BAKER RIVER PROJECT RELICENSE

Aquatic Resources Working Group
Technical Sub-committee on Instream Flows

December 15, 2003
9:00 a.m. - 3:00 p.m.
Puget Sound Energy
Camelot Conference Room, 2nd floor (425/424-6550)
19900 North Creek Parkway, Bothell, WA

Meeting Purpose: Develop a process to resolve flow-related issues for Baker River Project relicensing.

ANNOTATED DRAFT AGENDA

1) Review Draft Agenda *[AnnotatedAgenda-121503]*

Note: Reference to files previously provided for 11/17/03 instream flow technical meeting are shown in [brackets], reference to files provided for 12/15/03 meeting are *[bracketed and italicized]*.

2) Status of Action Items from September 25, 2003 Instream Flow Meeting

- □ All - Review the meeting materials, draft meeting record and recommended analysis decisions, and submit edits or changes to the meeting record before the next instream flow meeting.
- □ All – Let Sue know if you would like a copy of the 2003 helicopter video (Sue has made copies made for SSIT/STC, USFS, Skagit County, PSE-Bellevue, PSE-Concrete, DNR and the R2 Baker library).
- □ Stuart/Phil – examine alternative locations to measure ramping rate compliance and prepare a recommendation for the group to consider at the next meeting.
- □ All – set aside Dec 15th, Monday for next Instream Flow Technical team meeting.
- □ All – set aside Dec 17th for next Aquatics RESOLVE session - and encourage the "Olympia contingent" to attend the meeting.

3) Recap Flow and Habitat Modeling Procedures

- HYDROPS Post-Processing: 5 Representative Energy Years (EY) through Level 3, 12 years through Level 4 (EY 1991 to EY 2002). "What to include in Level 3 and 4?"
- Middle Skagit River Flow Routing of HYDROPS Output
  - Travel Time, Accretion, and Stage:Q relationships covered in previous meetings
- Transect weighting [Transect Weighting Comparison – 111403.doc] [UpdatedTransect Weighting.doc]

  Previous Decision:

  No change to flow routing model.

  We agreed to minor changes to transect weightings.
- Critical Ramping Flow [CriticalFlowEvaluation.111003.xls]

  Previous Decision:

  Recommend that the critical downramping flow be set at 30,000 cfs, as measured at the USGS Skagit River gage near Concrete. R2 to consider location and procedures to measure ramping rate compliance and prepare a recommendation for the group to consider at the next meeting.

  NEW Analysis Decision:

  Recommend that R2 get busy and address the issue.

4) Skagit Hourly Habitat Analyses

- Ramping Rates [1995 Hourly Summary 111403.xls (Figures 15-26)]

  Previous Decision:

  We agreed to recommend that R2 include monthly charts of excursions of WDFW criteria, and stage drops exceeding 1, 2 and 4 inches per hour when flows are less than 30,000 cfs in Level 3 and Level 4 HYDROPS post-processing analyses.
- Varial Zone [1995 Hourly Summary 111403.xls (Figures 1-14)]

  Previous Decision:

  Recommend that Figures 1 and 8 (Upper extent based on previous 12 hours & lower extent on previous 7 days), and Figures 5 & 12 (Upper and lower extent based on previous 12 hours) be incorporated into Level 3 and Level 4 HYDROPS post-processing analyses.
- Flows During Spawning Periods [SalmonSpawnTiming-111403.doc]

  Previous Decision:

  Recommend that R2 integrate spawn timing and hourly flows using the proposed spawn timing periods.

Assumptions regarding the timing of spawning salmonids were reviewed during the 12/11/03 Aquatic Resource Working Group and the 12/12/03 Technical Scenario Teamlet meeting. As a result of discussion during those meetings, the instream flow teamlet is asked to consider extending the timing of chum spawning to December 31 to be consistent with the timing periods described in technical report A-09c Middle Skagit River Salmon Spawning Surveys dated October 2003. *[SalmonSpawnTiming-revised 121503.doc]*

NEW Analysis Decision:

> **Recommend that R2 use the revised periods of salmonid spawning as described in [SalmonSpawnTiming-revised 121503.doc] for the middle Skagit River hourly analyses.**

- Incubation Flow and Dewatering Analyses *[SpawningPreferenceCurves.doc]*

  Previous Decision:

  > Recommend that R2 use a running 2-day low flow as an index of incubation and quantify the risk of redd dewatering using an assumed spawning suitability factor developed for each transect.

  NEW Analysis Decision:

  > **Recommend that R2 assume for their analyses that impacts to redds occur when the water stage drops below the elevation of the surface of the spawning site.**

  NEW Analysis Decision:

  > **Recommend that R2 use a 90-day incubation period for fall spawning salmonids and a 70-day incubation period for steelhead spawning in the middle Skagit River.**

  NEW Analysis Decision:

  > **Recommend that R2 use a 0.5 suitability index of depth and velocity HSI curves to identify potential spawning areas in the middle Skagit River.**

  NEW Analysis Decision:

  > **Recommend that R2 implement the hourly dewatering models in Level 3 and Level 4 HYDROPS post-processing analyses to identify and isolate the risk of redd dewatering associated with alternate operational scenarios for the Baker River Project.**

- Scour Analyses

  It is unclear whether flood events decrease egg survival through physical scouring of the egg pockets or through intrusion of fine sediments into the redd environment that decreases oxygen exchange and smothers the eggs. Both potential effects can be evaluated by modeling shear velocities.

Previous Decision:

Recommend that R2 develop models that integrate spawning site suitability and an index of sediment movement (shear index) to identify and isolate the risk of high flow events affecting egg-to-fry survival.

NEW Analysis Decision:

Recommend that R2 implement the hourly scour models in Level 3 and Level 4 HYDROPS post-processing analyses.

- Integrate Redd Dewatering and High Flow Analyses

[SpawningIncubationConceptualModel.doc]

[EffectiveChinookSpawningWidth.doc]

[SpawningIncubation1995.doc]

Previous Decision:

Recommend that R2 develop an index of maximum sustainable spawning habitat that integrates the risk of redd dewatering and effects of flood flows on egg to fry survival.

NEW Analysis Decision:

Recommend that R2 combine the hourly redd dewatering and hourly scour models into an effective spawning habitat model that is implemented as part of Level 3 and Level 4 HYDROPS post-processing analyses.

6) Middle Skagit Daily Habitat Analyses

- PHABSIM (mainstem and secondary channels)
  - Model calibration details [PHABSIMHydraulicCalibration.doc]

Previous Decision:

Recommend that R2's PHABSIM model be accepted as a basis for analysis of potential habitat (Weighted Usable Area) in the middle Skagit River.

- Weighted Usable Area (WUA) vs. flow relationships for pink, Chinook, chum and steelhead spawning for the middle Skagit River

  [WUA-Spawning-121103.xls]

  [WUA-Spawning-SelectedTransects.doc]

Previous Decision:

Develop WUA vs. flow relationships for pink, Chinook, chum and steelhead spawning, and Chinook and steelhead rearing.

New Analysis Decision: Recommend that R2 develop daily habitat time series and 5%, 20%, 50%, 80% and 95% monthly habitat values of WUA vs. flow for pink, Chinook, chum and steelhead spawning and Chinook

and steelhead rearing as part of Level 4 HYDROPS post-processing analyses.

- Initial results for Chinook and steelhead rearing Weighted Usable Area (WUA) vs. flow for the middle Skagit River

  [WUA-Rearing-121103.xls]

  [ChinookRearingWUAJuneJulyAugust.doc]

New Analysis Decision: Recommend that R2 develop daily habitat time series and 5%, 20%, 50%, 80% and 95% monthly habitat values of WUA vs. flow for Chinook and steelhead rearing as part of Level 4 HYDROPS post-processing analyses.

- Side-channels: Wetted length of all sites and wetted area of all sites vs. mainstem flow [OffChannelSummary-111403.doc]

- Backwater sloughs: Wetted length of all surveyed sites, wetted area of all sites, and (in progress) wetted area by 1-ft depth increments of selected sites vs. mainstem flow. [OffChannelSummary-111403.doc]

Previous Decision:

Recommend that calculations of backwater slough & side channel data only be used in Level 4 analyses. Ruth will consider modifying the definition of freshets; and an index of the number of freshets on a monthly basis will be included in Level 3 analyses.

New Analysis Decision:

R2 will develop daily habitat time series and 5%, 20%, 50%, 80% and 95% monthly habitat calculations of backwater slough & side channel data in Level 4 HYDROPS post-processing. Sue Madsen-R2 will work with Ruth Mathews-TNC to modify the definition of freshets and include an index of the number of freshets on a monthly basis in Level 3 and Level 4 HYDROPS post-processing.

7) Integrating Model Results into Decision-Making

- Seasonal and Monthly Biological Considerations
  - Salmonid spawn timing *[SalmonSpawnTiming-revised 121503.doc]*
  - Incubation and emergence timing [90-day salmon, 70-day steelhead]
  - Seasonal ramping rates defined by WDFW ramping rate guidelines *[WDFWRamping Rates.doc]*
  - Reservoir euphotic zone[*EuphoticVolume_111403.doc*]

    Baker Reservoir Zooplankton [*BakerEuphoticZonePlankton-121503.doc*, also see Azit Mazumder's June 4, 2003 draft report]

    Lake Shannon Reservoir [Plots of temperature and zooplankton regimes - in progress]

- Natural “unregulated” hydrology regime [See A24 Part 1:Hydrology and Addendums]

- Economic Considerations
    - Average monthly energy values [*EnergyStreamflowPlot-100803*]
    - Monthly difference in peak/off-peak energy values [*EnergyStreamflowPlot-100803*]
    - Dependable capacity [www.pse.com/hydro/baker/meetings/2003/economics20030409handout.pdf]
    - Emergency generation reserves

- Flood Control Considerations
    - Timing and volume of storage required under Corps flood control agreement [see October 2003 PDEA]
    - Conditions under which the Corps controls Project operations
    - PSE 8-ft flood control buffer

- Cross-Resource Considerations
    - Recreation reservoir pool levels

      Baker Reservoir pool levels

      724.8 ft May 23-Sep 7
      713.8 ft May 9-Oct 5
      0.5 ft max daily fluctuations

      Lake Shannon pool levels

      _____ ft May 23-Sep 7
      _____ ft May 9-Oct 5
      0.5 ft max daily fluctuations
    - Wildlife reservoir pool levels
    - Water quality reservoir pool levels

      Baker Reservoir

      Lake Shannon pool levels

- Instream Flow Parameters
    - Minimum instream flow (MIF)

      Aug 16 to Sep 9 at 500 cfs
        - natural low flow period
        - high energy value
        - no salmonid spawning or incubation

      May, June and July at 1,800 cfs
        - natural high flow period

    - Baker Reservoir pool levels

Low

High

- Lake Shannon Reservoir pool levels

  Low

  High

- Ramping rates

- Amplitude (maximum Lower Baker controlled release ‘max powerhouse capacity’ minus minimum instream flow (MIF) release)

- Spill avoidance

8) Schedule and Decision Items

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Aquatic Resources Working Group
Technical Sub-committee on Instream Flows

December 15, 2003
9:00 a.m. - 3:00 p.m.
Puget Sound Energy
Camelot Conference Room, 2nd floor (425/424-6550)
19900 North Creek Parkway, Bothell, WA

Meeting Notes

Meeting Purpose: Develop a process to resolve flow-related issues for Baker River Project relicensing.

Fish Team Leader: Arnie Aspelund, 425-462-3442, aaspel@puget.com

PRESENT: Arnie Aspelund (PSE), Stuart Beck (R2), Cary Feldmann (PSE), Phil Hilgert (R2), Hal Beecher (WDFW), Chuck Ebel (USACE), Jeff McGowan (Skagit County), Brad Caldwell (DOE), Ruth Mathews (TNC), Stan Walsh (Sauk-Suiattle Indian Tribe/Swinomish Tribal Community), Jason Shappart (Meridian Environmental, Inc.), Margaret Beilharz, (US Forest Service) on the phone, and Lyn Wiltse, facilitator (PDSA Consulting), and Dawn Schink, (PSE) note taker.

1) Review Draft Agenda *[AnnotatedAgenda-121503]*

Decisions and recommendations from the November 17, 2003 instream flow meeting were listed in the annotated agenda (handout) to allow participants the opportunity to review and revise prior actions. If meeting participants still agree with the previous recommendation, the decision is considered final and will be implemented in the analysis process. Recommendations and actions identified during the December 15, 2003 meeting are characterized as NEW Decisions and will be considered tentative until reviewed at the next meeting.

Reference to files previously provided for the November 17, 2003 instream flow technical meeting are shown in [brackets], reference to files provided for the December 15, 2003 meeting are *[bracketed and italicized]*.

2) Status of Action Items from November 17, 2003 Instream Flow Meeting

√ All - Review the meeting materials, draft meeting record and recommended analysis decisions, and submit edits or changes to the meeting record before the next instream flow meeting.

√ All – Let Sue know if you would like a copy of the 2003 helicopter video (Sue has made copies made for SSIT/STC, USFS, Skagit County, PSE-Bellevue, PSE-Concrete, DNR and the R2 Baker library).

□ Stuart/Phil – examine alternative locations to measure ramping rate compliance and prepare a recommendation for the group to consider at the next meeting.

√ All – set aside Dec 15th, Monday for next Instream Flow Technical team meeting.

√ All – set aside Dec 17th for next Aquatics RESOLVE session - and encourage the "Olympia contingent" to attend the meeting. **Meeting canceled.**

3) Recap Flow and Habitat Modeling Procedures

- HYDROPS Post-Processing: 5 Representative Energy Years (EY) through Level 3, 12 years through Level 4 (EY 1991 to EY 2002). "What to include in Level 3 and 4?"
- Middle Skagit River Flow Routing of HYDROPS Output
  - Travel Time, Accretion, and Stage:Q relationships covered in previous meetings
- Transect weighting [Transect Weighting Comparison – 111403.doc] [UpdatedTransect Weighting.doc]

  Previous Decision: Decision stands

  No change to flow routing model.

  We agreed to minor changes to transect weightings.
- Critical Ramping Flow [CriticalFlowEvaluation.111003.xls]

  Previous Decision: Decision stands.

  Recommend that the critical downramping flow be set at 30,000 cfs, as measured at the USGS Skagit River gage near Concrete.

  NEW Decision/Action :

  R2 to consider location and procedures to measure ramping rate compliance and prepare a recommendation for the group to consider at the next meeting.

4) Skagit Hourly Habitat Analyses

- Ramping Rates [1995 Hourly Summary 111403.xls (Figures 15-26)]

  Previous Decision: Decision stands.

  We agreed to recommend that R2 include monthly charts of excursions of WDFW criteria, and stage drops exceeding 1, 2 and 4 inches per hour when flows are less than 30,000 cfs in Level 3 and Level 4 HYDROPS post-processing analyses.

- Varial Zone [1995 Hourly Summary 111403.xls (Figures 1-14)] OK

  Previous Decision: Decision stands.

  Recommend that Figures 1 and 8 (Upper extent based on previous 12 hours & lower extent on previous 7 days), and Figures 5 & 12 (Upper and lower extent based on previous 12 hours) be incorporated into Level 3 and Level 4 HYDROPS post-processing analyses.

- Flows During Spawning Periods [SalmonSpawnTiming-111403.doc]

  Previous Decision: - Decision modified.

  Recommend that R2 integrate spawn timing and hourly flows using the proposed spawn timing periods.

  Assumptions regarding the timing of spawning salmonids were reviewed during the 12/11/03 Aquatic Resource Working Group and the 12/12/03 Technical Scenario Teamlet meeting. As a result of discussion during those meetings, the instream flow teamlet was asked to consider extending the timing of chum spawning to December 31 to be consistent with the timing periods described in technical report A-09c Middle Skagit River Salmon Spawning Surveys dated October 2003. *[SalmonSpawnTiming-revised 121503.doc]*

  NEW Analysis Decision:

  The end of the chum-spawning period will be extended from December 21 to Dec 31, consistent with the periodicity identified in technical report A-09c:Middle Skagit River Salmon Spawning Surveys. Spawn timing for other salmonid species were approved for use in the middle Skagit River habitat analyses.

- Incubation Flow and Dewatering Analyses *[SpawningPreferenceCurves.doc]*

  Previous Decision: Decision stands.

  Recommend that R2 use a running 2-day low flow (two consecutive days) as an index of incubation. Using an assumed spawning suitability factor, the risk of redd dewatering will be evaluated on a cell-by-cell basis for each transect.

R2 has assumed that eggs within the redd environment will be affected when the river stage drops to the surface of the redds. Salmonid eggs are typically deposited 0.5 to 0.8-ft below the surface of the gravel, so this assumption may overestimate effects of dewatering on eggs. The assumption of using a 2-day low flow, rather than an instantaneous flow, to identify initiation of redd dewatering may underestimate dewatering risks; so together the two assumptions are believed to be appropriate for the analyses. While eggs may withstand short-term dewatering, alevins (newly hatched fish prior to emerging from the gravel environment) are injured when dewatered for even an hour. The alevins also need water over the gravel surface to emerge and become free-swimming. The alevins are able to move short distances through the gravel interstices, but the range of this movement is limited to inches rather than yards. The redd dewatering and incubation analyses outlined by R2 can be used to provide an index of effects of flow levels on egg incubation, but it does not address the potential need for higher stream flows during the alevin pre-emergence and emergence periods. R2 will look at data compiled for the A-09d report (Middle Skagit River Juvenile Salmonids) and identify the periods of emergence by species.

NEW Analysis Decision:

Recommend that R2 use a 0.5 suitability index of depth and velocity HSI curves to identify potential spawning areas in the middle Skagit River.

NEW Analysis Decision:

Recommend that R2 assume for their analyses that impacts to salmonid eggs occur when the water stage drops to the elevation of the surface of the spawning site.

NEW Analysis Decision:

Recommend that R2 use a 90-day incubation period for fall spawning salmonids and a 70-day incubation period for steelhead spawning in the middle Skagit River. R2 will attempt to identify salmonid emergence periods, and at the next meeting, the group will consider extending the incubation period and/or other methods to address flow conditions during the alevin pre-emergence period.

- Scour Analyses

Flood events may decrease egg survival through physical scouring of the egg pockets, and through intrusion of fine sediments into the redd environment that decreases oxygen exchange and smothers the eggs. Both potential effects can be evaluated by modeling shear velocities. While both physical scouring and fine sediment intrusion may be affecting egg survival, the process will be referenced as ‘redd-scour’.

Inception of redd-scour will be assessed on a cell-by-cell basis within each transect using the Meyer-Peter and Muller method. According to this method, bed load transport would be initiated when the shear stress on the bed surface is sufficient to disrupt the armor layer and expose the underlying finer sediment particles to the flow. Within each cell, the median gravel size (D_{50}) was estimated from a visual assessment of substrate composition taken during low flow conditions. Similarly, D_{90}, considered representative of the surface roughness of the substrate, was also derived from the visual assessment.

Hydraulic results from the PHABSIM model will be used to determine the nominal shear stress within each cell. The total energy loss in rivers results from a combination of form drag and surface friction. The effective shear stress represents the portion of nominal shear stress associated with surface friction, and thus represents the portion of the nominal shear stress capable of transporting the channel bed material. The Meyer-Peter and Muller (1948) method accounts for the effective shear stress. Based on this method, redd-scour would occur when the effective shear stress is sufficient to mobilize the armor layer of the substrate material. Once the armor layer is disturbed, scour of underlying sediments occurs rapidly, thus disruption of the armor layer is a reasonable indicator of the effects of scour on egg pockets.

Previous Decision: Decision stands.

Recommend that R2 develop models that integrate spawning site suitability and an index of sediment movement (shear index) to identify and isolate the risk of high flow events affecting egg-to-fry survival.

- Integrate Redd Dewatering and High Flow Analyses

[SpawningIncubationConceptualModel.doc]

[EffectiveChinookSpawningWidth.doc] Page *15*

[SpawningIncubation1995.doc]

Jason requested that plots be developed showing comparisons of proposed actions to PSE.01 (Recent Conditions) for the NEPA documents. Ruth suggested a comparison of one or more alternative actions to Unregulated Baker/Regulated Skagit. Phil stressed that R2 can compare an alternative action to PSE.01 and Unregulated Baker/Regulated Skagit for Level 3 (n=5 years), but does not want to start mixing alternatives when making Level 4 runs (n=12 years). It was agreed that Level 4 will not be run until the group has narrowed down the list of alternative scenarios to three or four.

Previous Decision: Decision stands.

Recommend that R2 develop an index of maximum sustainable spawning habitat that integrates the risk of redd dewatering and effects of flood flows on egg to fry survival.

NEW Analysis Decision:

Level 3 - Recommend that R2 implement the hourly dewatering models in Level 3. For each scenario, R2 will develop plots of effective spawning width, effective spawning/incubation width (accounting for redd-scour only), effective spawning/incubation width (accounting for redd-dewatering only), and effective spawning/incubation width (accounting for both redd-scour and redd-dewatering) for pink, Chinook, chum and steelhead at 23 transect locations and a transect-weighted, reach-averaged summary, comparing the target scenario with PSE.01 (Recent Conditions) and Unregulated Baker River/Regulated Skagit River.

Level 4 - Since Level 4 analyses will only be run for a few scenarios, the group agreed to defer identifying which scenarios to use for comparison until a subset of likely alternatives is apparent.

NEW Analysis Decision/Action:

The group requested that R2 run the effective spawning analyses assuming that Baker Project releases could be maintained at 4 kcfs, 6 kcfs, 8 kcfs, 10 kcfs, 16 kcfs and 32 kcfs flows during the peak Chinook spawning period of September 25 to October 31. R2 will use Unregulated Baker/Regulated Skagit flows for the November 1 to September 24 period for the five representative years. The results may help identify the potential benefits of maintaining higher releases during the spawning period. One objective would be to identify the flow at the benefits of additional Baker Project releases begin to provide less effective spawning habitat.

6) Middle Skagit Daily Habitat Analyses (weighted Usable Area: WUA)

- PHABSIM (mainstem and secondary channels)
  - Model calibration details [PHABSIMHydraulicCalibration.doc]

Previous Decision: Decision stands.

Recommend that R2's PHABSIM model be accepted as a basis for analysis of potential habitat (Weighted Usable Area) in the middle Skagit River.

- Weighted Usable Area (WUA) vs. flow relationships for pink, Chinook, chum and steelhead spawning for the middle Skagit River

[WUA-Spawning-121103.xls]

[WUA-Spawning-SelectedTransects.doc]

Stan stressed that he will be looking at releases from the Baker River Project that provide protection during the incubation season commensurate with flows released during the spawning season. Phil reiterated that the high-volume runoff of the Baker Basin and the small volume of available reservoir storage affects PSE's ability to limit flow releases during the spawning season and augment minimum flows during the incubation season. The HYDROPS modeling efforts and the middle Skagit River analyses will be used to explore available options.

Previous Decision: Decision stands.

Develop WUA vs. flow relationships for pink, Chinook, chum and steelhead spawning, and Chinook and steelhead rearing.

New Analysis Details: Recommend that R2 develop daily habitat time series and 5%, 20%, 50%, 80% and 95% monthly habitat values of WUA vs. flow for pink, Chinook, chum and steelhead spawning as part of Level 4 HYDROPS post-processing analyses.

- Initial results for Chinook and steelhead rearing Weighted Usable Area (WUA) vs. flow for the middle Skagit River

[WUA-Rearing-121103.xls]

[ChinookRearingWUAJuneJulyAugust.doc]

The group observed that the amount of rearing WUA did not appear sensitive to flow changes. Daily and hourly flow fluctuations during the summer months of 1995 (representative year) did not affect the amount of rearing WUA. Stan noted that the WUA calculations only address mainstem rearing habitat and do not address rearing habitat in backwater sloughs and side channels. Phil agreed and noted that separate models of backwater sloughs and side channels (off-channel habitats) have been developed (discussed at the November 17, 2003 meeting). The backwater slough and side channel models indicate that off-channel habitat increases as mainstem flows increase.

New Analysis Decision: Recommend that R2 develop daily habitat time series and 5%, 20%, 50%, 80% and 95% monthly habitat values of WUA vs. flow for Chinook and steelhead rearing as part of Level 4 HYDROPS post-processing analyses..

- Side-channels: Wetted length of all sites and wetted area of all sites vs. mainstem flow
  [OffChannelSummary-111403.doc]

- Backwater sloughs: Wetted length of all surveyed sites, wetted area of all sites, and (in progress) wetted area by 1-ft depth increments of selected sites vs. mainstem flow.
  [OffChannelSummary-111403.doc]

Previous Decision: Decision stands.

Recommend that calculations of backwater slough & side channel data only be used in Level 4 analyses.

New Analysis Detail:

R2 will develop daily habitat time series and 5%, 20%, 50%, 80% and 95% monthly habitat calculations of backwater slough & side channel data in Level 4 HYDROPS post-processing. Sue Madsen-R2 will work with Ruth Mathews-TNC to modify the definition of freshets and include an index of the number of freshets on a monthly basis in Level 3 and Level 4 HYDROPS post-processing.

7) Integrating Model Results into Decision-Making

The NEPA team will begin revising the October draft PDEA in January 2004 in order to submit the License Application and final PDEA to the FERC on April 30, 2004. The ARWG will need to submit a revised operating scenario (Draft Action) and associated environmental modeling results to the NEPA team by January 26, 2004. In an effort to identify potential areas of consensus, or areas of conflicts between aquatic resources, participants were asked to openly discuss their objectives for an acceptable instream flow regime. Feedback would not be considered to reflect an agency position, but simply an opportunity to collaborate on potential solutions. To initiate the discussion, R2 listed several documents that contained data they considered relevant to instream flow decisions.

- Seasonal and Monthly Biological Considerations
  - Salmonid spawn timing *[SalmonSpawnTiming-revised 121503.doc]*
  - Incubation and emergence timing [90-day salmon, 70-day steelhead but consider modifications for emergence]
  - Seasonal ramping rates defined by WDFW ramping rate guidelines *[WDFWRamping Rates.doc]* Page 10.
  - Reservoir euphotic zone[*EuphoticVolume_111403.doc*] Page 31 – 35.

    Baker Reservoir Zooplankton [*BakerEuphoticZonePlankton-121503.doc*, also see Azit Mazumder's June 4, 2003 draft report] Page 36 & 37

    Goal: Come up with an analysis procedure to evaluate the effect of alternate reservoir refill scenarios on reservoir productivity.
    - Key questions: early vs. late spring refill, and early vs. late evacuation of storage for flood control during the fall
    - Euphotic zone is an index of light penetration , which is related to productivity.
    - High value based on plankton abundance, warm water temperatures and presence of sockeye fry in summer
    - Stan thought the weighting factor for October, based on food availability and water temperature, should be increased from 0.6 to 0.8. After much discussion, the group agreed. Ruth thought that the March weighting factor of 0.5 was too high; after additional discussion, the group agreed to change it to 0.4.
    - Hal will ask Gary Sprague-WDFW to review the weighting factors by the end of the year. Unless R2 hears from Hal or Gary, they will use the modified weighting factors for the post-HYDROPS analyses to be produced in early January.

    Lake Shannon Reservoir [Plots of temperature and zooplankton regimes - in progress]
  - Timing of downstream movement of juvenile salmonids

    Baker reservoirs [see March 200 Initial Consultation Document]

    Middle Skagit River [see A-09d – in progress]
    - Consideration for spill avoidance
  - Natural "unregulated" hydrology regime [See A24 Part 1:Hydrology and Addendums]

- Economic Considerations
  - Average monthly energy values [*EnergyStreamflowPlot-100803*]

New Analysis Detail:

R2 will delete the columns of Weighted Peak and Off-peak Energy Values in the table, and arrange the months by Energy Year for clarity.

- Monthly difference in peak/off-peak energy values [*EnergyStreamflowPlot-100803*]
- Dependable capacity
  [www.pse.com/hydro/baker/meetings/2003/economics20030409handout.pdf]
- Emergency generation reserves
  - There is a 5 foot energy buffer, a week of full generation. Spread out from August through March.

- Flood Control Considerations
  - Timing and volume of storage required under Corps flood control agreement
    [see October 2003 PDEA]
  - Conditions under which the Corps controls Project operations
  - PSE 8-ft flood control buffer

- Cross-Resource Considerations
  - Recreation reservoir pool levels
    - Baker Reservoir pool levels

      724.8 ft May 23-Sep 7
      713.8 ft May 9-Oct 5
    - Lake Shannon pool levels

      Based on water quality pool level of 383.

      380.75 ft = Shannon Boat Ramp.
  - Wildlife reservoir pool levels
  - Water quality reservoir pool levels
    - Baker Reservoir
    - Lake Shannon pool levels

- Instream Flow Parameters
  - Amplitude (maximum Lower Baker controlled release 'max powerhouse capacity' minus minimum instream flow (MIF) release)
    - Important to minimize amplitude during incubation - Sept 10^{th} until July 31^{st}.
    - Is amplitude of less importance during the period Oct 15^{th} to Dec 15^{th} when natural flows fluctuate due to storm events? Stan acknowledged that there is a lot of variation during that period, but part of the amplitude is going to be associated with Baker Project operations, which may exacerbate the range of natural flow fluctuations.
  - Spill avoidance (periods you want to avoid spill)
    - Stan suggested that we want to avoid spill year round; however, spill is especially injurious to fish during the spring outmigration season (Feb 1 through June 30).

- Ramping is especially injurious to fish during December to July (presence of salmon fry) and August (presence of steelhead fry).

Brad suggested the group examine critical aquatic life stages on a month-by-month basis to identify those factors that may have highest priority:

(S) Spawning (I) Incubation (R) Rearing (E) Emergence

- Fish (assume year round incubation)
  - ♦ August – Sept 10th
    1. Reservoir rearing sockeye
    2. Steelhead fry in Skagit River
  - ♦ September 10th– Mid-Oct
    1. Pink & Chinook (S)
    2. Sockeye (R)
  - ♦ Mid-October to Mid-Nov
    1. Chum (S) (I)
  - ♦ Nov & Dec
    1. Chinook (S)
    2. Chum (S)
  - ♦ Nov, Dec, Jan & Feb
    1. Sockeye in reservoir
  - ♦ December
    1. Chinook & Pink (I)
    2. Chinook Fry
    3. Chinook (S)
    4. Chum (S)
  - ♦ January
    1. Chinook & Pink (I) (E)
    2. Chum (I)
  - ♦ February
    1. Chum (I)
  - ♦ Feb – Mach 15th
    1. Chinook & Pink (A)
  - ♦ March & April
    2. Steelhead (S) (I)
    3. Chum (A)
  - ♦ April & May
    1. Steelhead (S) (I) (R)
  - ♦ May
    1. All Fry
  - ♦ June & July
    1. Steelhead (I) (R)

8) New Actions Items:

- R2: Incorporate the results of analyzing effective spawning width accounting for only dewatering of redds into the summary figures.
- R2: Send out data summary supporting spawning suitability figure.
- R2: Evaluate data compiled in A-09d (Middle Skagit River Juvenile Salmonids) and identify the timing of alevin pre-emergence/emergence by species.
- All: Submit any additional HYDROPS run requests to Paul Wetherbee by year-end.
- R2: Find out why Transect 12 provides more Chinook spawning habitat than chum and steelhead spawning habitat.
- R2: Run the effective spawning analyses assuming that Baker Project releases could be maintained at 4 kcfs, 6 kcfs, 8 kcfs, 10 kcfs, 16 kcfs and 32 kcfs flows during the peak Chinook spawning period of September 25 to October 31.
- All (including Hal Beecher contacting Gary Sprague): Get R2 your feedback on euphotic zone weighing factors by year end, or R2 will use the modified weighting factors identified during the meeting for Level 3 Analysis.
- R2: Develop a table of average monthly water temperature in the middle Skagit River.
- R2: Flesh out flow regime diagram (monthly calendar) and send it out so it can be discussed at January 8th Aquatic Resources Working Group meeting.

Next Meeting – Wednesday & Thursday, January 7 & 8, 2004

BAKER RIVER HYDROELECTRIC PROJECT

FERC No. 2150

Application for New License
Major Project—Existing Dam

VOLUME II, Part 1 of 2

Applicant-Prepared
Preliminary Draft Environmental Assessment

18 CFR, Part 4, Subpart F, Section 4.51

October 2003

Draft for Public Review

Puget Sound Energy
Bellevue, Washington

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ACRONYMS AND ABBREVIATIONS

Access Board	U.S. Architectural and Transportation Barriers Compliance Board
ACOE	U.S. Army Corps of Engineers
Advisory Council	Advisory Council on Historic Preservation
AESI	Associated Earth Sciences, Inc.
ALP	alternative licensing process
aMW	average megawatt
APE	area of potential effect
Baker River Project	Baker River Hydroelectric Project
BMU	Bear Management Unit
BPA	Bonneville Power Administration
BRC	Baker River Committee
BRCC	Baker River Coordinating Committee
BRCC-AS	Baker River Coordinating Committee–Aquatic Subgroup
cfs	cubic feet per second
Commission	Federal Energy Regulatory Commission
CPUE	catch per unit effort
CRAG	Cultural Resources Advisory Group
CRMF	Cultural Resources Management Fund
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dbh	diameter at breast height
DCA	Designated Conservation Area
DDT	dichlorodiphenyltrichloroethane
DO	dissolved oxygen
DPS	distinct population segment
EA	environmental assessment
EFH	essential fish habitat
EIS	environmental impact statement
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
FSC	floating surface collector
FWS	U.S. Fish and Wildlife Service
GIS	geographic information system
GMA	Growth Management Act
GMU	Game Management Unit
HCP	Habitat Conservation Plan
HERC	Habitat Enhancement, Restoration, and Conservation
HSRG	Hatchery Scientific Review Group
IHN	infectious hematopoietic necrosis
kV	kilovolt
LMZ	Lynx Management Zone

LRMP	Land and Resource Management Plan
LSR	late successional reserve
LWD	large woody debris
MBSNF	Mt. Baker-Snoqualmie National Forest
MDN	marine-derived nutrients
MIS	management indicator species
MOA	Memorandum of Agreement
MSA	Magnuson-Stevens Fishery Conservation and Management Act
msl	mean sea level
MW	megawatt(s)
MWh	megawatt-hour
National Register	National Register of Historic Places
NAVD 88	North American Vertical Datum of 1988
NCNP	North Cascades National Park
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries (formerly NMFS)
NPS	National Park Service
NTU	nephelometric turbidity unit
NWPPC	Northwest Power Planning Council
PAOT	people-at-one-time
PDEA	preliminary draft environmental assessment
PFMC	Pacific Fishery Management Council
PME	protection, mitigation, and enhancement
PNUCC	Pacific Northwest Utilities Conference Committee
Power Plan	Northwest Conservation and Electric Power Plan
Project	Baker River Hydroelectric Project
Puget	Puget Sound Energy
RM	river mile
RRM	Recreation Resource Management
RV	recreational vehicle
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SHPO	State Historic Preservation Officer
Skagit Project	Skagit River Hydroelectric Project
SMP	Shoreline Master Program
Solution Team	Baker Solution Team
SPCC	Spill Prevention Control and Countermeasure
TDG	total dissolved gas
TERF	Terrestrial Enhancement and Research Fund
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources

WDOE	Washington Department of Ecology
WRIA	Water Resources Inventory Area
WSPRC	Washington State Parks and Recreation Commission
WTRWG	Wildlife and Terrestrial Resources Working Group

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1.0 APPLICATION

On or about April 30, 2004, Puget Sound Energy (Puget) will file an application with the Federal Energy Regulatory Commission (Commission or FERC) for a new license for the existing Baker River Hydroelectric Project (Baker River Project or Project). The Project, consisting of two developments, has a total installed capacity of 170.03 megawatts (MW). The Project is located in Whatcom and Skagit counties, Washington, immediately north of the Town of Concrete (refer to appendix A, figure 1-1). About 5,168.5 acres of the 8,465 acres of total Project lands (including submerged lands) are located within the boundaries of the Mt. Baker-Snoqualmie National Forest (MBSNF). The Project currently operates under a license issued by the Commission on May 1, 1956, which expires on April 30, 2006.

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2.0 PURPOSE OF ACTION AND NEED FOR POWER

2.1 Purpose of Action

The Commission must decide whether to relicense the Project and what conditions should be placed on any license issued. In deciding whether to authorize the continued operation of the Project and related facilities in compliance with the Federal Power Act (FPA) and other applicable laws, the Commission must determine that the Project will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and developmental purposes for which licenses are issued (e.g., flood control, irrigation, and water supply), the Commission must give equal consideration to the purposes of energy conservation; the protection of, mitigation of damage to, and enhancement of fish and wildlife (including related spawning grounds and habitat); the protection of recreational opportunities; and the preservation of other aspects of environmental quality.

In this preliminary draft environmental assessment (PDEA), we assess the environmental and economic effects of: (1) continuing to operate the Project as it is currently operated (No-action Alternative) and (2) operating the Project in keeping with an interim plan (Draft Action). We also consider federal takeover, nonpower license, and Project retirement options. Briefly, the principal issues addressed in the PDEA include: (1) reservoir operations as related to flood control, power generation, and other purposes; (2) Project releases for the protection of the long-term viability of native fish populations; (3) fish passage; (4) fishery management programs; (5) protection and enhancement of wildlife habitat; (6) potential effects on threatened and endangered species; (7) recreational access and facility improvements; and (8) protection of cultural and historic resources.

2.2 Need for Power

Puget is an investor-owned utility that provides electric service to approximately 958,000 residential, commercial, and industrial customers in the state of Washington. Puget's customers are located in a service territory covering approximately 6,300 square miles extending from Olympia to Bellingham and including the greater Everett/Seattle/Bellevue/Tacoma area.

As of year-end 2002, Puget's peak electric power resources were approximately 4,577 MW, and Puget's historical peak load (occurring December 21, 1998) was 4,847 MW (Puget, 2003a).

Puget meets the majority of its customers' peak power needs (about 61 percent in 2002) through power purchases from multiple generating sources including various mid-Columbia public utility districts and non-utility generators. Puget-controlled generating plants provide the remaining 39 percent of the peak demand of its customers (Puget, 2003a). Hydroelectric resources account for about 17 percent of Puget's company-controlled capacity, and the Baker River Project represents over half (about 57 percent) of Puget's company-controlled hydroelectric resource base.

Puget expects its electric sales to grow (base case forecast) at an average annual rate of 1.4 percent, from 2,181 average megawatts (aMW) in 2002 to 2,891 aMW in 2022. This forecast is driven primarily by the absorption of new customers, and it incorporates anticipated conservation savings. Without conservation savings, the forecasted base case average annual growth rate would be 1.7 percent. Compared to the historical growth rate of 2.1 percent per year, the forecast is lower as a result of a ramp-up in conservation program savings, slower growth in population and employment in the near term, and an increasing share of multi-family residential units, which have lower use per customer. Puget forecasts increased peak loads over time as the number of customers increases. The forecasted annual rate of growth in the peak loads (about 1.6 percent) is slightly higher than the growth rate in energy needs (about 1.4 percent) since residential energy load is growing faster than non-residential, and the residential sector makes a larger contribution to peak demands. Puget forecasts peak load to grow from 4,670 MW in 2002 to 6,384 MW in 2022 (Puget, 2003b).

The loss of existing resources, including the expiration of power supply and non-utility generation contracts, significantly affects Puget's load-resource outlook. Puget will lose 314 aMW of energy and 755 MW of capacity by 2010 due to the expiration of current power supply contracts, and will lose another 600 aMW of energy through the expiration of hydropower and non-utility generator contracts by 2012.

Based on forecasted load growth and on scheduled expiration of existing power purchase contracts, Puget has a shortage of 385 aMW of energy in 2004, growing to 1,551 aMW by 2013 and 2,229 aMW by 2023. With regard to peaking capacity, Puget identifies a need for additional capacity of 1,403 MW in 2004, rising to 3,385 MW in 2013 and 4,590 MW by 2023 (Puget, 2003b).

For the Pacific Northwest region as a whole, the Northwest Power Planning Council (NWPPC) estimates a loss of load probability ranging from less than 1 percent to about 6 percent in the years 2004–2006, depending primarily on the amount of power available for import from other regions (NWPPC, 2003). According to the Pacific Northwest Utilities Conference Committee (PNUCC), the combined energy forecast of the Northwest Regional Planning Area utilities has been adjusted downward for the past 3 years (since 2000), primarily because of the region's economic downturn (PNUCC, 2003). Meanwhile, over the same period, there has been substantial new resource development in the region (2,650 MW of generating capacity). The majority of this new generation is in the form of combined-cycle combustion turbines and wind projects. Although construction of three projects totaling 1,200 MW has been suspended and other projects in the planning process have been slowed, delayed, or abandoned, there is still substantial regional capacity (approximately 17,300 MW) in various stages of planning. The reduction in demand and the development of additional generation has translated into an improved regional surplus/deficit situation. Although the decade of the 1990s saw a growing energy deficit, the PNUCC reports a trend over the past 3 years back toward a regional supply/demand balance (PNUCC, 2003).

The Baker River Project, with an installed capacity of 170.03 MW, generated an annual average of 708,000 megawatt-hours (MWh), or about 81 aMW, over a 22-year period from 1981 through 2002 water years. This is equivalent to supplying energy to about 57,249 homes per year. Overall, the Project accounts for about 3.7 percent of Puget's peak power resources and about 2.6 percent of Puget's average annual generation. If relicensed, the Project would continue to contribute toward meeting Puget's power requirements and to regional power supply sufficiency.

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3.0 DRAFT ACTION AND ALTERNATIVES

3.1 No-action Alternative

Under the No-action Alternative, the Project would continue to operate under the terms and conditions of the existing license, and no new environmental measures would be implemented. We use this alternative to establish baseline conditions for comparison with the Draft Action and other alternatives. A description follows of the existing Project facilities, current operations, and current environmental measures.

3.1.1 Existing Project Facilities

The Baker River Project consists of two developments, Upper Baker and Lower Baker. The two developments adjoin one another over a distance of about 18 miles on the Baker River. The Project has an installed capacity of 170.03 MW.[1]

3.1.1.1 Upper Baker Development

The Upper Baker Development, which begins at river mile (RM) 9.35, was constructed between June 1956 and October 1959. The development consists of the following facilities:

- a 312-foot-high, 1,200-foot-long concrete gravity dam (figure 3-1) incorporating an ogee-type spillway containing three radial gates that are each 25 feet wide and 30 feet high, a concrete gravity gated intake section with an intake fish baffle, three gravity-type concrete non-overflow sections totaling approximately 1,000 feet in length, and a 12-foot-wide roadway running along the top of the dam at elevation 735.77 feet mean sea level (msl) (North American Vertical Datum of 1988 [NAVD 88])[2];

- a 115-foot-high, 1,200-foot-long earth and rock-fill dike (West Pass dike) with an adjacent auxiliary earth-fill dike;

- a 9-mile-long reservoir (Baker Lake) having a surface area of 4,980 acres and a total volume of 274,202 acre-feet at normal full pool elevation of 727.77 feet msl (NAVD 88);

- a 0.7-mile-long pond (Depression Lake) adjacent to West Pass dike having a surface area of about 51 acres and a total volume of about 699 acre-feet at a full pool elevation of 705.77 feet msl (NAVD 88), formed by a 3,000-foot-long, 22-foot-high earth-fill dike with a 44-foot-wide overflow spillway;

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[1] In the remainder of the document, we round 170.03 MW to 170 MW.

[2] In the late spring of 2003, participants in the alternative licensing process (ALP) decided to reconcile datum discrepancies by converting elevations based on 1929 datum (NGVD 29) to GIS-based datum of 1988 (NAVD 88). Although most new elevations were converted for inclusion in the Draft License Application, not all could be done before the deadline. The text notes those elevations that are still based on NGVD 29.

