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Green-Duwamish	total strays on grounds	451	398	488	537	429	390	515	515	315	377	377	377	297	356	356	356
	Escapement to the hatchery	5,016	5,948	5,948	10,827	5,019	5,982	5,981	10,470	4,558	5,950	5,950	7,558	4,512	5,995	5,995	7,242
	strays from hatchery to grounds	2,007	2,379	2,379	4,331	2,007	2,393	2,393	4,188	1,823	2,380	2,380	3,023	1,805	2,398	2,398	2,897
	% of hatchery return to hatchery	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	total strays on grounds	3,344	3,965	3,965	7,218	3,346	3,988	3,988	6,980	3,039	3,967	3,967	5,039	3,008	3,997	3,997	4,828

CHINOOK	Hatchery Contribution to Natural Spawning				Hatchery Contribution to Natural Spawning				Hatchery Contribution to Natural Spawning				Hatchery Contribution to Natural Spawning			
	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4
Nooksack Spring	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%
Snohomish	51%	49%	51%	56%	50%	49%	55%	55%	51%	56%	56%	56%	50%	55%	55%	55%
Green-Duwamish	57%	68%	68%	68%	58%	69%	69%	69%	52%	68%	68%	68%	52%	69%	69%	69%

3 Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, November 2004.
 4

1 **Alternative 2 – Escapement Goal Management at the Management Unit Level**

2 Under Alternative 2, the hatchery contribution rate is predicted to remain the same for the Nooksack
3 spring system and increase within the Green-Duwamish River system, compared to Alternative 1. The
4 hatchery contribution rate for the Snohomish River system is predicted to decline slightly under high
5 abundance conditions (similar to those in 2003), and increase under low abundance conditions
6 compared with Alternative 1. The magnitude of stray rates under Alternative 2 would be similar to
7 those under Alternative 1.

8 **Summary of Scenario Differences**

9 As with Alternative 1, no consistent pattern of hatchery contribution rates was indicated across
10 modeled scenarios among the three representative systems under Alternative 2 (Table 4.3.7-7). For the
11 Nooksack spring system, the stray rate is predicted to be consistent across scenarios. For the
12 Snohomish system, the modeled stray rate was lowest under Scenario A (high abundance and
13 Canadian/Alaskan fisheries similar to those in 2003), and Scenario B (high abundance and maximum
14 Canadian/Alaskan fisheries), followed by Scenario D (30% reduction in abundance with maximum
15 Canadian/Alaskan fisheries), and Scenario C (30% reduction in abundance with Canadian/Alaskan
16 fisheries similar to those in 2003). For the Green-Duwamish River system, the modeled stray rate was
17 lowest under Scenarios A and C which had the same predicted stray rate, followed by Scenario B and
18 Scenario D.

19 As with Alternative 1, there is little predicted variation in hatchery contribution rates across scenarios
20 under Alternative 1 (Table 4.3.7-7). Hatchery strays are predicted to average approximately 93 percent
21 of total natural escapement in the Nooksack spring system; 49 to 56 percent of total natural escapement
22 in the Snohomish River system; and 68 to 69 percent of total natural spawners in the Green-Duwamish
23 River system (Puget Sound Technical Recovery Team 2003).

24 **Comparison of Alternative 2 with Alternative 1 (Proposed Action/Status Quo)**

25 Under Alternative 2, Scenario B, the hatchery contribution rate is predicted to remain the same for the
26 Nooksack spring system; increase by 11 percent for the Green-Duwamish River system, and decline by
27 1 percent for the Snohomish River system compared to Alternative 1 (Table 4.3.7-7). The magnitude of
28 stray rates under Alternative 2 is predicted to be similar to those predicted under Alternative 1.

29 Under Alternative 2, Scenarios A, C, or D, the hatchery contribution rate is predicted to remain the
30 same for the Nooksack spring system and increase for the Green-Duwamish River system by 11 to 17

1 percent compared to Alternative 1. The hatchery contribution rate for the Snohomish River system is
2 predicted to decrease by 1 percent under Scenario A (same as Scenario B), and increase by 5 percent
3 under Scenarios C or D, compared with Alternative 1 (Table 4.3.7-7). The differences in hatchery
4 contribution rate between Alternative 2 and Alternative 1 would be greater under low abundance
5 conditions (Scenarios C or D) than under high abundance conditions (Scenarios A or B) for the
6 Snohomish and Green-Duwamish River systems.

7 As described under Alternative 1, the population origin of straying hatchery fish, and on-going
8 hatchery reform measures implemented to reduce risks to natural-origin chinook salmon, bear upon any
9 assessment of risk posed by straying hatchery fish to natural-origin fish populations. The hatchery
10 contribution rates estimated under Alternative 2 could be expected to have an elevated adverse affect
11 on the genetic diversity, and potentially on the productivity of natural-origin chinook salmon
12 populations, relative to Alternative 1 for the Snohomish and Green-Duwamish River systems; however,
13 again, the hatchery-origin fish straying within these watersheds are predominantly of native population-
14 origin, which is expected to attenuate the potential for adverse ecological and genetic effects. Scenario
15 B, the most likely to occur over the duration of the Proposed Action (the 2004–2009 fishing seasons),
16 is predicted to result in a no to low change in the hatchery contribution rate for the Nooksack spring
17 and Snohomish systems, and a moderate change in the Green-Duwamish system hatchery contribution
18 rate compared to Alternative 1. The greater potential for adverse effects would come from substantial
19 increases in the escapements of hatchery coho and chum salmon that would occur in these areas. The
20 much greater escapement of hatchery coho and chum salmon (Tables 4.3.7-8 and 4.3.7-9) could
21 exacerbate inter-species predation, competition, and genetic diversity effects in some areas. Therefore,
22 primarily as a result of straying non-chinook salmon species, moderate to substantial short- and long-
23 term risks are predicted under Alternative 2 for hatchery fish straying at the levels described above to
24 contribute, combined with other factors for decline, to impairment of the ability of natural populations
25 to sustain themselves.

26 **Alternative 3 – Escapement Goal Management at the Population Level with Terminal Fisheries**
27 **Only**

28 Under Alternative 1, the hatchery contribution rate is predicted to remain the same for the Nooksack
29 spring system; increase for the Green-Duwamish River system, and have at most a low increase for the
30 Snohomish River system compared to Alternative 1.