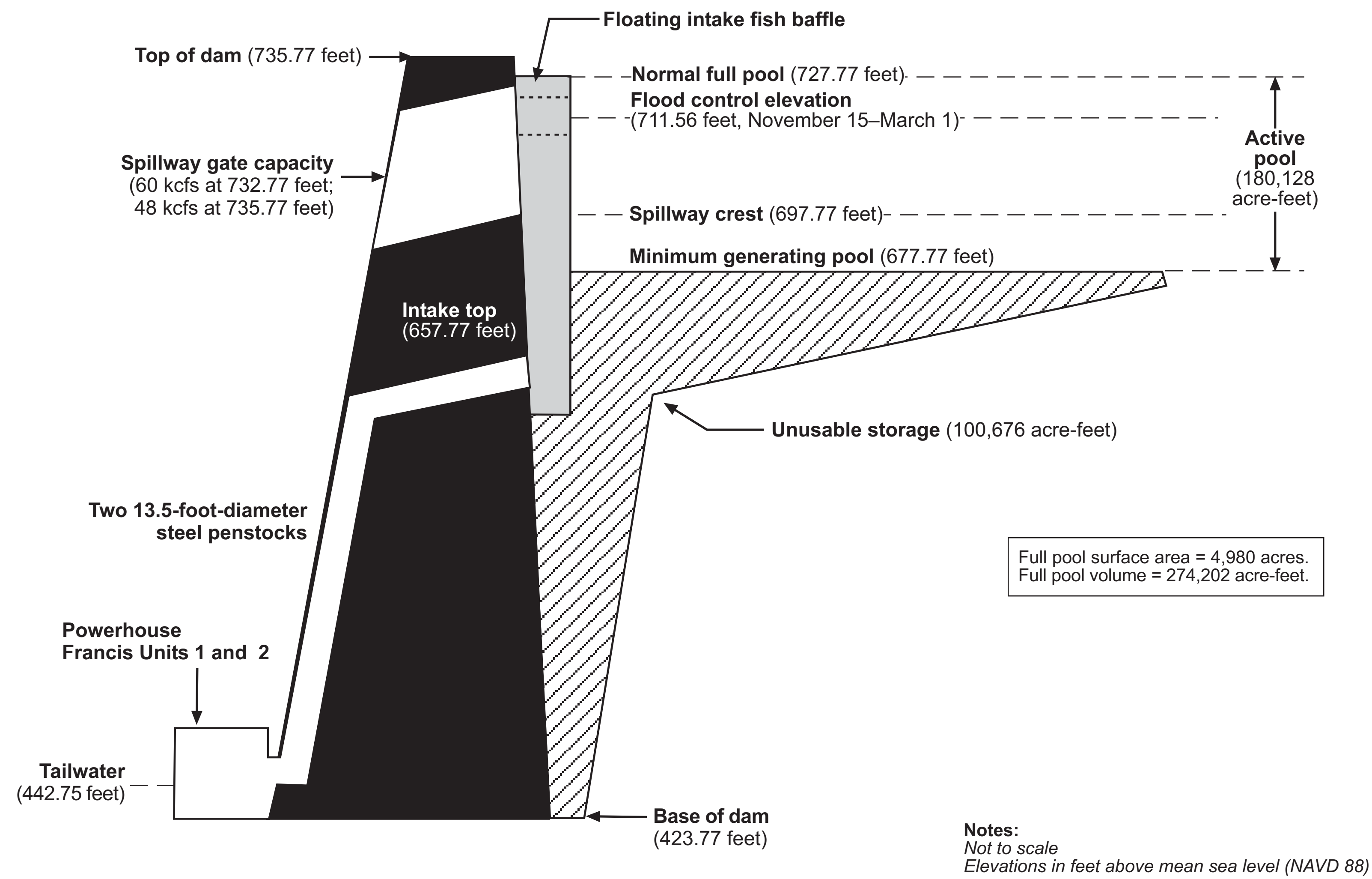

Figure 3-1. Upper Baker dam cross-section. (Source: Adapted from Puget)

- a water recovery pumping station located at the southwest corner of Depression Lake containing two 54,000-gallon-per-minute vertical propeller recovery pumps and a discharge channel into Baker Lake;

- two 13.5-foot-diameter, 320-foot-long steel penstocks;

- a 122-foot-long, 59-foot-wide reinforced concrete and structural steel powerhouse at the downstream toe of the dam containing two turbine-driven generators with a combined authorized installed capacity of 90.7 MW;

- a step-up transformer bank consisting of three single-phase, 35,000 kilovolt (kV) transformers;

- downstream fish passage facilities (i.e., barrier net, floating surface collector [FSC], fish trap/sampling area, and fish transport system);

- artificial sockeye spawning beaches;

- juvenile fish rearing facility; and

- appurtenant facilities.

3.1.1.2 Lower Baker Development

The Lower Baker Development, which begins at RM 0.6, was constructed between April 1924 and November 1925. The dam was raised 33 feet to its current elevation in 1927. In 1965, a landslide destroyed the 3-unit powerhouse. Turbine-generator Units 1 and 2 were abandoned, and a new powerhouse structure was built for Unit 3, which was refurbished and reinstalled. Unit 3 returned to service in September 1968. The development consists of the following facilities:

- a 285-foot-high, 550-foot-long concrete gravity arch dam (figure 3-2) at RM 1.2 with two non-overflow sections and a centrally located spillway section containing 23 vertical slide spill gates that are each 14 feet high and 9.5 feet wide;

- a 7-mile-long reservoir (Lake Shannon) having a surface area of 2,278 acres and a total volume of 146,279 acre-feet at normal full pool elevation of 442.35 feet msl (NAVD 88);

- a concrete intake equipped with trashracks and gatehouse located at the dam's left abutment;

- a 1,410-foot-long pressure tunnel, having a 905-foot-long, 22-foot-diameter concrete-lined section transitioning to a 505-foot-long, 16-foot-diameter steel-lined section;

- a 20-foot-diameter, 259-foot-high concrete surge chamber;

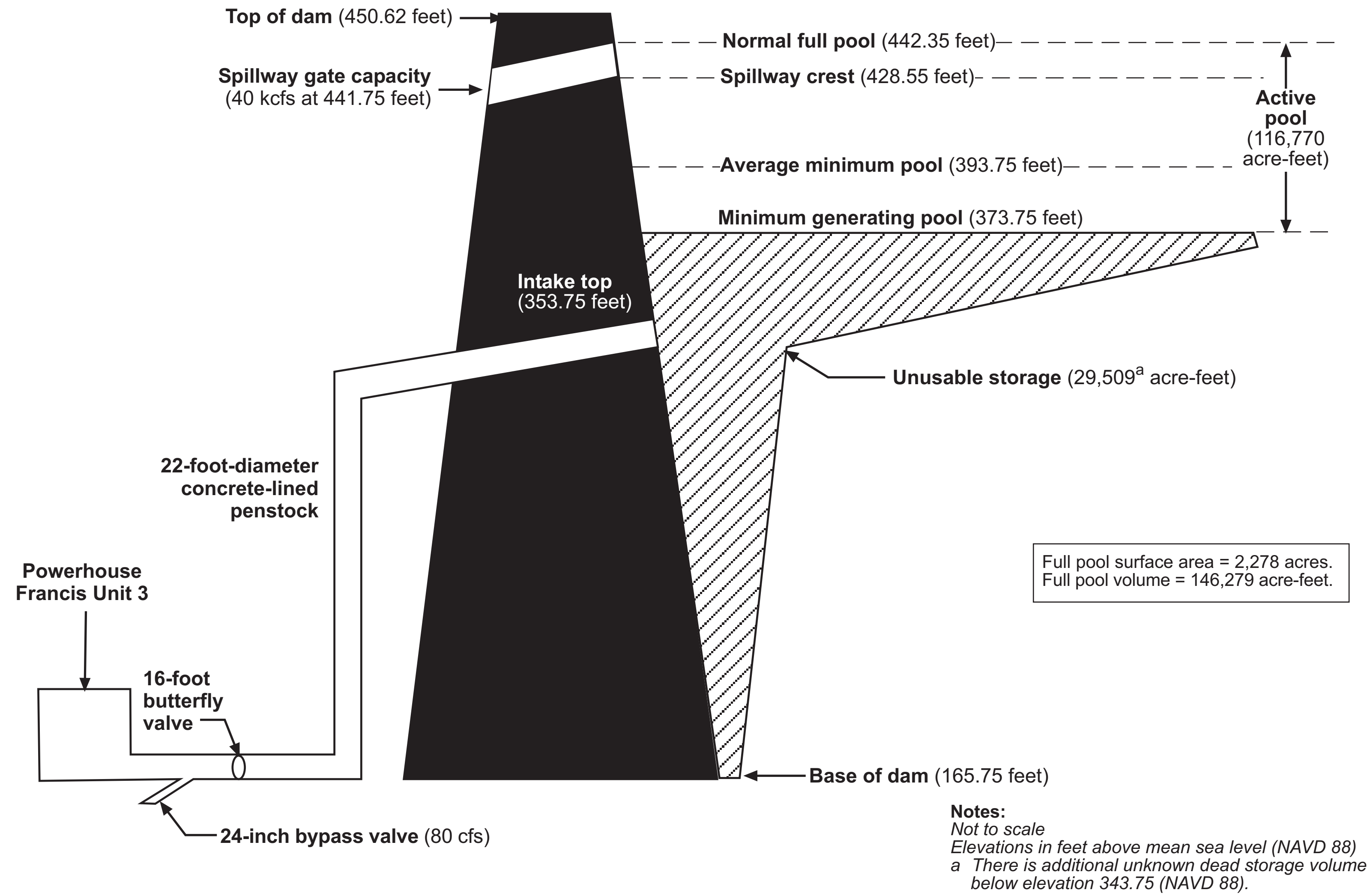

Figure 3-2. Lower Baker dam cross-section. (Source: Adapted from Puget)

- a 90-foot-long, 66-foot-wide reinforced concrete and structural steel powerhouse located on the east bank of the Baker River at RM 0.9 containing a single turbine generator with an authorized capacity of 79.3 MW;

- a single, three-phase, step-up transformer with a maximum continuous power production capability of 77.0 MW;

- a 750-foot-long, 115-kV primary transmission line from the transformer to the Baker River substation;

- an upstream trap-and-haul fish passage facility (i.e., 150-foot-long barrier dam at RM 0.6, fish trap, holding ponds and fish lift) and downstream passage facilities (i.e., barrier net, FSC, fish trap/sampling area, and fish transport system);

- Lake Shannon net pens; and

- appurtenant facilities.

3.1.2 Current Project Operation

The Baker River Project is operated as a multi-purpose facility. The Project is managed for hydropower generation, flood control, recreation, and fisheries. Water levels in both reservoirs (Baker Lake and Lake Shannon) fluctuate seasonally in response to operational objectives, flood control requirements, and variations in natural inflows to the reservoirs.

3.1.2.1 Power Generation Operations

Puget generally operates the Baker River Project in coordination with its other power supply resources to meet the power needs of its customers within the constraints of flood control restrictions at the Upper Baker Development. On a weekly basis, the demand for electricity is generally higher Monday through Friday than on weekends, and, on a daily basis, the demand for power peaks during the morning (6 a.m. to 10 a.m.) and early evening (5 p.m. to 9 p.m.). Typically, the Project generates power on weekdays between 5 a.m. and 9 p.m. Depending on lake levels, inflows, weather forecasts, and system demand, the Project may not generate weeknights and on weekends. During periods of high inflow, however, the Project may generate continuously for several days or weeks.

Electricity demand in the Northwest is relatively high from October through March. During this period, Puget typically drafts the Project reservoirs during the daily and weekly peaks to provide power for meeting the higher demand. This drawdown also serves to make room in the reservoirs to perform flood control as well as to capture the spring runoff from snowmelt. Due to snowmelt and lower regional electricity demand during the warmer months, the reservoirs are typically refilled to near full pool during the April-to-June period. With lower regional electricity demand in the summer and higher recreation demand, the reservoirs traditionally remain near full during the summer. There is a regional trend, however, for major Northwest power producers to sell power into high-demand markets in California and the

Southwest during the summer. This trend is increasing the likelihood that Baker Lake and Lake Shannon would be drafted during the summer to meet regional market demands.

The two developments generally follow similar operational patterns, but Puget must generate power at the Lower Baker Development about 20 percent longer duration than at Upper Baker to avoid spill. This is a result of higher Project inflows at Lower Baker coupled with a smaller reservoir volume and lower hydraulic capacity through the power plant. Consequently, Upper Baker has a historical plant capacity factor of approximately 38 percent, while that for Lower Baker is about 59 percent.

3.1.2.2 Flood Control Operation

Article 32 of the existing license specifies that Puget shall provide each year 16,000 acre-feet of reservoir storage in Baker Lake as replacement valley storage eliminated by the development of the Project, and up to a maximum of an additional 84,000 acre-feet as may be requested by the U.S. Army Corps of Engineers (ACOE). In a September 10, 1976, report to Congress, ACOE recommended 58,000 acre-feet flood control storage in addition to the 16,000 acre-feet required by the license, for a total of 74,000 acre-feet. The ACOE recommendation was confirmed by Congressional authorization in 1977. The flood control operation is governed by an agreement between ACOE and Puget.

Under the agreement (and consistent with Article 32 of the existing license), Puget operates the Upper Baker Development to provide 16,000 acre-feet of flood control storage space between November 1 and November 15; this requires that Baker Lake be drawn down to elevation 724.50 feet msl (NAVD 88) (3.2 feet below full pool) by November 1 of each year. Additionally, the agreement specifies that under normal operating conditions the full 74,000 acre-feet of flood control storage be provided from November 15 to March 1; this requires that Baker Lake be drawn down to elevation 711.56 feet msl (NAVD 88) by November 15 of each year (16.2 feet below full pool).

During flood events when natural flow in the Skagit River is forecasted to exceed 90,000 cubic feet per second (cfs) at Concrete, ACOE assumes responsibility for Baker Lake flood control regulation and coordinates the Upper Baker Development operation with Seattle City Light's Ross Lake reservoir on the Upper Skagit River to reduce the flood peak in the Lower Skagit River valley. Collectively, Baker Lake and Ross Lake reservoir control runoff from about 39 percent of the Skagit River basin. The flood control storage space is used to retain water during floods that can be later released as the unregulated flood flows in the Skagit River recede.

The Lower Baker Development is not required to provide any part of the 74,000 acre-feet of flood control storage required of the Baker River Project. During flood events, Puget retains control of operations at Lower Baker, but avoids operating it in any way that would adversely affect the ACOE's flood control operations. Specifically, Puget avoids drafting Lake Shannon during a flood event to the extent possible in order to avoid increasing flood discharges in the Skagit River unnecessarily, and Lower Baker passes reservoir inflow in a timely manner to avoid interfering with the ACOE's Upper Baker regulation plan and to avoid unnecessary storage in Lake Shannon.

3.1.2.3 Recreation Operations

When consistent with operational objectives, Puget seeks to maintain reservoir levels favorable for recreational activities during the recreation season. At Baker Lake, Puget maintains, when possible, reservoir elevations at or above 718.77 feet msl (NAVD 88) from July 4 through the Labor Day weekend. At Lake Shannon, Puget maintains, when possible, reservoir elevations at or above 404.75 feet msl (NAVD 88) from April 15 through the Labor Day weekend.

3.1.2.4 Fishery Management Operations[3]

Puget provides a continuous minimum release of 80 cfs at the Lower Baker Development for the operation of the adult fish trap-and-haul facility located 0.3 mile downstream of the powerhouse. When the Lower Baker turbine-generator unit is shut down, Puget supplements approximately 55 cfs of dam leakage with a 25-cfs release through a 24-inch-diameter fish water release pipe that discharges into the Lower Baker tailrace.[4]

Puget, when consistent with operational objectives and in a voluntary effort to reduce the potential for fish stranding, seeks to limit the average downramp rate in the Baker River downstream of the Lower Baker powerhouse to approximately 2,000 cfs per hour whenever the Skagit River flow falls below 18,000 cfs, as measured at the Skagit River near Concrete gage.[5]

3.1.3 Current Environmental Measures

Currently, the Baker River Project provides facilities and programs related to fisheries, wildlife, and recreation. Refer to sections 5.6, *Aquatic Resources*, 5.7, *Terrestrial Resources*, and 5.10, *Recreational Resources*, respectively, for discussion of these facilities and programs.

3.2 Draft Action

Under the Draft Action, which is described in this section, Puget would continue to operate the Project, but with a modified reservoir management plan and release regime. To

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3 We do not include interim salmon spawning and incubation flow plans (i.e., Enhanced Flood Control/Coordinated Flow Management Plan and Split Spawning Season Flow Management Plan) as part of current operations. These flow measures are intended as interim steps to be replaced by flow regimes developed through the relicensing process (Puget, 2002a). Further, there has been insufficient historical operation under these flow measures to establish a baseline for comparing alternative measures.

4 In the event the penstock is evacuated for inspection and/or maintenance, water is unavailable to pass through the 24-inch pipeline for minimum flow purposes. During such periods, minimum flow may be supplied through spill if the lake level is high enough or reduced to approximately 55 cfs, the amount of water passing through dam leakage.

5 There are periods when the downramp target has not been met (message from S. Walsh, Fisheries Biologist, Skagit System Cooperative, LaConner, WA, to C. Feldmann, Asset Manager, Environmental Strategies, Puget, Bellevue, WA, dated January 27, 2003; response from C. Feldmann, Asset Manager, Environmental Strategies, Puget, Bellevue, WA, to S. Walsh, Fisheries Biologist, Skagit System Cooperative, LaConner, WA, dated February 19, 2003).

effect the new release regime, the powerhouse facilities at the Lower Baker Development would be expanded and a new turbine generator installed. Additionally, Puget would implement various protection, mitigation, and enhancement (PME) measures (refer to appendix B for the full text of these measures).[6]

3.2.1 Project Facilities

For the purpose of providing capability to ramp powerhouse releases consistent with the draft release regime and to generate power with the proposed minimum flow (see section 3.2.2, *Project Operation*), the Draft Action would include partial rehabilitation of the original power generating facilities at the Lower Baker Development that were destroyed by the 1965 landslide. The auxiliary powerhouse would include a new turbine generator installed on an existing penstock within the concrete foundation of the original 1925 powerhouse located adjacent to and immediately north (upstream) of the existing Lower Baker powerhouse.

A 153-foot-long by 50-foot-wide reinforced concrete powerhouse would be constructed on the existing abandoned powerhouse foundation. It would house the new turbine generator, a new 13,000 kV ampere transformer, and associated mechanical and electrical support equipment. The new powerhouse would be connected to the existing Unit 3 powerhouse with a 25-foot by 25-foot room containing a connecting stairway. The new auxiliary powerhouse superstructure would be about 17 feet high, with two steel roof hatches for access to the turbine generator and the transformer. Crane rails for the existing overhead gantry crane at Unit 3 would be extended some 153 feet north to provide for use of the crane during installation and maintenance of the new equipment. Additional access for construction, operation, and maintenance of the new facilities would be provided by a new access bridge to be built adjacent to the west side of the auxiliary powerhouse foundation.

A new 680-cfs horizontal-shaft Francis turbine and generator would be connected to an existing abandoned 7-foot diameter penstock. The new turbine would have a stainless steel runner diameter of 5.9 feet, rotate at 257 rpm, and produce 12.5 MW at 680 cfs. A horizontal synchronous generator would be direct-connected to the turbine and provide an output voltage of 4.16 kV to the low voltage side of a step-up transformer. The new turbine configuration would include a new 84-inch butterfly valve that would serve as a turbine guard valve. The new unit would be configured to operate in synchronization with the existing Unit 3, thus providing a continuous minimum 300-cfs discharge at all times when the penstocks are watered up.

3.2.2 Project Operation

Under the Draft Action, the reservoir management plan and release regime that characterize current operations would be modified.

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[6] Puget provided this set of draft measures on June 2, 2003, for the purpose of fulfilling the requirements of the Commission's regulations that call for public review of a draft license application prior to application filing. The Draft Action will be updated in the final PDEA to reflect agreements reached under the continuing collaborative process toward settlement.

Reservoir stage limits would be established to support various resource values, while also accommodating human health and safety, flood protection, power generation, and operational constraints (refer to PME 6.3 in appendix B). Table 3-1 presents the Draft Action reservoir management plan for the Upper Baker Development (Baker Lake). The Draft Action reservoir management plan for the Lower Baker Development (Lake Shannon) is displayed in table 3-2. At Lake Shannon, there would be an additional water quality requirement that would establish 383.75 feet msl (NAVD 88) as the minimum year-round pool elevation (PME 3.5.2).

Table 3-1. Draft reservoir management regime for the Upper Baker Development.

Month	Target Elevation (NAVD 88)	Resource Emphasis
January	≤ 711.6	Flood control
February	≤ 711.6	Flood control
March	≤ 713.8	Wildlife
April	≤ 713.8	Cultural protection/wildlife/power
May 1–15	≤ 713.8	Cultural protection/wildlife/power
May 16–31	≥ 718.8	Cultural protection/recreation/power
June	≥ 718.8	Cultural protection/recreation/power
July	≥ 718.8	Cultural protection/recreation/power
August 1–Labor Day	≥ 718.8	Cultural protection/recreation/power
September (after Labor Day–September 30)	≤ 718.8	Wildlife
October	≤ 718.8	Wildlife
November 1–14	≤ 718.8	Wildlife
November 15–30	≤ 711.6	Flood control
December	≤ 711.6	Flood control

Table 3-2. Draft reservoir management regime for the Lower Baker Development.

Month	Target Elevation (NAVD 88)	Resource Emphasis
January	≤ 442.35	Power/instream flow management
February	≤ 428.75	Wildlife
March2	≤ 428.75	Wildlife
April	≤ 428.75	Wildlife
May	≤ 428.75	Wildlife
June	≥ 404.75	Recreation
July	≥ 404.75	Recreation
August	≥ 404.75	Recreation
September	≥ 404.75	Recreation
October	≤ 442.35	Power/instream flow management
November	≤ 442.35	Power/instream flow management
December	≤ 442.35	Power/instream flow management

In addition to managing reservoir levels, Puget would control releases from the Project to satisfy minimum instream flow, ramping, and amplitude requirements (PME 3.3.1).

Puget would release a minimum of 300 cfs year-round from the Baker River Project as measured at the Baker River at Concrete gage.

Puget would release flow from the Project to achieve the less restrictive of two ramp rate standards: (1) no greater than 650 cfs reduction per hour caused by the Lower Baker Development on the Baker River measured at the Baker River at Concrete gage; or (2) 6 inches per hour total reduction as measured at the Skagit River near Concrete gage. These ramping restrictions would be in effect whenever the flow, as measured at the Skagit River above the Baker River confluence, is less than or equal to 18,000 cfs. For the purpose of ramping compliance, rate of change per 15-minute increment would be used.

Finally, changes of maximum and minimum stage in the Skagit River by virtue of operation of the Baker River Project would not exceed 2 feet on a daily basis. Amplitude would be measured to the nearest 0.1 foot at the Skagit River near Concrete gage and would be compared on a rolling 24-hour basis.

Temporary departures from the foregoing release regime could occur to address unforeseen circumstances, such as in the event that human health and safety were at risk, if the Lower Baker generating unit(s) were at risk of failure or involuntarily forced off-line, or under force majeure due to significant unforeseen acts of nature.

3.2.3 Environmental Measures

The Draft Action would include 51 environmental PME measures listed here (with their numerical designation) and fully described in appendix B.

Terrestrial Resource Measures

- Provide young deciduous forest, forested wetland, shrub wetland and wet meadow (1.1.1)
- Evaluate the potential for establishing beneficial vegetation in the fluctuation zones (1.1.2)
- Provide foraging habitat for elk (1.2.1)
- Provide spring foraging habitat for grizzly bears (1.2.2)
- Enhance summer habitat for mountain goats (1.2.3)
- Provide breeding habitat for amphibians (1.2.4)
- Provide nest structures for osprey at Lake Shannon (1.3.1)

- Provide floating nest platforms for common loons (1.3.2)
- Provide habitat for riparian cavity dwellers (1.3.3)
- Support the development of bald eagle nest management plan (1.3.4)
- Protect plants of special status (1.4.1)
- Develop and implement a noxious weed management plan (1.4.2)
- Provide a Terrestrial Enhancement and Research Fund (TERF) (1.5.1)

Recreation and Aesthetics Resource Measures

- Implement a water recreation safety program (2.1.1)
- Develop and implement a boating hazard management plan (2.1.2)
- Develop law enforcement support (2.1.3)
- Fund dispersed campsite improvement, operation, and maintenance (2.2.1)
- Manage dispersed camping impact (2.2.2)
- Develop and implement an aesthetics management plan for Lower Baker and Upper Baker (2.3.1)
- Create new trails (2.4.1)
- Maintain existing trails and trailheads (2.4.2)
- Enhance Bayview Campground (2.5.1)
- Fund the U.S. Forest Service (USFS) campground operation and maintenance (2.5.2)
- Provide access and development to Lake Shannon or another suitable lakefront site (2.5.3)
- Provide improvements to Kulshan Campground (2.5.4)
- Support redevelopment of Baker Lake Resort (2.5.5)
- Provide funding for wildlife observation facility (2.5.6)

- Provide and fund ADA compliance (2.5.7)
- Provide a Recreation Adaptive Management (RAM) Fund (2.6.1)

Aquatic Resource Measures

- Create Habitat Enhancement, Restoration, and Conservation (HERC) Fund (3.1.1)
- Provide fish propagation and enhancement programs and facilities (3.1.2)
- Provide upstream passage continuity for migratory fish species (anadromous, adfluvial, fluvial, resident) (3.2.1)
- Address connectivity between Baker Lake and Lake Shannon (3.2.2)
- Provide downstream passage continuity for migratory fish species (anadromous, adfluvial, fluvial, resident) (3.2.3)
- Implement flow regime for the Baker River Project (3.3.1)
- Implement fluvial geomorphic management (3.4.1)
- Implement large woody debris (LWD) management (3.4.2)
- Develop and implement an erosion control plan (3.4.3)
- Implement flow release water quality management (3.5.1)
- Implement reservoir water quality management (3.5.2)
- Implement a stormwater pollution prevention plan (3.5.3)

Cultural and Historic Resource Measures

- Implement the Historic Properties Management Plan (4.1.1)
- Provide a Cultural Resources Management Fund (CRMF) (4.2.1)

Flood Control Measure

- Maintain current levels of flood control at Upper Baker (16,000 acre-feet as replacement storage and an additional 58,000 acre-feet for a total of 74,000 acre-feet of flood control storage) (5.1)

Shared Resource Measures

- Utilize adaptive management principles (6.1)
- Create Baker River Coordinating Committee (BRCC) (6.2)
- Implement a reservoir level management and operations plan (6.3)
- Implement an access management program (6.4)
- Provide visitor information (6.5.1)
- Provide interpretive services (6.5.2)
- Provide cultural and natural resource and conservation education (6.5.3)

We analyze each of the foregoing measures in the appropriate *Environmental Effects* section (section 5.0), and we assess the economic impact in the *Developmental Analysis* section (section 6.0, *Developmental Analysis*).

3.3 Alternatives Considered but Eliminated from Detailed Study

We also considered other alternatives, but eliminated them from detailed study because they are not reasonable alternatives, as defined by the National Environmental Policy Act (NEPA), in the circumstances of this case.

3.3.1 Federal Takeover

Federal takeover and operation of the Project is not a reasonable alternative, because it would not achieve the Project's purpose and because it is considered unlikely. Federal takeover and operation of the Project would require Congressional approval, and there is no evidence to indicate that federal takeover should be recommended to Congress. No party has suggested that a federal takeover would be appropriate, and no federal agency has expressed an interest in operating the Project.

3.3.2 Nonpower License

The FPA permits governmental bodies to obtain a temporary nonpower license. A nonpower license is temporary in that the Commission would terminate the nonpower license whenever it determines that another government agency would assume regulatory authority and supervision over the lands and facilities covered by the nonpower license. Such a nonpower license could preserve the reservoir and the flood storage, but not allow the generation of power. In the case of the Baker River Project, no agency has suggested its willingness or ability to accept a nonpower license. No party has sought a nonpower license, and there is no basis for concluding that the Project should no longer be used to produce power. A nonpower license would not achieve purposes of the Project, and issuance of a nonpower license is considered unlikely. As such, a nonpower license is not viewed as a reasonable alternative requiring further analysis.

3.3.3 Project Retirement

Project retirement could result from: (1) Puget notifying the Commission that it sought to surrender its license; (2) Puget failing to file its license application; or (3) an order of termination issued by the Commission based on an implied surrender. Surrender of the license might or might not require dam removal; however, the Commission could require dam removal as a condition of license surrender. Because a portion of the Project's flood control is provided by the federal government pursuant to federal mandate, Project retirement would also need to address flood control storage provided at the Upper Baker Development and any related approval by the ACOE or through federal legislation as applicable. If dam removal was not required, the Commission could require certain modifications to project works, such as backfilling the Lower Baker power tunnel and surge chamber, disabling or removing equipment used to generate electricity, and vandal-proofing the facilities that remain.

Project retirement with dam removal could be undertaken in various sequences and over various timeframes, resulting in different environmental impacts. In order to address the impacts of this alternative with reasonable specificity, we describe one potential sequence for the timing and nature of Project retirement developed by the Baker River Wildlife and Terrestrial Resources Working Group (WTRWG) as a basis for that group's evaluation of the effects of project retirement (Puget, 2003c). This retirement scenario represents one possible analysis of the range of dam removal options and river stabilization responses associated with Project retirement. Due to the fact that this alternative is not deemed likely as Puget has indicated its intent to seek a new license, and that Project retirement would not achieve the Project's purpose, Project retirement is not considered a reasonable alternative.

Upper Baker dam would be removed first so that Lake Shannon could act as a temporary sediment trap during the re-establishment of the Baker River between the upstream end of Baker Lake and Lake Shannon. Upper Baker dam removal would begin approximately 6 years after the expiration of the current license, with the prior 5 years being used for dam removal studies and for securing necessary approvals. Then, the Baker River would be routed around the Upper Baker dam to allow completion of dam removal. The historical floodplain beneath Baker Lake would undergo frequent disturbance as the river re-establishes a main channel. Upland and wetland portions of the former reservoir would be planted with appropriate native trees, shrubs, forbs, and grasses.

Lower Baker dam would be removed after Upper Baker dam had been removed and sufficient time had elapsed to assess sediment loading on the Lower Baker and Skagit rivers. The Baker River would be routed around Lower Baker dam approximately 11 years after current license expiration, and the dam would then be removed. Sites historically supporting forested habitat would be planted with native tree species. All upland forested habitat in the area currently occupied by Lake Shannon would be managed for commercial timber production.

Under any retirement scenario, it is assumed that the energy generated by the Project (historically 708,000 MWh annually) and its capacity (170 MW) would be foregone. The power generating resource would need to be replaced by an alternative power generating source or by use of conservation and load management resources. Based on the least cost alternative power source (*Application for New License, Major Project—Existing Dam*, exhibit H, section H.3.3.2, *Power Production Costs of the Least Cost Alternative*), the annual cost of the foregone Project generation would be $34,922,100 (without inflation) and $49,838,000 (with inflation).

Additionally, Project-generated employment (approximately 42 jobs with an aggregate payroll of $1.3 million) and Project-related tax and fee payments to federal, state, and local governments (approximately $1.1 million) would cease (Puget, 2002c), representing a socioeconomic impact. Also, under either retirement scenario, current license articles requiring environmental enhancements would not be available, and any environmental improvement measures that might be required by the Commission in conjunction with a new license would be foregone.

Under the dam removal scenario, and potentially with dam retention (depending on whether any government entity assumed management control of the retired project), the flood control afforded by the Baker River Project might no longer be provided. According to the ACOE, the Upper Baker Development has prevented flood damages estimated at $90 million since 1977, including a savings of approximately $50 million in the flood of November 1995. Without Upper Baker's flood control contribution, the probability of exceeding levee capacity along the Lower Skagit River in the Sedro-Woolley/Mount Vernon reach would rise from about 5 percent annually to 10 percent (presentation given by K. Brettmann, Hydraulic Engineer, Hydrology and Hydraulics Section, Seattle District, ACOE, Seattle, WA, to Economics and Operations Working Group, presented on October 28, 2002).

Dam removal activities would require removal and disposal of more than 700,000 cubic yards of concrete and would result in substantial increases in noise, dust, exhaust emissions, and traffic in the Project vicinity over the approximate 10-year period of facility removal and land restoration.

Dam removal activities would have a short-term adverse effect on fisheries resources. The process of removing the dams would cause increases in total suspended solids and turbidity, because materials currently trapped behind the dams would be flushed downstream. Subsequent to removal, flood-related turbidity levels would increase over current conditions due to the absence of flood control storage to mitigate sediment transport. High concentrations of suspended solids can adversely affect aquatic species, including, but not limited to, numerous behavioral and physiological responses by fish species, such as avoidance of turbid waters, reduced feeding and growth, respiratory impairment and other physiological stresses, damage to gills, increased disease susceptibility, and direct mortality (Herbert and Merkens, 1961). The severity of these effects depends on both the magnitude and the duration of the exposure. Many species can withstand rather high total suspended sediment concentrations for short periods but may suffer harmful effects when exposure is prolonged.

In addition, high sediment levels can degrade aquatic habitat quality. Increased total suspended sediment is known to decrease bank stability, reduce habitat complexity, reduce the quality and quantity of spawning substrate, and reduce or eliminate suitable substrate for macroinvertebrate production (Bjornn and Reiser, 1991; Furniss et al., 1991; National Research Council, 1996). Implementation of best management practices during decommissioning and revegetation of exposed lands would reduce sediment delivery to the Baker River, although increases in total suspended sediment and turbidity could not be fully alleviated.

Following dam removal activities, stabilization of the stream channel may occur and improve aquatic habitat conditions in the Baker River system; however, lake habitat would be degraded. Removal of the dams could allow for the return of natural LWD, bedload, and sediment movement processes to the watershed, and restoration of these processes would increase aquatic habitat complexity. Additional salmonid spawning habitat would be exposed in the Baker River and tributary reaches that are currently inundated. The sockeye spawning grounds along the beaches of the historical Baker Lake would again be exposed. However, sockeye spawning areas as a whole may be reduced in comparison to existing conditions, as much of the habitat currently available is provided through license-related habitat management.

River flow patterns would change with the lack of river regulation provided by the Project. Average monthly flows would be lower than under current conditions from August to March and higher from April through July (section 5.4.1.1, *Surface Water*). Maximum flows would increase in most months. Fall extreme low flows could no longer be moderated using Project storage. The unregulated flow regime would have less daily variation, which would reduce stranding potential in the Lower Baker and Skagit rivers. However, peak flow events would be anticipated to be higher than with the dams in place, which could increase the scouring of salmonid redds. Flows during May and June would be increased over existing conditions, which could benefit outmigrating salmonid smolts, whereas fall low flows could no longer be moderated from Project storage, which could adversely affect salmonid redds.

Removal of the Lower and Upper Baker dams would reduce foraging and loafing habitat for wintering waterfowl associated with existing reservoir-related habitat conditions. The reduced number of waterfowl would, in turn, affect the winter foraging resource for bald eagles. To the extent this loss is offset by increases in native salmon runs after the period of restoration of the non-regulated river, this adverse effect would be lessened. The removal of the reservoirs would also adversely affect osprey and bald eagles during the breeding season due to reduced foraging habitat and food availability during that time. With the conversion of Lake Shannon into riverine habitat, kokanee, which are currently stocked in Lake Shannon, would no longer be available as a food source. The historical Baker Lake would be expected to support sockeye and coho; however, its area would be much reduced from the size of the current Baker Lake reservoir. Food and habitat for other breeding birds and mammals that use the reservoir and reservoir shorelines, such as ducks, Canada geese, and tree swallows, would also be reduced as a result of dam removal.

Over time, different types of upland and wetland habitats would replace the habitat provided under existing conditions. Under the representative scenario discussed here, it was estimated that the area under Lake Shannon could be vegetated to provide 1,141 acres of upland forest, 705 acres of riparian habitat, 69 acres of wetlands, 4 acres of ponds, 330 acres of river, and 26 acres of roads (Puget, 2003c). Similarly, it was estimated that the land currently inundated by Baker Lake reservoir could be converted to approximately 1,766 acres of upland forest, 1,484 acres of riparian forest, 351 acres of wetlands, 1,133 acres of lakes and river (primarily the historical Baker Lake), 15 acres of ponds, and 25 acres of roads.

Although the potential for successful habitat conversion cannot be accurately predicted, we estimate that after approximately 50 years from dam removal, the riparian forested stands would be predominantly in the sapling/pole, closed canopy stage of development. In the same timeframe, upland conifer stands could reach the small tree, single story, closed canopy stage and be available for commercial timber extraction. The vegetated stands could provide habitat for wildlife that use small-diameter conifers, small deciduous trees, and deciduous shrubs, such as ruffed grouse, yellow warbler, willow flycatcher, savannah sparrow, black-tailed deer and elk (Puget, 2003c).

With dam removal, use of existing reservoir-related and other recreational facilities operated and maintained by Puget and the USFS would be reduced, while there would be new river-based recreational opportunities afforded by the restoration of approximately 15 miles of riverine conditions. Only original Baker Lake (550 acres) would be available to provide flat-water opportunities. Removing the reservoirs would greatly reduce flat-water recreational opportunities. Visitors seeking some kinds of flat-water recreational activities might not come to the area, and overall visitation could decrease.

Because people are predictably drawn to waterside settings, visitors would seek out new campsites, day-use areas, and fishing access points near the Baker River. As the water line retreats into its narrow channel, there would be fewer points of access to the water because of steeper terrain. User-defined roads and trails would emerge, and access routes would likely need to be formalized to manage recreational use. Also, new facilities would likely be needed to address resource effects from recreational uses that would occur at the river. The existing campgrounds and other recreational facilities would receive little use since they would be located at a distance from the water and would be less desirable to visitors. It could become uneconomical to operate these facilities if visitation and, consequently, the funding to operate and maintain these facilities were to decrease. Any new recreational developments on National Forest System lands in the basin would have to be consistent with federal land management plans in effect at that time, and the USFS interprets the current plan as restricting new development along the river.

In the short-term, noise and traffic associated with dam removal and restoration efforts would likely affect visitor use. Visual effects of stumps and barren land beneath the high-water mark would displease most visitors, and visitation to the former reservoir sites would be minimal. Eventually, the river would provide a setting for stream fishing, hiking along the river, riverside camping, and swimming. With the removal of the FERC Project boundary, land use pressure on Puget's private lands for residential development along the Lower Baker River may increase, thereby potentially removing land from public recreational access and resulting in impacts associated with shoreline development.

The short-term effects of dam removal on historic properties would be adverse. Initially, dam removal could result in slumping of unstable shoreline areas and terraces that may contain eligible archaeological material as well as exposure of potentially eligible archaeological sites in the historical floodplain. Slumping could result in the downward (and possibly downstream) movement of archaeological materials and would disturb the integrity of archaeological sites situated on inundated terraces and along shoreline margins. Dewatering terraces would expose eligible archaeological sites to artifact hunting and looting, which would also result in site disturbance. Dewatering the historical floodplain would provide increased opportunities for dispersed recreation and could result in site disturbance to potentially eligible archaeological and historic sites located in the historical floodplain. These effects could be partially mitigated through site surveys and evaluations following dam removal.

Over time, vegetation would stabilize the shoreline and reduce the potential for future erosion of sites located on terraces and in the previous shoreline margins. Also, over time eligible archaeological sites in shoreline areas currently subject to erosion resulting from impoundment fluctuations would benefit from dam removal, provided that these areas do not slump during the removal process. Removal of the dams would eliminate the reservoir fluctuations that threaten to disturb these sites. Project retirement and dam removal could provide renewed access to any traditional cultural properties of significance to Indian Tribes that might have been rendered inaccessible because of Project construction and operation.

Removal of the Lower Baker dam, a property listed in the National Register of Historic Places (National Register), would adversely affect the characteristics that qualify the dam for inclusion in the National Register. Removal would also affect the proposed Lower Baker Development Historic District by removing historic fabric and discontinuing use of the Project for hydropower purposes. Effects could be partially mitigated through recordation of the structure prior to removal. Removal of the Upper Baker dam would likely disturb or remove fish passage facilities that are considered eligible for listing in the National Register as part of the Baker River Fisheries Historic District.

Given the adverse effects of the dam removal process, including adverse effects on species relying on the habitat opportunities provided under existing conditions, the loss of the renewable energy potential of this river reach, and the potential for adverse downstream effects associated with non-regulated flood flows, project retirement, either with dam retention or dam removal, is not considered to be a reasonable alternative warranting additional evaluation.

4.0 CONSULTATION AND COMPLIANCE

4.1 Agency Consultation

On July 19, 2002, the Commission approved Puget's request to use an alternative licensing process (ALP) for the relicensing of the Baker River Project. The ALP is intended to facilitate participation and improve communication among interested parties, avoid unnecessary conflict, increase confidence that all reasonable alternatives have been adequately and fairly evaluated, and increase the likelihood of a comprehensive settlement. The ALP also seeks to expedite Project licensing by combining the pre-filing consultation and environmental review steps into a single process.

In March 2000, Puget initiated collaborative discussions about relicensing the Project by contacting potentially interested parties to make them familiar with the Project and with Puget's plans for ongoing Project operation through the pursuit of a new license. In March and April 2000, Puget held public meetings to describe Project features, discuss the relicensing process, and invite involvement in the process. In May 2000, Puget began a collaborative process, in preparation for the ALP, by establishing six working groups to focus on issues within major resource areas: hydrology, fisheries, terrestrial/wildlife resources, recreational/aesthetic resources, cultural/historical resources, and economic/operational issues.[7] In July 2000, Puget issued the Baker River Project Information Package, held a public meeting, and conducted a public tour of the Project. Puget formed the Baker Solution Team (Solution Team) in October 2000 to provide policy guidance and oversight of the collaborative process. The Solution Team includes wide representation from federal, state, and local agencies; local communities; Tribes; and non-governmental organizations.[8]

4.2 Scoping

Public scoping meetings and an open and extensive collaborative relicensing process were used to define the issues addressed in the PDEA, as well as to guide the selection and design of resource studies associated with those issues. The scoping of environmental issues was initiated through the collaborative process at the working group level, consistent with procedures defined in the ALP Process Document (Puget, 2002b).

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[7] The Hydrology and Fisheries Working Groups later combined to form the Aquatic Resources Working Group due to the similarities of issues being addressed by the two groups.

[8] The Solution Team comprises representatives from Puget Sound Energy, the public, the U.S. Forest Service (Mt. Baker-Snoqualmie National Forest), North Cascades National Park, National Park Service, National Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Washington Department of Ecology, Washington Department of Fish and Wildlife, Washington Department of Natural Resources, Skagit System Cooperative, American Rivers, City of Anacortes and Skagit County Public Utilities District, Concrete Heritage Museum Association, U.S. Environmental Protection Agency, Federal Energy Regulatory Commission, Interagency Committee for Outdoor Recreation, The Nature Conservancy, North Cascades Conservation Council, North Cascades Institute, Office of Archaeology and Historic Preservation, Rocky Mountain Elk Foundation, Skagit County Public Works, Skagit Fisheries Enhancement Group, Town of Concrete, Trout Unlimited, and Wildcat Steelhead Club.

On April 19, 2002, the Commission issued notice that it intended to perform early scoping for the Baker River Project in accordance with NEPA and the Commission's regulations for using the ALP. Puget and the Commission staff jointly issued Scoping Document 1 on April 19, 2002, and held public scoping meetings in Concrete, Washington, and in Mount Vernon, Washington, on May 21 and May 22, 2002, respectively. Additionally, Puget and the Commission staff hosted a site visit to the Project on May 21, 2002. On May 8, 2003, the Commission staff issued Scoping Document 2, in which staff addressed comments filed on Scoping Document 1.

4.3 Water Quality Certification

Under Section 401 of the Clean Water Act (CWA), a license applicant must obtain certification from the appropriate state pollution control agency verifying compliance with the CWA. Puget has consulted with the Washington Department of Ecology (WDOE) on the scope of water quality studies that WDOE will require to evaluate Puget's request for certification. *Puget will submit the results of those studies, and it plans to request certification on or about April 30, 2004, coincident with Puget's submittal of its license application to the Commission.*[9]

4.4 Section 18 Fishway Prescription

Section 18 of the FPA states that the Commission is to require construction, maintenance, and operation by a licensee of such fishways as the Secretaries of Commerce and Interior may prescribe. National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries) and the U.S. Fish and Wildlife Service (FWS) have been working with Puget and other interested parties within the collaborative process to develop appropriate fish passage facility designs. *Based on the Solution Team's relicensing schedule, NOAA Fisheries and FWS will file preliminary fishway prescriptions in January 2004, draft prescriptions in September 2004, and final Section 18 prescriptions in January 2005.*

4.5 Section 4(e) Federal Land Management Conditions

Section 4(e) of the FPA provides that any license issued by the Commission for a Project within a federal reservation shall be subject to and contain such conditions as the Secretary of the responsible federal land management agency deems necessary for the adequate protection and use of the reservation. The Baker River Project occupies approximately 5,168.5 acres within the MBSNF. The USFS is, therefore, the federal land management agency responsible for issuing conditions under Section 4(e) and is actively participating in the collaborative process and, according to the Solution Team's relicensing schedule, will file preliminary Section 4(e) conditions in January 2004, draft 4(e) conditions in September 2004, and the final conditions in May 2005.

In addition, the USFS will assess the Baker River Project relicensing as to its effect on the "outstandingly remarkable" values of the Skagit River, which was designated a Wild and

[9] The dates referenced here and in the following sections are based on Baker Relicense Project-Flow Chart Schedule prepared by K. Olin, Manager – Technical Services, Puget, Bellevue, WA, dated August 25, 2003, referred to as the Solution Team's relicening schedule.