1 Summary of Scenario Differences

2 As with Alternative 1 or 2, modeled scenarios showed little variation in hatchery contribution rates
3 among the three representative systems. The hatchery contribution rate is predicted to be consistent
4 across scenarios for the Nooksack spring and Green-Duwamish River systems. For the Snohomish
5 system, the modeled stray rate was lowest under Scenario A (high abundance and Canadian/Alaskan
6 fisheries similar to those in 2003). Hatchery contribution rates under Scenarios B (high abundance and
7 maximum Canadian/Alaskan fisheries), D (30% reduction in abundance with maximum
8 Canadian/Alaskan fisheries), or C (30% reduction in abundance with Canadian/Alaskan fisheries
9 similar to those in 2003) are predicted to be higher, but within 1 percent of each other.

10 Hatchery strays are predicted to average approximately 93 percent of total natural escapement in the
11 Nooksack spring system; 51 to 56 percent of total natural escapement in the Snohomish River system;
12 and 68 to 69 percent of the total natural spawners in the Green-Duwamish River system (Puget Sound
13 Technical Recovery Team 2003).

14 Comparison of Alternative 3 with Alternative 1 (the Proposed Action/Status Quo)

15 Under Alternative 3, Scenario B, the hatchery contribution rate is predicted to remain the same for the
16 Nooksack spring system, increase by 5 percent for the Green-Duwamish River system, and increase 11
17 percent for the Snohomish River system compared to Alternative 1 (Table 4.3.7-7). The magnitude of
18 the hatchery contribution rates under Alternative 3 would be similar to the rates under Alternative 1
19 or 2.

20 With the exception of Scenario A for the Snohomish system, Alternative 3 Scenarios A, C, or D are
21 predicted to result in hatchery contribution rates relative to Alternative 1 of within 1 percent of those
22 described for Scenario B. Hatchery contribution rates under Alternative 3, Scenario A, for Snohomish
23 chinook salmon are predicted to be the same as Alternative 1, or 5 percent lower than under Scenario
24 B. Hatchery contribution rates are predicted to range from 55 to 56 percent under Scenarios C and D
25 for the Snohomish River system, and 68 to 69 percent under all scenarios for the Green-Duwamish
26 River system (Table 4.3.7-7).

27 As described above, the population origin of straying hatchery fish, and on-going hatchery reform
28 measures being implemented to reduce risks to natural-origin chinook salmon, bear upon any
29 assessment of risk posed by the straying hatchery fish to natural-origin fish populations. The hatchery
30 contribution rates estimated under Alternative 3 could be expected to have an elevated adverse affect
31 on the genetic diversity, and potentially on the productivity of the Green-Duwamish and Snohomish

1 system natural-origin chinook salmon populations, relative to Alternative 1; however, again, the
2 hatchery-origin fish straying within these watersheds are predominantly of native population-origin,
3 which is expected to attenuate the potential for adverse ecological and genetic effects. Scenario B, the
4 most likely to occur over the duration of the Proposed Action (the 2004–2009 fishing seasons), is
5 predicted to result in a no to low change in the hatchery contribution rate for the Nooksack spring and
6 Snohomish systems, and a moderate change in the Green-Duwamish system contribution rate
7 compared with Alternative 1. The greater potential for adverse effects would come from substantial
8 increases in the escapements of hatchery coho and chum salmon. The much greater escapement of
9 hatchery coho and chum salmon (Tables 4.3.7-8 and 4.3.7-9) could exacerbate inter-species predation,
10 competition, and genetic diversity effects in some areas. Under Alternative 3, primarily as a result of
11 straying of non-chinook species, there would be moderate to substantial short- and long-term risk that
12 hatchery fish straying at the levels described above may contribute, combined with other factors for
13 decline, to impairment of the ability of natural populations to sustain themselves.

14 **Alternative 4 – No Action/No Authorized Take**

15 The estimated hatchery contribution rate comparisons under Alternative 4 would be very similar to
16 those estimated under Alternative 3.

17 Summary of Scenario Differences

18 Under Alternative 4, hatchery contribution rates are predicted to differ by 1 percent or less across
19 scenarios for each system (Table 4.3.7-7). Hatchery strays would average approximately 93 percent of
20 total natural escapement in the Nooksack spring system; 55 to 56 percent of total natural escapement in
21 the Snohomish River system; and 68 to 69 percent of total natural spawners in the Green-Duwamish
22 River system (Puget Sound Technical Recovery Team 2003).

23 Comparison of Alternative 4 with Alternative 1 (the Proposed Action/Status Quo)

24 The estimated hatchery contribution rates under Alternative 4, Scenario B, would be the same as those
25 estimated under Alternative 3. The results of Scenarios A, C, or D are also predicted to be the same as
26 Alternative 3, except for Scenario A for the Snohomish system (Table 4.3.7-7). The estimated
27 contribution of hatchery-origin spawners to the Snohomish system natural escapement is predicted to
28 increase to 56 percent, compared with 51 percent under Scenario A for Alternative 3 and Alternative 1.
29 However, the magnitude of contribution rates is predicted to be the same as that of Alternative 3, so the
30 level of hatchery-related effects to natural-origin chinook salmon populations associated with
31 Alternative 4 would be unlikely to differ from effects surmised under Alternative 3. The much greater

1 escapements of hatchery coho and chum salmon could exacerbate inter-species predation, competition,
2 and genetic diversity effects in some areas. Under Alternative 4, particularly because of the substantial
3 increases in non-chinook hatchery escapements, there would be moderate to substantial short- and
4 long-term risks that hatchery fish straying at the levels described above may contribute, combined with
5 other factors for decline, to impairment of the ability of natural populations to sustain themselves.

6 Summary

7 Hatchery contribution rates of chinook, coho, and chum salmon were predicted to be substantial for all
8 alternatives. Chinook hatchery contribution rates were not predicted to change significantly with
9 change in abundance or the magnitude of northern fisheries; varying 7 percent or less among scenarios
10 for each alternative. The modeled differences in hatchery chinook contribution rates among alternatives
11 were generally low, except for the Green-Duwamish River system where hatchery contribution rates
12 are predicted to increased by as much as 17 percent under low abundance conditions when compared
13 with Alternative 1. The much greater escapements of hatchery coho and chum salmon could exacerbate
14 inter-species predation, competition, and genetic diversity effects in some areas. Particularly because of
15 substantial increases in non-chinook hatchery escapements, there would likely be moderate to
16 substantial short- and long-term risks that hatchery fish straying at the levels described above may
17 contribute, combined with other factors for decline, to impairment of the ability of natural populations
18 to sustain themselves under Alternatives 2, 3, or 4. Under Alternative 1, straying hatchery fish are
19 expected to result in a low to moderate short-term risk of adverse impact to the ability of natural
20 populations to sustain themselves. Impacts over the long-term are also expected to be low to moderate,
21 since Alternative 1 is the baseline condition.

22 **4.3.7.2 Straying of Coho and Chum Salmon**

23 Both total hatchery and natural escapement for coho and chum salmon would show substantial
24 increases (39% to 236%) in escapement under Alternatives 2, 3, or 4 compared with Alternative 1. For
25 each alternative, the change in hatchery escapement is predicted to be 2 to 2.5 times the change in
26 natural escapement (Tables 4.3.7-8 and 4.3.7-9). As with chinook salmon, changes in hatchery and
27 natural escapements would vary by region and management unit. Stray rate estimates are not available
28 for the coho and chum salmon management units in Tables 4.3.7-8 and 4.3.7-9.

Section 4 – Environmental Consequences

1 Table 4.3.7-8. Comparisons of hatchery- and natural-spawning coho salmon escapement with the proposed action and alternatives. Substantial
 2 differences (greater than 30%) in escapement from Alternative 1 are shaded.

COHO	Alternative 1 - Proposed Action		Alternative 2 - Escapement Goal/Manag. Unit Level		Alternative 3 - Escapement Goal/Pop Level/Terminal		Alternative 4 - No Listed Take		Comparisons to the Proposed Action								
	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Natural Escapement			Hatchery Escapement					
									Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1			
Juan de Fuca																	
Juan de Fuca	9,513	17,320	17,622	18,819	17,622	18,819	21,732	18,819	9%	9%	9%	1	85%	128%			
Regional Average									9%	9%	9%	85%	85%	128%			
North Sound																	
Nooksack/Samish	27,508	8,182	56,057	14,272	56,057	14,272	56,057	15,305	74%	74%	87%	1	104%	104%			
Skagit	5,840	73,624	9,241	109,887	9,241	109,887	9,253	110,022	49%	49%	49%	1	58%	58%			
Stillaguamish	1,173	24,017	1,239	28,689	1,317	34,840	1,317	34,840	19%	45%	45%	0	12%	12%			
Snohomish	13,494	136,873	17,854	165,820	30,938	187,066	30,938	187,066	21%	37%	37%	0	129%	129%			
Regional Average									41%	51%	55%	50%	76%	76%			
South Sound																	
South Sound	119,369	47,086	233,962	69,945	233,962	69,945	293,781	97,804	49%	49%	108%	1	96%	146%			
									49%	49%	108%	96%	96%	146%			
Hood Canal																	
Hood Canal	11,379	19,012	37,046	28,533	37,046	28,533	41,214	30,345	50%	50%	60%	2	226%	262%			
Regional Average									44%	44%	64%	63%	63%	162%			
Total	62,859	197,456			230,334	309,828	306,719	334,498	Aver	39%	45%	56%	87%	101%	120%		

3
 4 Table 4.3.7-9. Comparisons of hatchery- and natural-spawning chum salmon escapement with the proposed action and alternatives. Substantial
 5 differences (greater than 30%) in escapement from Alternative 1 are shaded.

CHUM	Alternative 1 - Proposed Action		Alternative 2 - Escapement Goal/Manag. Unit Level		Goal/Pop Level/Terminal Only		Alternative 4 - No Listed Take		Comparisons to the Proposed Action								
	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Natural Escapement			Hatchery Escapement					
									Alt2/Alt1	Alt3/Alt1	Alt4/Alt1	Alt2/Alt1	Alt3/Alt1	Alt4/Alt1			
Juan de Fuca																	
Juan de Fuca	--	2,585	--	2,722	--	2,722	--	2,722	5%	5%	5%						
Regional Average									5%	5%	5%						
North Sound																	
Nooksack/Samish	7,936	35,610	17,713	79,482	17,713	79,482	17,717	79,501	123%	123%	123%	123%	123%	123%			
Skagit	1,834	42,237	2,000	46,071	2,000	46,071	2,000	46,071	9%	9%	9%	9%	9%	9%			
Stillaguamish	700	14,400	1,631	34,194	1,668	34,964	1,668	34,964	137%	143%	143%	133%	138%	138%			
Snohomish	7,200	17,600	43,262	35,583	43,262	35,583	43,262	35,583	102%	102%	102%	501%	501%	501%			
Regional Average									93%	94%	94%	192%	193%	193%			
South Sound																	
South Sound	17,540	150,923	46,459	399,761	46,459	399,761	51,310	441,499	165%	165%	193%	165%	165%	193%			
Regional Average									165%	165%	193%	165%	165%	193%			
Hood Canal																	
Hood Canal	37,637	50,382	145,084	95,473	145,084	95,473	207,023	99,621	89%	89%	98%	285%	285%	450%			
Regional Average									89%	89%	98%	285%	285%	450%			
Total	72,846	313,736			256,149	693,285	322,981	739,961	Aver	90%	91%	96%	203%	204%	236%		

6
 7 Source: Larrie Lavoy, Puget Sound Chinook Resource Management Plan NEPA Interdisciplinary Team, March 2003 and November 2004.

1 **4.3.8 Indirect and Cumulative Effects**

2 **4.3.8.1 Indirect Effects**

3 Indirect effects on fish species are those that would be further removed from the direct effects. In the
4 case of listed and unlisted salmonid species affected by the Proposed Action, the primary direct effect
5 would be changes in spawning escapement brought about by changes in catch, and the primary indirect
6 effect would be resulting changes in abundance of the progeny of these spawning populations. Because
7 the action considered in this Environmental Impact Statement applies to a six-year resource
8 management plan, changes in abundance would be limited to the progeny of spawners returning from
9 2004 to 2010; i.e., progeny returning in 2006–2015. The extent to which increased abundance of the
10 progeny of these spawners may affect spawning abundance in subsequent years depends on freshwater
11 and marine habitat conditions that influence survival, and on the fishing regimes that will be in place
12 after 2010. Of these, marine conditions are thought to play the dominant short-term role.

13 In the case of chinook salmon, changes in spawning escapement would, theoretically, be most evident
14 in the abundance of progeny returning as Age-3 and Age-4 spawners, though there would also be
15 changes in abundance for Age-2 (precocious) spawners, and the relatively small proportion of chinook
16 populations returning as Age-5 and Age-6 spawners. Similarly, for other species, changes in spawning
17 escapement would apply to subsequent brood years according to the species age-at-maturity profiles.
18 As noted in Subsection 4.3.1, these effects could be beneficial or negative, depending on the magnitude
19 of change and the productivity characteristics of the particular watershed from which a population
20 originates. An indirect effect that would likely result from fishery closures under Alternative 2 is the
21 expected reduction in the amount of lost fishing gear in marine areas closed to fishing and, conversely,
22 an increase in lost fishing gear in those terminal fisheries where fishing may increase. Changes in the
23 number of lost or derelict nets affect the amount of unintended mortality on salmonids and other
24 species that become entangled in lost nets and, to a lesser extent, lost sport fishing tackle. This issue is
25 discussed in Subsection 3.3.5, Fish Habitat Affected by Salmon Fishing: Affected Environment.