Scenic River on November 10, 1978, and on the values of stream segments within the Baker River watershed that are considered eligible additions to the Wild and Scenic River System.[10] None of the Project's facilities lie within the designated system corridor area. The USFS administers the relevant, designated segment of the Skagit River and Baker River and will need to determine that the continued operation of the Project will not unreasonably diminish the values of the river that existed at the time of designation. *The USFS conclusions regarding compliance with the Wild and Scenic Rivers Act are scheduled to be filed coincident with the USFS's filing of its final Section 4(e) conditions in May 2005.*

4.6 Section 10(j) Recommendations

Under Section 10(j) of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the Project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendations, expertise, and statutory responsibilities of the agency. *According to the Solution Team's relicensing schedule, the fish and wildlife agencies will file preliminary Section 10(j) recommendations in January 2004, and final Section 10(j) recommendations in September 2004.*

In section 8.0, *Recommendations of Fish and Wildlife Agencies*, we *(will)* list each of the recommendations subject to Section 10(j), and note whether the recommendations are included within the Draft Action (Settlement Agreement). Any recommendations that we believe are outside the scope of Section 10(j) will nonetheless be considered under Section 10(a) of the FPA within the appropriate resource sections of the PDEA.

4.7 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. Two federally listed fish species and six federally listed wildlife species are known to occur or potentially could occur in the Baker River Project vicinity over the next 30 to 50 years.[11] We present our analyses of Project effects on threatened and endangered species in section 5.8¸ *Federally Listed Threatened and Endangered Species and Essential Fish Habitat*. Formal consultation with FWS and NOAA Fisheries under the ESA will commence with the Commission staff's issuance of the Commission staff's environmental assessment (EA), currently scheduled for November 2004. The EA will serve as the Commission's Biological

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[10] These segments are the first 2.1 miles of the Baker River above Baker Lake; the upper 11.2 miles of the Baker River; and the full length of Noisy Creek, a 6.1-mile-long tributary to Baker Lake.

[11] The species are Chinook salmon, bull trout, gray wolf, grizzly bear, Canada lynx, bald eagle, marbled murrelet, and spotted owl.

Assessment. According to the Solution Team's relicensing schedule, FWS and NOAA Fisheries will issue their biological opinions in March 2005.

4.8 Magnuson-Stevens Fishery Conservation and Management Act

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSA) require the identification of essential fish habitat (EFH) for federally managed fishery species and the implementation of measures to conserve and enhance this habitat. The MSA requires federal agencies to consult with NOAA Fisheries on activities that may adversely affect EFH. MSA-managed species occurring in the Baker River Project vicinity are Chinook, coho, and pink salmon. NOAA Fisheries' EFH regulations encourage the use of existing interagency consultation or environmental review procedures for EFH consultations. Information provided by the Commission in the Commission staff's EA will serve as the EFH Assessment for the MSA-managed species, both ESA-listed and non-listed. *NOAA Fisheries will provide its preliminary EFH conservation recommendations coincident with its Section 10(j) recommendations and Section 18 prescriptions in January 2004, and its final EFH conservation recommendations coincident with its biological opinion scheduled for March 2005.*

4.9 Coastal Zone Management Act

Section 307(c)(3) of the Coastal Zone Management Act (CZMA) requires that all federally licensed and permitted activities be consistent with approved state coastal zone management programs. If the Project is located within a coastal zone boundary, the license applicant must certify that the Project is consistent with the state Coastal Zone Management Program. The Baker River Project, being located within Skagit and Whatcom counties, lies within the boundaries of the coastal zone. According to the Solution Team's relicensing schedule, Puget will submit with its license application a certification that the Project complies with and will be conducted in a manner consistent with the relevant coastal zone management program, and WDOE will complete its consistency review approximately 6 months after it determines receipt of sufficient information to commence with its review, pursuant to 15 C.F.R. ' 930.60(a), unless WDOE and Puget mutually agree upon an extension. *According to the Solution's Team relicensing schedule, WDOE's review of the consistency certification is expected to commence February 2005.*

4.10 Pacific Northwest Power Planning and Conservation Act

Under Section 4(d) of the Pacific Northwest Power Planning and Conservation Act, the NWPCC developed the Northwest Conservation and Electric Power Plan (Power Plan). In 1988, the Council adopted a Protected Areas Amendment to the Power Plan that designated 44,000 stream miles, roughly 20 percent of the Northwest's rivers and streams, as areas that should be protected from future hydroelectric development due to the presence of particularly valuable fish or wildlife habitat. The 1.4-mile-long reach from the Baker River mouth to Lake Shannon and the 0.2-mile-long reach from Lake Shannon to Baker Lake have been designated as protected (NWPPC, 1989). However, the relicensing of existing hydroelectric projects, including modification of any existing project, is not affected by protected area designation (NWPPC, 2000).

4.11 National Historic Preservation Act

Relicensing is considered an undertaking within Section 106 of the National Historic Preservation Act of 1966, as amended. Section 106 requires that every federal agency "take into account" how each of its undertakings could affect historic properties. Historic properties are districts, sites, buildings, structures, traditional cultural places, and objects (significant in American history, architecture, archaeology, engineering, and culture) that are eligible for inclusion on the National Register. As the lead federal agency for issuing a new license, the Commission is responsible for ensuring that the licensee takes all necessary steps to "evaluate alternatives or modifications" that "could avoid, minimize, or mitigate any adverse effects on historic properties" during the term of any new license issued.

The lead agency must also consult with the State Historic Preservation Officer (SHPO), as well as with other land management agencies where the undertaking may have an effect, and with Indian Tribes who may have cultural affiliations with affected properties involved in the undertaking. The overall review process involving Section 106 is administered by the Advisory Council on Historic Preservation (Advisory Council), an independent federal agency. The Advisory Council's implementing regulations of Section 106 (36 CFR Part 800) provide guidelines to planners and federal agencies for carrying out the intent of the Section 106 process.

Puget, under jurisdiction of the Commission, and as part of its requirement under the FPA, has consulted with the SHPO, USFS, the Tribes, and other interested parties in the identification and evaluation of archeological resources, traditional cultural properties, and historic buildings in the pre-filing consultation process to date. Six prehistoric sites, 2 historic homestead sites, and 3 historic districts in the Project's area of potential effect (APE) are considered eligible for inclusion in the National Register. The resulting analysis of Project effects on historic properties is in section 5.9, *Cultural Resources*. Puget will develop a Historic Properties Management Plan (HPMP) to address the needs of historic properties as identified during the pre-filing consultation process. To meet the requirements of Section 106, the Commission will prepare and distribute a Programmatic Agreement to serve as the agreement for implementing the HPMP. *According to the Solution Team's relicensing schedule, Puget will prepare, in consultation with the above mentioned entities, a draft HPMP in September 2003 and a final HPMP in March to file with the license application. We will provide an analysis of the provisions of the HPMP in the final PDEA.*

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5.0 ENVIRONMENTAL ANALYSIS

In this section, we describe the anticipated environmental effects associated with implementation of the Draft Action. Our baseline for analysis is the No-action Alternative. The section begins with a summary description of the Baker River basin, followed by identification of resources that are cumulatively affected. The effects assessment is organized by resource topic, and the discussion is based on issues identified through the collaborative scoping process. For each resource, we begin by describing the affected environment. Next, we summarize each issue associated with continued Project operation and then assess the environmental effects of protection, mitigation and enhancement measures proposed to address the issue.

Throughout this section, we rely heavily on the HYDROPS optimization model for evaluating flow and water level effects of Project operation. The HYDROPS optimization model is used to specify the operating characteristics of hydroelectric plants and to optimize the operation of the plants to maximize potential revenues while meeting environmental and operational constraints. It was developed by the Powel Group and was tailored to the needs of the Baker River Project in consultation with Puget. The information to support model input and organize model results is stored in a series of databases.

The "engineering module" specifies the operating and physical characteristics of the plant including turbine performance characteristics (efficiency, generation limitations, rough zones, flow and head constraints), tailwater elevation curves, reservoir storage elevation curves, and rating curves for USGS gages. This module provides the engineering information necessary to operate the "study model." The "study model" allows the user to design a specific operational scenario to evaluate both economic and environmental effects associated with the specified alternative.

Several types of operating constraints and input parameters are also specified in the "study model" including the following:

- maximum and minimum reservoir elevations;
- maximum and minimum total release (can be specified below Upper Baker dam, Lower Baker dam and Skagit River below the Baker River confluence);
- maximum and minimum powerhouse generation;
- maximum and minimum system generation (both Upper and Lower Baker);
- maximum and minimum powerhouse discharge;
- maximum and minimum spill;
- ramping rates either by level or flow or a combination thereof;

- turbine maintenance schedule; and
- monthly peak and off-peak energy prices.

The constraints can be specified as hard constraints (must be met or the run becomes infeasible and terminates) or soft constraints (may be violated, but violations are reported to the user). Soft constraints are prioritized allowing the users to specify which constraints they would like to see violated first.

The “study model” facilitates the generation of several reports operational summaries, energy generation and revenues. Additionally the model provides inputs to other hydrologic and habitat models used to evaluate project effects (not available for this draft).

The hydrologic input data set includes unregulated flow into the Upper Baker reservoir, accretion between Upper Baker dam and the Baker River confluence with the Skagit River, and historical flow in the Skagit River upstream of the Baker confluence. The hydrology is based on representative energy years. Puget selected 5 energy years (August 1 of the previous year through the end of July of the energy year) with the goal of providing a representative analysis while limiting the need for processing numerous years through the model. The five selected years along with their general hydrologic characteristics are as follows:

- 2001—very dry,
- 1993—somewhat dry,
- 1995—average,
- 2002—somewhat wet, and
- 1996—very wet.

The selection process focused on both biological resources and hydrologic conditions. To capture realistic Upper Skagit River flows, the selection of years was restricted to the years of 1991–2002 to reflect post-relicensing operations at the Skagit River Project. Average unregulated Baker River flow for the five selected years is 97 percent of the long-term (energy years 1976–2002) average flow. Comparison of the unregulated Baker River flows indicate that the flow duration curves for the typical reservoir drawdown and refill periods are very similar for the selected period and the long-term conditions (memorandum titled Selection of Five Representative Years for Initial Evaluation of Project Alternatives from M. Killgore, Louis Berger, Bellevue, WA, prepared, for Technical Scenario Teamlet meeting, on July 11, 2003).

5.1 General Description of the Basin[12]

The Baker River watershed covers 297 square miles and ranges in elevation from 10,778 feet msl at the summit of Mt. Baker to 160 feet msl at the confluence of the Baker and Skagit rivers near the Town of Concrete. The Baker River is the second largest tributary to the Skagit River, which, in turn, is the largest drainage in Puget Sound. The Baker River's average annual flow contribution to the Skagit River is about 16 percent.

The headwaters of the Baker River are in the northeastern portion of the watershed and originate from glaciers and snowfields on Mt. Baker, Mt. Shuksan (elevation 9,127 feet msl) and nearby peaks. From its headwaters, the Baker River flows toward the southwest and reaches the valley floor (elevation 1,000 feet msl) after about 5 miles. From this point, the Baker River valley continues in a southwesterly to southerly direction for about 25 miles to its confluence with the Skagit River (refer to appendix A, figure 5-1). Lake Shannon and Baker Lake, both Baker River Project reservoirs, occupy about 16 lineal miles of the Baker River valley. Prior to Project construction, historical documents indicate that Baker Lake existed as a natural lake occupying about 550 acres of the valley bottom within the northern half of Baker Lake's current footprint.

Over 60 tributary streams totaling approximately 315 miles enter the Baker River, primarily discharging into Lake Shannon and Baker Lake. The primary tributary streams include Swift, Park, Boulder, Noisy, Thunder, Sulphur, Rocky, and Bear creeks. A number of the tributaries on the west side of the basin (e.g., Swift, Boulder, and Park creeks) are glacial streams, heavily dominated by glacial sediment.

The Baker River watershed is generally very steep, with slopes from 20 to 40 percent over most of its area, with the exception of the valley bottom along the Baker River channel and some of its major tributary streams. The lower basin consists of a wide, unconfined valley floor composed of glacial and stream sediments, into which the Baker River has carved a narrow canyon up to 500 feet deep. Lake Shannon occupies much of this canyon. The middle portion of the basin, site of Baker Lake, is a more confined valley where glacial and stream sediments have been covered by mudflows and recent alluvial deposits. The upper basin is a narrow rock canyon with a valley floor of recent deposits of sand and gravelly material. At the upper reaches of the watershed, Mt. Baker, Mt. Shuksan, and their adjacent ridges and pinnacles form a spectacular alpine topography that dominates the landscape.

The watershed lies in a convergence zone between Pacific weather systems from the west and Arctic weather systems from the north. During the summer, the Pacific systems dominate and bring periods of generally clear weather and reduced precipitation. During the winter, the Arctic systems usually dominate, with winter storms and increased precipitation. Lower temperatures at higher elevations in the watershed result in heavy snow in winter, a portion of which is stored in ice fields and glaciers. Average annual precipitation ranges from about 70 inches at Concrete to greater than 150 inches at some of the higher elevations.

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[12] This general basin description is based on Puget (2002c) and on USFS (2002a).

The main access into the watershed is afforded by the Baker Lake Highway (a.k.a. Baker River Highway and USFS Road 11), which begins at the junction with the North Cascades Highway about 6 miles west of Concrete. Land ownership and management in the watershed is dominated by federal government holdings in the MBSNF (55.6 percent of the total watershed area) and in North Cascades National Park (NCNP) (30.4 percent). Over 99 percent of the watershed above Upper Baker dam (RM 9.35) consists of federal lands. Private and state holdings account for the remaining 14 percent of the watershed's area. The private and state holdings are primarily confined to the lower watershed tributaries entering Lake Shannon and to the Lower Baker River downstream of Lake Shannon.

Consistent with the dominance of federal ownership, 49 percent of the watershed is managed as wilderness, roadless areas, or national park. Recreation and management of lands for protection of natural values are the predominant land uses in the watershed. Most of the 14 percent of land in private and state ownership has been extensively harvested and is managed for silviculture. The Baker River Project, including Baker Lake and Lake Shannon, occupies about 5 percent of the watershed.

Small hydroelectric projects were constructed in the watershed around 1906 to power cement operations in the Town of Concrete, but they were later abandoned. The two developments of the Baker River Project were completed in 1925 and 1959. In the early 1980s, there was renewed interest in small hydropower, and by 1990 13 potential projects had been studied. Only one project (Koma Kulshan) has been built. This project (FERC Project No. 3239) went into operation in 1990 and diverts water from Rocky and Sulphur creeks to a power plant on Sandy Creek. Another Commission-licensed project, on Bear Creek (FERC Project No. 10371), has not been constructed. A proposed project on Anderson Creek (FERC Project No. 10416) has an application pending. By letter order dated March 7, 2003, Commission staff dismissed an application for a project on Lower Rocky Creek (FERC Project No. 10311).

5.2 Cumulatively Affected Resources

According to the Council on Environmental Quality's regulations for implementing NEPA (Section 1508.7), an action may cause cumulative effects on the environment if its effects overlap in time and/or space with the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period, including hydropower and other land and water development activities.

Based on our review of the issues raised in the collaborative scoping process, we have identified the following resources as having potential to be cumulatively affected by the Project in combination with other past, present, and future activities: instream flows, water quality, anadromous fish, resident fish, wildlife habitat, wetlands, rare plants, and recreational resources.

In the following subsections, we discuss the geographic and temporal scope of our analysis of these cumulatively affected resources.

5.2.1 Geographic Scope

The geographic scope for each cumulative effect issue depends on the nature of the actions influencing the cumulatively affected resource.

5.2.1.1 Instream Flows

The storage and release of water for power generation and flood control at the Baker River Project affects flows in the mainstem Skagit River below the confluence of the Baker and Skagit rivers.

Under existing conditions, on a seasonal basis, Baker River Project operations tend to augment mainstem Skagit River flows from August through March, the months when there is typically a net removal of water from storage in the Project's reservoirs. Conversely, there is a net increase in storage of water from April through July; this results in reduced flow contribution to the Skagit River as compared to unregulated Baker River conditions (section 5.4.1.1, *Surface Water*).

Likewise under existing conditions, on a daily basis, Baker River Project load-following operations may cause fluctuations in mainstem Skagit River flows of up to 4,200 cfs over several hours each day. Stage differences between generating and non-generating periods may be between 0.9 feet and 1.2 feet as measured at the Skagit River near Concrete gage (Puget, 2002a). The Skagit River near Concrete gage (RM 54.1) is 2.4 miles downstream of the Baker/Skagit confluence (RM 56.5).

Releases from the Skagit River Hydroelectric Project (Skagit Project) operated by Seattle City Light also affect flows in the mainstem Skagit River. The Skagit Project consists of three dams and associated reservoirs on the Upper Skagit River, with the most downstream powerhouse (Gorge) being situated at RM 94.2, about 38 river miles above the Baker/Skagit confluence. The Skagit Project is typically operated as a load-following power generation plant with the amplitude of Skagit Project downramp events governed by terms of a 1991 Fisheries Settlement Agreement (FERC, 1991). The effects of fluctuating releases at the Skagit Project continue downstream but dampen in magnitude and are typically observed as river stage changes at the Skagit River near Concrete gage (RM 54.1) about 6 to 8 hours after the release occurs at the Skagit Project.

The effects of the Projects on river stage in the Skagit River near Concrete can amplify each other (be mutually additive or mutually reductive) or somewhat offset each other. These interactive effects are largely attenuated by the time they reach the vicinity of Mt. Vernon (RM 15.7) (Puget, 2002a). Accordingly, the geographic scope of our cumulative assessment of river flows extends along the Skagit River from the Baker/Skagit confluence to Mt. Vernon (RM 15.7).

5.2.1.2 Water Quality

Water quality is influenced by human activities in the Baker River watershed (including land management policies, and recreation), current Baker River Project operations, the interaction of Baker River flows with flows from the Upper Skagit River, and increasing human development along the middle reach of the Skagit River. Accordingly, the geographic scope of our cumulative water quality analysis includes the Baker River watershed and the Skagit River from the Baker River confluence downstream to Sedro-Woolley (RM 24.5).

5.2.1.3 Anadromous Fish Populations

Reservoir operations, fish passage, habitat modifications, fish propagation and enhancement programs, and flow regimes in both the Baker and Skagit rivers may potentially affect anadromous fish populations. Many of the anadromous salmonids inhabiting the Baker River watershed are considered to be components of Skagit River stocks. For example, fall Chinook entering the Baker River adult trap are considered to be part of the Lower Skagit mainstem/tributaries fall Chinook stock, while chum migrating to Baker River are part of the mainstem Skagit fall chum stock (WDFW et al., 1994). Therefore, potential effects on fisheries resources caused by the Baker River Project relicense could cumulatively affect Skagit River salmonid stocks when considered with other actions in the watershed that may affect those fish stocks.

Furthermore, anadromous fish migrating to the Baker River may also be cumulatively affected by non-related actions occurring in the Baker River watershed and the Skagit River from the confluence with the Baker River downstream to the Skagit River estuary. Non-related actions that result in degradation of aquatic habitat in the Middle and Lower Skagit River or the Baker River watershed may cumulatively affect Baker River fisheries resources.

Recovery efforts also have been initiated specifically linked to the ESA listing of Puget Sound Chinook salmon populations. Activities associated with such efforts that improve aquatic habitat, productivity, and/or survival of Chinook salmon in the Puget Sound evolutionarily significant unit (ESU) may also produce a cumulative benefit for Baker River fish populations when considered with other efforts to improve fisheries resources in the basin.

Considering these potential sources of cumulative effects on fisheries resources, the geographic scope of our cumulative effects analysis includes the Baker River watershed and the Skagit River from the confluence with the Baker River downstream to the estuary. To a lesser extent, the analysis will discuss potential cumulative effects on Puget Sound fisheries as they relate to current recovery efforts.

5.2.1.4 Resident Fish

Reservoir operations, fish passage, habitat modifications, fish propagation and enhancement programs, and flow regimes in both the Baker and Skagit rivers may also potentially affect resident fish populations. Project operations (e.g., flow regime, reservoir fluctuations) can affect the spawning and rearing habitat potential of resident fish species in both the Baker River and Skagit River systems. Fish passage and fish propagation actions could also influence the genetics in resident fish populations. These Project-related influences when considered with non-Project activities, such as potential timber harvest activities, recreational development, residential and commercial development, fish harvest, and other reasonably foreseeable human activities, could cumulatively affect Baker River and Skagit River resident fish species. Considering these factors, the geographic scope for our cumulative effects analysis of Project relicensing on resident fish includes the Baker River and tributaries up to migration barriers and the mainstem Skagit River from the confluence of the Baker to Mount Vernon.

5.2.1.5 Wildlife Habitat

Past actions from a variety of sources, including recreation, project construction and operation, and other human activities in the watershed have cumulatively affected certain wildlife habitats in the Baker River basin. Key habitats cumulatively affected include mature and old-growth coniferous forest, deciduous forest, riparian habitats, and wetlands. Additionally, on the basis of scoping comments, we consider cumulative effects on rare plants. The geographic scope of our assessment is the Baker River watershed. For some species, such as elk, the geographic scope extends beyond the basin.

5.2.1.6 Recreational Resources

Construction of the Baker River Project has contributed to the cumulative increase in developed recreational facilities within the Baker River watershed. Historically, the first trails in the watershed were hunting and gathering trails developed by Native Americans. Homesteaders in the region added to these trails as did loggers. Early mountain climbers used these early trails when attempting to climb Mt. Baker and Mt. Shuksan. The development of the Lake Shannon dam in 1925 led to more roads in the watershed allowing people easier access above Lake Shannon to the old Baker Lake and the surrounding high country. The creation of Baker Lake reservoir increased the amount of lakeside recreational opportunities in the watershed spurring the development of recreational facilities and trails. Accordingly, the geographic scope of our cumulative analysis of recreation will be the Baker River watershed.

5.2.2 Temporal Scope

Based on the anticipated term of any new license issued for the Baker River Project, we will look 30 to 50 years into the future, concentrating on the cumulative effects of relicensing the Project on water quality, fishery, wildlife habitat, and recreational resources in the context of past, present, and reasonably foreseeable future actions.

5.3 Geology and Soils

5.3.1 Affected Environment

5.3.1.1 Geology

The Baker River basin’s geology is the product of mountain building over millions of years through uplift, folding, and volcanism.[13] The current landforms have been sculpted by repeated glaciation and stream erosion. Alpine glaciation has produced the sharp peaks and ridges, as well as cut the deep valleys. Continental glaciation has rounded many of the

[13] The description of geology, soils, and geological hazards comes from Puget (2002c), except where noted.

landforms at lower elevations and scoured out the pre-existing drainages. These glaciers also created ice dams behind which large glacial lakes were formed, and into which heavily sediment-laden streams deposited their alluvium.

The post-glacial history is responsible for much of the geological complexity associated with the Upper Baker dam area. With the retreat of the Vashon Glacier about 15,000 years ago, the Baker River was left in a deeply glaciated valley about 400 to 500 feet deeper (at the dam site) than the current ground elevation. A series of eruptive events along the flanks of Mt. Baker produced a sequence of mudflows, pyroclastic flows, and lava flows down the tributary valleys draining the mountain. In the Baker River valley, the most extensive of these occurred in the pre-existing Sulphur Creek and Boulder Creek valleys. In the Sulphur Creek valley, one or more lava flows originating from a vent at Schreiber's Meadow extended about 8 miles down the valley and forced the Baker River against the eastern side of its valley and dammed the river temporarily. Based on stratigraphic data, this event took place after a major tephra eruption dated at 10,350 years ago and before the layer of ash that was deposited from the eruption of Mt. Mazama dating from 6,600 years ago. As a result, the current channel of the Baker River was downcut east of Glover Mountain rather than to the west, where the ancestral channel is now buried under many hundreds of feet of lava.

Lava from the vent at Schreiber's Meadow filled the valley of Sulphur Creek to a depth of up to 800 feet and, as it entered the Baker River valley, spread out upriver and pushed Sandy Creek to the northern side of its valley. Subsequent to this lava flow, mudflows, alluvium, and colluvium have filled in the pre-existing drainages to significant depths.

5.3.1.2 Soils

The soils of the watershed fall into one of two general classifications: alluvial soils or upland soils. The deeper and more fertile alluvial soils are associated with the floodplains of major watercourses, such as the Baker River and Lower Swift Creek. The upland soils are characteristically relatively shallow, low in fertility, and found on steep slopes. Typically, they are derived from glacial materials, although they can also be shallow, gravelly, or residual soils derived from the local bedrock.

Snyder and Wade (1970, as cited by Puget, 2002c) identified five major soil groups based on similarities in texture, structure, soil depth, and mode or origins in the reference soil resource inventory titled "Mt. Baker National Forest Soil Resource Inventory." All five of these soil groups are present in the Baker River basin.

The most prevalent category of soil in the Baker River basin is that of the high-elevation soils. These are the thin, intermittent soils formed on rocky outcrops, talus slopes, alpine meadows, and around snow and ice. These soils are both shallow and fragile, and they are easily eroded if the vegetation is removed. These soils occur above the timberline throughout the watershed. Alpine vegetation clinging to them is easily destroyed by even light foot traffic.

Soils categorized as shallow residual soils and deep glacial soils found on long steep slopes, ridges, and narrow valleys are the second most common in the watershed and generally occur at elevations above 1,000 feet. The shallow residual soils typically predominate at elevations above 3,000 feet to the tree line, while the deeper glacially derived soils occur more generally at lower elevations. The combination of weakly structured soils, high slopes, and heavy precipitation results in a high potential for surface erosion of the residual soils.

Less frequently encountered are the more localized, deep, unstable colluvial soils originating on steep toeslopes and midslopes. The hillside between Ermine and Noisy creeks on the east bank of Baker Lake is one of the best examples of these types of soils in the watershed. These soils generally consist of gravel or silt and sandy loam with subsoil textures of clay, gravel, and sand. When combined with steep slopes, weathered bedrock, and saturated subsoils, these areas are prone to slump even under undisturbed conditions.

Another major category is the deep, stable soils derived from glacial till and outwash deposits. These soil types are characteristic of the Baker River valley floor, from about Blum Creek downstream to Upper Baker dam, and the valley of lower Swift Creek as well. Most of this soil mapping unit has been inundated by the Upper Baker reservoir.

The final category of soils is the deep, unstable soils derived from glacial lake sediments, till, and outwash. In the Baker River basin, these soils occur downstream of the upper dam along the valley floor where they have been deeply incised by the Baker River. They also occur in combination with deep, unstable colluvial soils associated with the steep sideslopes of the Lower Baker River canyon.

5.3.1.3 Existing Geologic Hazards

The geologic hazards in the Baker River basin are derived from either the volcanic activity of Mt. Baker or the more general risk of earthquake.

The northern Cascades are underlain by a number of major fault zones. Extensive geological investigations have been conducted to identify the major fault zones closest to the dams and to determine if any of these faults showed signs of renewed activity (Coombs, 1989, as cited by Puget, 2002c). The following were investigated for signs of recent movement: the Straight Creek Fault, which runs north-south about 25 miles east of the Lower Baker River valley until it is cut off by the intrusive rocks of the Chilliwack Batholith; the southern edge of the Chilliwack Batholith about 20 miles east of Upper Baker dam; a series of scarps south of the batholith that were suggestive of a major fault zone; and the Shuksan Thrust. Tephrochronology (using known volcanic eruptions to date sediment layers) confirmed that neither the scarps nor the southern edge of the batholith had experienced any movement over the last 6,600 years, and there was no evidence that either the Shuksan Thrust or the Straight Creek Fault had experienced any movement over a much longer period.

The hazards posed by Mt. Baker were examined in considerable detail following the most recent increase in hydrothermal activity in Sherman Crater, which lies about 0.5 mile south of the summit (Hyde and Crandell, 1978, as cited by Puget, 2002c). This increased activity was monitored very closely in 1975–1976 when it peaked, but it has subsided to normal background conditions since that time. Hyde and Crandell (1978, as cited by Puget, 2002c) identified the four principal classes of volcanic hazards as the formation of mud flows and avalanches, the eruption of tephra, hot pyroclastic flows, and lava flows. An eruption often produces hazards in more than one class simultaneously.

With the exception of the emission of tephra, the direct effects from the other volcanic activity classes are limited to the tributary drainages radiating from Mt. Baker and the Baker River valley from the mouth of Rocky Creek to the upper end of Baker Lake. Secondary effects, such as forest fires or the flooding accompanying the sudden melting of large quantities of snow and ice, could result in effects both upstream and downstream of this area. The magnitude and extent of such effects would depend on wind direction and strength, antecedent snowfall accumulation, and seasonal reservoir water levels, factors independent of operational alternatives considered in this analysis.

5.3.1.4 Sediment Supply and Transport

Sediments are supplied to the Baker River system through one of three processes: (1) mass wasting, (2) surface erosion, and (3) soil creep. Mass wasting supplies most of the coarse-grained sediments, while also supplying fine-grained sediments. In contrast, surface erosion and soil creep provide mostly fine-grained sediments and virtually no coarse-grained sediments.

The primary means of mass wasting in the Baker River basin are debris avalanches, debris flows, and landslides. Debris avalanches and debris flows have moved down all of the drainages that have headwaters on Mt. Baker. Since 1958, at least six debris avalanches have occurred on Mt. Baker, all of which originated in the Sherman Crater area (Gardner et. al., 1995). Many debris avalanches at Mt. Baker transform into debris flows. Debris flows of moderate size, 0.002–0.02 square mile, have occurred during both eruptive and non-eruptive periods and have traveled 6 to 9 miles from the mountain’s summit. Gardner et al. (1995) indicated that moderate-sized debris flows are of special concern in basins that have headwaters on the east and southeast sides of Mt. Baker, because events in these drainages could potentially reach Baker Lake.

The impermeable glacial lake sediment deposits play a major role in mass wasting events in the basin. These sediments prevent infiltration to deeper sediments, which leads to saturation of levels above these sediments and increases the likelihood of landslides. High rates of precipitation and snowmelt in the basin exacerbate this condition.

Paulson (1999) inventoried landslides in the Baker River basin to determine the effects of land-use practices on sediments supplied to streams within the basin. Paulson compared sediment delivery rates for immature forests and road-related landslides to rates for mature forests. For the Baker Lake subbasin (i.e., streams draining to Baker Lake with the exception of the Baker River, Swift Creek, and Park Creek), results of Paulson’s investigation suggest that sediment delivery from landslides in immature forests was 10 times higher and road-related landslides were 21 times higher than landslides in mature forests. Similarly, computed rates were considerably higher in the Lake Shannon subbasin as is represented by a factor of 19 for immature forests to mature forests, and a factor of 150 for road-related to mature forests.

Paulson (1999) suggests that road-related landslides delivered sediment to Baker Lake and Lake Shannon at 21 times and 150 times the rate of landslides within mature forests, respectively. This suggests that land-use activities within the Lake Shannon subbasin have substantially altered sediment delivery. A major landslide that mobilized about 250,000 cubic yards of material destroyed part of the Lower Baker powerhouse in May 1965. In 1990, another landslide mobilized about 250,000 cubic yards of sediment from Miner's Creek into Lake Shannon (Paulson, 1999). Both of these events occurred during major precipitation events. Sediments from the Miner's Creek landslide elevated turbidity in Lake Shannon, the Lower Baker River, and the Skagit River for 3 years (USFS, 2002a). Erosion of moraines and other sediments deposited by glaciers also supplies streams and the reservoirs with coarse and fine sediments. In addition, glacial melt provides a source of fine sediments. As glacial melt increases during the progression of summer, very fine sediments (i.e., glacial flour) become entrained in the water and lead to naturally elevated turbidity in some streams draining the northwest portion of the basin, particularly Swift, Park, Boulder, Sandy, and Rocky creeks.

In addition to erosion occurring throughout the watershed, erosion occurs along the shorelines of Puget's reservoirs. Shoreline erosion associated with Project reservoirs can be influenced by several natural factors including local geology, soil type, bank configuration and wind direction, wind speed, and stream currents; along with human-influenced factors including reservoir pool elevation, fluctuations in pool levels, and land use activities. Puget conducted an evaluation of shoreline erosion around Baker Lake and Lake Shannon using ortho-corrected aerial photographs taken in 2001 and field surveys (AESI, 2003). Results of this evaluation indicate that the primary cause of erosion along the shoreline or in the drawdown zone was undercutting, either by wave or stream action, or a combination of both. Other erosion processes included bank toppling, slides and flows, rills and gullying, dry raveling, and ground water piping. AESI (2003) noted that generally two or more processes were affecting an area.

AESI (2003) categorized the severity of erosion along the shorelines of Baker Lake and Lake Shannon into one of four categories. A summary of results from Associated Earth Sciences, Inc. (AESI) is provided in table 5-1. Severe erosion (described as near-vertical bluffs of more than 10 feet high) occurred along approximately 2.5 to 2.8 percent of each reservoir's surveyed shoreline. High erosion defined by near-vertical bluffs or bank undercutting of 3 to 10 feet occurred along 8.5 percent of Baker Lake's surveyed shoreline and 11.5 percent of Lake Shannon's surveyed shoreline. The majority of the remaining shoreline was categorized as having low to moderate erosion for Lake Shannon and not eroding for Baker Lake.

Site geology and slope were similar for sites categorized as having high or severe erosion. Over half of the Baker Lake shoreline sites categorized as such had coarse-grained outwash and alluvium exposed. The vertical to near-vertical pre-Project terrace escarpments and Baker River cut banks were particularly susceptible to undercutting by wave action and streams. The most severe erosion areas occurred where outwash or alluvium was present on these steep slopes. Where coarse-grained outwash and alluvium were present on gentle slopes, wave action generally removed sand-sized particles, leaving behind a gravel lag deposit. At Lake Shannon, the majority (25 of 29) shoreline erosion sites that were categorized as high or severe were located on promontories that are heavily affected by wave erosion. Although AESI (2003) indicates that aspect does not appear to play a major role in eroding areas of either reservoir, it does not indicate how it came to this conclusion.

Table 5-1. Shoreline erosion categorization around Baker Lake and Lake Shannon. (Source: AESI, 2003)

Category	Category Description	Baker Lake Shoreline	Lake Shannon Shoreline
1-Severe	Near-vertical bluff height >10 feet	0.8 mile (2.5%)	0.7 mile (2.8%)
2-High	Near-vertical bluff height or undercutting of bank of 3–10 feet	2.7 miles (8.5%)	2.8 miles (11.5%)
3-Low to moderate	Near-vertical bluff height or undercutting of bank measurable, but <3 feet	11.8 miles (37.3%)	17.0 miles (70.0%)
4-Not eroding	No undercutting and no near-vertical exposed bluff[a]	16.3 miles (51.6%)	3.8 miles (15.6%)

[a] Includes areas where bedrock is exposed along shoreline.

Site geology and slope were similar for sites categorized as having high or severe erosion. Over half of the Baker Lake shoreline sites categorized as such had coarse-grained outwash and alluvium exposed. The vertical to near-vertical pre-Project terrace escarpments and Baker River cut banks were particularly susceptible to undercutting by wave action and streams. The most severe erosion areas occurred where outwash or alluvium was present on these steep slopes. Where coarse-grained outwash and alluvium were present on gentle slopes, wave action generally removed sand-sized particles, leaving behind a gravel lag deposit. At Lake Shannon, the majority (25 of 29) shoreline erosion sites that were categorized as high or severe were located on promontories that are heavily affected by wave erosion. Although AESI (2003) indicates that aspect does not appear to play a major role in eroding areas of either reservoir, it does not indicate how it came to this conclusion.

The majority of both reservoirs' shoreline sites that were categorized as having low to moderate erosion included long stretches of shoreline where undercutting had occurred, generally less than 2 feet. Stumps immediately adjacent to the shoreline had between 1 and 3 feet of roots exposed. Rill and gully erosion along with wave erosion are the predominant erosion processes in these areas.

Puget also evaluated erosion in the drawdown zones of Baker Lake and Lake Shannon. This study focused on erosion that was non-cyclic in nature and hence did not include evaluating erosion related to tributary fans since sediment transport and deposition in these areas is cyclic. No severe erosion sites were identified in the drawdown zone; however, 19 drawdown-zone sites in the two reservoirs were categorized as high erosion sites. Baker Lake had 17 high erosion sites and Lake Shannon had 2 high erosion sites (AESI, 2003). Wave action along the edge of flat terraces with recessional outwash or older alluvium along the western side of Baker Lake forms nearly all of the drawdown zone erosion sites identified in the reservoir. Similarly, wave action against the edge of a gently sloping terrace located just up-reservoir of the Bear Creek confluence with Lake Shannon is also responsible for high erosion.

The edges of most of these terraces where the high erosion sites were identified were at elevations of about 705 to 710 feet (NAVD 88) for Baker Lake and about 420 feet (NAVD 88) for Lake Shannon.

As sediment is transported into the Project's reservoirs, water velocities decrease rapidly, and consequently much of the sediment drops out of the water column. The rate at which sediment is no longer transported is highly dependent on the size of the sediment. The larger-sized sediments drop out first, followed by finer sediments farther down reservoir. Glacial flour continues farthest down reservoir, sometimes continuing completely through the reservoir depending on water velocities. Annual drawdown of the reservoirs mobilizes a portion of the deposited sediments, although virtually none of the coarse-grained sediments are transported past either the Upper or Lower Baker dams. Instead, reservoir drawdown causes resorting of the sediments (i.e., the rate of coarse-grained sediments being moved downslope to the reservoir footprint depends on their size and shape) and resuspension of fine-grained sediments that can lead to transporting them past the lower dam, depending on reservoir conditions at the time.

Puget evaluated the potential for the two reservoirs and natural Baker Lake, which was located within the area that was backwatered by the Upper Baker dam, to interrupt sediment transport down the Baker River. They used the modified Brune Curve method, which uses the ratio of reservoir capacity to mean annual water inflow to estimate the fraction of the sediment that is trapped in the impoundment (Linsley et al., 1982). To evaluate trap efficiencies for sediment size classes ranging from very fine clay to small cobbles, they used a method that the U.S. Bureau of Reclamation recommends for turbulent flow that is based on reservoir hydraulic characteristics (Borland, 1971; Chen, 1975; and Raudkivi, 1993). The results of these analyses are described in detail in a report produced by R2 (2003c).

Results of these evaluations indicate that approximately 15 percent of the suspended sediment entering the Baker Lake reservoir is routed past Upper Baker dam and into Lake Shannon. Approximately 23 percent of the suspended sediment entering Lake Shannon is routed past the Lower Baker dam and into the Lower Baker River and subsequently the Skagit River. Suspended sediments routed past the dams consist of fine silt and smaller size materials. In comparison, approximately 29 percent of the suspended sediment entering natural Baker Lake, which is within the Baker Lake reservoir, would be routed through the lake.

Sediment budgets for the existing condition are displayed in table 5-2. Under the current operating regime, the Baker River delivers approximately 8 percent of the sediments supplied to the Baker River upstream of the Lower Baker dam to the river downstream of the dam. Sediments supplied to this reach average 21,000 to 30,000 tons of suspended sediment per year and no bedload.

Table 5-2. Sediment budgets for Baker River with the influence of the Baker Project. (Source: Adapted from R2, 2003c)

Location	Current Conditions (tons per year)
Incoming from Baker River and tributaries above natural Baker Lake (tons per year)	
Total load	109,000–212,000
Suspended load	95,000–185,000
Bedload	14,000–28,000
Trapped in natural Baker Lake (% of incoming)	
Total load	NA
Suspended load	NA
Bedload	NA
Outgoing from natural Baker Lake (% percent of incoming)	
Total load	NA
Suspended load	NA
Bedload	NA
Incoming from tributaries downstream of natural Baker Lake (tons per year)	
Total load	49,000–114,000
Suspended load	43,000–99,000
Bedload	6,000–15,000
Trapped in Baker Lake reservoir (% of total incoming)	
Total load	87%
Suspended load	85%
Bedload	99%
Outgoing from Baker Lake reservoir (% of total incoming)	
Total load	13%
Suspended load	15%
Bedload	1%
Incoming from tributaries to Lake Shannon (tons per year)	
Total load	75,000–95,000
Suspended load	65,000–83,000
Bedload	10,000–12,000
Trapped in Lake Shannon (% of total incoming)	
Total load	78%
Suspended load	76%
Bedload	100%
Available for transport to Skagit River (% of total incoming)	
Total load	22%
Suspended load	24%
Bedload	0%

Location	Current Conditions (tons per year)
Available for transport to Skagit River (% percent of total incoming from basin upstream of Lower Baker dam)	
Total load	8%
Suspended load	9%
Bedload	0%
Note: NA – Not applicable	

The Baker River has two distinct sections below the Lower Baker dam. Between the Lower Baker dam and the weir at RM 0.6, the river flows through a narrow bedrock controlled canyon that has a high sediment transport potential with an armored layer consisting primarily of boulders and bedrock. The lowermost section of the river is much less confined, has a lower gradient than the canyon reach, is influenced by backwaters from the Skagit River, and has been straightened and dredged. Naturally this reach was an alluvial fan where sediments routed through the canyon were deposited and reworked in the lower energy reach. The current straight incised channel has a higher potential to transport sediments and receives less sediments (due to deposition above the dams), which has led to a coarse armor layer of bed sediments that remain stable even at high flows. High flows in the Skagit River result in backwater effects (i.e., reduced velocities and sediment transport capacity) in the lowermost section of the Baker River.

The Skagit River downstream of the confluence with the Baker River is a very large alluvial river. Large alluvial channels like the Skagit River typically achieve a state of “dynamic equilibrium” where sediment transport capacity and sediment supply are approximately equal over the long term. Since their bed and banks are comprised of material deposited by the river, they are generally very sensitive to changes in sediment yield and flow.

Numerous human-caused factors influence sediment supply to the Skagit River. Some of these tend to decrease the sediment supply, while others tend to increase the sediment supply. As described above, under existing condition, impounding water behind the Project’s dams prevents all of the bedload and most of the suspended load in the Baker River from passing the Lower Baker dam and entering the Skagit River. In a similar fashion, the Skagit Project operated by Seattle City Light reduces the sediment supply to the Upper Skagit River. In contrast, forest harvest practices and road building may increase sediment supply to Skagit River tributaries and consequently the Skagit River (Paulson, 1997).

Operation of the Baker and Skagit hydroelectric projects generally affects Skagit River flows by reducing flood flows and increasing daily flow fluctuations (refer to section 5.4.1.1, *Surface Water*). Flood control by the projects has reduced the sediment transport capacity of the Middle Skagit River. Without a large reduction in sediment supply, this reduction in sediment transport capacity would be expected to result in aggradation, particularly below large sediment sources. Although the Project has substantially reduced the sediment supply from the Baker River, there is no evidence that the in-channel sediment deposits have substantially decreased (R2, 2003c). In fact, recent reassessment of cross-sections and water surface elevations downstream of the Skagit River near Concrete gage site suggests that the reach has aggraded over the last several decades (ACOE, unpublished data, as cited in R2, 2003c). Surveys of transects located downstream of Sedro-Woolley suggest that the Lower Skagit River has aggraded by 1 to 2 feet since the 1970s.

5.3.1.5 Sediment Storage in Reservoirs

Lower Baker dam began storing water and trapping sediment being supplied by the Baker River and its tributaries to Lake Shannon in 1925. Lake Shannon continued to trap sediment from all these sources until Upper Baker dam was constructed in 1959. Since 1959, most of the sediments being transported by the Baker River above the Upper Baker dam have accumulated in Baker Lake, which has substantially reduced the rate of accumulation in Lake Shannon. Since construction of the upper dam, Lake Shannon has primarily trapped sediment from tributary sources to Lake Shannon not sediment routed past the Upper Baker dam.

Puget's evaluation of the sediment budget (which does not include sediment supplied by reservoir shoreline erosion) indicates that currently average annual sediment accumulations are approximately 137,000 to 283,000 tons in Baker Lake and approximately 74,000 to 107,000 tons in Lake Shannon (R2, 2003c). Prior to construction of Upper Baker dam, sediment accumulated at a considerably faster rate in Lake Shannon, since it was receiving much more sediment from the upper portion of the basin. Puget estimated that the total amount of sediment that has accumulated in the Baker Lake reservoir since the dam was constructed in 1959 is approximately 3,100 to 6,400 acre-feet, which accounts for about 1 to 3 percent of the total storage capacity of the reservoir. Since 1959, approximately 1,700 to 2,400 acre-feet of sediments have accumulated in Lake Shannon. In addition, approximately 4,111 acre-feet of sediment accumulated in Lake Shannon between completion of the Lower Baker dam in 1929 and completion of the Upper Baker dam in 1959 (R2, 2003c). The total estimated sediment accumulation in Lake Shannon has reduced the storage capacity of the reservoir by about 5 percent.