26 A potential advantage to Alternative 1, which makes use of exploitation rate management strategies for
27 many populations, is that, properly applied, exploitation rate management strategies are more robust
28 about uncertainties in key parameters like survival and management error. Given the imprecision of
29 abundance forecasts, this can be an important advantage, especially when combined with a strategy to
30 use conservative parameters in forecasting (Fieberg *in press*).

1 Another advantage of Alternative 1 compared to Alternative 2 (or 3) is that, at higher abundances,
2 Alternative 1 would be expected to return even more chinook spawners than under fixed escapement
3 goal management as exemplified by Alternative 2. The high abundance scenarios (Scenarios A and B)
4 support this for some systems (e.g., the Stillaguamish River, Snohomish River, Puyallup River). As
5 population abundance increases above current levels, this would be expected to be the case for more
6 chinook river systems. Conversely, under significantly lower abundance, Alternative 1 would be
7 expected to return fewer spawners than under fixed escapement goals for Alternatives 2 or 3, although
8 the current modeling of Scenarios B and D do not reflect this even at a 30 percent reduction in
9 abundance from current levels.

10 **Indirect Effects of Alternative 2 (Escapement Goal Management at the Management Unit Level**
11 **or Alternative 3 (Escapement Goal Management at the Population Level) on Listed Chinook and**
12 **Chum Salmon Populations**

13 The direct effects of predicted spawning escapement for Alternative 2, Scenario B (considered the most
14 likely abundance scenario) compared to Alternative 1, Scenario B were predicted to be of a low to
15 moderate beneficial nature for 11 of the 22 populations in the listed Puget Sound Chinook
16 Evolutionarily Significant Unit. (Modeled results of spawning escapement showed an increase from
17 2% to 26%.) Given favorable river and marine survival conditions, and fishing regimes resembling
18 those in place prior to the action, these increases could result in low to moderate increases in spawning
19 returns. However, similar decreases in exploitation rates for some of these same chinook salmon
20 populations observed in recent years have not been accompanied by increases in natural-origin
21 spawners. This suggests that habitat factors may be the primary constraint on natural production
22 (NMFS 2004 [4(d) determination]), and therefore increases in parental escapement would not result in
23 increased abundance in subsequent generations.

24 Modeled results of changes in chinook salmon spawning escapement for the remaining populations
25 varied. Most notably, escapement was predicted to decline by 60 percent for the North Fork and South
26 Fork Stillaguamish chinook salmon populations. Escapement of the Puyallup River fall and White
27 River Spring chinook salmon populations both were predicted to decline substantially (50% and 31%,
28 respectively). Changes of these magnitudes would be much more likely to have measurable effects on
29 abundance and escapement of the subsequent brood years. As noted in Subsection 4.3.1.2, however,
30 escapements of the North Fork Stillaguamish, Puyallup and White River chinook salmon populations
31 under Alternative 2 were predicted to meet current-condition escapement goals. Therefore, it is not
32 necessarily accurate to assume that the indirect effect of Alternative 2 would be substantially negative.

1 The indirect effects of Alternative 3 would be essentially the same as Alternative 2, with the exception
2 that the Stillaguamish chinook salmon management unit, where escapement was predicted to decline 60
3 percent relative to Alternative 1 under Alternative 2, would increase by approximately 7 percent
4 relative to Alternative 1, under Alternative 3.

5 Fixed escapement goal management strategies, as in Alternative 2 or 3, are less robust to uncertainties
6 in key parameters like survival and management error. Given the imprecision of abundance forecasts,
7 this could be an important advantage (Fieberg *in press*).

8 **Indirect Effects of Alternative 4 (No Fishing) on Listed Chinook and Chum Salmon Populations**

9 The direct effects of Alternative 4 (No Fishing) would be an increase in escapement for all Puget
10 Sound chinook salmon populations relative to Alternative 1 (the Proposed Action). In North Puget
11 Sound and the Strait of Juan de Fuca, increases in chinook salmon escapement would be very similar to
12 the increases under Alternative 2 or 3. In South Puget Sound and Hood Canal, increases in chinook
13 salmon escapement are predicted to range from 5 percent for the Mid-Hood Canal chinook salmon
14 population, to 190 percent for the Nisqually chinook salmon population. In addition to the substantial
15 increase in spawning escapement for the Nisqually chinook salmon population, increases of 75 percent
16 for the Green River population, 31 percent for the Puyallup River population, and 92 percent for the
17 Skokomish River population were predicted by the model. Increased escapements of this magnitude
18 could result in moderate to substantial increases in the spawning escapement of subsequent brood
19 years. However, there is also a possibility that escapements substantially in excess of current-condition
20 escapement goals would result in decreased survival owing to overcrowding of available freshwater
21 spawning and rearing habitat, and increased competition for food. However, much less severe
22 decreases in exploitation rates for some of these same populations observed in recent years have not
23 been accompanied by increases in natural-origin chinook salmon spawners. This suggests that habitat
24 factors may be the primary constraint on natural production (NMFS 2004 [4(d) determination]), and
25 therefore increases in parental escapement would not result in increased abundance in subsequent
26 generations.

27 **Indirect Effects of Alternative 2 or 3 on Other Salmon Species**

28 As noted in Subsections 4.3.2.2 and 4.3.2.3, Alternative 2 or 3 would substantially increase escapement
29 of coho, pink, and fall chum salmon relative to Alternative 1. Modeling results predicted that overall
30 escapement of naturally-spawning fish would increase from 44 percent to 136 percent depending on the
31 species and the harvest management alternative selected. While this could have the effect of
32 substantially increasing escapement of subsequent brood years, modeled escapements in many

1 management units substantially exceed current-condition escapement goals, and could result in
2 decreased productivity. For many coho salmon management units, exploitation rate objectives are
3 based on stock recruit functions which would predict that large increases in escapement would not
4 result in substantial increases in progeny (personal communication via e-mail from William Beattie to
5 The William Douglas Company, February 17, 2004). There would be similarly large increases in the
6 escapement of hatchery-origin spawners, with the likely result that there would be increased straying of
7 hatchery fish to the spawning grounds. The indirect effects on sockeye populations would be low or
8 none. Indirect effects on steelhead populations would be low or none owing to the very small changes
9 in catch on this species under either Alternative 2 or 3.

10 **4.3.8.2 Cumulative Effects of the Proposed Action or Alternatives on Fish Species**

11 NEPA defines cumulative effects as “the impact on the environment which results from the incremental
12 impact of the action when added to other past, present, and reasonably foreseeable future actions,
13 regardless of what agency (federal or non-federal) or person undertakes such other actions” (40
14 CFR1508.7). For the purpose of this discussion, the terms “effects” and “impacts” will be considered
15 synonymously with “consequences,” and consequences may be negative or beneficial. This subsection
16 presents an analysis of the cumulative effects (negative or beneficial) of the Proposed Action on fish
17 resources in the context of other local, state, tribal, and federal management activities in the Puget
18 Sound region.

19 The geographic scope of the cumulative effects analysis area includes the entire Puget Sound region.
20 The analysis area covers both inland and marine environments that are managed under laws, policies,
21 regulations, and plans having a direct or indirect impact on fish. The substantive scope of the
22 cumulative effects analysis is predicated on a review of laws, policies, regulations, and plans that
23 specifically pertain to fish-related management activities or that have an indirect negative or beneficial
24 effect on fish resources. These laws, policies, regulations, and plans are described in Section 1 and
25 Appendix F. Due to the geographic scope of the analysis area, it is not feasible to analyze all habitat-
26 specific activities that are occurring, have occurred in the past, or that will occur in the future in a
27 quantitative manner. By reviewing applicable laws, policies, regulations, and plans, the analysis
28 captures the objectives of management activities that are occurring or are planned to occur that may
29 interface with fish resources within the Puget Sound region. It is assumed that no management activity
30 is occurring or would occur outside of an implemented law, policy, regulation, or sanctioned plan at the
31 federal, tribal, state, or local level. Although the analysis is necessarily qualitative, it provides a
32 thorough review of other activities within the region that, when combined with the Proposed Action,

1 could have a negative or beneficial affect on fish resources. Table 4.3.8.2-1 summarizes the potential
2 cumulative effects of implementing the Proposed Action or alternatives with the effects of these
3 existing plans, policies, programs, and laws.

4 The Proposed Action is implementation of the Puget Sound Chinook Harvest Resource Management
5 Plan (RMP), jointly prepared by the Washington Department of Fish and Wildlife (WDFW) and the
6 Puget Sound Treaty Tribes (co-managers). Factors common to the relationship between the RMP and
7 the various existing plans, policies and programs include: 1) the Resource Management Plan would
8 provide protection to Puget Sound chinook salmon by conserving the productivity, abundance, and
9 diversity of populations within the Puget Sound Chinook Evolutionarily Significant Unit (ESU), while
10 managing harvest of strong salmon stocks; and 2) conserving productivity requires biological integrity
11 in the freshwater systems in which salmon spawn and rear. As shown in Table 4.3.8.2-1, the RMP
12 would be consistent with the intent and policies of each of the federal, tribal, state, and local plans,
13 programs, and laws reviewed for the cumulative effects analysis, and is predicted to enhance the
14 benefits of these other measures as they relate to the conservation and/or enhancement of fish and
15 wildlife habitat and fish populations.

1 Table 4.3.8-1. Federal, Tribal, Washington state, and local plans, policies, and programs that influence fish within the Puget Sound Action Area:
2 2004.

Federal/Tribal/State/Local		
Plans, Policies, and Programs (in chronological order of earliest to most recent)	Description and Intent	Cumulative Effect when Combined with the Proposed Action
Fish and Wildlife Coordination Act, 1956, as amended in 1964 (FWCA).	The FWCA recognizes “the vital contribution of our wildlife resources to the Nation, the increasing public interest and significance thereof due to expansion of our national economy and other factors, and to provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs through the effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation and rehabilitation.”	The Resource Management Plan would allow the harvest of salmon in coordination with ongoing conservation and rehabilitation efforts for chinook salmon. With an estimated value of \$35 million (\$16.2 million commercial plus \$18.8 million recreational), the Puget Sound fishing industries are important to the Nation’s economy. The Proposed Action would be consistent with the FWCA by recognizing the vital contribution of Puget Sound chinook salmon to the Nation and our national economy. It is predicted that implementation of the Resource Management Plan, in combination with the FWCA, would strive to balance considerations of the national economy, while also providing for fish conservation.
Washington State Shoreline Management Act of 1971 (SMA).	The SMA was adopted in Washington in 1972 with the goal of “prevent[ing] the inherent harm in an uncoordinated and piecemeal development of the state’s shorelines.” The provisions of this law are designed to guide the development of the shoreline lands in a manner that will promote and enhance the public interest. The law expresses the public concern for protection against adverse effects to public health, the land and its vegetation and wildlife, and the aquatic life of the waters.	Rearing habitat within shoreline areas of Washington State is essential to conserving the productivity of Puget Sound chinook salmon. Consequently, the Proposed Action would be consistent with the SMA by ensuring that harvest works in concert with habitat protection efforts under the SMA. Accordingly, it is predicted that implementation of the Resource Management Plan, in combination with the SMA, would protect fish from adverse effects associated with uncoordinated and piecemeal development of the state’s shorelines.
The National Marine Sanctuaries Act. Also known as Title III of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA).	The MPRSA authorizes the Secretary of Commerce to designate and manage areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or a esthetic qualities as National Marine Sanctuaries. One of the purposes and policies of the MPRSA is “to maintain the natural biological communities in the national marine sanctuaries, and to protect, and, where appropriate, restore and enhance natural habitats, populations, and ecological processes.”	Protecting the marine environment where chinook salmon mature is important to conserving the productivity of Puget Sound chinook salmon. Consequently, the Proposed Action would be consistent with the MPRSA by maintaining chinook salmon populations of the natural biological communities in the marine environment. Accordingly, it is predicted that implementation of the Resource Management Plan, in combination with the MPRSA, would strive to restore and enhance natural habitats, populations, and ecological processes of fish.