Much of the sediment that accumulates in the reservoirs is deposited in deltas located just down-gradient of inflowing tributaries. The largest delta is the feature where the Baker River flows into the upper end of Baker Lake. Comparison of topographic data from 1959 and 1999 suggests that deposits within the drawdown zone on this feature are typically 5 to 10 feet in thickness, although this is within the range of error associated with the data sets. By assuming even distribution of all of the bedload and 60 percent of the suspended load, Puget estimated that deposits on the delta feature are 2 to 4.5 feet deep (R2, 2003c), which is reasonably consistent with estimates developed from the topographic data. Delta deposits are also present at the mouths of other glacially-fed tributaries draining the east slopes of Mount Baker. Comparison of 1959 and 1999 topographic profiles indicates that typically 5 to 15 feet of deposition has occurred in the drawdown zone of these deltas.

In Lake Shannon, sediment deposition is most obvious in the upper end of the reservoir and near the Thunder Creek confluence with the reservoir. Prior to construction of the Upper Baker dam, a considerable sediment load entered the reservoir from the Baker River and much of it was deposited at the upper end of the reservoir. Comparison of 1929 and 1959 storage capacity curves suggest that sediments accumulated between roughly 440 and 415 feet (NGVD

29) (i.e., 443.75 and 418.75 feet NAVD 88). Puget estimated that the depth of these sediments is probably about 5 to 15 feet (R2, 2003c). Thunder Creek is the only Lake Shannon tributary that has a pronounced delta feature. Coarse-grained sediment has completely filled in the original Thunder Creek embayment of the reservoir (personal communication, R. Barnes, Program Manager, Water Resources, Puget, Bellevue, WA, and B. Mattax, Senior Aquatic Scientist, Louis Berger, Bellevue, WA, on September 12, 2003).

5.3.1.6 Hazardous Materials

It is necessary to use, store, and dispose of hazardous materials to operate the Baker River Project. Such potentially hazardous materials include lubricants for the generators, fuel and oil for vehicles, and chemicals for propagating fish (i.e., formalin, sodium bisulfate, and sodium hyprochorite) (personal communication, L. Boyle, Associate Environmental Scientist, Puget, Bellevue, WA, and B. Mattax, Senior Aquatic Scientist, Louis Berger, Bellevue, WA, April 7, 2003). Puget has corporate policies mandating that all employees be made aware of onsite hazardous materials. In addition, Puget maintains and implements Spill Prevention Control and Countermeasure (SPCC) plans that are specifically designed to address potential oil spills from the Upper Baker generation plant, Lower Baker generation plant, and the Baker Lake Resort. Each SPCC plan establishes procedures, methods, and equipment to be used to prevent a spill from occurring, if possible, or to contain and clean up a spill that does occur, and Puget employees are trained regarding the proper procedures and precautions to take in event of a spill.

5.3.2 Environmental Effects

5.3.2.1 Effects of Project Operations

Reservoir Level Management

Erosion of sediments occurs along the shoreline and within the drawdown zone of both Baker Lake and Lake Shannon (AESI, 2003). The extent of shoreline erosion is influenced by natural factors including soil type, bank configuration, and wind direction, but is also influenced by factors controlled by humans such as reservoir pool level, fluctuations in pool levels, land use activities, and recreational use. Recent evaluation of shoreline erosion associated with the Project's reservoirs indicates that approximately 11 percent of the Baker Lake shoreline and 14 percent of the Lake Shannon shoreline currently have "high" to "severe" erosion, as defined by AESI (refer to section 5.3.1.4, *Sediment Supply and Transport*). Additional "high" erosion sites were identified in the drawdown zone of both reservoirs. Continued operation of the reservoirs would result in continued potential for erosion along the reservoir shorelines and within the reservoirs.

Under the Draft Action, reservoir water levels would be controlled by operating the Project to satisfy proposed target reservoir water levels and proposed target flow levels. Target reservoir water levels are set to maintain current levels of flood control operations (PME 5.1), balance conflicts between resources (PME 6.3), and limit resuspension of sediments deposited at the upper end of Lake Shannon (PME 3.5.2). The specific minimum Lake Shannon operating level set in PME 3.5.2 is 383.75 feet (NAVD 88). Target minimum flow levels and ramping rate restrictions are set to protect aquatic resources in PME 3.3.1. We describe these measures along with their effects on the water levels of Baker Lake and Lake Shannon in section 5.4.2.1, *Effects of Project Operations,* in *Water Quantity*. Refer to appendix B for the full text of these measures.

Effects Analysis

Operating the Project under the Draft Action would not substantially change the morphologic characteristics of Baker Lake or Lake Shannon; hence sediment deposition in the reservoirs would remain similar to existing conditions.

Study A14a, *Reservoir Shoreline Erosion and Deposition,* includes an evaluation of the current state of erosion along the shoreline and within a portion of the drawdown zones of Baker Lake and Lake Shannon (AESI, 2003). The study has yet to provide an assessment of the effects of water level changes on erosion potential. We will incorporate any new information from the revised report into our analysis, as appropriate.

We base our preliminary analysis of effects of the Draft Action on the potential for erosion on the fact that the primary cause of erosion both along the shoreline and within the drawdown zone is undercutting caused by either wave action and/or stream action, and that most active erosion sites occur either along the shoreline or along the edge of terraces within the drawdown zones. We have incorporated an evaluation of water level fluctuations into our analysis to identify their potential for changing reservoir erosion rates. Our analysis assumes the following:

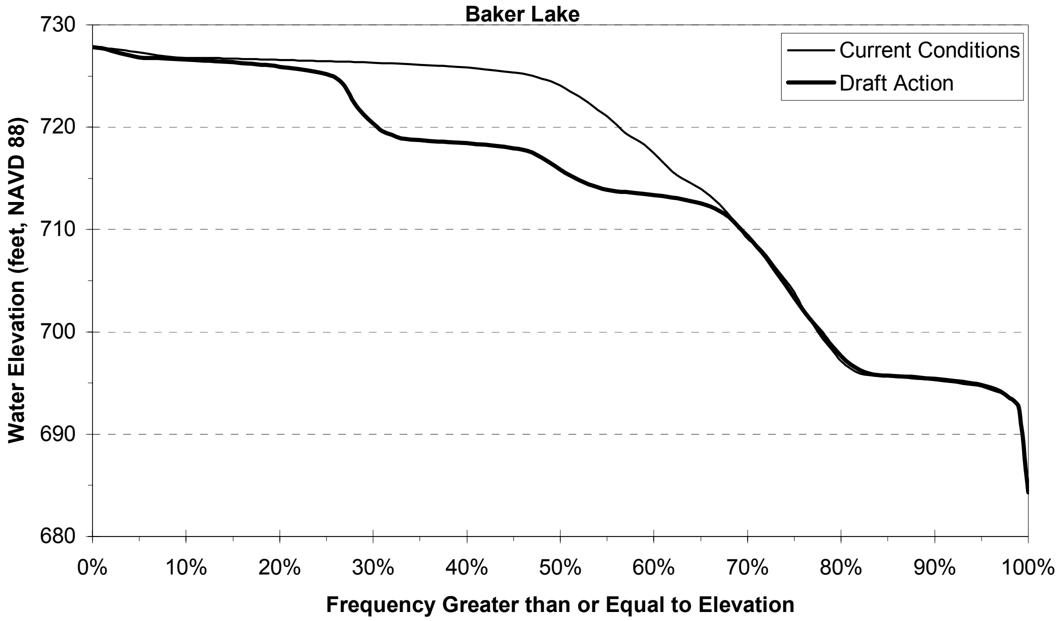
- Wave action is the principal cause of shoreline erosion, and maintaining a reservoir water level within 3 feet of the normal full pool would result in repeated wave action along the reservoir shoreline, thereby increasing the potential for erosion due to the relatively steep slopes above full pool;

- Maintaining reservoir water levels at elevations of less than the edge of most terraces with “high” erosion sites along their edges would increase the potential for erosion. These elevations are 710 feet (NAVD 88) for Baker Lake and 420 feet (NAVD 88) for Lake Shannon; and

- Increases in the frequency and extent of water-level fluctuations are indicative of increased potential for erosion within the reservoirs.

To evaluate changes in the amount of time that water levels are within certain ranges and the extent of daily fluctuations, we analyzed water levels modeled with the HYDROPS model. The analysis consisted of percent exceedance analyses for water levels and daily water level fluctuations for Baker Lake and Lake Shannon. Results of the analysis of water elevations are displayed in figure 5-2, and results of the analysis of water level fluctuations are displayed in figure 5-3.

Based on Interim HYDROPS Model Output (mid-July 2003)



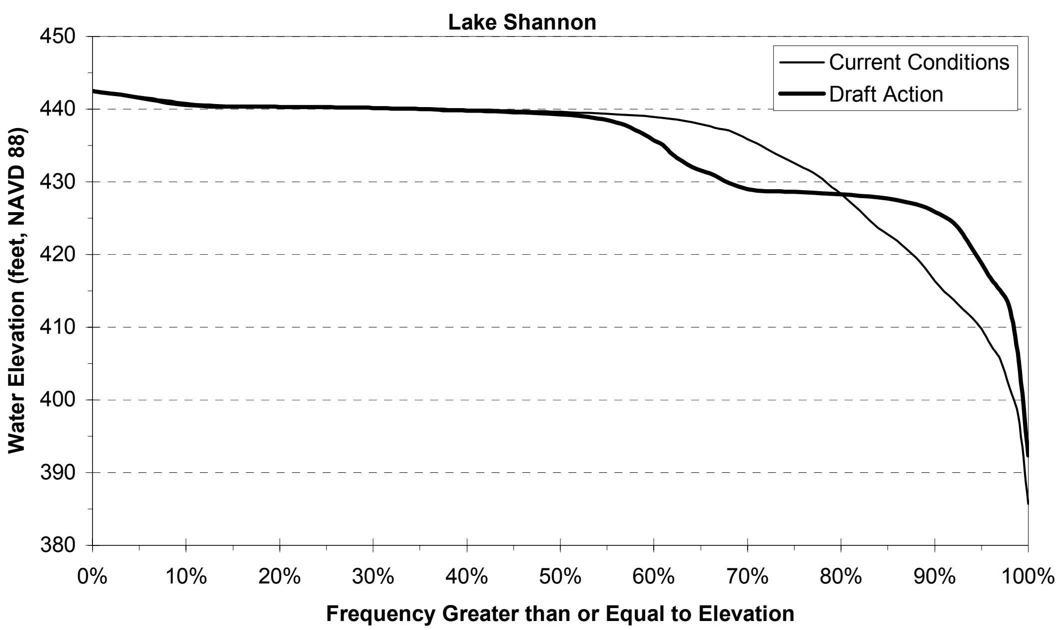


Figure 5-2. Duration analysis of modeled water elevations for Baker Lake and Lake Shannon, based on HYDROPS results for 5 representative years.

Based on Interim HYDROPS Model Output (mid-July 2003)

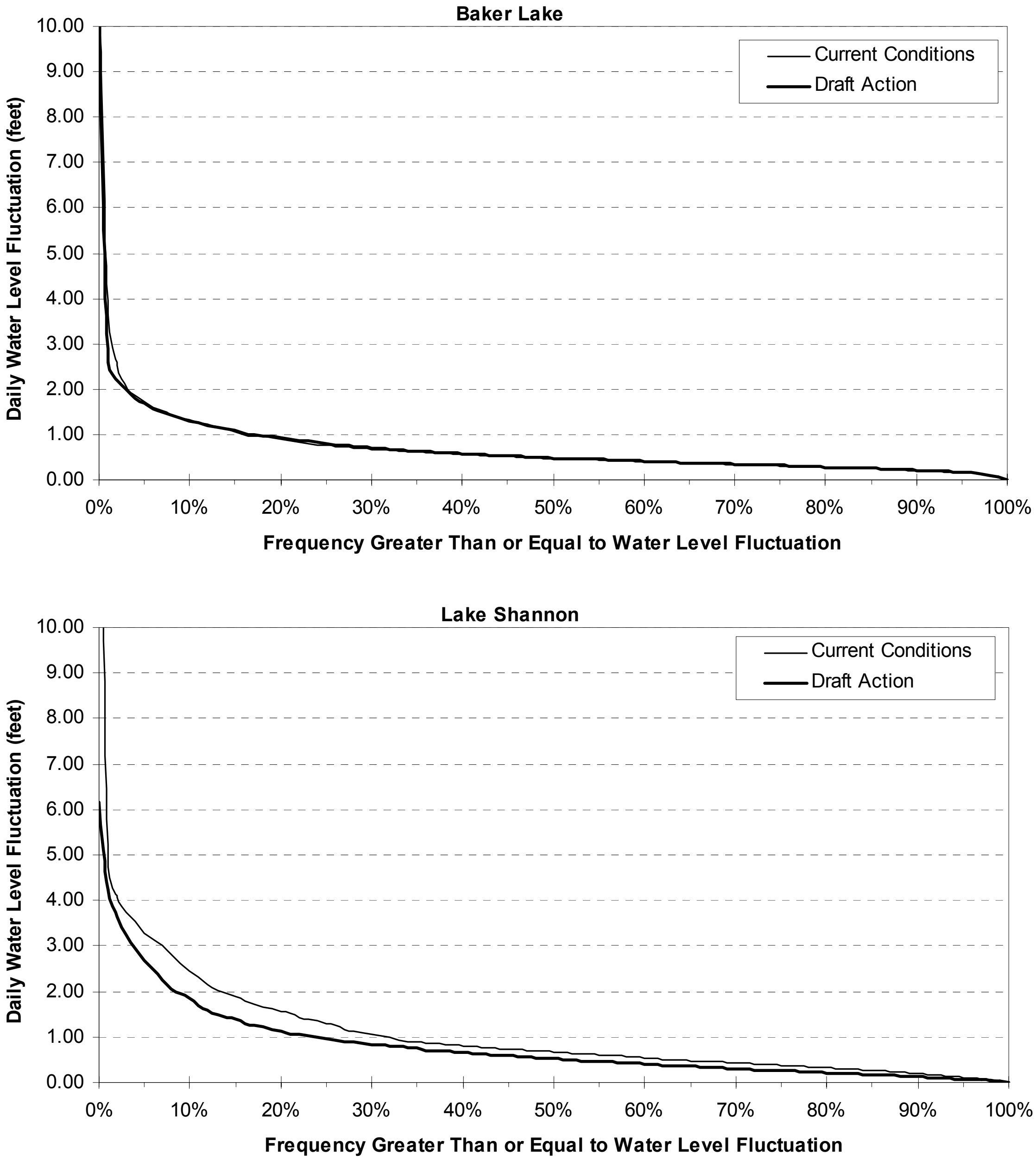


Figure 5-3. Duration analysis of modeled daily water elevation fluctuations for Baker Lake and Lake Shannon, based on HYDROPS results for 5 representative years.

The results of this analysis indicates that operating the Project under the Draft Action would result in reduced Baker Lake water levels about half the time (figure 5-2), and that daily water level fluctuations would remain very similar to current conditions (figure 5-3). Baker Lake's water level would be within 3 feet of normal full pool about 26 percent of the time under the Draft Action, whereas it would be within this range about 48 percent of the time under current conditions. Reducing the amount of time that the reservoir is near full pool would reduce the potential for wave action occurring at or near the full pool elevation, which could consequently cause a reduction in the potential for shoreline erosion around Baker Lake.

Based on our analysis, Project operations under the Draft Action would result in virtually the same frequency of Baker Lake water levels of less than 710 feet (NAVD 88) (figure 5-2). Evaluation of the frequency of water levels below 710 feet (NAVD 88) indicates that each level would occur at virtually the same frequency. Based on this analysis, we believe that the erosion potential within the drawdown zone of Baker Lake would remain very similar under Draft Action operations.

Based on a similar analysis for Lake Shannon, there would be little change in the erosion potential for the shoreline of the reservoir. HYDROPS results indicate that under both the Draft Action and current conditions the reservoir would be within 3 feet of normal full pool about 50 percent of the time (figure 5-2).

Operating Lake Shannon to meet a higher target minimum water level would reduce the frequency of water levels that are below the edge of the terraces with sites within the drawdown zone categorized for "high" erosion (i.e., 420 feet, NAVD 88). Under the Draft Action, water levels below this level would occur less than half as often as under current conditions (figure 5-2). Furthermore, HYDROPS results do not indicate that the Draft Action would result in Lake Shannon water levels dropping below 390 feet (NAVD 88), the elevation at which downcutting and resuspension of settled solids at the upstream end of Lake Shannon would be likely to occur. In addition, there would be a reduction in the magnitude and frequency of daily water level fluctuations (figure 5-3). Therefore, we anticipate that there would typically be a reduction in the potential for eroding sediments deposited within the drawdown zone at the upper end of Lake Shannon and the vicinity of the Bear Creek confluence.

We discuss the effects of Project operations on turbidities in section 5.4.2.1, *Effects of Project Operations,* in *Water Quantity*.

Project Releases

Operating the Project to meet power demands and provide for reduced flooding potential has substantially influenced flows in the Lower Baker River in comparison to the natural flow regime. The level and frequency of peak flows have been substantially reduced. In contrast, the frequency of flows between 2,800 and 4,000 cfs has increased. The net result of these flow alterations on sediment transport is a reduction in the capacity to transport gravel and larger-sized sediments.

Under the Draft Action, Puget would operate the Project to meet a minimum flow level of 300 cfs at the Baker River at Concrete gage and restrict ramping of flow releases (PME 3.3.1). Refer to appendix B for the full text of this measure.

Effects Analysis

Under the Draft Action, the Lower Baker River would continue to receive only a small portion of the sediment supplied to the Baker River upstream of the Lower Baker dam. All of the bedload and most of the suspended load would be intercepted by the reservoirs. Sediment would continue to be primarily supplied to the Lower Baker River by episodic mass wasting events occurring below the Lower Baker dam and temporary deposition of suspended sediments carried by floods in the Skagit River.

Operating the Project under the Draft Action would result in a similar flow regime as under the existing conditions in the Lower Baker River. Peak flows occurring naturally would continue to be reduced substantially by flood control operations. Operation of a new unit to facilitate instream flow releases and assist in meeting down-ramp rates would increase the frequency of flows of about 4,600 cfs.

Based on these changes to the flow regime, we believe that the sediment transport capacity for the Lower Baker River would be increased somewhat and that sediments would continue to be quickly routed through most of the reach. However, the effects of backwater from the Skagit River during high flows would continue to reduce the effects of the Project on sediment transport capacity in the lowermost section of the Baker River.

We anticipate incorporating appropriate information from Study A16, Feasibility Assessment of Potential Protection, Mitigation and Enhancement Measures for Lower Baker Alluvial Fan, following its completion.

5.3.2.2 Sediment Transport

The downstream movement of most sediment, including all bedload (gravel and larger-sized sediments) is blocked by the Upper and Lower Baker dams (section 5.3.1.4). Currently, only a small portion of the Baker River's suspended sediment load passes the Project. Available evidence suggests that the Middle Skagit River is currently aggrading. The aggradation may be the result of increased sediment yields from tributary streams as a result of historical land management activities, the reduction in transport capacity caused by flood control at the Baker and Skagit projects, or a combination of these, or other, factors.

The Draft Action includes a measure to enhance the Baker River's sediment transport capacity with a goal of restoring the natural functioning of sediment transport to the Lower Baker and Skagit rivers downstream of the Baker Project, and undertaking actions to enhance channel morphologic function of the Lower Baker alluvial fan (PME 3.4.1).

Puget would develop a plan for immediate implementation of habitat enhancement actions intended to improve the geomorphic function of the Lower Baker River alluvial fan. The fan landform is defined as the mainstem river channel and the associated depositional feature located within the Skagit River floodplain. Also, Puget would develop a plan developed to address the potential for future augmentation of gravel to the Skagit River.

To determine when and if gravel augmentation to the Skagit River may be desirable, Puget would develop and implement a plan to monitor trends in the bed surface texture and the tendency toward aggradation/degradation for the Middle Skagit River downstream of the Project. Currently, the monitoring program is expected to consist of annual evaluation of stage discharge relationships, surveying streambed profiles at 5-year intervals, and sampling the bed surface texture at gravel bars within the active channel that are exposed by low flows. If and when degradation or bed coarsening is first observed, the frequency of monitoring may be increased to ensure timely identification of long-term trends.

If this and/or other monitoring documents a consistent long-term trend toward coarsening of the bed surface or degradation in the Middle Skagit River downstream of the Baker River confluence, a proposal for gravel augmentation intended to restore bedload inputs from the Baker River would be developed and presented to the BRCC.[14] Initially, small supplemental increments, such as 1,000 tons per year, would be applied in conjunction with monitoring, which would be used to determine the need for increasing or decreasing these amounts in following years. In no case would the amount of gravel placed exceed the amount of bedload intercepted by the Baker River (which is currently estimated to be approximately 12,500 tons of gravel and small-sized sediment). The sediments used would consist of gravel-to-cobble sized as specified in the plan and would be alluvial or glacial material.

Effects Analysis

Construction of the Baker Project cut off the supply of bedload from the Baker River basin upstream of the Lower Baker dam beginning in 1929. R2 (2003c) estimated that the Project reduced the sediment supply to the Skagit River by approximately 6.5 percent, although there is no evidence that in-channel sediment deposits have substantially decreased in the Skagit River downstream of the Baker River confluence.

The Skagit Project blocked sediment supply from the Skagit River beginning around the same time as the Baker Project. Since the Skagit Project is located about 38 miles upstream, its interruption of sediment supply may not have yet affected the channel downstream of the Baker River confluence. By applying bedload velocities documented for other gravel bedded rivers (i.e., 0.5 to 1 mile per year), R2 estimated that the effects of the Skagit Project would reach the Skagit River near Concrete gage between 1971 and 2013.

The Baker and Skagit projects have reduced sediment supply in the Skagit River, and they have also reduced the river's sediment transport capacity through flood control. At the present time, the relative effects of the reduced sediment supply versus the reduced transport capacity is unknown; however, channel cross-sections and water surface elevations suggest that

[14] Refer to section 5.6.2.7, *Ongoing Resource Monitoring and Management*, for a discussion of the role of the BRCC.

the river has aggraded downstream of the Skagit River near Concrete gage over the last several decades (ACOE, unpublished data, as cited in R2, 2003c). The causes of this aggradation are unknown but could be the result of increased tributary sediment inputs, a reduction in the river's sediment transport capacity as a result of flood control, or a combination of these and other factors that are unrelated to Baker Project operations. Determining the reason for the existing Skagit River aggradation is beyond the scope of the Baker Project gravel augmentation plan.

A recent screening-level assessment of the Skagit River Basin concluded that sediment supply was substantially higher than it would be without land management in over half the subbasins. As a result, the Skagit Watershed Council set a high priority on sediment reduction in unregulated tributaries (Beamer et al., 2000).

Given the focus on reducing sediments in tributaries to the Skagit River and the fact that the full effects of blocking sediment passage at the Skagit Project may not have yet reached the Baker River confluence, it is likely that sediment supplied to the Middle Skagit River would decrease in the future compared with current conditions. This could result in coarsening of the Middle Skagit River's streambed and possibly incision of the thalweg to the point of abandonment of side channels and backwater channels.

By implementing PME 3.4.1, Puget would provide a means of regularly reviewing the status of the Middle Skagit River channel's streambed characteristics during the term of any new license issued. The BRCC would determine if there is a need for augmenting the reach's sediment supply. If the BRCC determines the need for sediment augmentation, Puget would supply up to the amount blocked by the Project. Augmentation would be conducted by starting with small volumes (e.g., 1,000 tons per year) and adaptively managing supplies for the next year based on results of monitoring. Using this method would ensure that Puget provides an appropriate quantity of sediment to offset any adverse effect caused by the Project's blockage of sediment.

The reporting requirements would ensure that Puget documents the condition of the Middle Skagit River channel at least every 5 years and would provide the information necessary for the BRCC to determine whether Puget should supply sediment.

In the future, we plan to use the results of Study A16, Feasibility Assessment of Potential Protection, Mitigation and Enhancement Measures for Lower Baker Alluvial Fan, and refinement of the portion of the measure addressing the Lower Baker alluvial fan to describe the effects of this measure on the Lower Baker River alluvial fan.

5.3.2.3 Erosion

Continued operation of the Project would result in continued risk of erosion associated with reservoir-related fluctuations and wave action (see section 5.3.2.1). In addition, construction activities necessary to ensure continued efficient Project operations along with implementation of measures included in the Draft Action have the potential to increase the risk of erosion.

Under the Draft Action, Puget would develop an erosion control and implementation plan (PME 3.4.3). The plan would identify and prioritize sites for treatment; detail treatment methods, materials, costs, and timing; provide an implementation framework and schedule; provide for monitoring treatment effectiveness; and provide for treatment maintenance.

The objective of the plan would be to adequately address erosion control for construction, containment from Project-related failures, and continuing reservoir erosion. The plan would also include a methodology for identifying and addressing effects of ground-disturbing activities associated with all newly implemented resource measures. Refer to appendix B for the full text of this measure.

Effects Analysis

This measure would provide a mechanism for limiting risks of erosion associated with ongoing operation of the Project and with construction of new facilities and measures. We also note that maintaining Lake Shannon at an elevation of at least 383.75 feet (NAVD 88) as called for in PME 3.5.2 would limit the risk of erosion associated with drawing down Lake Shannon, and the storm water pollution prevention plan (PME 3.5.3) would address the effects of erosion as related to water quality. These measures are discussed in sections 5.5.2.1 and 5.5.2.2, respectively.

Development of this type of plan has been found to be a successful way to communicate priorities with resolving potential erosion problems, and provide detailed treatment methods to minimize erosion associated with construction activities and Project operations. By monitoring treatment effectiveness, Puget would evaluate the success of treatment methods employed and adaptively shift emphasis to implementation of treatments that are found to be most successful.

5.3.3 Unavoidable Adverse Effects

Conducting the Lower Baker powerhouse upgrade; construction and/or improvement of fish passage facilities, trails, campsites, boat ramps; and stump removal, all elements of the Draft Action, would result in minor short-term localized increases in the potential for erosion. Project operations would continue to result in long-term erosion of portions of the shoreline of Baker Lake and Lake Shannon. All bedload and most suspended load would continue to be intercepted by the impoundments above the Upper Baker and Lower Baker dams, although adverse effects on the Lower Baker River alluvial fan and Middle Skagit River would be offset by PME 3.4.1.

5.4 Water Quantity

5.4.1 Affected Environment

5.4.1.1 Surface Water

Baker River Flows

The Baker River has a drainage area of approximately 297 square miles and contributes approximately 18 percent of the Skagit River's flow as measured at the Skagit River near Concrete gage (Puget, 2003s). Streamflows in the Baker River and its tributaries are driven by rainfall, snow, and glacial melt, and to a lesser extent, groundwater discharge to the stream channel network.

Baker River flows have been monitored near the Project at several USGS surface water gages (table 5-3). Average annual runoff from the Baker River basin is about 120 inches. Based on records from the USGS gages, average annual runoff from tributaries to the Baker River varies from about 73 inches in Sulphur Creek to about 150–160 inches in Swift and Park creeks. It is important to note, however, that the discharge of Sulphur Springs averages 83 to 132 cfs, a portion of which is derived from the Sulphur Creek basin, substantially increasing the runoff estimates for Sulphur Creek.

Table 5-3. Streamflow surface water station information near the Baker River Project. (Sources: Kimbrough et al., undated; USGS, 2003, 1964)

USGS Gage No.	Gage Name	Period of Record	Latitude	Longitude	Drainage Area (square miles)	Mean Annual Flow (cfs)	Annual Runoff (inches)
12190710	Swift Creek near Concrete	1982–1990	48 44'07"	121 39'26"	36.4	424	158
12190718	Park Creek at upper bridge near Concrete	1982–1990	48 44'36"	121 41'23"	10.5	117	151
	Koma Kulshan powerhouse[a]	Up to 120 cfs of Lower Baker inflow from Sulphur and Rocky creeks routed to Upper Baker, since construction of the Koma Kulshan Project in 1990			NA		NA
12191910	Sandy Creek near Concrete	1953–1954	48 41'05"	121 42'23"	10.8	117	146
12191800	Sulphur Creek near Concrete	1963–1973, 1981–1982	48 40'40"	121 45'00"	8.36	44.9	73
12192600	Bear Creek below tributaries, near Concrete	1982–1986	48 37'11"	121 44'09"	14.4	90.2	85
12192700	Thunder Creek near Concrete	1982–1994	48 36'08"	121 42'17"	22.4	137	83
12191500	Baker River below Anderson Creek, near Concrete	1911–1925, 1928–1931, 1955–1959	48 39'50"	121 40'25"	211	1,983	128
12193500	Baker River at Concrete	1910–1915, 1943–present	48 32'24"	121 44'31"	297	2,654[b]	121
12181000	Skagit River near Marblemount	1943–1944, 1946–1951, 1976–present	48 32'02"	121 25'43"	1,381	6,038	59

USGS Gage No.	Gage Name	Period of Record	Latitude	Longitude	Drainage Area (square miles)	Mean Annual Flow (cfs)	Annual Runoff (inches)
12189500	Sauk River near Sauk[c]	1910–1912, 1928–present	48 25'29"	121 34'02"	714	4,343	83
12194000	Skagit River near Concrete	1924–present	48 31'28"	121 46'11"	2,737	15,040	75

Note: NA – Not applicable

[a] Water diverted from Sulphur and Rocky creeks and discharged into Sandy Creek.

[b] Adjusted for storage in Lake Shannon and Baker Lake.

[c] Published as "near Suiattle Crossing, near Sauk" 1910–1912.

Glaciers in the headwaters of streams in the northwestern part of the Baker River basin substantially affect flows during the low-flow period. Pelto and Hartzell (undated) reports that glacial melt accounts for 16 percent of the flow at Baker River's terminus between July 1 and October 1. The percentage of glacial melt contribution is higher during dry, warm periods. For example, glacial melt accounted for 45 percent of Baker River's outflow during the drought months of 1998. Between 1979 and 1997, glaciers in the basin retreated. Further glacial recession could reduce summer runoff and increase spring runoff from headwater streams.

Most of the tributaries to the Baker River are unregulated; however, the Koma Kulshan Hydroelectric Project (FERC No. 3239), which began operation in 1990, diverts up to 120 cfs of flow from Sulphur and Rocky creeks (tributaries to Lake Shannon) to Sandy Creek (a tributary to Baker Lake). The Koma Kulshan Project is operated as run-of-river; therefore, it does not significantly alter the timing of inflow to the Baker River.

In the mid-1980s, the USGS developed flow estimates for several ungaged tributaries in the basin (Williams, 1987). These estimates are based on regressions of flow with drainage area, precipitation, and a factor that accounts for the percentage of the basin that is glaciated. We present estimates of mean monthly tributary flows, 3-day high flows, and 7-day low flows in table 5-4. Flow estimates provided in table 5-4 do not account for the effects of the Koma Kulshan Project.

Flow data for the Baker River at Concrete gage reflect the Project's influence on flow patterns. The reported gage data present existing conditions; Puget estimated unregulated flows by removing the storage effects of Baker Lake and Lake Shannon. Summaries of both regulated and unregulated (i.e., adjusted for storage) daily mean, maximum 3-day maximum, and minimum 7-day low flows are presented in tables 5-5, 5-6, and 5-7, respectively.[15]

[15] Operation of the Project evolved during the late 1970s to early 1980s and has remained relatively stable since that time. Accordingly, we use water years 1981 through 2002 to represent flows under existing operating conditions.

Table 5-4. Mean monthly flow, 3-day high flow, and 7-day low flow estimates (in cfs) from regression relationships for selected streamflow characteristics at tributaries to the Baker River system. (Source: Williams, 1987)

	Upper Baker Tributaries			Lower Baker Tributaries				
Period	**Swift**	**Park**	**Sandy**	**Sulphur**[a]	**Rocky**	**Bear**	**N.F. Bear**	**Thunder**
October	210	71	67	53	47	61	7	130
November	230	71	67	53	47	66	10	140
December	220	57	55	41	38	59	6	130
January	180	50	48	36	33	53	6	110
February	160	44	42	32	29	48	5	100
March	130	33	31	24	21	36	4	80
April	200	47	57	37	42	60	7	140
May	370	110	120	82	92	99	13	240
June	440	160	160	120	110	99	13	250
July	290	130	110	93	72	58	8	160
August	140	71	49	49	31	28	3	74
September	140	61	45	43	28	31	4	75
3-Day high flow[b]	1,200	390	380	300	270	350	49	750
7-Day low flow[b]	48	14	18	11	14	11	1	30

[a] Louis Berger estimates based on USGS regressions.
[b] Fifty percent probability of being exceeded.

Table 5-5. Daily mean flow statistics (cfs) for Baker River at Concrete under historical and unregulated conditions (water years 1981 through 2002).[a]

	Unregulated[b]			Historical		
Period	**Minimum**	**Mean**	**Maximum**	**Minimum**	**Mean**	**Maximum**
October	456	2,148	18,609	95	2,643	19,200
November	484	3,601	38,418	95	4,155	21,500
December	573	2,550	32,485	82	2,967	19,000
January	428	2,561	29,853	80	2,864	14,100
February	279	2,374	19,592	80	2,720	5,960
March	366	2,047	27,206	47	2,330	4,100
April	371	2,538	14,475	30	1,683	9,990
May	869	3,484	15,402	56	2,485	5,040
June	1,575	4,004	12,311	91	3,320	13,500
July	1,170	3,159	20,427	95	2,899	21,000
August	591	1,903	10,675	66	2,094	7,080
September	577	1,413	9,165	66	1,740	5,120
Annual	279	2,648	38,418	30	2,657	21,500

[a] Water data for 2002 is based on provisional data collected by Puget in 2002. Some values were rounded in accordance with USGS standard practices in the final data published in "Water Resources Data, Washington, Water Year 2002." The difference amounts to 1 cfs on any given day and does not materially affect the long-term statistics.
[b] Unregulated flows were computed by correcting for changes in storage of Baker Lake and Lake Shannon.

Table 5-6. Maximum 3-day maximum flow statistics (cfs) for Baker River at Concrete under historical and unregulated conditions (water years 1981 through 2002).[a]

Period	Unregulated[b]			Historical		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
October	950	5,839	12,134	1,549	4,211	11,567
November	2,000	9,701	26,701	2,540	7,871	16,333
December	1,202	6,901	20,695	1,308	5,335	15,233
January	2,030	7,331	17,269	2,363	4,316	9,127
February	1,669	6,019	15,121	2,443	3,590	5,047
March	1,485	4,699	16,530	312	3,385	4,100
April	2,534	5,100	10,337	2,034	3,516	7,727
May	4,320	6,191	11,354	1,953	3,649	5,383
June	3,636	6,112	10,977	2,840	4,567	10,570
July	2,997	5,302	17,487	2,717	4,881	17,567
August	1,605	3,249	6,980	1,650	3,357	5,613
September	1,175	2,916	6,057	1,527	3,098	4,550
Annual[c]	6,770	13,844	26,701	4,030	9,760	17,567

[a] Water data for 2002 is based on provisional data collected by Puget in 2002. Some values were rounded in accordance with USGS standard practices in the final data published in "Water Resources Data, Washington, Water Year 2002." The difference amounts to 1 cfs on any given day and does not materially affect the long-term statistics.
[b] Unregulated flows were computed by correcting for changes in storage of Baker Lake and Lake Shannon.
[c] This row shows values occurring at any time during the course of the water year.

Table 5-7. Minimum 7-day low flow statistics (cfs) for Baker River at Concrete under historical and unregulated conditions (water years 1981 through 2002).[a]

Period	Unregulated[b]			Historical		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
October	476	937	2,212	175	1,405	2,856
November	525	1,469	2,707	736	2,439	4,011
December	741	1,174	2,103	176	1,618	3,526
January	543	1,148	1,760	115	1,577	3,726
February	607	1,175	2,219	151	1,900	3,724
March	585	1,213	1,735	49	1,306	3,759
April	893	1,532	2,333	32	560	2,549
May	1,350	2,130	3,216	79	1,249	3,106
June	2,010	2,999	4,487	93	2,120	4,013
July	1,391	2,230	4,556	125	1,707	3,720
August	885	1,299	2,325	90	1,230	3,283
September	622	907	1,178	90	869	1,425
Annual[c]	476	744	1,133	32	150	736

[a] Water data for 2002 is based on provisional data collected by Puget in 2002. Some values were rounded in accordance with USGS standard practices in the final data published in "Water Resources Data, Washington, Water Year 2002." The difference amounts to 1 cfs on any given day and does not materially affect the long-term statistics.
[b] Unregulated flows were computed by correcting for changes in storage of Baker Lake and Lake Shannon.
[c] This row shows values occurring at any time during the course of the water year.

Based on monthly means of daily mean flows, unregulated flows are highest in November, May, and June, and lowest in September. Operation of the Project generally increases daily mean flows during September to March because the Project draws down the reservoirs and shifts runoff from peak flow events to later in the year, and it reduces daily mean flows in April to July as the reservoirs are refilled (table 5-5). Historical average daily mean flows for each month remain within the unregulated range of variability (i.e., range of flows that fall within one standard deviation of the mean) for all months except May, which is lower than the unregulated range of variability due to refilling of the reservoirs (Puget, 2003s).

The Project, under existing conditions, substantially reduces peak flow events. The highest daily mean flows for unregulated conditions occur from November to January (about 30,000 to 38,500 cfs), but are reduced by at least 13,700 cfs with the Project (table 5-5). Similarly, maximum 3-day maximum flows in November to January are reduced substantially (approximately 5,500 to 10,500 cfs) by Project operations (table 5-6). The average annual 3-day maximum flow under historical conditions is approximately 29 percent less than under unregulated conditions that would occur without the Project (9,760 cfs versus 13,739 cfs). From July 12 to 14, 1983, a storm event resulted in an atypical increase of the 3-day maximum flow to about 17,567 cfs, compared to an unregulated flow of about 13,321 cfs.

The Project, under existing conditions, also reduces annual 7-day low flows (table 5-7). Generally, Project operations reduce 7-day low flows from April to August, increase 7-day low flows from October to March, and have less effect on 7-day low flows in September. Under regulated conditions, the annual 7-day low flow most frequently occurs during spring refill (i.e., from April to June), but it can occur during any month of the year. In contrast, unregulated 7-day low flows tend to occur in late summer to early fall or in the winter. In general, Project operations cause greater interannual variation in 7-day low flows. The increased variability in 7-day low-flow levels and the timing is primarily related to maintenance outages, which can restrict Project outflows to 80 cfs for several consecutive days (Puget, 2003s).

The Baker River Project is typically operated as a load-following facility (section 3.1.2.2, *Power Generation Operations*). Flows in the Lower Baker River depend largely on the Lower Baker Development's single generating unit, which was refurbished in 2001. This unit efficiently operates between 3,700 and 4,100 cfs at a head of 253 feet. At flows of less than about 75 percent of capacity, the unit develops severe vibrations commonly referred to as cavitation (Puget, 2002a). When the unit is shut down, 25 cfs is continually released through a bypass valve. In addition, about 55 cfs leaks through pressure relief holes in Lower Baker dam abutments to contribute to the flow in Baker River below the dam, resulting in a flow of 80 cfs when the Lower Baker Development if off-line.

Daily load-following operations cause flows in the Lower Baker River to fluctuate up to 4,200 cfs within several hours. During late June through July (periods of peak sockeye adult migration), Puget typically generates power at the Lower Baker Development for 4 hours beginning at daylight to provide additional attraction for adult sockeye staging at the confluence of the Skagit and Baker rivers (Puget, 2002a). Since 1978, Puget has implemented a voluntary restriction on the Lower Baker Development's downramp rate when Skagit River flows (as measured at the Skagit River near Concrete gage) are less than 18,000 cfs (Puget, 2002a). Following this protocol requires Puget to operate in the Lower Baker turbine's cavitation zone for about 1 hour during downramp events.

Skagit River Flows

Daily and hourly fluctuations of Skagit River flows depend on many different factors, including natural runoff from glacial and non-glacial streams and operations of the Skagit River and Baker River Projects (section 5.2.1.1, *Instream Flows*). Figure 5-4 presents an example of the effects of current Baker Project load-following operations and natural fluctuations on flows at the Skagit River near Concrete gage. The Skagit River Project was operated at relatively constant flows during this period (May 1998); therefore, this example does not show the effects of the Skagit River Project load-following operations. Since the water travel time from the Lower Baker Development to the Skagit River near Concrete gage is only 30 minutes, it closely reflects Baker Project flow fluctuations without appreciable attenuation. Under existing conditions, load-following operations at the Lower Baker Development cause the Skagit River to fluctuate up to 3,800 cfs on a daily basis (Puget, 2002a). Refer to section 5.2.1.1, *Instream Flows*, for further discussion of fluctuations of Skagit River flow and stage levels.

Early in May 1998, naturally caused hourly flow fluctuations at the Skagit River near Concrete gage had about the same magnitude as effects from load-following operations at the Baker River Project, which occurred later in the month. During early May, neither the Baker River Project nor the Skagit River Project was operated as load following. Instead, snowmelt produced diurnal flow fluctuations over a cycle of about 12 hours (refer to Sauk River in figure 5-4). Snowmelt resulted in peak flows at the Skagit River near Concrete gage at around 5:00 a.m. and lowest flow levels at around 4:30 p.m. (Puget, 2003s).

Load-following operations are also typical at Seattle City Light's Skagit River Project. The Skagit Project's lowermost facility is the Gorge powerhouse, which is located approximately 40 miles upstream of the Baker River confluence. The Baker River and Skagit River Projects often follow similar load-following regimes; however, the magnitude of downramping events at the Skagit River Project are more variable than at the Baker River Project. Puget (2003s) reported that the magnitude of the Skagit River Project's ramping events ranged from 1,260 to 3,120 cfs in 1998. Figure 5-5 displays an example of attenuation, lag time, and accumulation of water from other sources as water moves down the river to the Skagit River near Concrete gage. Substantial attenuation occurs upstream of this gage, which results in a slower rate of reduction (and an increase in upramping) of flows. It typically takes approximately 6 to 8 hours for Skagit River Project outflows to reach the confluence with the Baker River. Under current Baker River and Skagit River Project operations, load-following operations of the two projects can either amplify or somewhat offset flow fluctuations of each other (Puget, 2002a). As water moves farther down the Skagit River, attenuation dampens flow fluctuations.