1 Table 4.3.8-1. Federal, Tribal, Washington state, and local plans, policies, and programs that influence fish within the Puget Sound Action Area:
2 2004 (continued)

Federal/Tribal/State/Local		
Plans, Policies, and Programs (in chronological order of earliest to most recent)	Description and Intent	Cumulative Effect when Combined with the Proposed Action
Coastal Zone Management Act of 1972 (CZMA), as amended through The Coastal Zone Protection Act of 1996.	The CZMA declares the national policy is “to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation’s coastal zone for this and succeeding generations by “the protection of natural resources, including wetlands, floodplains, estuaries, beaches, dunes, barrier islands, coral reefs, and fish and wildlife and their habitat, within the coastal zone.”	Chinook salmon are one of the Nation’s resources within the CZMA’s coastal zone. The Proposed Action would be consistent with the CZMA by encouraging preservation and protection of Puget Sound chinook salmon and their habitat within the coastal zone for existing and succeeding generations, and by ensuring that harvest is consistent with the production and capacity of the habitat. Accordingly, it is predicted that implementation of the Resource Management Plan, in combination with the CZMA, would preserve, protect, restore or enhance the fish resources of the Nation’s coastal zone.
Marine Mammal Protection Act of 1972, as amended through 1996 (MMPA).	The MMPA establishes a Federal responsibility to conserve marine mammals, with management vested in the Department of Commerce for cetaceans and pinnipeds other than walrus. The MMPA states that the “Secretary must undertake a program of research and development for improving fishing methods and gear to reduce to the maximum extent practical the incidental taking of marine mammals in commercial fishing.” To meet this requirement, the “Secretary must issue regulations to reduce to the lowest practical level the taking of marine mammals incidental to commercial fishing operations.” Secretary of Commerce has issued regulation that prohibits deterrent devices that might seriously injure or kill a marine mammal and for fishermen to report unintentional marine mammal mortality.	The Proposed Action would be consistent with the MMPA to conserve marine mammals because the fisheries would be in compliance with Department of Commerce regulations to reduce to the lowest practical level the take of marine mammals incidental to commercial fishing operations. Although not specifically addressed in the Resource Management Plan, Department of Commerce regulations require Puget Sound fishermen to use non-lethal deterrent devices and to report unintentional marine mammal mortality. As chinook salmon are prey of marine mammals, implementation of the Resource Management Plan, in combination with the MMPA, is predicted to potentially reduce the amount of available prey for marine mammals over what would have been available had the fisheries not occurred. It is also true that the fisheries reduce the number of salmon in the short term because they are removing fish, some of which would otherwise spawn. Over the long term, however, it is expected that the RMP will aid in the recovery of the populations by ensuring that enough fish escape to produce more in subsequent generations as habitat improves.

1 Table 4.3.8-1. Federal, Tribal, Washington state, and local plans, policies, and programs that influence fish within the Puget Sound Action Area:
 2 2004 (continued)

Federal/Tribal/State/Local		
Plans, Policies, and Programs (in chronological order of earliest to most recent)	Description and Intent	Cumulative Effect when Combined with the Proposed Action
The Endangered Species Act of 1973, as amended through December, 1996 (ESA).	The purpose of the ESA is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species..." On July 10, 2000, NMFS issued a rule under section 4(d) of the ESA (referred hereafter as the 4(d) Rule). The 4(d) Rule provided limits on the application of the take prohibitions; i.e., take prohibitions would not apply to the plans and activities set out in the rule if those plans and activities adequately address criteria of the rule, including that implementation and enforcement of the resource management plan will not appreciably reduce the likelihood of survival and recovery of affected threatened ESUs.	The Puget Sound Chinook Salmon ESU is listed as threatened under the ESA. The Proposed Action to implement the Puget Sound Chinook Salmon Resource Management Plan includes a condition that the Secretary of Commerce will determine whether the Resource Management Plan adequately addresses the criteria outlined in Limit 6 of the ESA 4(d) Rule. Consequently, the Proposed Action would be consistent with the ESA by meeting these criteria designed to foster goals and objectives of the ESA, including to avoid appreciably reducing the likelihood of survival and recovery of Puget Sound chinook salmon ESU. The ESA would not only have a beneficial impact to listed Puget Sound chinook salmon, but species listed under the ESA also include predators of chinook salmon such as bull trout and bald eagle. Accordingly, it is predicted that implementation of the Resource Management Plan, in combination with the ESA, would potentially have both unquantifiable beneficial and adverse impacts on fish resources.
United States of America, Plaintiff, Quinault Tribe of Indians on its own behalf and on behalf of the Queets Band of Indians, et al., Intervenor-Plaintiffs, v. State of Washington, Defendant, Thor C. Tollefson, Director, Washington State Department of Fisheries, et al., Intervenor-Defendants, Case number C70-9213, February 12, 1974 (Boldt Decision).	The Boldt Decision reaffirmed the rights of Washington Indian tribes to fish in accustomed places, and allocated 50 percent of the annual catch to treaty tribes. Judge Boldt held that the government's promise to secure the fisheries for the tribes was central to the treaty-making process, and that the tribes had an original right to the fish, which they extended to white settlers. Judge Boldt ordered the state to take action to limit fishing by non-Indians. The court decision recognized that "assuring proper spawning escapement is the basic element of conservation involved in restricting the harvest of salmon and Steelhead." The decision further defined adequate production escapement as "... that level of escapement from each fishery which will produce viable offspring in numbers to fully utilize all natural spawning grounds and propagation facilities reasonable and necessary for conservation of the resource..."	The objectives and principles of the Resource Management Plan jointly developed by the co-managers include compliance with the requirements of the Boldt Decision. The Boldt Decision would not have an appreciable effect on the total harvest, but addresses which party and where the harvest can occur. The Boldt Decision encourages the conservation of the species. The Resource Management Plan would conserve the productivity, abundance, and diversity of chinook salmon populations within the ESU. Therefore, it is predicted that implementation of the Resource Management Plan, in combination with the Boldt Decision, would have a beneficial impact on fish resources.

1 Table 4.3.8-1. Federal, Tribal, Washington state, and local plans, policies, and programs that influence fish within the Puget Sound Action Area:
2 2004 (continued)

Federal/Tribal/State/Local		
Plans, Policies, and Programs (in chronological order of earliest to most recent)	Description and Intent	Cumulative Effect when Combined with the Proposed Action
State of Washington, Chapter 76.09 of the Revised Code of Washington (RCW), Forest Practices Act (FPA), 1974.	The FPA defines a plan to protect public resources while assuring that Washington continues to be a productive timber-growing area. The FPA regulates activities related to growing, harvesting or processing timber on all local government, state and private forest lands. The Washington Forest Practices Board was established in 1975 by the Legislature under the State Forest Practices Act. By law, the board is charged with establishing rules to protect the state's natural resources while maintaining a viable timber industry. Those rules, as embodied in the Washington Administrative Code (WAC), specifically consider the effects of various forest practices on fish, wildlife and water quality, as well as on capital improvements of the state or of its political subdivisions.	The Proposed Action would be consistent with the intent of the FPA to protect the natural resources of Washington State. Accordingly, it is predicted that implementation of the Resource Management Plan, in combination with the FPA, would have a net beneficial impact on fish resources.
The Clean Water Act, 1977, (CWA). A 1977 amendment to the Federal Water Pollution Control Act (FWPCA) was titled "The Clean Water Act."	The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. As stated in the CWA, maintaining or restoring water quality "provides for the protection and propagation of fish, shellfish, and wildlife..."	The fisheries that would be allowed by the Resource Management Plan are predicted to have minimal to negligible effect on the Nation's water quality. Primarily because the CWA would maintain water quality that provides for the protection and propagation of fish, it is predicted that implementation of the Resource Management Plan, in combination with the CWA, would have a net beneficial impact on fish resources.
The Treaty between the Government of Canada and the Government of the United States of America concerning Pacific Salmon, 1985, including 1999 revised annexes (Pacific Salmon Treaty).	The Pacific Salmon Treaty calls on the U.S. and Canada (Parties) to conduct its fisheries as to "prevent overfishing and provide for optimum production." The Pacific Salmon Treaty defines "overfishing" as "fishing patterns which result in escapements significantly less than those required to produce maximum sustainable yields [MSY]." Annex IV, Chapter 3, Chinook Salmon of the Pacific Salmon Treaty further states that the Parties shall establish a chinook management program that "sustains healthy stocks and rebuilds stocks that have yet to achieve MSY or other biologically-based escapement objectives." Salmon subject to the Pacific Salmon Treaty includes Pacific salmon stocks which originate in the waters of one Party and subject to interception by the other Party.	Puget Sound chinook salmon are intercepted in Canadian fisheries under the authority of the Pacific Salmon Treaty. The Resource Management Plan accounts for all sources of fishery-related chinook salmon mortality, including mortality related to Canadian fisheries. Although the Resource Management Plan would allow exploitation rates that would result in escapements less than those required to produce maximum sustainable yields in some years, the Resource Management Plan would, overall, sustain healthy populations and rebuild stocks toward maximum sustainable yield. Consequently, the Proposed Action would be consistent with the Pacific Salmon Treaty. Accordingly, it is predicted that the implementation of the Resource Management Plan, in combination with the Pacific Salmon Treaty, would have a net beneficial impact on fish resources.

1 Table 4.3.8-1. Federal, Tribal, Washington state, and local plans, policies, and programs that influence fish within the Puget Sound Action Area:
 2 2004 (continued)

Federal/Tribal/State/Local		
Plans, Policies, and Programs (in chronological order of earliest to most recent)	Description and Intent	Cumulative Effect when Combined with the Proposed Action
<p>State of Washington, Chapter 36.70A RCW Growth Management – Planning by Selected Counties and Cities. Commonly referred to as the Growth Management Act (GMA). Adopted by the state in 1990.</p>	<p>The GMA guides the development and adoption of comprehensive land use plans and development regulations of counties and cities within the state of Washington. The goals of the GMA include: “[m]aintain and enhance natural resource-based industries, including productive timber, agricultural, and fisheries industries” and “[p]rotect the environment and enhance the state’s high quality of life, including air and water quality, and the availability of water.”</p>	<p>The fisheries that would be allowed by the Resource Management Plan are predicted to have minimal to negligible effect on Washington State water quality. It is predicted that implementation of the Resource Management Plan would provide protection for fish conservation, and would not conflict with planned growth objectives of the GMA.</p>
<p>Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, commonly referred to as the Northwest Forest Plan (NFP), 1994.</p>	<p>The NFP is an integrated, comprehensive design for ecosystem management, intergovernmental and public collaboration, and rural community economic assistance for federal forests in western Oregon, Washington, and northern California. The management direction of the NFP consists of extensive standards and guidelines, including land allocations that comprise a comprehensive ecosystem management strategy. Aquatic conservation strategy objectives outlined in the NFP (Attachment A of the NFP) include, but are not limited to: “Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted;” and, “Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.”</p>	<p>The Proposed Action would be consistent with the intent of NFP to maintain and restore the distribution, diversity, and complexity of watersheds. Accordingly, it is predicted that implementation of the Resource Management Plan, in combination with the NFP, would have a net beneficial impact on fish resources.</p>

1 Table 4.3.8-1. Federal, Tribal, Washington state, and local plans, policies, and programs that influence fish within the Puget Sound Action Area:
 2 2004 (continued)

Federal/Tribal/State/Local		
Plans, Policies, and Programs (in chronological order of earliest to most recent)	Description and Intent	Cumulative Effect when Combined with the Proposed Action
<p>Magnuson-Stevens Conservation and Management Act, as amended through October 11, 1996 (MSCMA).</p>	<p>The stated purpose of the MSCMA is “to promote domestic commercial and recreational fishing under sound conservation and management principles.” The MSCMA is “to provide for the preparation and implementation, in accordance with national standards, of fishery management plans which will achieve and maintain, on a continuing basis, the optimum yield from each fishery.” The MSCMS defines the term “optimum,” with respect to the yield from a fishery, as the amount of fish which -- a) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems; b) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and c) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.</p> <p>The National Standards that serve as the overarching objectives for fishery conservation and management include:</p> <ul style="list-style-type: none"> • Conservation and management measures shall prevent overfishing. The terms “overfishing” and “overfished” mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis. • Conservation and management measures shall be based upon the best scientific information available. 	<p>Based on consistency with the National Standards addressed below, it is predicted that implementation of the Resource Management Plan, in combination with the MSCMA, would have a net beneficial impact on fish resources.</p> <ul style="list-style-type: none"> • The Resource Management Plan provides for rebuilding to a level consistent with producing the maximum sustainable yield in the fishery. Consequently, the Proposed Action would be consistent with the National Standard that the management plan “shall prevent overfishing,” as defined in the MSCMA. • The objectives of the Resource Management Plan include adequately addressing the criteria of a management plan under Limit 6 of the ESA 4(d) Rule. ESA requires the Secretary of Commerce to make such determinations on the basis of the best scientific and commercial data available. Consequently, the Proposed Action would be consistent with the National Standard of the MSCMA to use the best scientific information available.