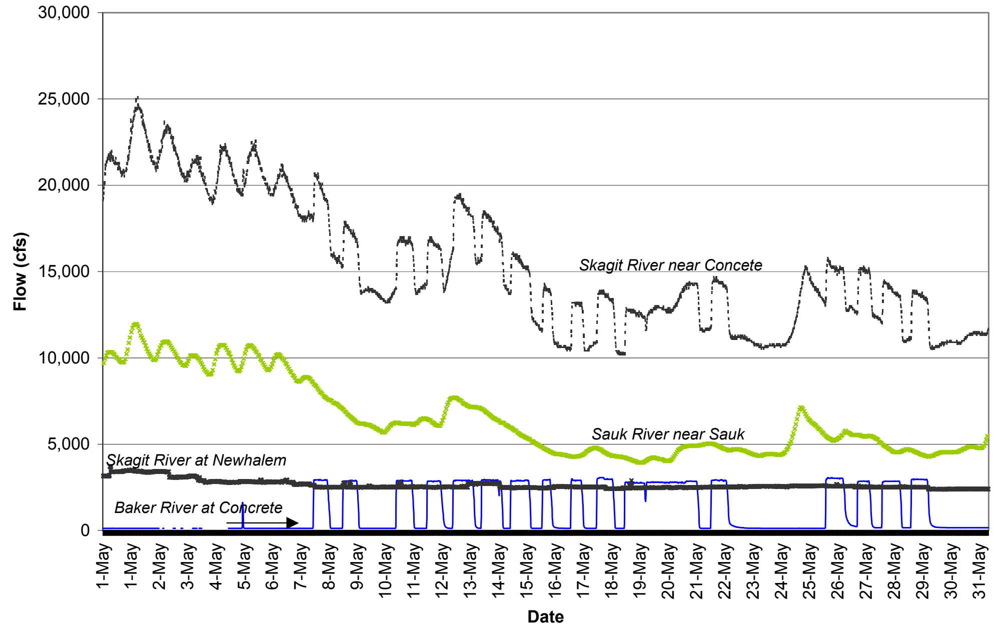


Figure 5-4. Example of the effect of current hydropower operations and natural diurnal fluctuations on May 1998 streamflow at the Skagit River near Concrete gage. Note that the Skagit Project is not load following during this period. (Source: Puget, 2003s)

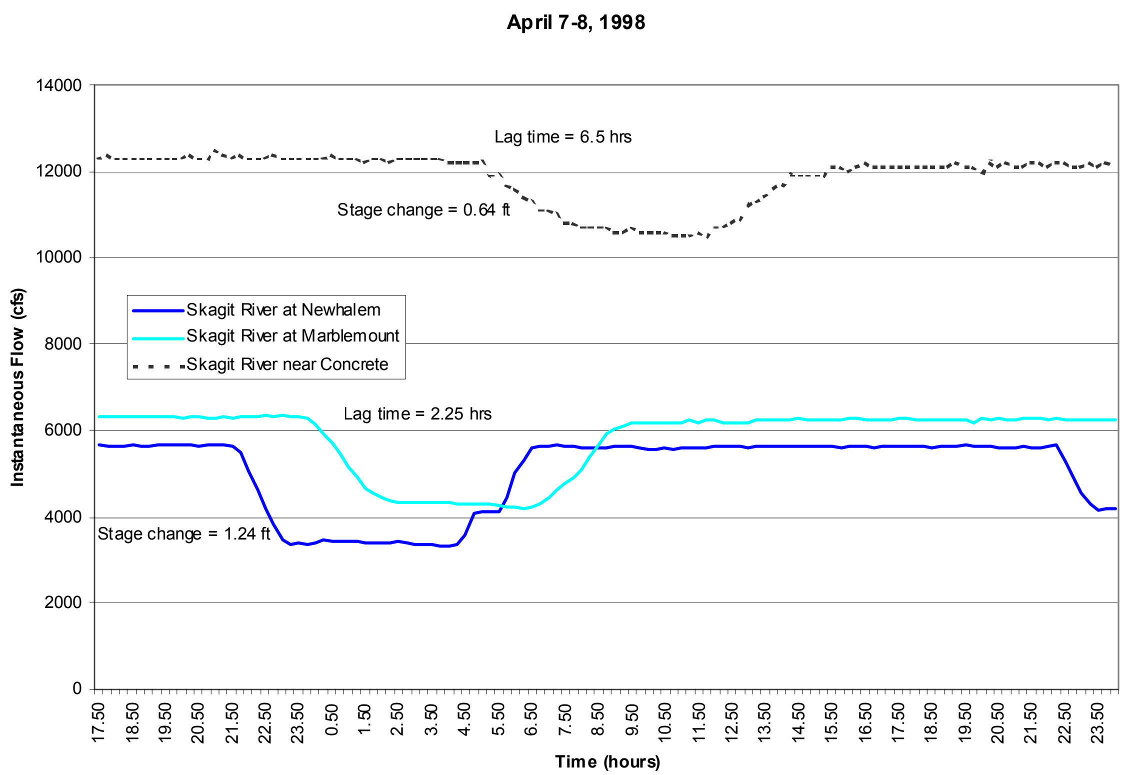


Figure 5-5. Example of attenuation and lag time upstream of the Skagit River near Concrete gage associated with a typical load-following event at Seattle City Light's Skagit Project on April 7–8, 1998. (Source: Puget, 2003s)

Skagit River Instream Flow Protection Program

In April 2001, the WDOE began implementing Washington Administrative Code (WAC) 173-503, "Instream Resources Protection Program—Lower and Upper Skagit Water Resources Inventory Areas (WRIAs 3 and 4)," to protect the beneficial uses of surface waters in the Lower Skagit River and its estuary. The rule sets criteria to limit total withdrawals of water from the Skagit River and selected tributaries (including withdrawals from surface waters and groundwater that is hydraulically linked with regulated surface waters) to protect the aquatic ecosystem. In addition, the rule states that 200 cfs is available for further consumptive appropriation in the Upper and Lower Skagit River watershed. The Project operates pursuant to an existing water right and is therefore unaffected by the consumptive appropriation limit.

At the time the rule was adopted, 93 applications were pending for water rights in the watershed (Chapter 173-503 WAC). This rule will limit approval of these water rights and/or any future claims. As part of the rule, WDOE established minimum instream flows of 10,000 to 13,000 cfs at the Skagit River near Mt. Vernon gage (table 5-8). Based on WDOE evaluation of probable benefits and costs of the rule (Chapter 173-503 WAC), WDOE concluded[16] that restriction of post-rule water rights would be restricted for 1 month of the year in approximately 72 years out of 100. More lengthy periods of restriction would occur less frequently.

Table 5-8. Instream flows established for the Skagit River near Mount Vernon gage. (Source: WAC 173-503-040(2))

Period	Instantaneous Flow (cfs)
January 1–March 31	10,000
April 1–June 30	12,000
July 1–September 30	10,000
October 1–November 15	13,000
November 16–December 15	11,000
December 16–December 31	10,000

Reservoir Water Levels

Baker Lake—Baker Lake, impounded by the Upper Baker dam, is approximately 9 miles long and 1 mile wide. At the normal full pool elevation of 727.77 feet (NAVD 88), the lake has a surface area of 4,980 acres, has an estimated storage capacity of 274,202 acre-feet, and provides approximately 180,128 acre-feet of active storage above the minimum generating level. The reservoir has hydraulic residence times of 15 to 80 days (HDR, 2001).

Baker Lake is held near full pool during the summer, and minimum reservoir levels typically occur between November and early April. Baker Lake's historical water surface levels are summarized for water years 1981 through 2002 in table 5-9. During this period, Baker Lake water levels varied between about 678.6 and 727.9 feet (NAVD 88). Based on monthly median

[16] Puget submitted comments to WDOE at the time of the proposed rulemaking related to WRIAs 3 and 4, which are not being considered for purposes of the Draft Action.

values, Baker Lake was within 10 feet of full pool from June to October, and was lowest (about 30 feet below full pool) during March.

Table 5-9. End-of-day water surface elevation statistics (NAVD 88) for Baker Lake and Lake Shannon under historical conditions (water years 1981 through 2002). (Source: Puget, 2003r)

	Baker Lake			Lake Shannon		
Month	**Minimum**	**Median**	**Maximum**	**Minimum**	**Median**	**Maximum**
October	703.3	719.1	727.9	405.3	435.7	442.4
November	679.5	710.3	725.7	384.6	437.5	442.3
December	682.3	705.0	722.9	378.0	433.5	442.3
January	679.3	702.3	715.2	384.2	429.0	442.4
February	678.5	700.2	713.4	374.4	421.5	442.3
March	679.0	697.4	713.9	376.0	409.5	439.6
April	679.3	700.0	727.2	387.2	411.8	441.4
May	678.9	714.8	727.6	392.4	419.7	442.2
June	682.0	723.6	727.8	390.6	432.5	442.3
July	711.3	725.4	728.0	416.2	437.9	442.4
August	711.0	725.1	727.8	407.7	439.1	442.6
September	708.9	724.1	727.6	385.7	437.9	442.6
Annual	678.5	712.0	728.0	374.4	431.9	442.6

Lake Shannon—Lower Baker dam impounds Lake Shannon. At the normal full pool elevation of 442.35 feet (NAVD 88), the reservoir is about 7 miles long, and it has a surface area of 2,278 acres and an estimated storage capacity of 146,279 acre-feet (plus unknown additional storage between elevations 343.75 and 373.75). The reservoir has an active storage capacity of approximately 116,770 acre-feet above the minimum generating pool level (373.75 feet [NAVD 88]). Hydraulic residence time of the reservoir ranges from 7 to 30 days (HDR, 2001).

A summary of historical Lake Shannon water levels for water years 1981 through 2002 is provided in table 5-9. Lake Shannon reaches the normal full pool elevation in most years. In many years, the normal full pool level is exceeded for short periods while water is spilled through the dam's spillway gates.

Based on monthly median water levels, the reservoir was within 10 feet of full pool from June to December. Monthly median levels were within 5 feet of the full pool elevation from July to September and November. The lowest monthly median level was approximately 33 feet below full pool and occurred in March.

Depression Lake—Depression Lake is adjacent to West Pass dike at the Upper Baker Development. Water enters Depression Lake, in part, as a result of subsurface leakage from Baker Lake, which is transmitted through native materials that include a series of lava flows underlying both Baker and Depression lakes. When Baker Lake drops below an elevation of 701.77 feet (NAVD 88), seepage stops. The water that collects in Depression Lake is transferred into Baker Lake via a water recovery pumping station and a channel leading to Baker Lake. The pumping station includes two vertical propeller recovery pumps that are rated at 54,000 gallons per minute each. Only one pump is typically in operation at a time. Depression Lake receives an average inflow of 70 to 80 cfs, principally from groundwater sources, when Baker Lake is near full pool (personal communication, R. Barnes, Program Manager, Water Resources, Puget, Bellevue, WA, and B. Mattax, Senior Aquatic Scientist, Louis Berger, Bellevue, WA, April 2003). Typically, Puget operates the pumping station for about 14 hours each day to maintain Depression Lake's water surface at an elevation of 695.77 to 698.77 feet (NAVD 88), which results in a hydraulic residence time of about 4 days. At a water level of 705.77 feet (NAVD 88), Depression Lake has a surface area of approximately 51 acres, and a storage capacity of about 699 acre-feet.

5.4.1.2 Groundwater

Groundwater is present throughout the Baker River basin within consolidated and unconsolidated geologic units.

An aquifer is a saturated permeable geologic unit capable of transmitting a usable quantity of water. Aquifers within the Baker River basin consist primarily of unconsolidated alluvial and glacial deposits composed mainly of sand and gravel. These deposits are found in significant thickness and areal extent only along portions of the main Baker River valley and along the lower reaches of some of the major tributary valleys.

A generalized map of groundwater availability in the Skagit River basin (Drost and Lombard, 1978, as cited by Puget, 2002c) suggests that well yields from unconsolidated aquifer units in the Baker River basin range from 11 to 25 gallons per minute. This magnitude of well yield is generally sufficient for single-family domestic use and limited irrigation use.

Groundwater data for consolidated geologic units are limited; however, review of data for similar geologic units indicates that well yields would be adequate for only limited domestic use under most circumstances. Possible exceptions are the Sulphur Creek lava flows located along the southwest rim of Baker Lake near West Pass dike and the Horseshoe Cove area of Baker Lake. Field investigations have confirmed the presence of fractured zones within the lava that may have relatively high permeability. Shannon & Wilson (1979) estimated water losses in the southwest part of Depression Lake to be about 5,000 to 10,000 gallons per minute (11 to 22 cfs) when the impoundment was full in 1978 and 1979. Further, the presence and water quality of several springs that discharge from lava where it outcrops near the base of a hill slope adjacent to Sulphur Creek are indicative of highly permeable lava. Discharges from Sulphur Springs averaged 83 to 132 cfs following dam construction and reached as high as 194 cfs in 1987 (USFS, 2002a). In addition, FishPro (1986, as cited by USFS, 2002a) reported that water quality at Sulphur Springs was nearly identical to that of Baker Lake reservoir. No groundwater effects are anticipated from Project relicensing.

5.4.1.3 Water Rights

Puget operates the Baker River Project under water rights issued by the state of Washington (table 5-10). The Upper Baker Development is operated under permits for 298,000 acre-feet of storage and a total of 4,800 cfs for the production of power. The Lower Baker Development is operated under permits for a total of 190,000 acre-feet of storage and a total of 6,000 cfs for the production of energy. In addition to these rights, Puget has been issued water rights that are used for fish propagation at the Upper Baker spawning beaches and Sulphur Creek spawning beaches and rearing pond and for domestic uses near the Upper Baker dam.

Table 5-10. Water rights for the Baker River Project. (Source: electronic mail from M. Snoeberger, Water Resources Program, WDOE, Bellevue, WA, to B. Mattax, Senior Aquatic Scientist, Louis Berger Group, Bellevue, WA, March 21, 2003)

Facility	Source	Control Number	Date Issued	Instant. Quantity (cfs)	Annual Storage (acre-feet)
Power					
Upper Baker Development	Baker River	R1-*13630CWRIS 08391	10/13/1955		298,000
	Baker Lake[a]	S1-*13629CWRIS 08225	10/13/1955	4,300	
	Baker Lake[a]	S1-*14637CWRIS 08226	01/17/1958	500	
Lower Baker Development	Baker River	R1-*01012CWRIS 00110	01/10/1924		50,000
	Baker River	R1-*01650CWRIS 00503	03/20/1926		140,000
	Baker River	S1-*01011CWRIS 00090	01/10/1924	4,000	
	Lake Shannon	S1-*14638CWRIS 08070	01/17/1958	2,000	
Fish Propagation					
Upper Baker spawning beaches	Channel Creek	S1-*15046CWRIS 08229	09/03/1958	20	
Sulphur Creek spawning beaches and rearing pond	Big (Sulphur) Springs	S1-25440	05/10/1989	40	
Domestic Multiple					
Near Upper Baker dam	Well	G1-27798	03/19/1997	75 gpm	40 gpm

Note: * – Internal WDOE marker identifying computer-generated control numbers.

[a] WDOE reported Lake Shannon as the source for this water right instead of Baker Lake, although WDOE's reported township range and section are consistent with the Upper Baker dam.

5.4.2 Environmental Effects

5.4.2.1 Effects of Project Operations

Operation of the Project depends on the proposed target lake levels and the flow release regime. We describe the effects of Project operations on reservoir water levels and Project releases separately below.

Reservoir Level Management

Under the existing license, Puget operates the Project with the goal of meeting target water levels in both reservoirs. Puget operates with the goal of maintaining Baker Lake water levels at elevation 718.77 feet msl (NAVD 88) at a minimum from the July 4th weekend through the Labor Day weekend. At Lake Shannon, Puget operates the Project with the goal of maintaining water levels at elevation 404.75 feet msl (NAVD 88) at a minimum from April 15 through the Labor Day weekend. In addition to managing the reservoirs within these ranges, Puget also operates the Project for flood control protection for the Middle and Lower Skagit River based on an agreement between Puget and the ACOE, as described in section 3.1.2.2, *Flood Control Operation*.

Input received during the collaborative process highlighted the importance of improving the balance between competing resources.

The Draft Action includes two measures that would routinely influence reservoir water levels, and one measure that could influence Lake Shannon water levels during periods of substantial drawdown. The Draft Action calls for the implementation of a reservoir level management and operations plan, based on a variety of factors including aquatic, recreational, cultural, and terrestrial resource needs, as well as human health and safety, property, and Project economic and operational issues (PME 6.3). The Draft Action also includes a measure that maintains current levels of flood control operations at the Upper Baker Development (PME 5.1).

Although neither the proposed flood control nor the reservoir level management and operations plans (PME 5.1 or PME 6.3) set specific target Lake Shannon water levels for flood control, Puget plans to continue operating the Project (including the Lower Baker Development) in accordance with the Water Control Manual (ACOE, 2000b), which includes a restriction on drawing down Lake Shannon so as to avoid further increasing flood flows when the Project is being operated in flood control flow mode.

In addition to the targets discussed above, the Draft Action restricts drafting Lake Shannon below an elevation 383.75 feet msl (NAVD 88) to limit the likelihood of resuspending fine sediments that have deposited in the reservoir (PME 3.5.2).

Figures 5-6 and 5-7 display the proposed target maximum and minimum water levels for the Draft Action in comparison with current operations for Baker Lake and Lake Shannon, respectively. These figures consolidate restrictions set in all three of the measures referred to above. In section 3.2.2, we provide a general description of the target reservoir water levels under the Draft Action. Refer to appendix B for the full text of these measures.

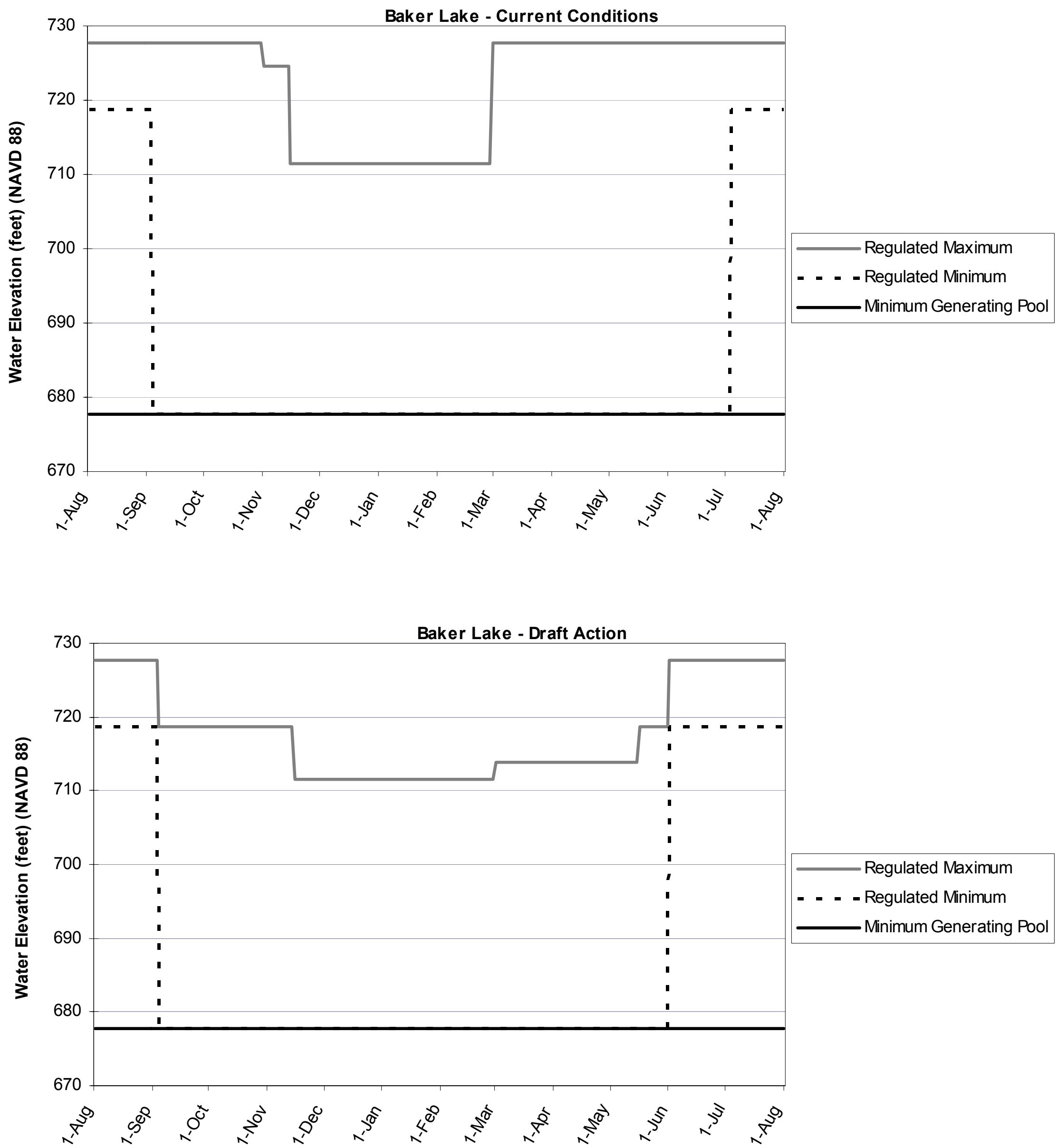
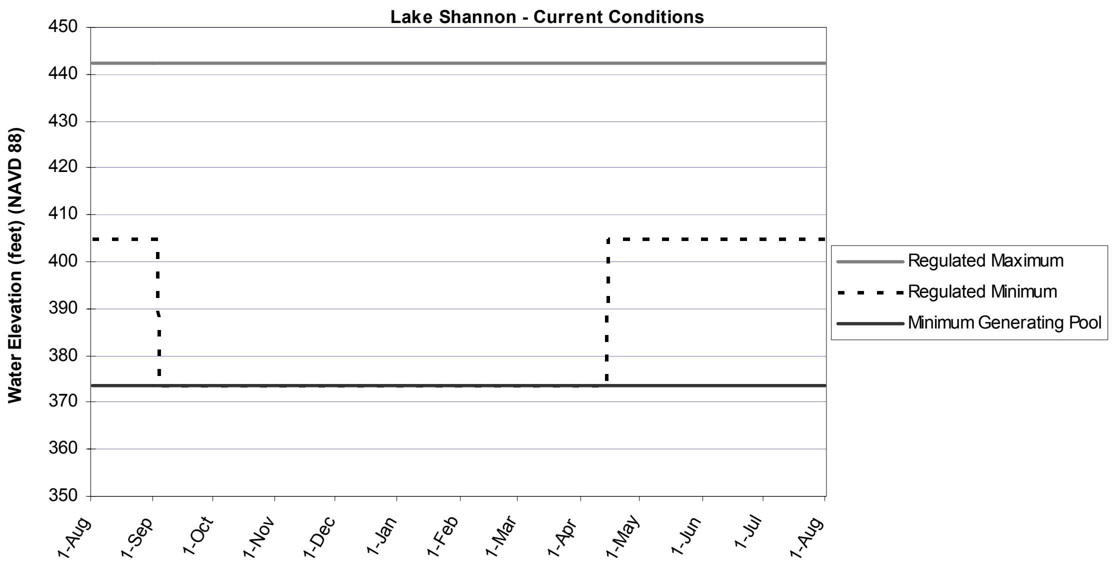


Figure 5-6. Current operations and Draft Action target maximum and minimum Baker Lake water levels.



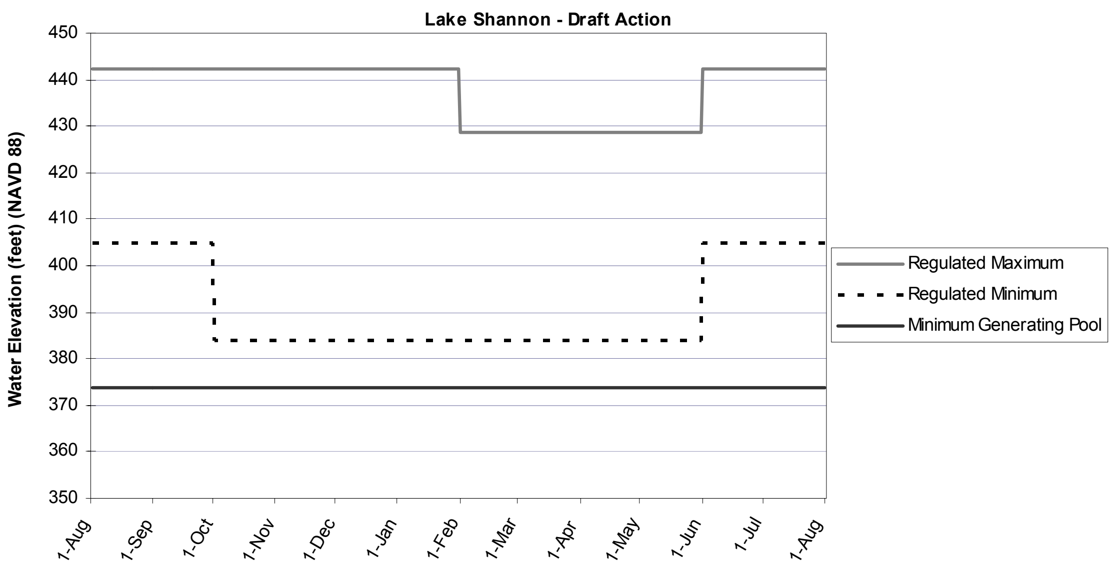


Figure 5-7. Current operations and Draft Action target maximum and minimum Lake Shannon water levels.

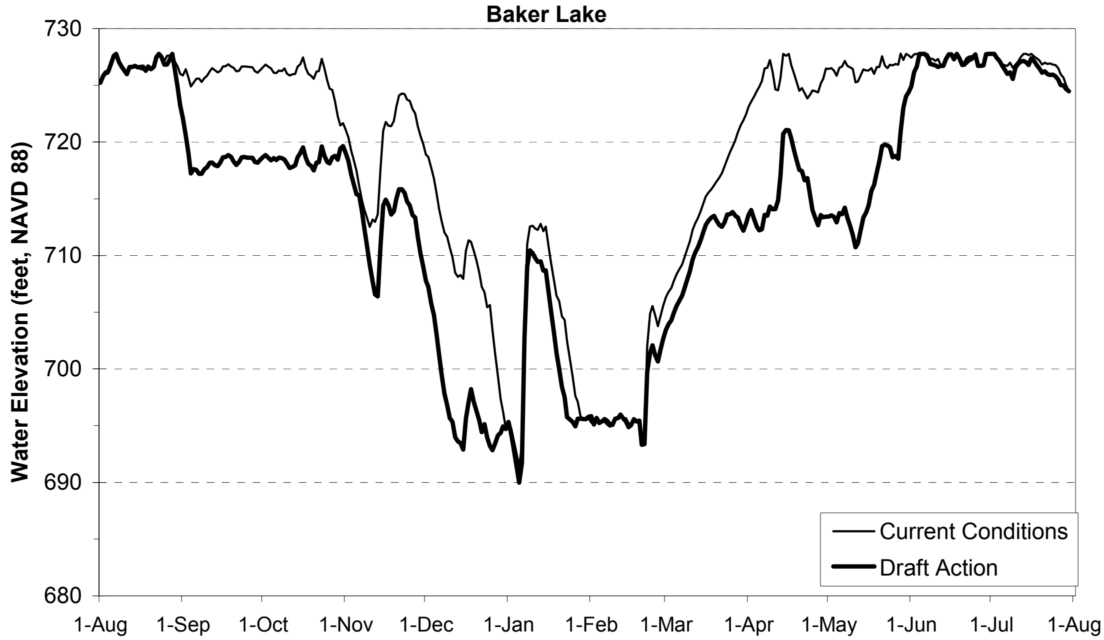
Effects Analysis

The following analysis of reservoir water levels is based on modeling of Project operations for 5 representative years using the HYDROPS model (refer to section 5.0 for information about the model).

Figures 5-8 through 5-12 display time series plots of the modeled end-of-day water levels for both Baker Lake and Lake Shannon for each of the 5 selected years. The order of these plots is such that the wettest year is presented first followed in order of decreasing overall flow.

Figure 5-8. Estimated Baker Lake and Lake Shannon end-of-day water elevations under current operations and Draft Action operations for very wet hydrologic conditions, energy year 1996 (August 1995–July 1996).

Based on Interim HYDROPS Model Output (mid-July 2003)



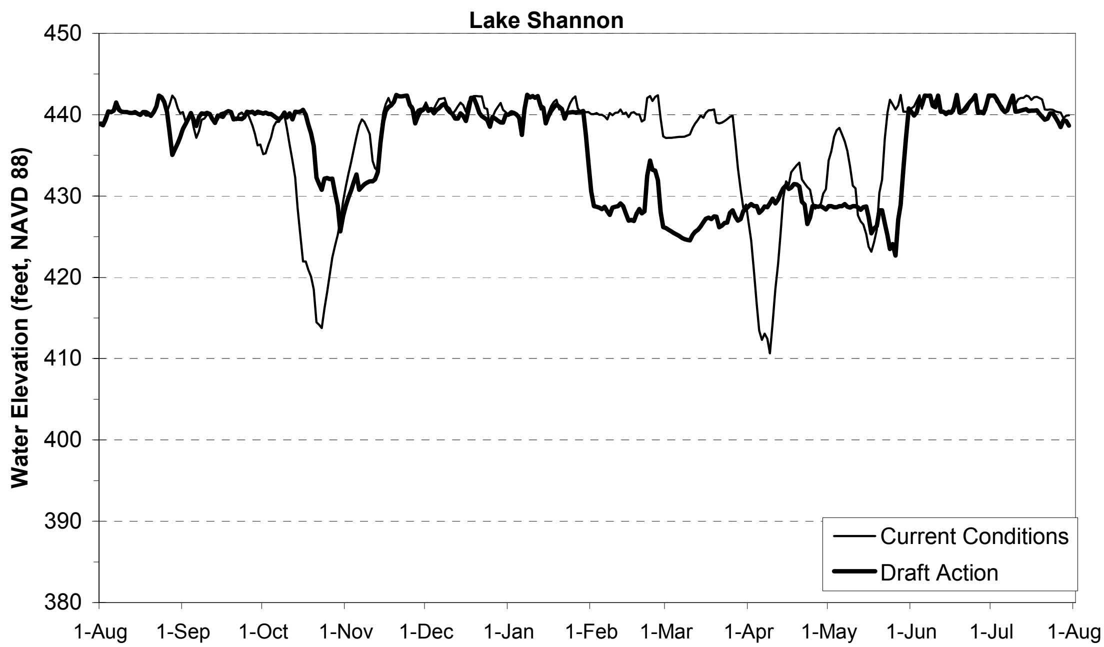


Figure 5-9. Estimated Baker Lake and Lake Shannon end-of-day water elevations under current and Draft Action operations for somewhat wet hydrologic conditions, energy year 2002 (August 2001–July 2002).

Figure 5-10. Estimated Baker Lake and Lake Shannon end-of-day water elevations under current operations and Draft Action for average hydrologic conditions, energy year 1995 (August 1994–July 1995).

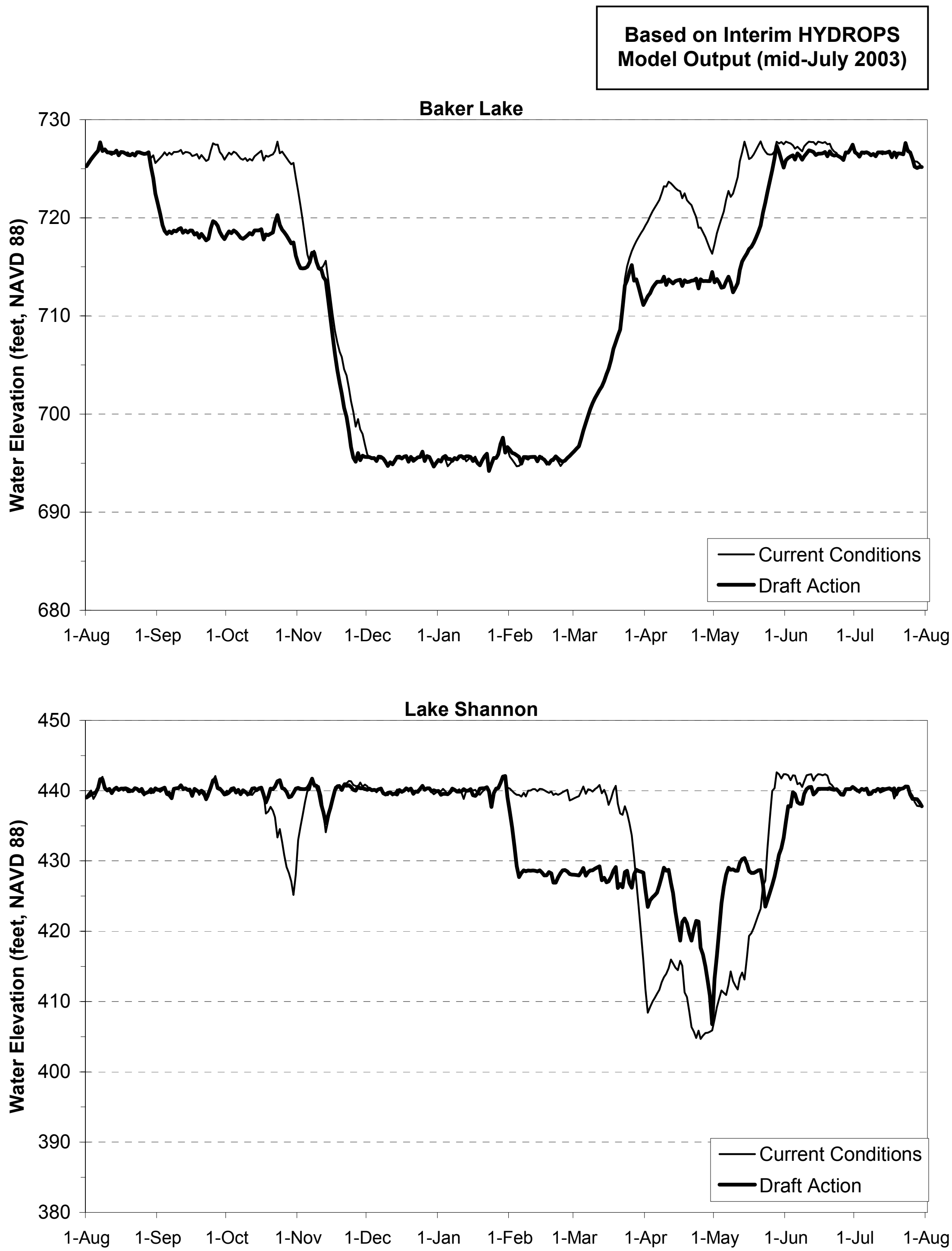


Figure 5-11. Estimated Baker Lake and Lake Shannon end-of-day water elevations under current operations and Draft Action for somewhat dry hydrologic conditions, energy year 1993 (August 1992–July 1993).

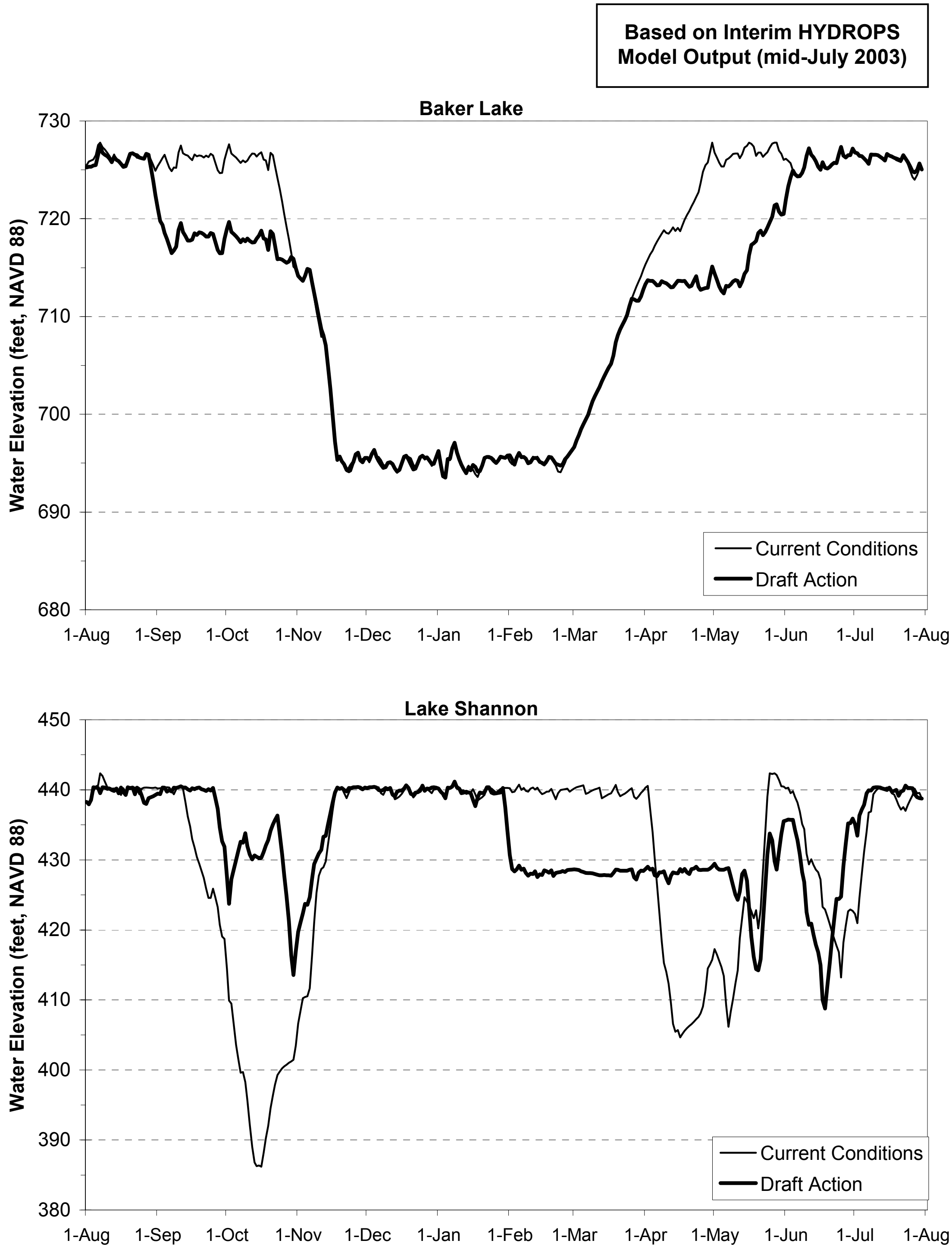


Figure 5-12. Estimated Baker Lake and Lake Shannon end-of-day water elevations under current operations and Draft Action for very dry hydrologic conditions, energy year 2001 (August 2000–July 2001).

Review of the plots for Baker Lake indicates that operating the Project under the Draft Action would typically result in earlier drawdown and later refill of the reservoir in comparison with current operations. Instead of initiating drawdown of the reservoir in mid- to late October as occurs under the current operations, drawdown would be initiated in early September. The reservoir would be drawn down to an elevation of about 718 feet msl (NAVD 88) in a few days and remain relatively stable at that level until mid- to late October when it would usually be drawn down further to provide storage for flood control. From November through mid- to late March the reservoir's water level would follow a similar pattern to current operations, although large differences would be experienced in very wet and somewhat wet years. The most extreme differences in modeled Baker Lake water levels occurred for the very wet energy year of 1996 when the Draft Action was 15 to 20 feet higher than current operations during the period of late December through mid-January (figure 5-8). Typically, under the Draft Action, the reservoir would not refill until June, whereas it refills as early as early April under current operations. Baker Lake water levels would be within 3 feet of full pool under both the Draft Action and current operations during June through late August.

Under the Draft Action, Lake Shannon would have much more stable water levels than under current operations. As under current operations, it would be within 3 feet of full pool from early June through September of most years. Fall drawdown would continue to occur, although the drawdown would not be as deep or prolonged. The most extreme fall drawdown was modeled for the fall of 2000, a very dry year (figure 5-12). In this case, the HYDROPS results indicate that Lake Shannon's water level would drop to approximately elevation 414 feet msl (NAVD 88) under the Draft Action in comparison to approximately elevation 386 feet msl (NAVD 88) under current operations. In early February, Lake Shannon's water level would be drawn down to about 428 feet (NAVD 88) and remain relatively stable near this elevation during much of the period until late May of most years.

Project Releases

The Baker River Project has the ability to control most flows originating from the Baker River basin, except when the inflow to the Project exceeds its storage capacity or when it is under the direct control of the ACOE for flood control operations. Under current operations, 80 cfs is continually provided to the Lower Baker River to allow operation of the adult trap-and-haul facility. Of this 80 cfs, approximately 55 cfs occurs from dam leakage and 25 cfs is routed through a bypass value. Typically, Puget operates the Project in load-following mode to facilitate meeting the demand for energy. These operations cause flows in the Lower Baker River to fluctuate by as much as 4,200 cfs within several hours (section 5.4.1.1). Puget's Baker River Project load-following operations, under existing conditions, along with Seattle City Light's (SCL) similar operation of the Skagit River Project have considerable influence on flows in the Middle Skagit River, and can either amplify or somewhat offset the effects of SCL operations on the Middle Skagit River.

Under the Draft Action, Puget would implement the new flow regime (PME 3.3.1.) This regime includes the following:

- Minimum year-round instream flow of 300 cfs as measured at the Baker River at Concrete gage.

- Target least restrictive downramp rates of no greater than 650 cfs per hour reduction by the Lower Baker Development as measured at the Baker River at Concrete gage or 6 inches per hour total reduction as measured at the Skagit River near Concrete gage whenever the Skagit River flow upstream of the Baker River confluence is less than or equal to 18,000 cfs.

- Maximum changes in Skagit River stage by virtue of Baker River Project operations would not exceed 2 feet on a daily basis.

The Draft Action flow regime also includes protocols for monitoring, evaluating compliance, and reporting (PME 3.3.1). The Baker River at Concrete gage would be used for measuring compliance with the flow release restrictions, and the Skagit River near Concrete gage or other gage(s) as approved by the BRCC would be used for measuring compliance with the ramping and amplitude restrictions. Puget would continuously monitor flow and stage at the appropriate gages, and provide the data through the Internet at the USGS or other appropriate site. Puget would also provide an annual flow report and annual updates on compliance to the Commission and BRCC. In the event of a violation of the flow release, ramping, or amplitude schedule, Puget would report such violations within 24 hours. Puget would provide the Commission and BRCC a follow-up report within two weeks of the incident that contains a summary of the incident, the cause of the incident, response to the incident, and actions taken to prevent a recurrence of similar incidents in the future. Refer to appendix B for the full text of this measure.

Effects Analysis

Similar to our evaluation of the effects of Project operations on reservoir water levels, we based our evaluation of Project operations on the flow regimes of the Baker and Skagit rivers on HYDROPS modeling of the selected 5 representative years. We describe the effects on average flows and 90 percent and 10 percent exceedance flows for the Baker River below the Upper and Lower Baker Developments and at the Skagit River near Concrete gage. We conducted all of this analysis on a monthly interval so as to be able to evaluate shifts that would occur in the hydrologic regime throughout the year. In addition, we evaluated the effects of the Draft Action on daily flow fluctuations through the use of duration analyses for the three modeled locations.

Review of modeled hourly 90 percent exceedance flows, which were used to evaluate low flows, indicates that, under the Draft Action, minimum flows would be very similar to current operations in the Baker River below the Upper Baker Development and in the Skagit River near Concrete; however, 90 percent exceedance flows would be considerably higher in the Lower Baker River. Below the Upper Baker Development, 90 percent exceedance flows would continue to be zero cfs during all months of the year under the Draft Action. Lower Baker River 90 percent exceedance flows would be increased from 80 cfs to 300 cfs during all months of the year. Modeled 90 percent exceedance flows in the Skagit River would increase slightly throughout most of the year, although HYDROPS results indicate that the minimum flow for the high flow months of May and June would be reduced by more than 800 cfs (figure 5-13).

Average monthly flows provide a way to evaluate general changes in water balance throughout the year. Management of the reservoir water levels as described above largely determines these values. Figure 5-14 indicates the similarity of the general flow patterns that results from operating the Project under current conditions and the Draft Action. The primary differences in the average monthly flows would result from shifting the drawdown and refill season for Baker Lake. Under the Draft Action, average flows for August and September would be increased somewhat and average flows for May and June would be reduced in comparison with current operations. In the Skagit River, resulting changes would be very small in comparison to overall flow levels.

Based on analysis of HYDROPS hourly flow modeling, the 10 percent exceedance flows, which were used to evaluate high flows, under the Draft Action would be similar to flows under current operations. Figure 5-15 displays these values for the three locations evaluated. Review of this information indicates that the main difference in 10 percent exceedance flows would occur in the Baker River below the Lower Baker Development where values would increase from about 4,000 cfs under the current operations to about 4,600 cfs under the Draft Action for all months of the year. This increase is directly linked to operation of a new unit at the Lower Baker power plant to facilitate instream flow releases and assist in meeting down-ramp rates. HYDROPS model results also indicate that large increases in the 10 percent exceedance flows would occur for the Baker River below the Upper Baker Development in March and September, although these higher values remained lower than 10 percent exceedance flows for most other months.

Flow fluctuations computed from the hourly modeled values produced by HYDROPS were computed for each day modeled. These values indicate that daily flow fluctuations would remain similar to that which would occur under current operations in most cases. Overall, the results of the HYDROPS model indicate that daily flow fluctuations under the Draft Action would be very similar to current operations at all three locations modeled (figure 5-16). Review of annual percent exceedances indicates that there would be little change in the overall percent of time that daily flow fluctuations exceeded most levels; however, the results of the HYDROPS models indicates that the magnitude of daily fluctuations at the Baker River at Concrete gage would be increased by about 100 to 300 cfs approximately 20 percent of the time. These increases would generally amount to less than a 5 percent increase over daily fluctuations under current operations.

Figure 5-17 shows the frequency that various modeled daily flow fluctuations are exceeded between January and May, the fry emergence period. These results suggest that the Draft Action would sometimes result in larger daily flow fluctuations in the Baker River downstream of the Upper Baker and Lower Baker developments; however, daily flow fluctuations in the Skagit River would remain very similar to current operations.

Based on Interim HYDROPS
Model Output (mid-July 2003)

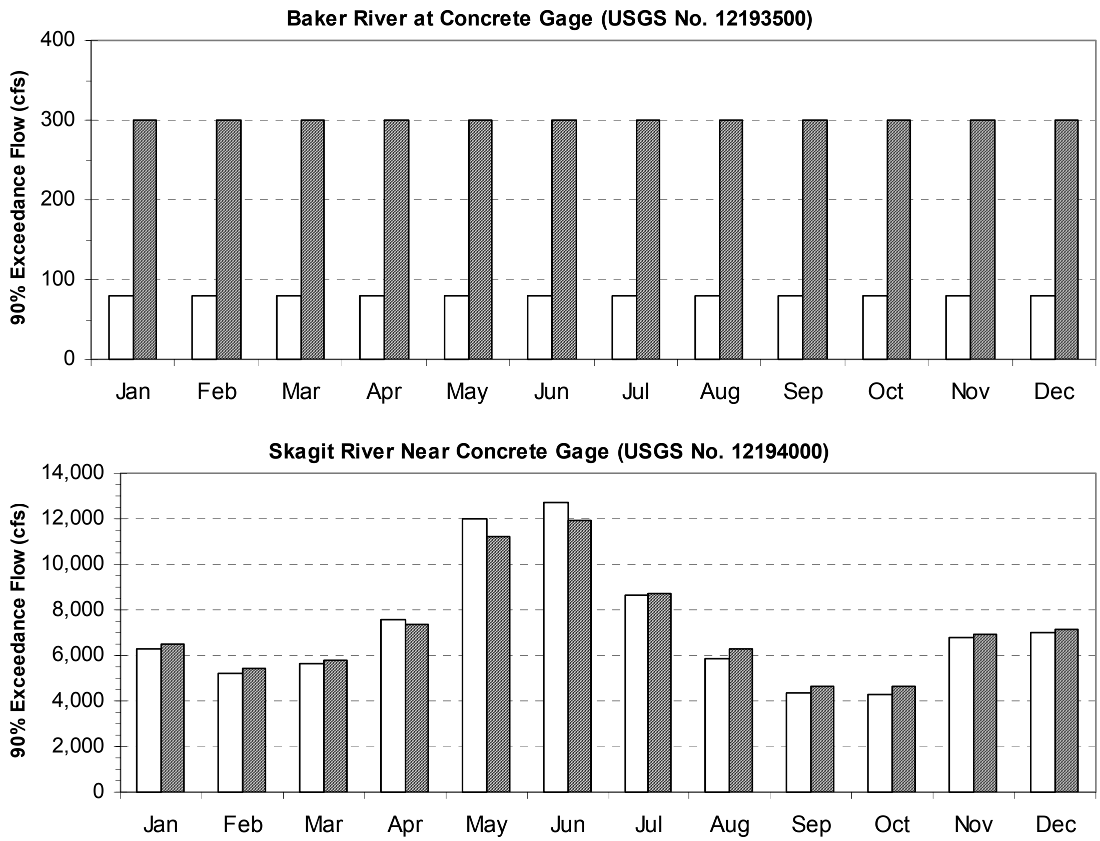


Figure 5-13. Modeled 90 percent exceedance flows for current operations (open) and Draft Action (shaded), based on 5 representative years.

Based on Interim HYDROPS Model Output (mid-July 2003)

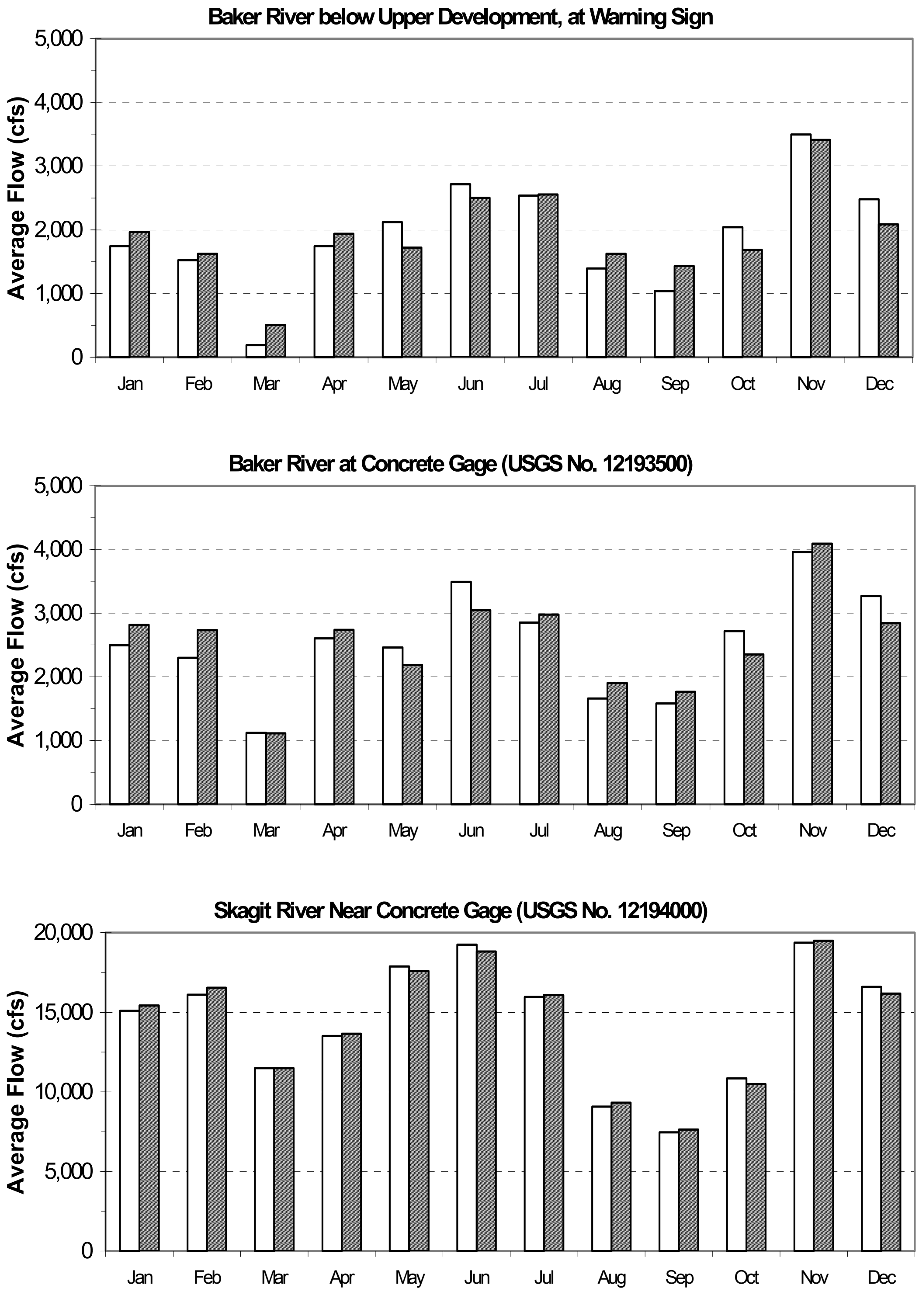


Figure 5-14. Modeled average flows for current operations (open) and Draft Action (shaded), based on 5 representative years.

Based on Interim HYDROPS Model Output (mid-July 2003)

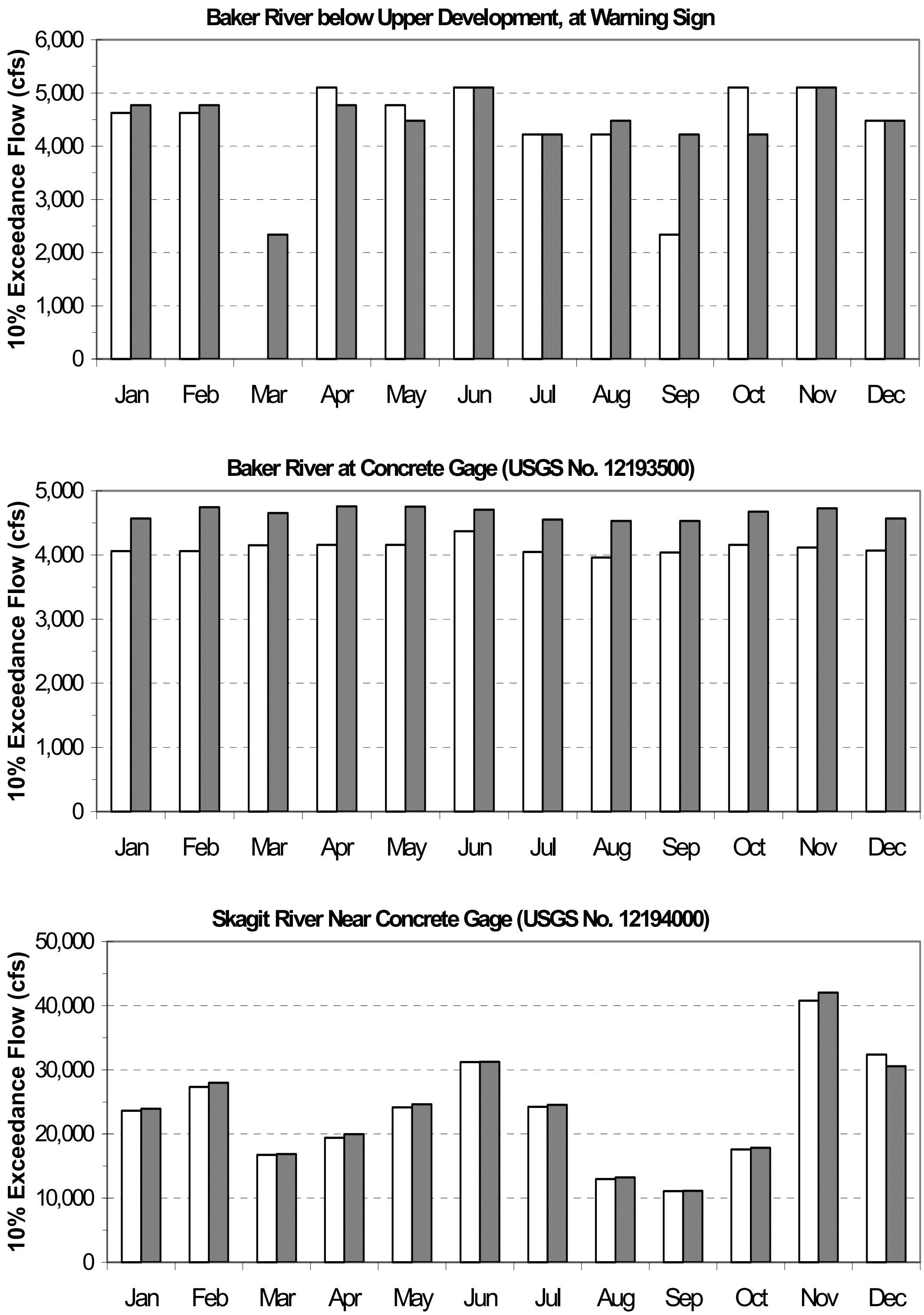


Figure 5-15. Modeled 10 percent exceedance flows for current operations (open) and Draft Action (shaded), based on 5 representative years.

Based on Interim HYDROPS Model Output (mid-July 2003)

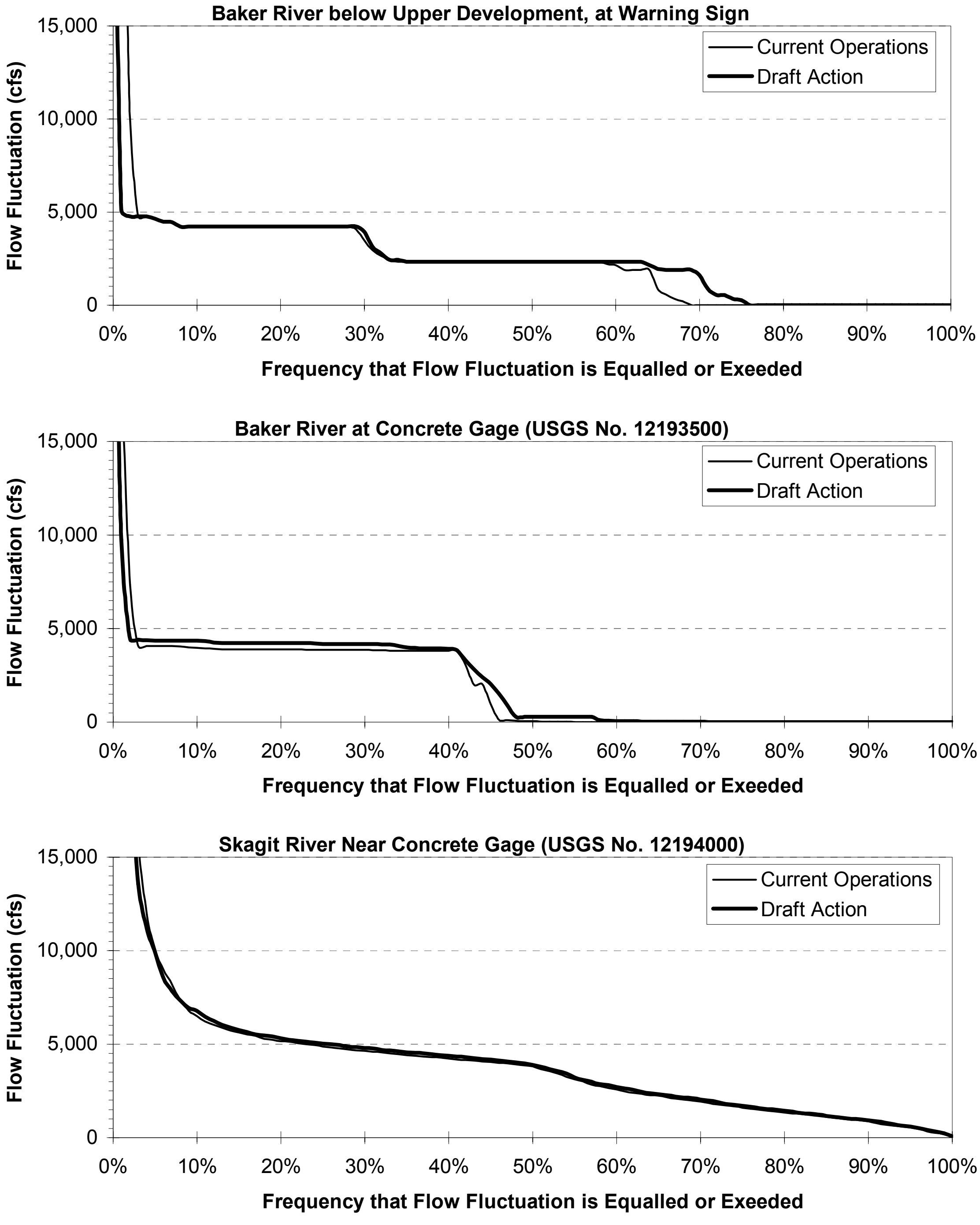
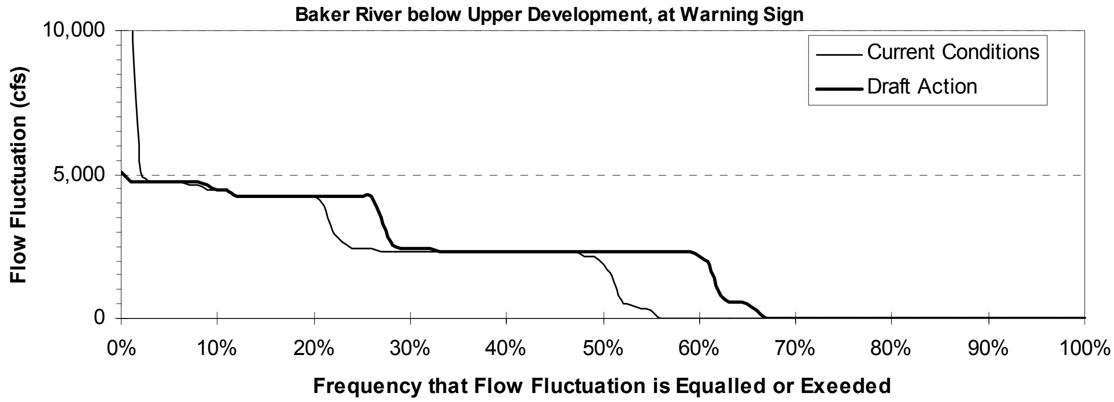
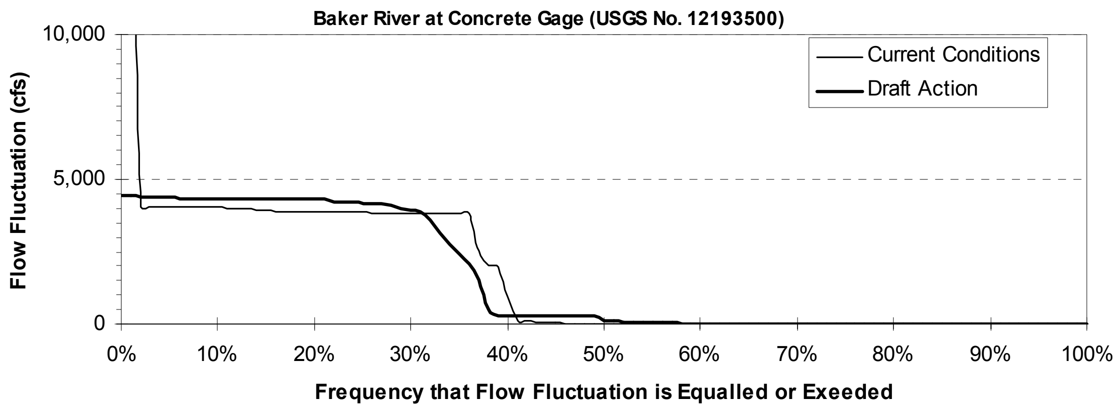


Figure 5-16. Percent exceedances of modeled daily flow fluctuations for current operations and Draft Action, based on 5 representative years.

Based on Interim HYDROPS Model Output (mid-July 2003)





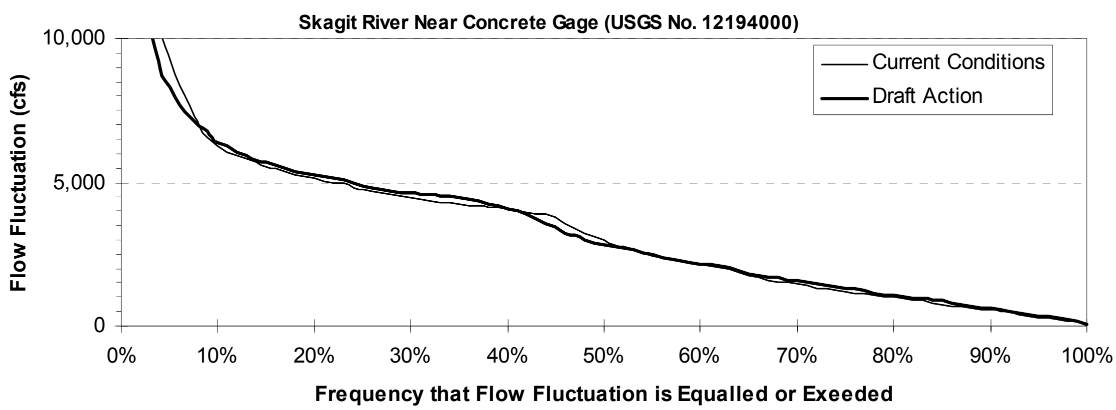


Figure 5-17. Percent exceedances of modeled January to May daily flow fluctuations for current operations and Draft Action, based on 5 representative years.

Under the Draft Action, Puget would install a 680-cfs turbine generator at the Lower Baker power plant to enable operating the Project to meet ramping and minimum flow restrictions set in the proposed flow regime (PME 3.3.1). Synchronous operation of this new turbine with Unit 3 would typically result in a slower rate for downramps associated with Project load-following operations.

Puget's monitoring and reporting protocol would provide adequate evaluations of compliance with the flow, ramping, and amplitude restrictions along with documentation of causes and resolution of non-compliance events. By providing access through the Internet to flow and stage data, Puget would facilitate interested persons in determining the status of conditions in the Lower Baker and Middle Skagit rivers. If so desired, interested persons could use this data to conduct an independent evaluation of compliance with the flow, ramping, and amplitude restrictions on a real-time basis.

5.4.3 Cumulative Effects

The Baker River Project affects flows in the mainstem Skagit River below the confluence of the Baker and Skagit rivers (RM 56.5) through its storage and release of water for power generation and flood control. Through its seasonal storage and release of water, the Project tends to augment mainstem Skagit River flows from August through March and reduce mainstem Skagit River flows from April through July. Under existing conditions, Puget typically operates the Project in load-following mode, which may cause fluctuations in mainstem Skagit River flows of up to 4,200 cfs over several hours each day. At the Skagit River near Concrete gage (RM 54.1) located 2.4 miles downstream of the Baker/Skagit confluence, stage changes resulting from Baker Project load-factoring operations may be between 0.9 foot and 1.2 feet.

Seattle City Light's operation of the Skagit Project also affects flows in the mainstem Skagit River. The Skagit Project consists of three dams and associated reservoirs on the Upper Skagit River, with the most downstream powerhouse (RM 94.2) located 38 river miles above the Baker/Skagit confluence. The Skagit Project is typically operated in load-following mode with the amplitude of the Skagit River downramp events governed by terms of a 1991 Fisheries Settlement Agreement (FERC, 1991). The effects of fluctuating flow releases at the Skagit Project are dampened as the water flows downstream and take about 6 to 8 hours to reach the Skagit River near Concrete gage.

The effects of load-following operations at the Baker and Skagit projects can either amplify or offset each other depending on the timing of releases. These interactive effects are largely attenuated by the time they reach the vicinity of Mount Vernon (RM 15.7).

Major changes in Seattle City Light's operation of the Skagit Project are not expected. We anticipate that it would continue to operate the Skagit Project in load-following mode and in accordance with the 1991 Fisheries Settlement Agreement (FERC, 1991).

Under the Draft Action, Puget plans to install a 680-cfs turbine generator at the Lower Baker power plant that would enable operating the Project in accordance with ramping and minimum flow restrictions set in PME 3.3.1. Synchronous operation of this new turbine with

Lower Baker Unit 3 would typically result in slower downramp rates associated with Baker Project load-following operations. However, the magnitude of daily fluctuations at the Baker River at Concrete gage would be increased by about 100 to 200 cfs during much of the year. Under current operations, these increases would generally amount to less than a 5 percent increase over daily fluctuations and would proceed down into the Middle Skagit River.

5.4.4 Unavoidable Adverse Effects

Under the Draft Action, the Project would continue to be operated in load-following mode. Consequently, flow fluctuations at the Baker River at Concrete gage would often times (approximately 40 percent of the time) exceed 3,000 cfs within a day. Similarly, flow fluctuations at the Skagit River near Concrete gage would frequently (approximately 50 percent of the time) exceed 4,000 cfs within a day.

5.5 Water Quality

5.5.1 Affected Environment

5.5.1.1 Water Quality Standards

On June 30, 2003, the WDOE adopted a revision to the water quality standards provided in WAC 173-201A. This revision (RCW 34.05.360) changes the current class-based system to a use-based system for designating beneficial uses, changes some of the criteria, and organizes the structure of the regulations to make it easier to use. Following adoption of the revision, the WDOE is required to submit the rule to the U.S. Environmental Protection Agency (EPA) for approval under the federal CWA. Although the rule was filed with the Washington State on July 1, 2003, it cannot be used for CWA actions until the approval process is complete. The approval process could take up to 6 months. Because the EPA has not yet approved WDOE's standards revision, we present both below.

The version of WAS 173-201A that currently applies to CWA actions designates the Baker and Skagit rivers as Class AA (extraordinary) waters. Baker Lake and Lake Shannon are Lake Class waters. Class AA and Lake Class waters must meet or exceed water quality standards to protect all or substantially all uses. Characteristic uses for Class AA and Lake Class waters include water supply (domestic, industrial, and agricultural); stock watering; fish and shellfish; salmonid and other fish migration, rearing, spawning, and harvesting; wildlife habitat; recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment); hydropower development; and commerce and navigation. Numeric water quality criteria for Class AA and Lake Class waters are displayed in table 5-11.

The newly adopted version of the WAC 173-201A designates uses of specific water bodies as presented in table 5-12. Numeric water quality criteria for the designated beneficial uses are given in table 5-13. As can be seen in table 5-13, the temperature criteria is more restrictive for char than for salmon and trout spawning, core rearing, and migration.

Table 5-11. Washington water quality criteria applicable for surface waters. (Source: Chapter 173-201A WAC)

Constituent	Class AA	Lake Class
Temperature	$\leq 16^{o}$C due to human activities; no increases of >0.3^{o}C when natural conditions are >16^{o}C[a]	No measurable change from natural conditions
Total dissolved gas (TDG)	$\leq$110% of saturation at any point[b]	
Dissolved oxygen (DO)	>9.5 mg/L	No measurable decrease from natural conditions
pH	Within 6.5–8.5, human-caused variation of <0.2 units.	No measurable change from natural conditions
Turbidity	$\leq$5 nephelometric turbidity units (NTU) increase over background turbidity of $\leq$50 NTU or $\leq$10% increase over background turbidity of >50 NTU	$\leq$5 NTU over background conditions
Fecal coliform	Levels shall not exceed a geometric mean of 50 colonies/100 (milliliters) mL or 100 colonies/100 mL for 10 percent of samples.	
Toxic, radioactive, or deleterious materials	Concentrations shall be below those that have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health.	
Aesthetic values	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.	

[a] Incremental temperature increases resulting from nonpoint source activities shall not exceed 2.8ºC. Incremental temperature increases resulting from point sources shall not exceed 23/(background temperature +5).

[b] TDG criteria does not apply when the stream flow exceeds the 7-day, 10-year frequency flood.

Table 5-12. Designated uses of water bodies affected by the Project as revised in June 2003. (Source: Chapter 173-201A WAC, June 24, 2003)

Water Body	Char	Salmon and Trout Spawning, Core Rearing, and Migration	Extraordinary Primary Contact	Domestic, Industrial, Agricultural, and Stock Water Supply	Wildlife Habitat	Harvesting	Commerce/Navigation	Boating	Aesthetics
Baker Lake and all tributaries	X		X	X	X	X	X	X	X
Baker River between Baker Lake and the mouth		X	X	X	X	X	X	X	X
Skagit River		X	X	X	X	X	X	X	X

Table 5-13 Washington water quality criteria as revised in June 2003. (Source: Chapter 173-201A WAC, June 24, 2003)

Constituent	Criteria
Temperature[a]	7-DADMax[b] not to exceed 12°C for designated char waters. 7-DADMax[b] not to exceed 16°C for designated core salmon/trout waters.
TDG[c]	Shall not exceed 110 percent of saturation at any point of sample collection
DO[a]	Lowest 1-day minimum not less than 9.5 mg/L
pH	Shall be within 6.5 to 8.5, with a human-caused variation within the above range of less than 0.2 units.
Turbidity	Shall not exceed 5 NTU increase over background turbidity of ≤50 NTU or 10% increase over background turbidity of >50 NTU
Fecal coliform	Extraordinary primary contact recreation: must not exceed a geometric mean of 50 colonies/100 (milliliters) mL, with no more than 10 percent of all samples exceeding 100 colonies/100 mL.

Constituent	Criteria
Toxic, radioactive, or deleterious materials	Concentrations must be below those that have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health.
Aesthetic values	Must not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

[a] Additional restrictions are included in the regulation.
[b] 7-DADMax is defined as the average of seven consecutive measures of daily maximum temperatures, based on the period from 3 days before and 3 days after the date.
[c] TDG criteria does not apply when the stream flow exceeds the 7-day, 10-year frequency flood. TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with a department approved gas abatement plan.

Water quality in the basin is generally considered good and meets the needs of designated beneficial uses. WDOE did not include any of the Baker River reaches affected by the Project on the 303(d) list of water-quality limited water bodies (WDOE, 2000). In addition to developing the 303(d) list, WDOE summarizes its routine stream monitoring data by using a Water Quality Index method developed for that purpose (Hallock, 2002). WDOE's (2003) assessment of the overall water quality in the Lower Baker River is of "lowest concern," based on the most recent data (water year 1993). Review of WDOE's Water Quality Index components indicates that suspended solids and turbidity are of moderate concern, and all of the other Water Quality Index components (i.e., temperature, DO, pH, fecal coliform, and total phosphorous) are of lowest concern.

The following description of water quality is based primarily on:

- Results of WDOE's (2003) routine water quality monitoring program;

- Several license applications for new projects on tributaries to the Baker River (Puget, 1983a, 1983b, 1983c, 1982a, 1982b);

- A study of the limnology of Baker Lake and Lake Shannon in August 1962–October 1964 (Westley, 1966); and

- Puget's ongoing water quality monitoring program, which was initiated in the late winter of 2002.

5.5.1.2 Temperature

Baker River and Tributary Streams

Water temperatures reported for numerous studies conducted since 1975 have been compiled by R2 (2003b). Based on the R2 (2003b) compilation, along with data reported by WDOE (2003) for the Lower Baker River, it appears that temperatures in the Baker River and tributary streams in the basin generally remain below the upper limit of 16ºC (WAC-173-201A). Because much of the data used for this evaluation was collected as point measurements, values probably do not represent the full range of temperatures experienced.

We plan to analyze Puget's thermograph data that are currently being collected to complete table 5-14, and provide an assessment of changes in Skagit River temperatures in the vicinity of the Baker River confluence.

Baker Lake and Lake Shannon

Westley (1966) investigated water flow patterns, temperatures, and DO concentrations in Baker Lake and Lake Shannon in the fall of 1962 through the fall of 1964. We describe Westley's primary findings related to temperature below.

Baker Lake surface water temperatures peaked (17–18ºC) during late August to mid-September. Ice covered the surface of the reservoir during much of the period from December to March. The Project is operated by withdrawing water from the reservoir through the mid-level intake, which results in stagnation of water behind the dam and in old Baker Lake, which leads to deep water having cool temperatures (approximately 3.5–5.0ºC) throughout the year. Westley reported water temperatures of about 4.0–14.5ºC for the discharges from the reservoir. Discharges were warmest in late September to October and coolest in February. The withdrawal of warm mid-level water from Baker Lake inhibits the formation of a well-defined thermocline in the reservoir's forebay.

Lake Shannon surface temperatures were warmest (approximately 16.5–17.5ºC) in late August or September, and coolest (approximately 4ºC) in January or February. The temperature of deep water in the reservoir remained nearly stable at about 4–6ºC throughout the year. Water discharged from the Lake Shannon was warmest (approximately 13–14ºC) from September to October and coolest (approximately 4ºC) in March.

The thermal regime of Lake Shannon is considerably different than Baker Lake's. By mid-July, a thermocline forms at about 25 feet with a second thermocline forming at 150 feet. By mid-September the upper thermocline weakens and moves toward the surface, while the deeper thermocline remains well defined at a slightly shallower depth. By October, the upper layer is mixed, but a deep thermocline still exists. Lake Shannon experiences complete mixing, overturn, in mid-December to spring, as does Baker Lake. Water near the bottom of the reservoir is isolated by early June and remains isolated until overturn in December.

We plan to analyze Puget's thermograph data that are currently being collected to complete table 5-15, and provide an assessment of differences in temperatures at various levels in the reservoirs.

Table 5-14. Summary of flowing water temperatures (ºC) recorded by Puget with thermographs.

Station	Absolute Minimum	Absolute Maximum	Average Daily Fluctuation	Average Daily Mean	Average Daily Maximum	Days with ≥ 20 Values[a]	Days with ≥ 16°C	Maximum 7-DADMax
Summer (July–September)								
Spawning Beach 3 outflow								
Sulphur Creek								
Upper Baker domestic								
Sulphur Springs								
Spawning Beach 4 outflow								
Baker River at adult fish trap								
Skagit River upstream of Sauk River								
Skagit River upstream of Baker River								
Skagit River at Dalles Bridge								
Skagit River at Hamilton								
Fall (October–December)								
Spawning Beach 3 outflow								
Sulphur Creek								
Upper Baker domestic								
Sulphur Springs								
Spawning Beach 4 outflow								
Baker River at adult fish trap								
Skagit River upstream of Sauk River								
Skagit River upstream of Baker River								
Skagit River at Dalles Bridge								
Skagit River at Hamilton								
Winter (January–March)								
Spawning Beach 3 outflow								
Sulphur Creek								
Upper Baker domestic								
Sulphur Springs								
Spawning Beach 4 outflow								
Baker River at adult fish trap								
Skagit River upstream of Sauk River								

Date being collected and compiled

Station	Absolute Minimum	Absolute Maximum	Average Daily Fluctuation	Average Daily Mean	Average Daily Maximum	Days with ≥ 20 Values[a]	Days with ≥ 16°C	Maximum 7-DADMax
Skagit River upstream of Baker River								
Skagit River at Dalles Bridge								
Skagit River at Hamilton								
Spring (April–June)								
Spawning Beach 3 outflow								
Sulphur Creek				Date being collected and compiled				
Upper Baker domestic								
Sulphur Springs								
Spawning Beach 4 outflow								
Baker River at adult fish trap								
Skagit River upstream of Sauk River								
Skagit River upstream of Baker River								
Skagit River at Dalles Bridge								
Skagit River at Hamilton								

[a] The average daily values are based on days with ≥20 measurements; therefore, this is the number of days that are represented under the "Daily Mean" and "Daily Fluctuation" columns.

Table 5-15. Summary of reservoir and tailrace water temperatures (°C).

Station	Absolute Minimum	Absolute Maximum	Average Daily Fluctuation	Average Daily Mean	Average Daily Maximum	Days with ≥ 20 Values[a]	Days with ≥ 16°C	Maximum 7-DADMax
Summer (July–September)								
Upper Baker gulper at 33 feet								
Upper Baker gulper at 120 feet								
Upper Baker gulper at 140 feet								
Upper Baker gulper at 160 feet								
Upper Baker gulper at 190 feet								
Upper Baker gulper at 225 feet								
Upper Baker powerhouse tailrace								
Lower Baker gulper at 150 feet				**Data being collected and compiled**				
Lower Baker gulper at 200 feet								
Lower Baker intake								
Fall (October–December)								
Upper Baker gulper at 33 feet								
Upper Baker gulper at 120 feet								
Upper Baker gulper at 140 feet								
Upper Baker gulper at 160 feet								
Upper Baker gulper at 190 feet								
Upper Baker gulper at 225 feet								
Upper Baker powerhouse tailrace								
Lower Baker gulper at 150 feet								
Lower Baker gulper at 200 feet								
Lower Baker intake								
Winter (January–March)								
Upper Baker gulper at 33 feet								
Upper Baker gulper at 120 feet								
Upper Baker gulper at 140 feet								
Upper Baker gulper at 160 feet								
Upper Baker gulper at 190 feet								
Upper Baker gulper at 225 feet								

Station	Absolute Minimum	Absolute Maximum	Average Daily Fluctuation	Average Daily Mean	Average Daily Maximum	Days with ≥ 20 Values[a]	Days with ≥ 16°C	Maximum 7-DADMax
Upper Baker powerhouse tailrace								
Lower Baker gulper at 150 feet								
Lower Baker gulper at 200 feet								
Lower Baker intake								
Spring (April–June)								
Upper Baker gulper at 33 feet				**Data being collected and compiled**				
Upper Baker gulper at 120 feet								
Upper Baker gulper at 140 feet								
Upper Baker gulper at 160 feet								
Upper Baker gulper at 190 feet								
Upper Baker gulper at 225 feet								
Upper Baker powerhouse tailrace								
Lower Baker gulper at 150 feet								
Lower Baker gulper at 200 feet								
Lower Baker intake								

[a] The average daily values are based on days with ≥20 measurements; therefore, this is the number of days that are represented under the “Daily Mean” and “Daily Fluctuation” columns.

5.5.1.3 Biological Productivity (Nutrients, DO, pH)

This section describes factors closely related to primary productivity, including principal ions, availability of nutrients, DO, pH, and Secchi depth as an indictor of the euphotic (i.e., depth of light) zone in the case of reservoirs.

Baker River and Tributary Streams

Water in Baker River basin streams is generally soft, with low to moderate alkalinity (which limits the buffering capacity against changes in pH levels), and is dominated by either calcium carbonate or calcium sulfate. The sulfate ion is associated with intermittent fumarole activity around Mt. Baker; therefore, streams that tend to be more dominated by calcium sulfate include Rocky, Sulphur, Boulder, Park, and Swift creeks and to a lesser extent Sandy Creek. Increased volcanic activity on Mt. Baker in 1975 reduced Boulder Creek's pH to as low as 3.4 standard units, in comparison to 6.0 to 6.6 prior to the increase in volcanic activity (Bortleson et al., 1977). Measurements reported by numerous sources indicate that other streams draining Mt. Baker have pH of 6.3 to 8.2 (R2, 2003b). Streams flowing into Baker Lake and Lake Shannon have relatively steep gradients, which maintains high reaeration ratios and nearly saturated oxygen levels. Generally, these streams have low nitrogen and phosphorous concentrations.

The quality of water in the Baker River downstream of the Lower Baker dam is generally similar to streams entering Baker Lake and Lake Shannon. The WDOE (2003) monitored and reported water quality in the Lower Baker River at Concrete (USGS gage no. 04B070). Values reported for water years 1979 to 1993 were DO concentrations of 8.7 to 14.0 mg/L, pH of 6.6 to 8.2 units, and indicate low phosphorous and nitrogen concentrations.

We plan to use the results of Study A05, Water Quality Monitoring, to update the status of water quality in the Lower Baker River.

Baker Lake and Lake Shannon

Baker Lake is classified as oligotrophic, based on the chlorophyll trophic state index developed by Carlson (1977). Using an evaluation of limnologic and morphologic data that Puget collected from 1983 to 1989, the Alaska Department of Fish and Game found that phosphorous levels are probably not limiting primary production in the reservoir, since seasonal total phosphorus levels fall within the mesotrophic range, and orthophosphorous (i.e., the biologically available form of phosphorous) comprises a large portion (approximately 60 percent) of total phosphorous levels (letter from G.B. Kyle and J.A. Edmundson, Limnologists, Alaska Department of Fish and Game, Soldotna, AK, to A. Aspelund, Fisheries Biologist, Puget Sound Power & Light Company, Bellevue, WA, November 10, 1992). Macrozooplankton densities averaged 140,325 organisms per square meter from April to October of 1983 to 1990. Cladocerans accounted for 86 percent of the total macrozooplankton density.

Evaluation of Baker Lake and Lake Shannon conditions from August 1962 through October 1964 indicate that DO concentrations remain high near the surface of the reservoirs year-round but become oxygen-deficient in deep waters during some periods of the year (Westley, 1966). DO concentrations recorded immediately upstream of the Upper Baker dam were about 9 to 9.5 mg/L at the surface and declined with depth. In August, the DO concentrations gradually declined to a minimum of 7 mg/L at 160 feet. The effects of stratification gradually increased throughout the summer and resulted in the lowest DO concentrations (less than 3 mg/L) in October prior to overturn, which results in mixing of the lake's water. From November through April, the DO concentrations were relatively uniform throughout the water column. Lake Shannon DO concentrations followed similar trends, although they varied considerably less throughout the water column. The lowest DO concentrations at Lake Shannon (6 to 8 mg/L) occurred in deep water from October through December prior to overturn, which mixed the lake's water column resulting in similar DO concentrations. In March, DO concentrations increased substantially in the upper 60 feet of water, while the Secchi depth decreased suggesting that the productivity of phytoplankton was high.

As described above, Mt. Baker volcanic activity increased mineral concentrations and lowered pH in Boulder Creek in 1975. These changes to the quality of water entering Baker Lake resulted in short-term effects in Baker Lake. In September 1975, a distinct layer of water from Boulder Creek extended at least 0.3 mile down-reservoir (Bortleson et al., 1977). The likelihood of a distinct layer of Boulder Creek water extending into Baker Lake is primarily controlled by three factors: (1) Boulder Creek's flow and water quality characteristics; (2) relative rates of inflow from other sources; and (3) the extent of reservoir stratification. Strong stratification, low inflows from other sources, and extreme water quality characteristics in Boulder Creek would produce the greatest opportunity for Boulder Creek water to persist as a discrete layer in the reservoir.

We plan to use results of Study A26A (Reservoir Limnology—Production Potential) to expand the description of Baker Lake's biological productivity.

5.5.1.4 Turbidity

Turbidity in the Baker River basin is a function of several factors including glacial melt, landslides, surface runoff, and drafting the reservoirs to levels that result in resuspension of sediments deposited in the reservoirs. Many of these factors occur naturally, although land-use activities have accelerated erosion rates, and operation of the Baker River Project can also elevate turbidity levels by resuspending sediments that have been deposited in the reservoirs. In contrast, the reservoirs usually result in deposition of suspended sediments, thus reduction of turbidity in the Baker River, and the Skagit River downstream of the confluence with the Baker River.

Turbidity has been measured at numerous locations in the Baker and Skagit River systems. A summary of turbidity values collected since September 1978 at locations pertinent to the Project is presented in table 5-16. This summary includes values for monitoring sites in the Baker River, Baker River tributaries, Skagit River upstream and downstream of the Baker River confluence, and the Sauk River. We provide a description of the post-September 1978 turbidity levels below.

Table 5-16. Summary of reported turbidity levels for streams near the Baker River Project, post September 1978.

Location	Period	Turbidity (NTU)	No. of Observations			Source
			Total	>5 NTU	>20 NTU	
Swift Creek	1981–1982	1.4–5.2	7	NA	0	Puget (1983a)
Park Creek	1981–1982	1.0–4.0	7	0	0	Puget (1983b)
Sandy Creek[a]	1980–1982	1.3–2.4	NA	0	0	Puget (1982a)
Sulphur Creek[a]	1980–1982	0.4–2.3	NA	0	0	Puget (1982a)
Rocky Creek[a]	1980–1982	0.4–3.2	NA	0	0	Puget (1982a)
Bear Creek	1981–1982	0.5–3.8	NA	0	0	Puget (1982b)
North Fork Bear Creek	1981–1982	1.4–3.2	NA	0	0	Puget (1982b)
Thunder Creek	1981–1982	0.4–8.8	7	NA	0	Puget, 1983c
Baker River at Concrete	Water years 1979–1993	0.8–43	163	56	13	WDOE, 2003 (USGS gage no. 04B070)
Skagit River at Marblemount	Water years 1979–1993 Water years 1994–2002	0.2–15 <0.5–28	174 107	8 5	0 2	WDOE, 2003 (USGS gage no. 04A100)
Sauk River near Rockport	Water years 1979–1993	0.8–200	163	83	26	WDOE, 2003 (USGS gage no. 04C070)
Skagit River near Concrete	Water years 1979–1993	<1–83	162	51	11	WDOE, 2003 (USGS gage no. 04A060)
Skagit River above Sedro-Woolley	Water year 2000	1.9–70	12	5	1	WDOE, 2003 (USGS gage no. 03A080)

Note: NA – Not available

[a] Measurements were recorded prior to construction of the Koma Kulshan Project (FERC No. 3239).

During water years 1978 through 1993, WDOE measured turbidity in the Baker River at the old State Route 20 crossing (USGS gage no. 04B070), located at Concrete (WDOE, 2003). WDOE generally made monthly measurements, and reported 163 values for the 16-year monitoring period. These turbidity measurements ranged from 0.8 to 43 NTU, with a median of 4 NTU, and a 10 percent exceedance level of 17 NTU. WDOE's turbidity levels reached more than 5 NTU during every month of the year, and in all but 3 of the years monitored (i.e., 1985, 1988, and 1992). Of the 163 measurements, 56 (34 percent) exceeded 5 NTU, and 13 (8 percent) exceeded 20 NTU. The timing of high turbidity levels did not follow any clear trend.

HDR Engineering conducted an investigation of these data to determine if there was a noticeable relationship between turbidity in the Lower Baker River and Baker Lake and/or Lake Shannon water levels (draft memorandum, J. Oppenheimer, Senior Project Scientist, HDR Engineering, Bellevue, WA, to N. Verretto, Fisheries Biologist, Puget, Bellevue, WA, dated November 27, 2002). HDR Engineering did not detect a direct relationship between Lower Baker River turbidity levels and corresponding daily reservoir elevations, and it did not identify the causes of elevated turbidity in the Lower Baker River. However, some of the high turbidity measurements seem to be related to episodic events. For instance, all of the values from December 1980 to March 1981 were at least 20 NTU, and all of the values from November 1990 to March 1991 were 17 NTU or more. The high turbidities reported during the 1990–1991 period in Lake Shannon are likely to be associated with the Miner's Creek landslide, which delivered 250,000 cubic yards of sediment from Miner's Creek into Lake Shannon in February 1990.

Reported turbidity levels for Baker River tributaries range from less than 1 NTU to nearly 10 NTU (table 5-16). Turbidities of greater than 5 NTU were only reported for two of the tributaries (Swift and Thunder creeks); however, relatively few samples were taken at tributary sites. Therefore, the reported values may not be representative of actual conditions. For example, the maximum turbidity reported for glacially fed streams (Swift, Park, Sulphur, and Rocky creeks) is slightly higher than 5 NTU, although, during the summer, glacial melt typically elevates concentrations of glacial flour along with turbidity in glacially fed streams (Uehlinger et al., 2002).

Table 5-16 includes summaries of levels reported for both the Skagit and Sauk rivers (WDOE, 2003). To present data pertinent to potential effects of the Baker River on the Skagit River, we have included summaries for the first Skagit River station monitored upstream of the Baker River, the two closest downstream Skagit River monitoring stations, and the most downstream monitoring station in the Sauk River. The Sauk River summary was included since the tributary has a major effect on Upper Skagit River water quality and the confluence of the Skagit and Sauk rivers is downstream of the upstream Skagit River station. The summary data show that Upper Skagit River and Sauk River turbidity levels are substantially different from one another. Turbidity ranged from 0.2 to 15 NTU in the Upper Skagit River during water years 1979 through 1993, while ranging from 0.8 to 200 NTU in the Sauk River. Turbidity in the Skagit River downstream of the Baker River confluence ranged from less than 1 to 83 NTU. *As part of Puget's ongoing water quality monitoring program, Puget is monitoring turbidity in the Skagit River a short distance upstream and 2.4 miles downstream of the Baker River confluence (HDR Engineering, 2001). Data collected at these monitoring stations will be used to evaluate the effects that the Baker River has on the Skagit River.*

In February and March 2001, high turbidity levels were observed in the Lower Baker River, along with a plume of turbid water immediately downstream of the confluence of the Baker and Skagit rivers (electronic mail from R. Wright, Water Quality Program, WDOE, Bellevue, WA, to N. Verretto, Fisheries Biologist, Puget, Bellevue, WA, January 16, 2003). On February 27, WDOE recorded turbidities of 39 to 46 NTU in the Lower Baker River.