1 Table 4.3.8-1. Federal, Tribal, Washington state, and local plans, policies, and programs that influence fish within the Puget Sound Action Area:
2 2004 (continued)

Federal/Tribal/State/Local		
Plans, Policies, and Programs (in chronological order of earliest to most recent)	Description and Intent	Cumulative Effect when Combined with the Proposed Action
<p>Magnuson-Stevens Conservation and Management Act, as amended through October 11, 1996 (MSCMA), continued</p>	<ul style="list-style-type: none"> • To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated populations of fish shall be managed as a unit or in close coordination. • Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches. • Conservation and management measures shall minimize by-catch. 	<ul style="list-style-type: none"> • For harvest management purposes, the Resource Management Plan defines 15 Puget Sound chinook salmon management units. The Resource Management Plan defines a management unit as a “stock or group of [chinook salmon] stocks which are aggregated for the purpose of achieving a management objective.” The Resource Management Plan places limits to the cumulative fishery-related mortality to each Puget Sound chinook salmon population or management unit throughout its entire range. Thus, the Resource Management Plan accounts for all sources of fishery-related chinook salmon mortality throughout its range. The Proposed Action would be consistent with the National Standard of the MSCMA to manage populations throughout its range. • As outlined in the Resource Management Plan, in managing fisheries in-season, the co-managers would implement guidelines established during the pre-season planning process to meet conservation requirements. However, these guidelines could be modified in-season based on in-season assessments of effort, catch, abundance, and escapement, while still meeting conservation requirements. Consequently, the Proposed Action would be consistent with the National Standard of the MSCMA to allow contingencies in fisheries. • The Resource Management Plan is based on limits to the cumulative fishery-related mortality to each Puget Sound chinook salmon population or management unit. The Proposed Action would limit the cumulative mortality, which includes by-catch, to these limits. Consequently, the Proposed Action would be consistent with the National Standard of the MSCMA to minimize by-catch.

1 Table 4.3.8-1. Federal, Tribal, Washington state, and local plans, policies, and programs that influence fish within the Puget Sound Action Area:
2 2004 (continued)

Federal/Tribal/State/Local		
Plans, Policies, and Programs (in chronological order of earliest to most recent)	Description and Intent	Cumulative Effect when Combined with the Proposed Action
Gravel to Gravel, Regional Salmon Recovery Policy for the Puget Sound and the Coast of Washington, Western Washington Treaty Tribes, July 25, 1997 (Gravel to Gravel Policy).	Major elements of the Gravel to Gravel Policy are to provide habitat protection and restoration, ensuring abundant spawners, managing fisheries, and integrating hatchery production.	The Proposed Action would be consistent with the Gravel to Gravel policy of managing fisheries to ensure abundant spawners. Accordingly, it is predicted that implementation of the Resource Management Plan, in combination with the Gravel to Gravel Policy, would have a beneficial impact on fish resources.
Policy of Washington Department of Fish and Wildlife and Western Washington Treaty Tribes Concerning Wild Salmonids (Wild Salmon Policy). Adopted by Washington Fish and Wildlife Commission on December 5, 1997. (Despite the title, the tribal governments have not adopted this Wild Salmon Policy.)	The stated goals of the Wild Salmon Policy include restoring Washington stocks of wild salmon and steelhead to healthy, harvestable runs by “managing commercial and sport fishing to ensure enough wild runs return to spawn while providing fishing opportunities where possible.”	The Proposed Action would be consistent with the Wild Salmon Policy’s intent to manage commercial and recreational fishing to ensure enough wild salmon return to spawn while providing fishing opportunities where possible. Accordingly, it is predicted that implementation of the Resource Management Plan, in combination with the Wild Salmon Policy, would have a beneficial impact on fish resources.
Statewide Strategy to Recover Salmon, September 21, 1999 (SSRS).	The goal of the SSRS is to “[r]estore salmon, steelhead, and trout populations to healthy and harvestable levels and improve the habitats on which fish rely.” The SSRS is the long-term vision or guide for salmon recovery within the State of Washington.	The Proposed Action would be consistent with the intent of SSRS to restore salmon populations to healthy and harvestable levels. Accordingly, it is predicted that implementation of the Resource Management Plan, in combination with the SSRS, would have a beneficial impact on fish resources.
Local Plans, Policies, and Programs	Local activities that influence cumulative effects to fish include, but are not limited to: Water Supply Projects: Local water departments operate and maintain water reservoirs, pump stations, and water mains to deliver drinkable water to their customers. Local projects have minimized the adverse impacts of water withdrawal by installing additional water gauges to monitor flows and regulate water use, reducing water intake during critical environmental periods, and by purchasing existing water rights to return water to the system.	Many of these local activities are conducted in cooperation with federal, tribal, and state actions. The fisheries that would be allowed by the Resource Management Plan are predicted to have minimal to negligible effect on Washington State water quality. Because many of these local plans, policies, and programs would maintain water quality that provides for the protection and propagation of fish, it is predicted that the implementation of the Resource Management Plan, in combination with local plans, policies, and programs, would have a net beneficial impact on fish resources.

1 Table 4.3.8-1. Federal, Tribal, Washington state, and local plans, policies, and programs that influence fish within the Puget Sound Action Area:
 2 2004 (continued)

Federal/Tribal/State/Local		
Plans, Policies, and Programs (in chronological order of earliest to most recent)	Description and Intent	Cumulative Effect when Combined with the Proposed Action
<p>Local Plans, Policies, and Programs, <i>continued</i></p>	<p>Levee Maintenance: A levee is a natural or manmade structure, usually earthen or riprap, which parallels the course of a river. It functions to prevent flooding of the adjoining countryside. However, it also confines the flow of the river resulting in higher, faster water flow. In recent years, local levee maintenance projects have included setting back or removing levees.</p> <p>Stormwater Management: Surface water runoff results from rainfall or snow melt that does not infiltrate the ground or evaporate due to impervious surfaces. Instead, this runoff flows onto adjacent land, or into watercourses, or is routed into storm drainage collection systems managed by local entities. Local cities and counties are in the process of developing watershed plans, subbasin plans, and revising codes to minimize the adverse impacts of surface water runoff.</p> <p>Wastewater Treatment Projects: Municipal wastewater treatment plants process domestic sewage, and commercial and industrial wastewaters. Stormwater and groundwater infiltration may also enter wastewater treatment plants, though efforts are being made to segregate these flows. Local cities and counties are in the process of developing facilities plans and revising codes to minimize adverse impacts associated with wastewater treatment projects.</p> <p>Salmon Recovery Efforts: Local communities are undertaking activities to protect listed species and their habitat. Examples of activities conducted include, but are not limited to: reducing barriers to fish passage; improving habitat forming processes; increasing channel diversity; improving estuarine habitat; and enhancing streamside vegetation.</p> <p>Watershed Conservation Plans: As mandated by the 1998 state of Washington Watershed Management Act and Salmon Recovery Planning Act, counties are conducting watershed planning to address water quality, water quantity, and salmon habitat issues.</p>	

3