Aerial photographs taken on March 4 and 6 indicate that the high turbidities in the Lower Baker River were caused by resuspension of fine-grained sediments near Bear Creek's discharge to Lake Shannon. During this period, the reservoir was drafted to a level that resulted in water cutting through sediments that had deposited at the mouth of the creek. The photographs indicate that discharges from the Upper Baker Development were relatively clear. The high turbidities coincided with particularly low water surface elevation at Lake Shannon (approximately 378 feet msl [NAVD 88]) associated with the turbine refurbishment at the Lower Baker Development. Based on records for water years 1981 through 2002, Lake Shannon water levels drop below the level coinciding with the high February 2001 turbidities less than 0.5 percent of the time.

In February 2003, the WDOE recommended that Puget revise its ongoing sampling strategy for turbidity to include monitoring in the Baker River upstream of Baker Lake (personal communication, R. Wright, Water Quality Program, WDOE, Bellevue, WA, and N. Verretto, Fisheries Biologist, Puget, Bellevue, WA, February 26, 2003). *Puget made this revision to their water quality monitoring program in March 2003, and it began to sample turbidity in the Upper Baker River in April 2003. We plan to incorporate data collected from the Baker River into our discussion of turbidity.*

5.5.1.5 Total Dissolved Gas

Spilling water over the Upper and/or Lower Baker dams has the potential to force air down into the plunge pools and result in entrainment of gasses into the water, thereby elevating TDG concentrations. In addition, air injection at the Project could elevate TDG concentrations. Two studies have been conducted to evaluate the effects of spill on entrained gas concentrations, and ongoing continuous (hourly) monitoring at the adult fish trap facilitates was conducted to evaluate Project effects on TDG.

During two spill events in June 1972, Seattle Marine Laboratories monitored dissolved nitrogen levels to evaluate the effect of the Baker River Project on nitrogen levels in the Baker and Skagit rivers (Steele, 1972). Spilling water over the Upper Baker dam had little effect on nitrogen levels, which remained below 110 percent of saturation. In contrast, dissolved nitrogen concentrations were increased by spill over the Lower Baker dam, and resulted in levels of up to 117 percent in the powerhouse tailrace and at the adult fish trap. Seattle Marine Laboratories attributed much of this increase in percent saturation to warming that occurred below the lower dam. The Baker River had minimal effects on nitrogen levels in the Skagit River where the highest TDG recorded was 101 percent.

As part of the relicensing studies and in order to establish existing conditions, Puget monitored TDG concentrations every other week in the Baker Lake and Lake Shannon forebays, and continuously at hourly intervals in the Lower Baker River at the adult fish trap. In addition, Puget monitored TDG in the left (east) side of the channel about 200 yards downstream of the lower powerhouse tailrace during a spill event.

An intense rainfall event in late January 2003 necessitated operating the Project as mandated by the ACOE (electronic mail from M. Ficklin, Fisheries Bio Tech, Puget, Bellevue, WA, to J. Oppenheimer, Senior Project Scientist, HDR Engineering, Bellevue, WA, dated April 4, 2003). Operation of the Project resulted in discharges from the Upper Baker Development exceeding the capacity of the Lower Baker Development's generator, and consequently resulted in the Lower Baker Development spilling approximately 1,800 to 2,400 cfs while generating at full load, which resulted in flows of 5,800 to 6,400 cfs from January 27 through February 1, 2003. Preliminary analysis of TDG concentrations measured downstream of the Lower Baker powerhouse twice a day during this spill event indicates that TDG ranged from 99 to 103 percent of saturation (meeting handout regarding spill TDG data February 12, 2003, J. Oppenheimer, Senior Project Scientist, HDR Engineering, Bellevue, WA, to R. Wright, WDOE, Bellevue, WA, February 26, 2003). On the 6 days following the storm event, TDG concentrations measured at this site were 96 to 100 percent of saturation.

Preliminary continuous TDG concentrations recorded at the Lower Baker adult fish trap ranged from 94 to 114 percent between October 30, 2002, and June 4, 2003 (electronic mail from J. Oppenheimer, Senior Project Scientist, HDR Engineering, Bellevue, WA, to B. Mattax, Senior Aquatic Scientist, Louis Berger, Bellevue, WA, July 9, 2003). Evaluation of the relationship between TDG concentrations and flow levels indicate that elevated TDG concentrations at the adult fish trap coincide with low and no generation at the Lower Baker Development (figure 5-18). Generally, TDG increased as flows were reduced from about 4,000 cfs to 80 cfs. In many cases, TDG rapidly increased while the turbine flow was reduced, increased further after the project went off-line, and then rapidly decreased when the project was put back on-line. This trend can be observed in figure 5-18. Seventy-four of the 4,487 (1.6 percent) TDG measurements analyzed exceeded the 110 percent criterion. Most (67 of 74 measurements, or 91 percent) of the TDG values of greater than the 110 percent limit coincided with a flow of 140 cfs or less in the Lower Baker River. Many of these measurements were recorded when the Lower Baker Development generator was off-line.

5.5.1.6 Coliform Bacteria

During water years 1977 to 1993, WDOE monitored fecal coliform levels in the Baker River at Concrete (USGS gage no. 04B070) as part of its long-term monitoring program. Based on the values reported by WDOE (2003), fecal coliform levels satisfy the applicable standard in the Lower Baker River. The 204 reported fecal coliform measurements for water years 1977 to 1993 ranged from less than 1 to 70 organisms per 100 mL. The measurement of 70 organisms per 100 mL reported for May 21, 1991 was the only value of more than 20 organisms per 100 mL.

5.5.2 Environmental Effects

5.5.2.1 Effects of Project Operations

Operation of the Project can adversely affect water quality within the Project reservoirs and in stream reaches of the Lower Baker River and has the potential of influencing water quality in the Middle Skagit River.

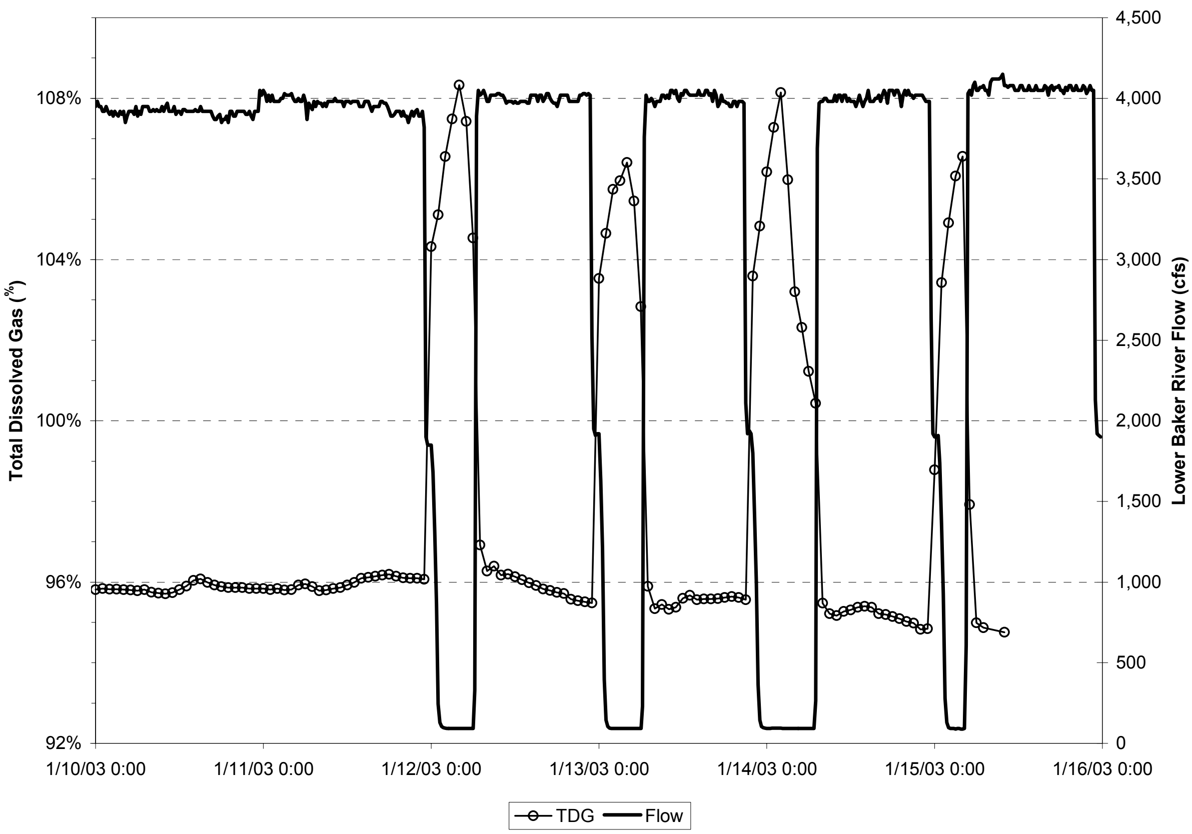


Figure 5-18. Typical patterns between TDG at the Baker adult fish trap and flow in the Lower Baker River, January 10 to 15, 2003. (Source: electronic mail from J. Oppenheimer, Senior Project Scientist, HDR Engineering, Bellevue, WA, to B. Mattax, Senior Aquatic Scientist, Louis Berger Group, Bellevue, WA, April 1, 2003)

Reservoir Water

Excessive turbidity levels have been documented to occur in Lake Shannon and the Lower Baker River in the past (refer to section 5.5.1.4, *Turbidity*). During a period when Lake Shannon's water level was drawn down to an elevation of approximately 378 feet (NAVD 88), excessive turbidity was observed in the reservoir and a turbidity of as high as 46 NTU was measured in the Lower Baker River. Review of aerial photographs taken during the reservoir drawdown indicates that re-suspending fine-grained sediments that had deposited near the mouth of Bear Creek likely caused the excessive turbidity. Other than these types of events, both reservoirs act as net deposition zones for suspended sediments that may be transported to the Skagit River.

Under the Draft Action, the reservoir management and operations plan is defined by PMEs 6.3, 5.1, and 3.5.2. We discuss the overall management of the reservoirs and their effects on Baker Lake and Lake Shannon water levels in section 5.4.2.1.

The proposed reservoir water quality management measure (PME 3.5.2) specifically sets a target minimum operating level for Lake Shannon at elevation 383.75 feet msl (NAVD 88) to reduce the potential of resuspending sediments deposited in the reservoir. The measure also includes development and implementation of a management program to ensure that the Project would comply with applicable State water quality standards for the reservoirs. Implementation of this measure would include monitoring water quality and reporting the results of monitoring to the Commission, WDOE, and BRCC as described in a water quality monitoring plan schedule, which is to be developed as part of the measure.

In the event of a violation of a water quality parameter, Puget would report the violation within 24 hours to the Commission, WDOE, and BRCC. Puget would provide a follow-up report within two weeks of the incident that summarizes the incident, its cause, response to the incident, and actions taken to prevent recurrence of similar incidents in the future. The actions to be taken in the future should include best available technologies, if necessary, to reach compliance with the applicable water quality standard.

In the event that a water quality parameter cannot be brought into compliance with the applicable water quality standards of the State, Puget would provide sufficient documentation of this fact and the reasons for failing to reach compliance. Refer to appendix B for the full text of this measure.

Effects Analysis

Evaluation of reservoir water levels modeled under the Draft Action indicate that operating the Project under the Draft Action would reduce the potential to resuspend sediments in Lake Shannon thereby reducing the potential to increase turbidity within the reservoir as compared to current operations As described in section 5.3.2.1, operating the Project under the Draft Action would result in a reduced frequency of water levels being below the edge of terraces that were identified to have "high" erosion sites. This would substantially reduce the potential for eroding sideslopes within the reservoir, and consequently the potential for increasing turbidity within Lake Shannon and passing turbid water to the Lower Baker River.

It is possible that there would be occasions when it would be necessary under the Draft Action when Project upgrades or rehabilitation of Project facilities may necessitate atypical reservoir management that includes drawing the reservoir's water level down to less than 383.75 feet (NAVD 88). Such drawdowns would require prior notification of WDOE and receipt of a WDOE Water Quality Modification specifying conditions for the drawdown.

Under this measure, Puget would also develop and implement a plan to monitor water quality. The plan would identify measured exceedance(s) of applicable State water quality standards, identify pathways to resolve exceedances of the State standards (if applicable), and provide feedback on the success of methods used to avoid recurrence of problems. PME 3.5.2 also provides assurance that Puget would apply best available technologies as necessary to resolve Project effects causing non-compliance with applicable State water quality standards.

Project Releases

Water quality monitoring results indicate that Project operations sometimes adversely affect water quality in the Lower Baker River. Turbidities of as high as 46 NTU were recorded during an extreme Lake Shannon drawdown event related to refurbishing the Lower Baker turbine in early 2001 (refer to section 5.5.1.4, *Turbidity*). TDG concentrations at the adult fish trap exceeded the maximum allowable limit of 110 percent during some periods (refer to section 5.5.1.5, *Total Dissolved Gas*). All of the TDG measurements of greater than 110 percent were recorded during periods of extremely low flows in the Lower Baker River.

In addition to operating the Project as described in PME 3.3.1, the Draft Action would include a plan to monitor Project effects on water quality (PME 3.5.1). Implementation of this measure would include monitoring water quality and reporting the results of monitoring to the Commission, WDOE, and BRCC as described in a water quality monitoring plan schedule, which would be developed as part of the measure. Refer to appendix B for the full text of this measure.

Effects Analysis

Under current operations, TDG sometimes exceeds the criteria of 110 percent (section 5.5.1.5, *Total Dissolved Gas*). These TDG concentrations generally occur when outflow from the Project is less than 140 cfs; however, the cause of these elevated values has not yet been determined. Increasing the minimum flow release from 80 cfs to 300 cfs as called for in the Draft Action would potentially reduce TDG concentrations; analysis of the cause of elevated TDG in the reach is ongoing.

Implementation of PME 3.5.1 would provide a mechanism to assess the extent of Project effects on TDG and other stream water quality constituents. It would also provide a way to evaluate compliance with applicable State water quality standards, identify means to resolve exceedances of the State standards (if they are observed), and provide feedback on the success of methods used to avoid recurrence of problems. PME 3.5.1 also provides assurance that Puget would apply best available technologies as necessary to resolve Project effects causing non-compliance with applicable State water quality standards in streams.

5.5.2.2 Stormwater Management

Operation and maintenance of the Project necessitates the storage, use, and disposal of potentially hazardous materials, and presents a risk that these materials could enter waters of the State and subsequently adversely affect beneficial uses of these waters. In addition, some Project maintenance activities could increase the risk of runoff adversely affecting water quality.

Under the Draft Action, Puget would develop and implement a stormwater pollution prevention plan for all Project-related facilities, including access roads, transmission corridors, structures, and staging areas, and for all activities related to Project operation and maintenance (PME 3.5.3). The stormwater pollution prevention plan would conform to the guidance provided in the most current edition of the Stormwater Management Manual for Western Washington (WDOE, 2001). The stormwater pollution prevention plan would include best management practices for erosion control; facility maintenance; source control; and spill prevention, containment, and cleanup. Throughout the license term, Puget would update the stormwater pollution prevention plan as needed to comply with applicable regulations.

In addition, Puget would obtain coverage under a National Pollutant Discharge Elimination System Construction Stormwater General Permit for land disturbing activities exceeding 1 acre, prior to implementing construction-related activity. Refer to appendix B for the full text of this measure.

Effects Analysis

By following guidance provided in WDOE's Stormwater Management Manual for Western Washington, Puget would develop an appropriate stormwater pollution prevention plan for all Project-related facilities, and for all activities related to Project operation and maintenance. The manual provides a commonly accepted set of technical standards and guidance on stormwater management measures that would control the quantity and quality of stormwater produced by new development and redevelopment through the implementation of best management practices.

Puget would include in the stormwater pollution prevention plan appropriate best management practices to protect beneficial uses of water resources. Best management practices would include schedules of activities, prohibition of practices, maintenance procedures, managerial practices, or structural features that prevent or reduce adverse effects to waters of the State. Puget would either adopt best management practices provided in the manual or select other appropriate best management practices to meet the specific needs of this Project. These best management practices would reduce pollutant loads and concentrations and reduce discharges that cause channel erosion.

By developing and implementing a stormwater pollution prevention plan for the Project using the guidance provided in the Stormwater Management Manual for Western Washington, Puget would be able to control stormwater runoff and comply with water quality standards and protect beneficial uses of the receiving waters.

5.5.2.3 Secondary Effects of Proposed Measures

In this subsection and in similarly titled subsections in other resource sections, we described the direct, cross-resource effects of the proposed PME measures. PMEs designed to enhance one resource may have beneficial or adverse effects on other resources and are considered secondary effects. We evaluate these secondary effects in the subsections titled *Secondary Effects of Proposed Measures*.

Lower Baker Power Plant Modifications

To enable provision of the ramping and minimum flow restrictions set in PME 3.3.1, the Draft Action would include rehabilitation of the original Lower Baker Development power generating facilities that were destroyed by a 1965 landslide. This would include the following:

- Constructing a new permanent access bridge adjacent to the west side of the powerhouse foundation,
- Excavating and hauling the slide debris from the old powerhouse location to a nearby disposal area,
- Identifying the presence of any contaminants from old equipment,
- Removing the original Units 1 and 2, if needed,
- Selective demolition and excavation of existing structures, and
- Linking the new 680-cfs turbine generator to the existing penstock.

Due to limited access to the area, Puget would use barge-mounted excavators, drilling equipment, and lifting cranes for preparation and installation of piers and abutments. Following installation of the piers and abutments, a barge-mounted heavy lift crane would be used to place the precast concrete decking onto the piers and abutments.

There is an estimated 10,000 cubic yards of debris, including loose soil, broken rock, and vegetative cover that would be removed from the area on top of and above the original Units 1 and 2. Due to risk of damage from this material falling onto the new facilities installation, this material would be removed before any new structures are placed. Puget plans to do this by loading the excavated material onto 40-ton off-road haulers that would haul the material to a Puget-owned disposal area, presumed to be less than 5 miles away.

The extent of previous removal of the original Units 1 and 2 is unknown; therefore, Puget has assumed that they would need to be removed. Puget would do so by using a small to medium sized rubber tired crane to lift the units onto short lowboys or haul trucks, which would transport them to a final disposal site or salvage area. Puget could concurrently identify the presence of any contaminants that may have originated from the old equipment, so that they can be disposed of in a safe manner.

Puget would conduct mechanical demolition and limited controlled blasting to remove portions of the original concrete structures.

Effects Analysis

Modifying the Lower Baker power plant as proposed in the Draft Action would require earthwork and could disturb potentially hazardous materials from the old equipment at the site. These activities could result in increased erosion and further contamination of the area if appropriate actions are not taken. Puget would limit the risk of increasing erosion by implementing the erosion control and implementation plan (PME 3.4.3). In addition, Puget would implement the Project-specific stormwater pollution prevention plan (PME 3.5.3) to limit the risk of degrading water quality during and following construction activities. This would likely include adoption of best management practices that limit the timing of activities such as in-water construction, control of sources of pollution, and limiting erosion at the site.

It would be important to determine the extent of contamination by potentially hazardous materials prior to their disturbance through the preparation of a Phase I Environmental Assessment. If potentially hazardous materials were present, it would be important to conduct the removal of the original equipment during a season of low precipitation to limit the potential for runoff from the work site to spread the contamination. By consulting with the WDOE, Puget could determine a preferred method for investigating the extent of contamination, if any, and discarding contaminated materials.

Implementation of appropriate best management practices would limit the risk of construction-related erosion, and is expected to result in minor localized erosion during and immediately after the 2-year construction period. Minor erosion of the construction site along with some runoff of fine-grained sediments is expected to cause short-term localized turbidity increases of more than the amount allowed by the State criteria. The general pattern expected is that turbidity would be elevated in the immediate vicinity of point discharges to the Lower Baker River, but turbidity would dissipate quickly as inflowing water mixes with the Baker River flow.

To construct the new bridge, it would be necessary to conduct in-water construction while installing the bridge piers and abutments. By performing the in-water construction during a low-flow period, Puget could ensure that the piers and abutments could be constructed in an efficient manner and adverse effects on the aquatic ecosystem could be limited. It would also be especially important to implement appropriate best management practices for this activity that would limit the likelihood of introducing potentially hazardous materials or substantially increasing turbidity to the Lower Baker River.

Since the status of the original Units 1 and 2 and related facilities is unknown, it would be important to determine the extent of contamination by potentially hazardous materials from them prior to disturbing them. Puget could determine a preferred method to accomplish this goal and discard materials containing potentially hazardous materials, if any exist. By conducting these actions, Puget could minimize the risk of introducing any contaminants that exist into surface and ground waters in the area.

Aquatic Measures

Under existing conditions, Upper Baker dam and Lower Baker dam block natural passage of migratory fish in the Baker River system. Under current license conditions, Puget passes fish both upstream and downstream using facilities constructed and operated for those purposes. Upstream migrating adult salmon and steelhead are captured at the Lower Baker trap-and-haul facility, where they are sorted and subsequently transported to the upper basin according to management priorities. An FSC located in front of the Upper Baker and Lower Baker dams is used to capture downstream migrating fish, which are subsequently transported to the mouth of the Baker River.

The Draft Action includes measures to improve upstream and downstream fish passage. Implementation of PME 3.2.1 would include construction of facilities for attraction, capture, and transport of upstream migrating fish at the Lower Baker Development. The facilities may use the existing site and some or all existing facilities as agreed to by the BRCC, FWS, and NOAA Fisheries. In addition, PME 3.2.2 could include construction of a test and permanent trap-and-haul facility for the Upper Baker Development depending on the opinion of the BRCC. Puget would also provide and operate passage facilities for downstream migratory fish at the Upper Baker and Lower Baker developments using sequential development of FSC technology, with trap-and-haul and acclimation ponds for release (PME 3.2.3). Implementing this measure would include construction and installation of FSCs for the Upper Baker dam and Lower Baker dam, and construction of acclimation facilities located near the confluence of the Baker and Skagit rivers. Refer to appendix B for the full text of these measures.

Effects Analysis

Construction of the upstream and downstream fish passage facilities would require disturbance of existing landforms; in-water construction; and the use, storage, and disposal of potentially hazardous materials. Performing these activities increases the short-term risk of erosion, introducing sediments to surface waters, and the potential for contaminating waters. By implementing the erosion control and implementation plan (PME 3.4.3) and stormwater pollution prevention plan (PME 3.5.3), Puget would reduce the risk of these actions causing adverse effects on water quality. There would still be some circumstances that would result in localized elevated turbidity levels and the possibility of contaminating water with potentially hazardous materials. For example, moving sediments along the bed of the channel or reservoir would increase turbidity. These increases could be minimized through the use of appropriate best management practices. Similarly, implementation of best management practices would limit the risk of contaminating water with potentially hazardous materials. As a result, it is anticipated that there would be minor short-term adverse effects on water quality.

Terrestrial Measures

The Draft Action includes PME 1.2.4, which would include creation and/or enhancement of 3 acres of ponded wetland habitat suitable for amphibian breeding.

Effects Analysis

Under PME 1.2.4, described in more detail in section 5.7.2.5, *Wildlife and Special Status Wildlife Species*, Puget could develop ponded wetland habitat within reservoir drawdown zones, enhance existing wetlands within the Project area or elsewhere in the basin, or create new wetlands elsewhere. In order to develop the desired amphibian breeding habitat, Puget could perform construction activities in either the reservoir drawdown zones or existing wetlands. Prior to initiating construction activities, Puget would implement the erosion control and implementation plan (PME 3.4.3) and the Project's stormwater pollution prevention plan (PME 3.5.3). In addition, a Section 404 Permit would need to be obtained prior to initiating construction. These protective measures would ensure that appropriate best management practices would be implemented to limit the potential for increasing turbidity and contaminating water with potentially hazardous materials used for the construction activity. As a result, we anticipate that compliance with water quality standards would generally not be affected. However, minor localized short-term increases in turbidity could occur.

Recreational Measures

The Baker River Project attracts many day use and overnight recreationists to the area. To address the level of demand for recreation, several measures were included into the Draft Action. Some of these measures have the potential to affect water quality. These activities include:

- Constructing new trails and maintaining existing trails
- Constructing and expanding campgrounds
- Constructing day-use facility and a small-scale viewing facility
- Constructing designated parking areas
- Reconfiguring road and paving existing roads
- Removing buildings, boat dock, and fuel tanks at the Baker Lake Resort
- Constructing an ADA-accessible fishing platform
- Removing or trimming select hazard stumps and snags in Baker Lake and Lake Shannon
- Constructing and upgrading restrooms/toilet facilities

Refer to section 5.10.2 for a description of environmental effects of the Draft Action on recreation resources. Refer to appendix B for the full text of these measures.

Effects Analysis

Performing the activities listed above has the potential to affect water quality. The primary way in which this could occur would be by increasing erosion, although there is also the potential to contaminate waters with fuel and other potentially hazardous materials used, stored and disposed of onsite. Removal of the fuel tanks from the Baker Lake Resort would also present a risk of contaminating waters, although there would be a reduced risk once they are removed from the Project area. Puget would limit risks of degrading water quality through implementation of the erosion control and implementation plan (PME 3.4.3) and stormwater pollution prevention plan (PME 3.5.3). This would include adoption of appropriate best management practices for each activity.

Installation and upgrading toilet facilities at dispersed camping sites could result in less human fecal matter near the shoreline of reservoirs, and could subsequently reduce the concentration of fecal coliform and disease-causing organisms in near shore waters. The level of this beneficial effect would be dependent upon the behavior of persons using these areas.

As a result, we anticipate that minor localized short-term adverse effects would be likely during and immediately following the activities listed above. We also expect minor localized long-term beneficial effects from improved use of toilet facilities at dispersed camping sites. Depending on the behavior of persons using these areas, it is possible that there could be major localized beneficial effects.

5.5.3 Cumulative Effects

Several human activities influence water quality in the Baker River basin and the Middle Skagit River. Factors affecting water quality include land management policies, recreation, Baker River Project operations, the interaction of Baker River flows with flows from the Upper Skagit River, and increasing development along the Middle Skagit River.

Based on current trends, we anticipate that demand for recreating in the area would increase, as would continued development along the Middle Skagit River. Both of these foreseeable actions would adversely effect water quality in the basin.

Under the Draft Action, the Project operations would result in enhanced water quality conditions in comparison to current conditions. Lake Shannon's water level would typically be maintained at elevation 383.75 feet msl (NAVD 88) or higher, which would reduce resuspension of sediments deposited in the reservoir and subsequently turbidity in both the reservoir and downstream. Operation of the new 680-cfs turbine at the Lower Baker Development may reduce TDG concentrations, although it is not clear whether this would be the case at this time. Additionally, installation and maintenance of improved toilet facilities in areas near the reservoirs could reduce the occurrence of improper human waste disposal and thus reduce the extent of fecal coliform and disease-causing organisms near these sites. Construction activities associated with modifications to the Lower Baker power plant, and implementation of enhancement measures for upstream and downstream fish passage, creation of amphibian breeding habitat, and recreation facilities could result in minor short-term localized increases in turbidity. However, implementation of the erosion control and implementation plan and the stormwater pollution prevention plan would minimize these risks.

5.5.4 Unavoidable Adverse Effects

Construction activity associated with the Lower Baker Powerhouse modification; upstream and downstream fish passage facilities, trails, campsites, and boat ramps; and stump removal could all result in minor short-term localized increases in turbidity.

5.6 Aquatic Resources

The following sections describe the existing aquatic habitat and fish species occurring in the Project vicinity. Additional information on federally listed threatened and endangered species (Chinook salmon and bull trout) is provided in section 5.8, *Federally Listed Threatened and Endangered Species and Essential Fish Habitat*.

5.6.1 Affected Environment

5.6.1.1 Aquatic Habitat Conditions

For the purpose of characterizing existing aquatic habitat conditions, we defined five subbasins: the Upper Baker River (headwaters to RM 18.4), Baker Lake (RM 18.4 to RM 9.35), Lake Shannon (RM 8.2 to RM 1.2), Lower Baker River (RM 1.2 to RM 0.0), and the Middle Skagit River (RM 56.5 to RM 24.5) and Lower Skagit River (RM 24.5 to RM 0.0). *The Aquatic Resources Working Group has initiated a number of studies that will add to the understanding of Baker River watershed aquatic habitat once they are completed. We present the studies related to aquatic habitat in the following table.*

Study	*Study Number*
Reservoir Tributary Habitat Surveys	*A01a*
Reservoir Tributary Delta Surveys	*A01c*
Lower Baker River Habitat Mapping	*A02*
Skagit River Flow and Habitat Assessment	*A09a*
Upper Baker River Delta Scour	*A15*
Lower Baker Alluvial Fan/Channelization	*A16*
Baker River Habitat Surveys Upstream of 1 km	*A18*
Hydrologic and Geomorphic Analysis	*A24*

A number of human activities, including hydroelectric development, has affected aquatic habitat in the Baker River system. We present a general overview of existing habitat conditions in the system in the following paragraphs, and, where information is available, we also describe how past actions have contributed to the current conditions.

Upper Baker River

The Upper Baker River includes approximately 15 miles of the mainstem from its headwaters near RM 34 downstream to the full-pool shoreline of Baker Lake at approximately RM 18.4 (Puget, 2002d) (appendix A, figure 5-19). The major tributaries in this subbasin include Picket, Pass, Bald Eagle, Crystal, and Sulphide creeks (Puget, 1983b; Williams et al., 1975). Glacial melt from Mt. Shuksan to the north and Mt. Blum and Bacon Peak to the east influence flows in the Upper Baker River and many of its tributaries. The majority of the subbasin is within the NCNP, which is predominantly free of past human disturbances (Puget, 2002c).

From Pass Creek (approximately RM 31) to the headwaters, the stream habitat in the mainstem Baker River is dominated by steep gradient. Cascades and rapids are abundant, and there are only a few stretches of pools and riffles. Most of the channel is narrowly confined with steep, well-vegetated sideslopes.

Below Pass Creek for the next 6 to 8 miles the valley widens with stream widths ranging from 36 to 60 feet. Gradients through this reach are generally low with riffles and pools being the primary habitat types. Substrates are dominated by cobble, with gravels in many of the riffles (Williams et al., 1975).

From Sulphide Creek (RM 23) down to the confluence with Baker Lake, the channel is low gradient and predominantly comprises pools and riffles. The floodplain is rather wide and the river frequently shifts and meanders along the valley floor. The stream channel becomes braided in this reach, especially near the confluence with Baker Lake, which is commonly referred to as the Upper Baker River delta. Substrate is composed mainly of gravel and cobble (Williams et al., 1975; Puget, 2002d).

Water temperatures in the Upper Baker River and many of its tributary streams are generally cold throughout the year. Glaciers feed many of the streams, resulting in seasonal increases in suspended solids from spring and summer glacial melt. Nutrient levels are generally low in the Upper Baker River, which may limit productivity (USFS, 2002a).

The Upper Baker River transports sediments and LWD from the upper watershed to Baker Lake, where the downstream movement of these materials is blocked. Approximately 182 pieces of LWD are delivered annually to Baker Lake from the Upper Baker River and its tributaries (Puget, 2003d). The Upper Baker River delivers the majority of the 157,000 to 325,000 tons of total sediment delivered to Baker Lake each year. Approximately 20,000 to 42,000 tons of the material are composed of bedload.

Baker Lake

Baker Lake, located immediately downstream of the Upper Baker River, is approximately 9 miles long and covers 4,980 surface acres at full pool (section 3.1.1.1, *Upper Baker Development*). The reservoir provides flood control and must be drawn down below 724.5 feet msl (NAVD 88) (3.27 feet below full pool) by November 1 and must be below 711.56 feet msl (NAVD 88) (16.2 feet below full pool) from November 15 through March 1. Minimum reservoir elevations are typically attained from November through March or early April. Based on daily stage data for the period 1981 through 2002, the annual minimum pool elevation averages about 689.1 feet msl (NAVD 88), which represents a drawdown of 38.7 feet below the normal full pool elevation of 727.77 feet msl (NAVD 88). The reservoir drawdown exposes potential salmonid spawning habitat in the Baker River delta and tributary streams, although the quality of this habitat is unknown. *Studies are ongoing to assess the amount and quality of aquatic habitat in the reservoir drawdown zone, and information will be added when available.*

Water quality data collected in Baker River suggest that the reservoir is oligotrophic (i.e., it contains low nutrient concentrations and low plant growth), which limits productivity. Preliminary phytoplankton studies suggest that Baker Lake is similar to other oligotrophic systems. Hydroacoustic studies conducted in the reservoir suggest that fish are not generally abundant in Baker Lake (Puget, 1987).

Baker Lake stores sediments and LWD transported from the upper watershed. In addition to these materials, 280 pieces of LWD are contributed annually to Baker Lake from fallen trees along the reservoir margin and 66 pieces of LWD are transported from tributary streams. Management of woody debris in the reservoirs has varied over time. Currently, wood is removed from the reservoir only if it poses a possible operational or safety hazard. No large pieces of woody debris are passed downstream of Upper Baker dam (Puget, 2003d). Baker Lake traps the vast majority of sediment delivered to the reservoir each year. Of the 157,000 to 325,000 tons of sediment delivered annually, only 20,000 to 42,000 tons are passed on to Lake Shannon. Fine, suspended sediments entirely comprise the materials delivered downstream to Lake Shannon (Puget, 2003n).

Resident and anadromous fish have access to portions of approximately 30 tributaries to Baker Lake. Steep gradients limit anadromous fish use of many of the streams. Approximately 10 streams have substantial sections with appropriate gradient for salmonid habitat. These include Sandy, Little Sandy, Silver, Beaver, Little Park, Park, Swift, Morovitz, Shannon, and Channel creeks (Puget, 2002d). Human development has not disturbed aquatic habitat in the majority of the Baker Lake tributaries, although road construction and past timber harvests in the MBSNF have affected some drainages. Past mining and prospecting activities may have also affected habitat quality in some streams, such as Swift and Noisy creeks (USFS, 2002a).

Lake Shannon

Lake Shannon is located approximately 1 mile downstream of Baker Lake. The reservoir is approximately 7 miles long (RM 1.2 to RM 8.2) and 1 mile wide, covering an area of 2,278 acres. Seasonal drawdown occurs on a regular basis, with no provision for flood storage. Based on daily reservoir stage data for the period 1981 through 2002, the annual minimum pool elevation averages about 393.9 feet msl (NAVD 88), which represents a drawdown of about 48.5 feet below the normal full pool elevation of 442.35 feet msl (NAVD 88).

Lake Shannon displays the same oligotrophic characteristics as described for Baker Lake, which limits productivity. In addition, this subbasin has experienced substantial historical and ongoing logging activities. As a result, many of the tributaries experience relatively high sediment loads and increased water temperatures (USFS, 2002a). Resuspension of glacial sediments delivered to Lake Shannon by tributary streams led to high turbidity within the lake when the reservoir's water surface elevation was drawn down to approximately 378 feet in March 2001, which is within 4 feet of the lowest level since October 1980 (see section 5.5.1.4, *Turbidity*). Furthermore, some of the tributary aquatic habitat may have been influenced by past mineral extraction activities (USFS, 2002a).

Lower Baker dam prevents the downstream transport of sediment and LWD from Lake Shannon and its tributaries. Each year, 224 pieces of LWD are contributed to Lake Shannon from fallen trees along the reservoir margin and landslides. Tributary streams to Lake Shannon contribute an additional 22 pieces of LWD. Woody debris in the reservoir is only removed if it poses an operational or safety hazard. Under current management, no large pieces of woody debris are transported downstream of Lower Baker dam (Puget, 2003d).

In addition to the suspended sediment passed downstream from Baker Lake, Lake Shannon also receives 75,000 to 95,000 tons of sediments from its tributary streams. Of the total sediments delivered to Lake Shannon, only 21,000 to 30,000 tons of total sediment are passed below Lower Baker dam each year. Fine, suspended sediments entirely comprise the materials delivered to the Lower Baker River (Puget, 2003n).

Migratory fish have access to portions of approximately 22 tributary streams in the Lake Shannon subbasin, although the majority of these streams have rather steep gradients and are poor quality salmonid habitat. However, portions of Everett Lake, Three-mile, Rocky, and Sulphur creeks contain low gradient reaches that provide salmonid habitat.

Lower Baker River

The Lower Baker River consists of just over 1 mile of stream extending from Lower Baker dam (RM 1.2) down to the confluence with the Skagit River. This area can be divided into three reaches: (1) Lower Baker dam to the powerhouse (RM 0.9), (2) powerhouse to the barrier dam (RM 0.6), and (3) barrier dam to confluence with the Skagit River.

From the dam downstream to the powerhouse, flow is limited to approximately 55 cfs from dam leakage, except during periods of spill (Puget, circa 2001). This reach is located in a narrow, bedrock-controlled canyon. The channel gradient is approximately 2.5 percent, and boulders and bedrock dominate the substrate (Puget, 2003n). Only resident fish or those that pass over the dam during spill or through the Project turbines have access to this reach. Because of available aquatic habitat and variable flows, it is not likely that this reach supports self-sustaining resident fish populations.

The reach from the powerhouse downstream to the barrier dam carries flow from the powerhouse in addition to the seepage from the dam. Flows in this reach typically range from 150 to around 4,100 cfs (Puget, 2003n; Puget, circa 2001). Flow in this reach changes rapidly as the Lower Baker Development goes off-line, with stage changes of more than 3 feet in less than an hour commonly occurring (Puget, 2003n). This reach is also narrowly confined by steep sideslopes on both sides. Channel gradient and substrate are similar to the dam-to-powerhouse reach and stream channel is approximately 100 feet wide at the barrier dam (Puget, 2003n). Again, only resident fish or those passing over the spillway or through the Project turbines have access to this reach.

The barrier dam precludes upstream anadromous fish migration and directs fish to the Baker River adult trap facility. Much of the reach between the dam and the confluence with the Skagit River is inundated by backflow from the mainstem Skagit River, even during low flow conditions. The majority of the streambanks have been hardened, and the channel is well confined. The stream gradient is low and both anadromous and resident fish have access to this reach.

This reach of the Lower Baker River is also the location of the historical Little Baker River side channel. The Little Baker River side channel originally flowed from the Highway 20 Bridge crossing on the west side of the mainstem channel for approximately 1 mile before entering the Skagit River, immediately downstream of the mainstem Baker River confluence. During dredging activities conducted in the mainstem Baker River in the late 1950s associated with construction activities, the Little Baker River side channel was dewatered, which led to the loss of salmonid spawning and rearing habitat. The Skagit Fisheries Enhancement Group, Town of Concrete, and ACOE are currently formulating a plan to restore the Little Baker River side channel.

Middle and Lower Skagit River

The Baker River enters the mainstem Skagit River at RM 56.5 near the Town of Concrete. The Middle Skagit River is defined as the reach upstream of RM 24.5 to the confluence with the Baker River, while the Lower Skagit River consists of all reaches downstream of RM 24.5.

In the Middle Skagit River, the channel width varies from about 400 feet to over 1,000 feet. Near the confluence with the Baker River, the channel is rather confined. Farther downstream, the valley floor broadens to as much as 1 mile to 4 miles in width. Gradient is generally low with predominantly riffle, glide, and pool habitat. Substrates are characterized by cobble and gravel. This reach contains various sloughs and side channels that provide important resident and anadromous salmonid spawning and rearing habitat (Williams et al., 1975).

The Lower Skagit River is low gradient, and pools and glides are the dominant habitat type. Below RM 22 down to the Skagit River delta, sand is the dominant substrate. Before the Skagit River enters the Skagit Bay estuary, it splits into a north and south fork in addition to numerous sloughs.

Human development increases along the shores of the Skagit River in these lower reaches. Past and ongoing human disturbances in the Lower Skagit River have led to the degradation of aquatic habitat. Off-channel habitat and tributary streams, which are critical components of juvenile salmonid rearing habitat, have been the most heavily affected (Bishop and Morgan, 1996; Beechie et al., 1994). Channelization associated with flood control activities also has degraded mainstem aquatic habitat (Bishop and Morgan, 1996). In addition, over 60 percent of the historical Skagit River tidal wetlands and estuarine areas have been lost, primarily due to conversion to agricultural lands (Dean et al., 2000; City of Seattle, 2001). These estuarine areas provide important juvenile salmonid rearing habitat.

The Baker River affects stream flows in both the Middle and Lower Skagit River reaches. Operation of Seattle City Light's Skagit River Project, located approximately 40 miles upstream of the Baker River confluence, also affects these reaches. As described in greater detail in section 5.4.1.1, *Surface Water*, the relationship between flows from the Baker River Project and Seattle City Light's Skagit River Project can combine to produce daily flow fluctuations in the Middle and Lower Skagit River of up to 6,000 to 8,000 cfs under existing conditions. These flow fluctuations can influence resident and anadromous fish habitat by wetting and subsequently dewatering spawning and rearing areas. In recent years, Puget has been working with the resource agencies in an attempt to reduce the potential adverse effects of Baker River Project operations on Middle and Lower Skagit River habitat. A more detailed description of Skagit River flow issues related to the Baker River Project can be found in Puget's 2002 biological assessment for Chinook salmon (Puget, 2002a).

5.6.1.2 Anadromous Fish Species

Seven species of anadromous salmonids occur in the Baker River Project area; they are sockeye (*Oncorhynchu nerka*), coho (*O. kisutch*), Chinook (*O. tshawytscha*), steelhead (*O. mykiss*), pink (*O. gorbuscha*), chum salmon (*O. keta*), and coastal cutthroat trout (*O. clarki*). In addition, native char (*Salvelinus sp.*) have been observed at the Baker River trap and juvenile collection facilities. Although displaying both anadromous and resident life histories, native char are discussed in section 5.6.1.3, *Resident Fish Species*. Pacific and river lamprey (*Lampetra tridentate* and *L. ayresi*) and white sturgeon (*Acipenser transmontanus*) may have also once used the Baker River drainage, although no observations of these species have been documented.

Coho and sockeye are the most abundant salmon stocks returning to the adult fish trap with the remaining species comprising only about 7 percent of the total trap returns (table 5-17). The following paragraphs provide brief descriptions of each anadromous species' distribution, abundance, and general life history in the Baker River drainage.

Table 5-17. Species composition of adult anadromous salmonids returning to the Baker River Project, 1926–2000.

Species	Average	Percent of Total	Minimum	Maximum
Sockeye	3,078	31	99	15,991
Coho	6,061	61	187	26,549
Chinook	219	2	0	1,453
Steelhead	169	2	0	929
Pink	344	3	0	6,123
Chum	27	0	0	185
Coastal cutthroat trout	NA	NA	NA	NA

Note: NA – Not available

Sockeye Salmon

The Baker River sockeye population has been a focus of fisheries management for over 100 years and is believed to be the only naturally occurring sockeye population in the Puget Sound Region (USFS, 2002a). The sockeye run is an important component of the Baker River fishery comprising approximately 31 percent of total anadromous salmonid returns to the system (table 5-17). The Washington Department of Fish and Wildlife (WDFW) considers the Baker River population a distinct stock on the basis of its geographic separation from other sockeye runs and its genetic characteristics (WDFW et al., 1994). In the past, there were efforts to develop sockeye runs in other areas of the Skagit River watershed using Baker River stock, although the attempts were ultimately unsuccessful (Gustafson et al., 1997). However, Baker River sockeye were successfully transplanted to Lake Washington (Issaquah Creek and Cedar River) (Gustafson et al., 1997).

Abundance of Baker River sockeye salmon prior to Euro-American settlement is not well understood. Anecdotal estimates of historical escapement suggest that the run size ranged from approximately 10,000 to 20,000 adults (Kemmerich, 1945; SSC, 1996). Prior to construction of Upper Baker dam, sockeye in the basin were primarily beach spawners, using areas of upwelling along the original Baker Lake. Surveys conducted in the 1950s estimated that as much as 95 percent of sockeye spawning occurred along the shoreline of Baker Lake (Quistorff, 1959). Sockeye spawning has also been observed in Channel Creek, Silver Creek, the Upper Baker River, and in a few small tributaries. The majority of the historical sockeye spawning habitat was inundated with the completion of Upper Baker dam in 1959.

As mitigation for the loss of spawning habitat, Puget constructed three artificial sockeye spawning beaches (Spawning Beaches 1, 2, and 3) to provide for continued sockeye production in the Baker River system. In addition, a fourth artificial spawning beach (Spawning Beach 4) was constructed in 1990 to replace the other beaches, which were in danger of inundation as a result of changing channel conditions in the mainstem Upper Baker River. Currently, only Spawning Beaches 3 and 4 are actively used. The beaches provide spawning habitat for approximately 4,500 adults. Spawner success and fry survival is considerably higher in the spawning beaches than is demonstrated in the wild. Additional information on the spawning beaches is presented in section 5.6.1.4, *Existing Fish Facilities and Programs*.

When adult returns to the Baker River are forecasted to exceed the capacity of the spawning beaches, fish are released directly into Baker Lake. Preliminary studies of natural sockeye spawning have found that these fish tend to spawn in the Baker River delta, Channel Creek, and smaller tributaries to Baker Lake. Much of this spawning occurs in the Baker Lake drawdown zone. There is concern regarding natural sockeye production, because redds in the drawdown zone have been dewatered as Baker Lake is drafted in the fall for flood control (Walsh et al., 1996).

Adult sockeye return to the Baker River basin from June through August, with peak returns in July (table 5-18). Spawning at the artificial beaches generally occurs from late September through December, peaking from late October to late November (WDFW et al., 1994). Adults normally spend 2 to 3 years rearing in the ocean prior to returning at a size of 4 to 8 pounds (Puget, 2002c). Adult sockeye returns to the Baker River trap from 1926 to 2002 ranged from a low of 99 to a maximum of 15,991, with an average of 3,115. A new record run was established in 2003, with 20,196 adult sockeye returns as of September 15, 2003. Because of the long-term negative trends in adult returns and smolt collection in the 1980s and early 1990s, WDFW designated Baker River sockeye status as “critical.” The critical designation denotes a stock of fish experiencing production levels low enough that permanent damage to the stock is likely or has already occurred (WDFW et al., 1994). In March 1994, a non-governmental organization, the Professional Resource Organization – Salmon, petitioned NOAA Fisheries to list Baker River sockeye salmon under the ESA. NOAA Fisheries conducted an evaluation of the Baker River population and on March 25, 1999, it ruled that the species did not warrant ESA protection, because adult returns had increased substantially. Since 1994, adult sockeye returns to the Baker River have increased substantially to an annual average of 7,803 sockeye, with record runs occurring in 6 of the last 10 years.

Table 5-18. Baker River anadromous salmonids periodicity chart. (Source: Adapted from Puget, 2002c)

Species and Life History	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sockeye												
Adult immigration						Gray	Black	Gray				
Juvenile emigration				Gray	Gray/Black	Black/Gray	Gray					
Coho												
Adult immigration									Gray	Black	Gray	Gray
Juvenile emigration			Gray	Gray	Black	Black	Gray	Gray				
Chinook												
Adult immigration								Gray	Gray	Black	Gray	
Juvenile emigration			Gray	Gray	Gray	Black	Black	Gray				
Steelhead (summer)												
Adult immigration				Gray	Gray	Gray	Black	Gray				
Juvenile emigration				Gray	Black	Gray	Gray					
Steelhead (winter)												
Adult immigration	Gray	Gray	Gray	Gray					Gray	Gray	Gray	Black
Juvenile emigration				Gray	Black	Gray	Gray					
Pink												
Adult immigration								Gray	Gray	Black	Gray	
Juvenile emigration				Gray	Gray	Black	Gray					
Chum												
Adult immigration										Gray	Black	Gray
Juvenile emigration												
Anadromous Coastal Cutthroat												
Adult immigration			Gray			Gray	Gray			Gray	Black	
Juvenile emigration				Gray	Black	Gray	Gray					

Notes: Black – Peak migration period
Gray – Span of run timing

Sockeye fry produced at the spawning beaches emerge from spawning gravels from February through late May or early June (SSC, 1996; letter from G. Sprague, Major Projects Section Manager, Habitat Program, WDFW, Olympia, WA, to C. Freeland, Licensing Program Manager, Puget, Bellevue, WA, dated June 3, 2003). At the upper spawning beach, fry are able to volitionally outmigrate to Baker Lake. At Spawning Beach 4, fry volitionally exit the spawning beaches and enter a holding area, and are then trucked to Baker Lake for release.

The majority of sockeye juveniles rear in Baker Lake for 12 to 20 months, although some may remain in freshwater for well over 36 months (Puget, 2002c; letter from G. Sprague, Major Projects Section Manager, Habitat Program, WDFW, Olympia, WA, to C. Freeland, Licensing Program Manager, Puget, Bellevue, WA, dated June 3, 2003). While rearing in Baker Lake, sockeye feed primarily on zooplankton and aquatic insect larvae. Preferred rearing temperatures for sockeye range from about 12 to 14°C (Bjornn and Reiser, 1991). Outmigration of sockeye smolts from the Baker River occurs from the end of March through July, peaking from mid-May to mid-June (table 5-18) (Puget, 2002c). Over the past 10 years, total juvenile sockeye counts at the Project gulpers have averaged about 125,800, with a peak of 194,955 sockeye in 2001 and a low of 25,848 in 1993.

Management of sockeye fisheries in the Baker River system is under the jurisdiction of WDFW and Tribal interests. In the early 1900s, Baker River sockeye salmon were also managed by the U.S. Fish Commission (now FWS), which operated a hatchery facility that propagated the majority of returning sockeye salmon from 1899 through 1933 (Gustafson et al., 1997). Currently, sockeye salmon in the Baker River system are included on the USFS Regional Forester's Sensitive Animal list.

Coho Salmon

Coho salmon are native to the Skagit River drainage. The WDFW has identified two stocks of coho in the basin: Skagit and Baker (WDFW et al., 1994). Skagit River coho generally spawn in tributary streams, although some spawning may occur in side channels and sloughs along the mainstem Skagit River. Coho juveniles may be present throughout the year in the Lower Skagit River, rearing in pools and off-channel habitat (WDFW et al., 1994). Based on escapement and commercial catches, total Skagit River adult coho run size was estimated to range from 17,100 to 127,000 (average of 54,100 fish) from 1985 to 2001, while total adult escapement ranged from 19,600 to 112,000 (average of 55,412 fish) (PFMC, 2003; WDFW, 2002). Because of declines in escapement numbers in the 1980s and early 1990s, WDFW considers this stock to be depressed (WDFW et al., 1994). A depressed stock is one in which production is below expected levels, based upon available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely.

In the WDFW State Salmonid Stock Inventory report, coho salmon from the Baker River were considered to be a separate stock from Skagit River coho, because they are a smaller size at maturity and historically had an earlier adult run timing than Skagit River stock. Adult Baker River coho tend to weigh only about 3 to 4 pounds in comparison to the 6- to 7-pound average of other Skagit River coho (Puget, 2002c; WDFW et al., 1994). The original Baker River coho stock returned as adults in August through September, compared to the September to October timing of other Skagit River coho (Quistorff and Kral, 1955; WDFW et al., 1994). Because of the introduction of outside coho stocks by resource management agencies, Baker River coho run timing has shifted to its current period of September through December, with peak migration occurring in October (table 5-18) (Puget, 2002c). In fact, a preliminary evaluation of the Baker River coho population suggests that the run has been substantially influenced by genetics from other populations, namely the Skagit River coho, and that it is highly unlikely that there is a genetically unadulterated native Baker River stock remaining in existence (memorandum from C. Baranski, Fish Biologist, Planning, Research, and Harvest Management Division, WDFW, Olympia, WA, to B. Tweit, Fish Biologist, WDFW, Olympia, WA, regarding Baker River early coho salmon stock, dated July 23, 1993; addendum to July 23, 1993, memorandum from

C. Baranski, Fish Biologist, Planning, Research, and Harvest Management Division, WDFW, Olympia, WA, to B. Tweit, Fish Biologist, WDFW, Olympia, WA, dated August 12, 1993).

Coho escapement to the Baker River, based on trap counts from 1926 to 2002 has averaged 6,139 adults with a high of 26,549, occurring in 1962, and a low of 187, occurring in 1928. Over the past 10 years, coho escapement to the Baker River has averaged 5,277. Most adult coho collected at the Baker River trap are transported upstream and released into Baker Lake, although some are transported to the Sulphur Creek facility to be used as broodstock for artificial production. Coho spawning generally occurs from October through January. Spawning ground surveys suggest that coho spawn in the Upper Baker River, in addition to the lower reaches of Sandy, Boulder, Park, Swift, Morovitz, Lake, Channel, and Beaver creeks (Egan, 1978; Puget, 2002c).

Baker River coho juveniles rear in the stream and lake habitats for 1 to 2 years. Preferred water temperatures for rearing coho range from about 12 to 14°C (Bjornn and Reiser, 1991). Coho smolts migrate to the ocean from March to August, with peak migration occurring in May and June (table 5-18) (Puget, 2002c).

Using potential habitat area as an indicator, estimates of total Baker River system coho smolt production potential were found to range from 100,000 to about 150,000 fish (Johnson, 1986; Beechie et al., 1994). Actual juvenile counts at the Baker River gulpers have averaged 48,989 coho smolts from 1987 to 2002, although these numbers do not include smolts that may have passed over Project spillways and turbines, or residualized in the lake.

Artificial production has influenced coho production in the Baker River system. Clark Creek coho from the Skagit River basin were released for many years into the Baker River system. From 1983 to 1993, approximately 150,000 Clark Creek coho smolts and fry were released each year into Baker Lake, Lake Shannon, tributary streams (i.e., Sulphur Creek, Little Park Creek), and below Lower Baker dam (USFS, 2002a; Puget, 2003m). Since the mid-1990s, artificial production efforts have used coho returns to the Lower Baker river trap as broodstock for the voluntary supplementation program. Coho are reared at the Sulphur Creek facility and the Lake Shannon net pens. An average of about 115,000 of these artificially produced Baker River coho were released into the Baker River system from 1994 to 2001. More detail regarding artificial production is provided in section 5.6.1.4, *Existing Fish Facilities and Programs*.

Management of coho fisheries in the Baker River system is under the jurisdiction of WDFW and Tribal interests. Coho salmon in the Baker River system are included on the USFS Regional Forester's Sensitive Animal list.

Chinook Salmon

Puget has already compiled general information regarding Chinook salmon in the Baker River. Thus, the majority of the information presented below is from Puget's 2002, biological assessment for Chinook salmon, which are listed as threatened under the ESA (Puget, 2002a). Additional information regarding the ESA listing of Chinook can be found in section 5.8, *Federally Listed Threatened and Endangered Species and Essential Fish Habitat.*

Chinook or king salmon are the largest of the Pacific salmon species; some individuals weigh over 100 pounds, although most adults weigh less than 40 pounds (Meehan and Bjornn, 1991). The Skagit River supports the largest natural run of Chinook salmon in the Puget Sound (WDFW et al., 1994). The WDFW has identified six distinct Skagit River Chinook stocks including two summer runs (Upper Skagit Mainstem/Tributaries and Lower Sauk), three spring runs (Upper Sauk, Suiattle, and Upper Cascade), and one fall run (Lower Skagit Mainstem/ Tributaries) (WDFW et al., 1994). Based on escapement and commercial catches, the total Skagit River adult Chinook run size was estimated to range from 5,200 to 26,400 fish from 1985 to 2001, with an average of about 14,175 adults (PFMC, 2003). In recent years, Chinook salmon returning to the Baker River have primarily been adult spring Chinook that are part of an experimental program, although some fish from the Lower Skagit River fall Chinook stock also have been observed in the trap. The potential first returns for the experimental program would have been in 2002. The majority of the other Skagit River stocks spawn in streams located upstream of the Baker River confluence.

The Lower Skagit fall Chinook run spawns primarily in the mainstem Skagit River and tributary streams from the Sauk River to Newhalem, excluding the Upper Cascade River (WDFW et al., 1994). Based upon redd counts, adult escapement for the period from 1985 to 2000 ranged from 409 to 4,584, with an average of 1,900 (WDFW, 2002). In general, adult escapement levels have tended to be lower in odd years than in even years, which may be partially attributable to incidental catch of Chinook in pink salmon fisheries, biennial differences in production or other factors (WDFW et al., 1994). Because of a long-term negative trend in escapement numbers, WDFW classified this Chinook stock as depressed (WDFW et al., 1994).

The Baker River system historically supported a portion of the fall Chinook that contributed to the Lower Skagit River stock; although Baker River return numbers prior to hydroelectric development are unknown, it is not certain whether returns to the Baker River system were fall or spring Chinook (Puget, 1983b; letter from G. Sprague, Major Projects Section Manager, Habitat Program, WDFW, Olympia, WA, to C. Freeland, Licensing Program Manager, Puget, Bellevue, WA, dated June 3, 2003). In 1921, a survey of the Baker River near Concrete noted the presence of "a few Chinook," although no quantitative studies were conducted (State of Washington, 1921). Chinook generally arrive at the Baker River trap from late July through November with a peak in October (table 5-18). An average of 220 Chinook salmon returned to the Baker River trap from 1926 to 2002, with a high of 1,453 Chinook in 1967 and low of 0 adults in 1938 (Puget, 2002a).

Originally, adult fall Chinook returning to the Baker River trap were transported to Baker Lake. In 1995, the WDFW reduced the number of adult Chinook transported to Baker Lake because it decided adults would have higher reproductive potential if they were returned to the Skagit River (Puget, 2002a). This decision was based on analysis of smolt trap counts, marine survival, and coded wire-tag analysis, which suggested that a high proportion of the adult Chinook entering the Baker River trap were actually strays from the Skagit River or from other Puget Sound drainages (letter from G. Sprague, Major Projects Section Manager, Habitat Program, WDFW, Olympia, WA, to C. Freeland, Licensing Program Manager, Puget, Bellevue, WA, dated June 3, 2003).

Juveniles from the Lower Skagit River fall Chinook stock are considered to be ocean type, because they generally migrate to the marine environment within a few weeks to months after emergence from the gravel. These Chinook salmon display two differing life history patterns—some fry migrate quickly to the estuary where they rear for an extended period and some of the Chinook remain in the riverine environment for several months following emergence and spend little time rearing in the estuary (Bishop and Morgan, 1996). In the Baker River, juvenile Chinook outmigration occurs from March through August, peaking in June and July (table 5-18). Over the past 11 years, an average of 1,303 juvenile Chinook salmon have been collected and transported downstream of the Baker Project annually. Based on length-frequency data, approximately 69 percent of the Chinook juvenile migrants handled at the Upper and Lower Baker facilities were classified as age-0 Chinook, 30 percent age-1+, and approximately 1 percent as age-2+ (Puget, 2002a).

The WDFW began introducing spring Chinook, with an early adult migration pattern, into the Baker River watershed in 1999. The intent of the experimental program is to determine if these Chinook are able to take advantage of habitat in and above the Baker River reservoirs (Puget, 2002a). From 1999 to 2002, the WDFW released 2,012; 673; 1,079; and 1,125 spring Chinook adults into Baker Lake, respectively (Baker River Committee [BRC], 2002a). The WDFW anticipates that 2002 will be the last year that WDFW would release Skagit River hatchery adults into Baker Lake. The WDFW will be monitoring the contribution of the 4,889 spring Chinook adults released since 1999 in an effort to evaluate the success of the experimental program (BRC, 2002b).

Adult spring Chinook released into the Upper Baker River have been observed spawning in Park and Swift creeks (BRC, 2000). As the experimental program is still rather new, productivity of spring Chinook in the Baker River system is not yet known. To provide for production of the experimental spring Chinook population, adult handling protocols at the Baker trap were altered in 2002. The new protocol states that unmarked Chinook adults less than 2.6 feet long entering the Baker trap prior to August 1 will be hauled and released into the Upper Baker River. Fish in this size class are presumed to be returns from the experimental releases of spring Chinook that began in 1999. Adult Chinook collected at the trap after August 1 are transported back to the Skagit River and released (BRC, 2002c).

Steelhead Trout

Three summer steelhead and three winter steelhead stocks have been identified in the Skagit River basin (WDFW et. al., 1994). Winter steelhead returning to the Baker River drainage belong to the Mainstem Skagit/Tributaries (Mainstem Skagit) stock (WDFW et al., 1994). This steelhead stock spawns in the Skagit River basin as far downstream as the city of Sedro-Woolley and upstream to the Seattle City Light hydroelectric projects. Escapement of the Mainstem Skagit River winter steelhead stock ranged from 3,780 to 13,194 from 1985 through 2001, with an average of about 8,150 adults (WDFW, 2002). The WDFW considers the Mainstem Skagit winter steelhead stock to be healthy, because, on average, escapement meets the goal of 6,000 adults (WDFW, 2002; WDFW et al., 1994).

In the Baker River basin, winter steelhead trout are a native species and are thought to have historically used areas primarily below Baker Lake for spawning (Puget, 1983c). Winter steelhead return to the Baker River from September through April. Summer steelhead adults have also been captured at the Baker River trap from April through August (table 5-18).

Since the completion of Lower Baker dam, steelhead adults captured at the Baker River trap have ranged from a low of 0 to a high of 929, although during some years the trap was not operated during the timing of steelhead returns (letter from G. Sprague, Major Projects Section Manager, Habitat Program, WDFW, Olympia, WA, to C. Freeland, Licensing Program Manager, Puget, Bellevue, WA, dated June 3, 2003). Steelhead returns increased to an average of 582 from 1988 through 1999, which was likely the result of a voluntary cooperative steelhead rearing program at the Lake Shannon net pen site conducted by Puget and the Skagit System Cooperative (which represents the Upper Skagit Indian Tribe, the Sauk-Suiattle Indian Tribe, and the Swinomish Tribal Community [Puget, 2002e]). This rearing program, which is described in greater detail in section 5.6.1.4, *Existing Fish Facilities and Programs*, was discontinued in 1998 due to budgetary constraints.

Until 1987, all adult steelhead entering the Baker River trap were transported and released in Baker Lake. After the net-pen rearing program was initiated in 1988, the steelhead policy was modified to transport only wild fish to Baker Lake due to stock dilution concerns (letter from G. Engman, Washington Department of Game, to R.W. Clubb, Puget, Bellevue, WA, 1988, as cited in Puget, 2002c). The steelhead transport policy was again modified in 1999 to exclude all summer-run fish (returning from June 1 to October 31), as well as hatchery returns, which are transported back to and released in the Skagit River. The number of adult steelhead transported to Baker Lake has been reduced recently as a result of poor reproductive success (Wasserman, 2002). This is evidenced by the juvenile collection data showing that from 1989 to 2001, an average of about 600 steelhead smolts were collected and transported downstream to the Skagit River (USFS, 2002a).

Juvenile steelhead in the Skagit River basin generally spend 2 or 3 years rearing in freshwater before migrating to the ocean. Steelhead juveniles are collected at the Project juvenile bypass system from April through July (table 5-18).

Pink Salmon

The Skagit River supports a single pink salmon stock that primarily uses the mainstem Skagit River and Sauk River. Spawning generally occurs from Newhalem (RM 93) downstream to Sedro-Woolley (RM 23), with the heaviest amount of spawning concentrated in the mainstem Skagit River from Marblemount (RM 78) upstream to Newhalem. Adult pink salmon primarily enter the Skagit River system in odd-numbered years. The Skagit River pink stock is the largest spawning stock in Washington State, with total run sizes ranging from 117,700 to 1,426,600 (average of 784,120 fish) from 1985 to 2001 (PFMC, 2003). Spawning escapements during the same period ranged from 60,000 to 894,100 fish, with an average of about 487,500 fish (PFMC, 2003). The WDFW considers this stock to be healthy (WDFW et al., 1994).

This historical presence of pink salmon in the Baker River system is largely unknown, as there are no data available to document the historical presence of pink salmon spawning areas in the Baker River drainage (Puget, 1983b). It is possible that in the past pink salmon may have used the mainstem Baker River or tributaries for spawning, although this cannot be confirmed.

An average of 347 pink salmon adults have been collected each year at the Baker River trap since 1926. Adults normally arrive at the trap from August through November, with the peak migration occurring in October (table 5-18). Fisheries management policy generally has been to return all pink salmon collected in the Baker River trap to the Skagit River (Puget, 2002c). This policy recently has been altered so that in years when the Skagit River escapement goal is reached, pink salmon entering the Baker River trap are transported to Baker Lake and released (letter from J. Phipps, Forest Supervisor, MBSNF, USFS, Mountlake Terrace, WA, to L. Pernela, Manager of Licensing, Energy Production and Storage, Puget, Bellevue, WA, dated July 22, 2002). One such release occurred in 1994. Small numbers of juveniles from the adults released were collected at the gulpers from April through July, with a peak in June (table 5-18). Pink salmon juveniles may have difficulty migrating through Project reservoirs.

Chum Salmon

The WDFW defines three stocks of Skagit River chum salmon: Mainstem Skagit, Sauk, and Lower Skagit Tributaries (WDFW et al., 1994). The Mainstem Skagit stock spawns in the mainstem Skagit River and larger tributaries from Newhalem (RM 93) downstream at least as far as Lyman (RM 34). Spawning primarily occurs from mid-November to late December, peaking in late November or early December. Skagit River chum tend to spawn in side channels or protected mainstem areas (WDFW et al., 1994).

Small numbers of chum salmon began returning to the Baker River traps starting in 1972 (only one adult was documented at the traps prior to that year). An average of 21 adult chum have been collected at the Baker River trap over the last 31 years. Most of the chum collected are assumed to be strays from the Skagit River. When adult chum are observed at the trap, they normally arrive from late September through December, with peak returns in November (table 5-18) (Puget, 2002c). Under current fisheries management, any adult chum captured is transported and released back into the Skagit River, as chum may not effectively migrate through reservoirs (BRC, 2002c).

Coastal Cutthroat Trout (Sea-run)

The WDFW has identified the Skagit River coastal cutthroat as a separate stock, based upon the geographic distribution of their spawning grounds. The watershed supports all life-history forms including anadromous, adfluvial, fluvial, and stream residents. All forms of cutthroat in the basin are considered native and are maintained by wild production (Blakley et al., 2000). There are no data regarding the total production, catch, or escapement for anadromous coastal cutthroat trout in the Skagit River. A rough estimate of approximately 13,000 returning spawners was observed in 1997 (Johnson et al., 1999). Because of the limited information regarding the abundance of coastal cutthroat in the Skagit River drainage, WDFW considers the status of the stock as unknown (Blakley et al., 2000).

The Baker River is known to support at least adfluvial and stream resident coastal cutthroat trout, which are described in greater detail in the following section. The status of anadromous cutthroat in the Baker River system is not fully understood, as documentation of adult collections at the Baker River trap has only been kept since 1995. From 1995 to 2000, 18 adult cutthroat were collected at the trap. Adult coastal cutthroat trout migrate into the Baker River sporadically throughout the year, but primarily in October and November (table 5-18).

There is increasing evidence that resident coastal cutthroat trout populations may have the capacity to produce marine migrants (67 FR 44933). Therefore, adfluvial and resident cutthroat in the Baker River system may produce anadromous progeny. There have been small numbers of juvenile cutthroat trout sampled at the Upper Baker River juvenile outmigrant trap, usually from April through July, peaking in May (table 5-18). For example, in 2001 and 2002, a total of 35 and 69 juveniles were collected at the trap, respectively. It is not known whether these fish are the progeny of anadromous or resident cutthroat.

Management of coastal cutthroat trout fisheries in the Baker River system is under the jurisdiction of WDFW and Tribal interests. Baker River cutthroat trout are included on the USFS Regional Forester's Sensitive Animal list.

Pacific and River Lamprey

Pacific and river lamprey both exhibit anadromous life history strategies. Upon hatching, larvae (ammocoetes) reside for several years in fine silt deposits in quiet backwater areas of streams. These immature lamprey are blind and toothless filter-feeders. At maturity, they are approximately 4 to 5 inches long, and they develop functioning eyes and teeth. River lamprey and Pacific lamprey then become parasitic, using other fish as hosts. Mature Pacific and river lamprey migrate to the ocean where they feed on fish hosts for several years before returning to freshwater to spawn (Nawa, 2003).

Anadromous lamprey historically had access to the Baker River at least as far upstream as Baker Lake. It is not known whether adult Pacific or river lamprey enter the adult collection facility, although no fish have been transported above Lower Baker dam since 1929. There have been no confirmed Pacific or river lamprey observations in the Baker River basin upstream of Lower Baker dam (Puget, 2003e).

On January 23, 2003, a group of 11 non-governmental organizations petitioned the FWS to list four species of lamprey in California, Oregon, Washington, and Idaho as threatened or endangered species under the ESA. These four species include Pacific lamprey (*Lampetra tridentate*), river lamprey (*L. ayresi*), Western brook lamprey (*L. richardsoni*), and Kern brook lamprey (*L. hubbsi*) (Nawa, 2003). The FWS is currently reviewing the status of these species and has not made a decision regarding the listing petition.

White Sturgeon

White sturgeon have historically had access to the Baker River. Sturgeon primarily inhabit large river systems and can be found holding in deep pools in the Lower Skagit and Snohomish rivers (Puget, 2003e). Adult sturgeon spend time rearing in estuarine and marine environments and spawn in freshwater during the spring. The historical presence of white sturgeon in the Baker River system has not been confirmed, and no adults have been captured for transport upstream of the Lower Baker dam.[17]

5.6.1.3 Resident Fish Species

Fifteen species of resident fish have been confirmed in the Baker River system. These include five species of native game fish, six species of native non-game fish, three species of non-native game fish, and one species of non-native, non-game fish (table 5-19). The paragraphs below provide a brief description of those resident fish species for which there is information specific to the Baker River system.

Table 5-19. Resident fish species confirmed present in the Baker River Project area.

Common Name	Scientific Name	Status
Kokanee (sockeye salmon)	*Oncorhynchus nerka*	Native game fish, common
Rainbow trout	*Oncorhynchus mykiss*	Native game fish, common
Coastal cutthroat trout	*Oncorhynchus clarki*	Native game fish, common
Bull trout	*Salvelinus confluentus*	Native game fish, common
Dolly Varden	*Salvelinus malma*	Native game fish, common
Mountain whitefish	*Prosopium williamsoni*	Native non-game fish, common
Three-spine stickleback	*Gasterosteus aculeatus*	Native non-game fish, uncommon
Torrent sculpin	*Cottus rhotheus*	Native non-game fish, common
Prickly sculpin	*Cottus asper*	Native non-game fish, common
Coastrange sculpin	*Cottus aleuticus*	Native non-game fish, common
Largescale sucker	*Catostomus macrocheilus*	Native non-game fish, common
Eastern brook trout	*Salvelinus fontinalis*	Non-native game fish, common
Brown trout	*Salmo trutta*	Non-native game fish, uncommon
Lake trout	*Salvelinus namaycush*	Non-native game fish, uncommon
Pumpkinseeds	*Lepomis gibbosus*	Non-native non-game fish, uncommon

[17] The Nature Conservancy commented that the discussion regarding native species, including lamprey and white sturgeon, should be expanded (electronic mail from L. Barson, Director of Federal Government Relations, The Nature Conservancy, to C. Freeland, Licensing Program Manager, Puget, Bellevue, WA, dated June 3, 2003). Available information has been reviewed and included in the analysis. Detailed information pertaining to lamprey, white sturgeon, and resident species abundance and distribution is not available, and adequate data about pre-project habitat conditions to characterize historical habitat availability do not exist.

Native Char (Bull Trout/Dolly Varden)

Puget has compiled general information regarding native char in the Baker River system; thus, the majority of the information presented below is from Puget's 2002 biological assessment for bull trout (Puget, 2002f). Information regarding the ESA status of Baker River bull trout is presented in section 5.8, *Federally Listed Threatened and Endangered Species and Essential Fish Habitat*. It is also important to note that both bull trout and Dolly Varden are char, classified in the genus Salvelinus. The two species are difficult to differentiate without genetic analysis. Therefore, references to bull trout or use of the term "native char" throughout this document are assumed to reflect both bull trout and Dolly Varden unless differences are specifically identified.

Bull trout can express four different life history patterns: anadromous, adfluvial, fluvial, and resident. The Skagit River basin supports the largest population of native char in the Puget Sound. All four life history patterns are displayed by native char in the basin and there is considerable overlap between fish exhibiting different life history strategies (WDFW, 1998).

Native char from the Baker River system were originally thought of as a separate stock because of their geographic distribution (WDFW, 1998). However, after further review of the Skagit River basin subpopulations, native char from the Baker River were designated as part of the Lower Skagit River stock (personal communication, C. Kraemer, WDFW, 2002, as cited in Puget 2002f). The WDFW considers this stock to be healthy based on large numbers of spawning adults and consistent counts in tributary streams (WDFW, 1998). Bull trout from this stock tend to spawn in the upper reaches of tributary streams, and no spawning has been noted in the mainstem Skagit River below the confluence with the Baker River.

There is little information on Baker River bull trout abundance and records of adult bull trout collection at the Baker River trap were not kept prior to 1994. Since 1994, an average of 18 native char per year have been collected at the adult trap and released into Baker Lake. However, it should be noted that the existing adult trap has a limited ability to catch smaller fish due to screen size. Therefore, actual numbers of adult bull trout migrating to the Lower Baker River may be greater than the capture numbers indicate. Adults generally arrive at the Baker River from May through January, with peaks occurring in May and October. It is not known whether native char moving between the mainstem Skagit River and the Baker River drainage exhibit an anadromous, adfluvial, or fluvial life history form, or a combination of all three (Puget, 2002c).

Few juvenile native char are counted at the Baker River Project downstream passage facility (an average of only 7 juveniles were counted from 1994 to 2002), but it is unclear whether this is the result of insufficient sampling or is indicative of a low rate of downstream movement. Large native char are frequently observed holding at the entrance to the downstream fish passage facilities in both reservoirs during the spring, presumably feeding on outmigrating salmonids. Large native char are also reported to congregate immediately below Upper Baker dam during the spring (Puget, 2002f).

The majority of char production is thought to come from tributaries to Baker Lake, including the Upper Baker River, Park Creek, and Pass Creek, although juvenile char have been observed in several tributaries to Lake Shannon (i.e., Bear and Sulphur creeks) (Puget, 2000f). Spawning in the Baker River system likely occurs from September through October (Goetz, 1989; Craig, 1997). Optimum water temperature for bull trout egg incubation is between 2 to 4°C. Bull trout require up to 220 days between egg deposition and emergence, making them especially vulnerable to habitat changes (FWS, 1998). Depending on the life history pattern, juvenile bull trout may be present in Baker River streams or tributaries year-round. Optimal water temperatures for rearing bull trout are about 7 to 8°C (Goetz, 1989).

Rainbow Trout

Rainbow trout have similar biology and habitat requirements to the anadromous steelhead component of the species. Rainbow trout are native to the Baker River watershed and are found in both Project reservoirs in addition to many of the tributary streams. These fish remain in freshwater for their entire lives and therefore reach smaller sizes at maturity than anadromous steelhead. In the Baker River system, most resident rainbow trout are less than 10 inches in length (Puget, 1983c).

Rainbow trout spawn in the spring, generally from February through May. The exact distribution of rainbow trout spawning in the Baker River system is unknown. Fry emerge in the late spring or early summer. Rearing juveniles may be present in tributary streams or the Project reservoirs feeding primarily upon macroinvertebrates, with larger individuals occasionally feeding upon small fish (Wydoski and Whitney, 1979).

As part of the recreational fishery in the Baker River system, rainbow trout have been stocked annually into Baker or Depression lakes since 1968 through a cooperative effort between Puget and WDFW. Details regarding this program are provided in section 5.6.1.4, *Existing Fish Facilities and Programs*.

Coastal Cutthroat Trout

Resident coastal cutthroat trout are also native to the Baker River system and share the same general biology and habitat requirements as the anadromous component of the species. Cutthroat trout have been found in both Project reservoirs and numerous tributary streams. In the past, unknown hatchery cutthroat trout stocks have been introduced to the watershed through releases in lakes and streams in the basin. No specific data were found regarding the extent of cutthroat stocking in the Baker River basin and details regarding abundance and distribution of the species in the basin are not well understood.

Resident cutthroat trout generally spawn from January through April in the upper portions of tributary drainages. Most juveniles have emerged from the gravel by mid-spring, where they rear for approximately 1 year before moving downstream to larger streams or lakes (Wydoski and Whitney, 1979). Cutthroat trout are opportunistic feeders, mostly consuming macroinvertebrates, although small fish are also a dietary component of larger resident adults (Cartwright et al., 1998).

Kokanee

The biology and distribution of kokanee salmon are similar to that of the species' anadromous component, the sockeye salmon. The U.S. Bureau of Fisheries (now FWS) reports suggested that the Baker River kokanee stock became established only after the creation of Lake Shannon. Beginning in 1927, large numbers of kokanee were observed in the Baker Lake System. In subsequent years, it was also observed that whenever there was limited overflow at Upper Baker dam during juvenile outmigration periods, above average numbers of sockeye would remain in Baker Lake (Puget, 1983b).

Adult kokanee usually reach smaller sizes at maturity in comparison to sockeye salmon, as lake environments are generally less productive than the ocean (Meehan and Bjornn, 1991). There have been no formal studies to quantify the abundance of kokanee in Baker Lake. Preliminary study of *O. nerka* taken in the sport fishery and collected at the Baker Lake juvenile collector suggests that most of the fish caught by anglers are actually residual sockeye salmon, not kokanee, although this has not been fully evaluated (Blakley and Volk, 1998; Puget, 2002c).

In the Baker River system, kokanee are believed to spawn in some of the smaller tributaries of Baker Lake and have been seen during spawning surveys in Channel Creek and immediately downstream of the Upper Baker dam (Puget, 2002c; personal communication, N. Verretto, Puget, Bellevue, WA, and M. Daily, Fisheries Biologist, Meridian Environmental, Seattle, WA, on September 16, 2003). Historically, kokanee also spawned in Silver Creek, the site of the original Baker Lake hatchery, although surveys in later years did not identify spawning activity in the stream (Puget, 2002c; Puget, 1983b). In general, kokanee mature and migrate into their natal streams from late August through October, with peak spawning occurring from September through late October.

In addition to natural kokanee production, WDFW has introduced Lake Whatcom hatchery kokanee to the Baker River system for the purpose of a sport fishery. From 1934 to 1940, an average of 228,500 kokanee were released in Lake Shannon (letter from J.M. Johnston to A. Blakely, WDFW, re: Baker Reservoir kokanee sport fishery, dated March 15, 1998). Since 1995, WDFW has resumed releases of Lake Whatcom kokanee into Lake Shannon, planting approximately 97,000 to 343,000 fry per year (Young, 2003; BRC, 2002a). Kokanee have been observed in Sulphur Creek. Genetic testing of *O. nerka* taken in the Lake Shannon sport fishery suggests that the majority of the fish caught by anglers are actually sockeye salmon from the Baker Lake population (Young, 2003). The fate of the kokanee released in Lake Shannon is not fully understood, but it is thought that a high percentage of these fish may succumb to infectious hematopoietic necrosis (IHN) virus infections, as the Lake Whatcom stock has little natural resistance to the disease (letter from G. Sprague, Major Projects Section Manager, Habitat Program, WDFW, Olympia, WA, to C. Freeland, Licensing Program Manager, Puget, Bellevue, WA, dated June 3, 2003).

Other Native Resident Species

Baker Lake historically supported a reportedly large native mountain whitefish population. These fish are currently present in Baker Lake and tributary streams, although abundance in the system is not known. In addition, other non-game resident fish species are native to the basin including: three-spine stickleback, torrent sculpin, prickly sculpin, coastrange sculpin, and largescale sucker. Puget fisheries personnel have frequently observed largescale sucker adults feeding on the algae and collected detritus of the Baker Lake and Lake Shannon guide nets, net pens, and FSCs (Puget, 2002c). All of these fish species have also been identified in various fisheries sampling efforts conducted by Puget over the years. There is no specific information regarding abundance and distribution of these native, non-game resident species. Western brook lamprey may also inhabit the Baker River drainage, although the presence of the species has not been confirmed. If the species is present, its abundance is likely low (Puget, 2003e).

Non-native Fish Species

Eastern brook trout, brown trout, pumpkinseeds, and possibly lake trout can be found in the Baker River basin. These four species are not indigenous to the system. Brook, brown, and lake trout were raised at the Baker River hatchery from 1933 to 1937 and planted in various lakes and streams throughout the watershed (Puget, 1983b). The exact numbers of these plants are not known. In recent years, eastern brook trout have been found in both Project reservoirs and various tributary streams, while brown trout have been identified in the Baker River adjacent to Spawning Beach 4 (Puget, 2002c). Pumpkinseeds have been sampled in recent years at the Lake Shannon juvenile fish trap. Lake trout have not been observed in the system since Project construction. The presence of eastern brook trout is of particular concern due to the ability of the species to hybridize with bull trout, which are protected under ESA.

5.6.1.4 Existing Fish Facilities and Programs

As part of the existing license for the Baker River Project, Puget is required to provide upstream and downstream fish passage and operate spawning beaches for sockeye production. In addition to these programs, Puget also operates the Sulphur Creek hatchery facility, where voluntary production and rearing programs are conducted. These facilities and programs are described in the following sections and are depicted on figure 5-19 (appendix A).

Adult Fish Passage

Adult upstream passage is provided at the Baker River Project through the use of a trap-and-haul fish transport system.

As is the case with most adult trap-and-haul facilities, the system at the Baker River Project is operated as a four-step process.

(1) A tailrace barrier (barrier dam) along with attraction flow (80 cfs) is used to guide the adults from the river into the trapping facility where they are directed into two holding pools, each 40 feet by 15 feet.

(2) A crowder system is then used to force the adults from the holding pools into a sorting and counting facility.

(3) Adults selected for transport are crowded using a vertical crowder (brail) and moved into the hopper pond. The hopper is a steel tank that holds approximately 1,000 gallons of water. The hopper is then lifted by crane and the fish-laden water is transferred into a transport truck equipped with aeration and oxygen diffusers.

(4) After loading, the fish are transported to release locations in the basin based on management objectives dictated by Treaty Tribes and WDFW for the species being transported. For fish transported to the Upper Baker facilities, total transport time is approximately 20 to 25 minutes.

The current Baker River Project upstream adult trap-and-haul facilities are located at RM 0.6 and have been in operation since 1957. The original adult collection facility, operated from 1926 to 1957, was located at the Lower Baker River powerhouse. The major fish species transported or collected at the Baker River trap include coho, sockeye, Chinook, steelhead, pink, chum, and native char. On average, about 10,000 anadromous fish are transported yearly from this facility. The most fish transported in any year since 1926 was approximately 32,000 fish. From 1994 to 2002, an average of 18 adult char was also collected each year at the facility, and transported and released upstream of the Upper Baker River Project (Puget, 2002f).

In general, the adult passage facilities operate year-round with the exception of a brief maintenance repair period that occurs in May or June.

Juvenile Fish Passage

Downstream migrating fish are able to pass Project facilities through spillways, turbines, and juvenile fish collection facilities. Juvenile fish passage facilities are located both at Upper and Lower Baker dams. The facilities at both Projects are similar in design and function. However, juvenile facilities at Lower Baker dam are smaller than those at Upper Baker dam. The juvenile passage systems function as follows:

(1) Full-depth barrier nets direct fish away from turbine openings and guide downstream migrating fish into the gulper, referred to as the gulper. The nets are constructed of 0.25-inch square mesh netting that extends completely across and to the bottom of the forebay.

(2) The gulper is an FSC equipped with a pumping system that provides the flow needed to attract downstream migrants to the entrance of the FSC. Total flow into the Upper Baker gulper is 130 cfs. The entrance of the FSC is 12 feet wide and extends approximately 9 feet below the surface of the water.

(3) The water and fish entering the FSC encounter a set of wooden louvers that are used to separate the fish from the flow. The louvers act as a fish behavioral device that directs migrants up into a 3-foot-wide chute that leads them to the FSC.

(4) Captured juveniles are sampled for biological information, counted, transferred to a tank trailer and trucked to the mouth of the Baker River where they are released.

Besides size, other differences between the juvenile facilities at Upper Baker and Lower Baker exist. Upper Baker has more pumping capacity through the gulper, has a larger collection trap, was the first to have full depth nets, and loads fish at the head of the dam. Lower Baker captures fewer fish, has a smaller-scale collection trap, and barges fish to shore for transport. Upper Baker has the more effective capture system and thus has become the focus of the downstream collection process, with most all production coming out of Baker Lake.

An engineering review of the juvenile collection facilities at both locations showed that the Upper Baker River system was in good working order as the guide nets and trapping facility were relatively new. However, the review also showed that the Lower Baker facility was considered to be in poor condition, primarily as a result of problems with debris handling (Montgomery Watson, 1999).

From 1987 to 2001, the average number of downstream migrants collected at Upper and Lower Baker was approximately 127,000 and 13,000, respectively. The juvenile fish passage facilities generally operate from March through July. When these facilities are not in operation, downstream migrants may pass through the Project via spillways and turbines.

Fixed-aspect hydroacoustics have been used in Baker Lake to estimate numbers of fish entering the turbine intakes versus those that enter the juvenile collection facility. The resulting data indicate that the percentage of fish using the bypass versus those entering the Project intake was estimated to be about 71 percent from 1988 to 1995. However, because of inconsistencies in the data, the efficiencies estimated from the hydroacoustic studies may not be fully representative of actual conditions.

Mark-recapture studies were also conducted from 1992 to 2002. Based on these studies, approximately 53 percent of juveniles used the Baker Lake FSC, while 23 percent used the Lake Shannon FSC. The numbers presented for the two FSCs are not true efficiency values because natural residualization and mortality associated with juvenile passage through the reservoirs affects the numbers available for capture at each FSC. Study-related handling stress and mortality may have also influenced the result. It should also be noted that approximately 2 percent of the marked coho released in Upper Baker over this same period was collected at the Lower Baker FSC. These data indicate that some juveniles are able to successfully migrate past the Project through turbines or spill.

Spawning Beaches

During construction of Upper Baker dam, WDFW began conducting studies to address sockeye spawning habitat, as the new Baker Lake would increase the water level by 60 feet, inundating historical spawning areas. To replace the lost sockeye spawning habitat, WDFW, with funding from Puget, created three spawning beaches at the upper end of Baker Lake along Channel Creek. Sockeye salmon Spawning Beaches 1, 2, and 3 were constructed in 1957, 1959, and 1966, respectively. Spawning Beach 1 was simply a test facility with the capacity for 100 spawning adults and was decommissioned in 1965. In addition, Spawning Beach 2 has not been used since 1994.

Spawning Beach 3 is an artificial pond approximately 100 feet by 150 feet with a designed capacity of 1,500 sockeye. Approximately 5 to 10 cfs of water is diverted from Channel Creek to supply the pond. A series of pipes underneath the spawning beach distributes the water, which percolates through the gravel to simulate natural sockeye spawning areas. Adult sockeye collected at the Baker River trap are delivered to the beaches and allowed to spawn naturally. After emergence, fry tend to spend between 10 to 14 days at the beach before volitionally migrating to Channel Creek and ultimately to Baker Lake (Quistorff, 1960). Egg to fry survival rates at the upper spawning beaches have been quite high, ranging from 25 to 95 percent and averaging about 61 percent, which is substantially higher than what would be expected in the wild (Puget, 2002g).

Because of concern that the migrating Upper Baker River channel would eventually reclaim the spawning beach facility, Spawning Beach 4 was constructed in 1990 at the Sulphur Creek facility. Spawning Beach 4 is also an artificial pond measuring 200 feet by 150 feet. The pond uses approximately 10 cfs of water, which is provided by a series of springs. Water is distributed using a similar system to the previous beaches, which allows inflow to percolate through the gravels to mimic natural spawning conditions.

Spawning Beach 4 has a standard capacity of 3,400 adults. In 2003, the upper limits of capacity are being tested with 3,750 adults. After a couple of years of initially poor survival due to sedimentation associated with slides at the water intake, egg to fry survival rates have been comparable to those observed at the upper spawning beaches. From 1993 to 2000 survival rates based on estimates of fecundity ranged from 40 to 74 percent with an average of about 57 percent. Fry emerging from the gravel at Spawning Beach 4 are allowed to volitionally exit the beaches where they are held at a collection structure until they are transported to Baker Lake and released at various locations.

Originally Spawning Beach 4 was managed as a single unit. However, because of concerns regarding an IHN virus outbreak in 1994, the beach was divided into four isolated compartments, each measuring 50 feet by 150 feet. Currently, if the IHN virus infection is detected in one of the compartments, the effluent can be diverted for chlorination treatment in accordance with the disease management protocol for the facility. Spawning adults carry the virus to the facility (BRC, 1999). In recent years, efforts have been made to remove adult sockeye from the spawning beaches earlier in the season in an attempt to avoid IHN virus transmission to emerging sockeye fry. Since the early removal of adults has been initiated, incidences of IHN virus infection have been dramatically reduced (BRC, 2002c). Efforts at reducing adult density in Spawning Beach 4 were also attempted, although no causal link was established between density and incidences of IHN virus infection (BRC, 2001).

The Upper Baker River channel has not yet caused the forecasted destruction of the Spawning Beach 3 facility. Therefore, as an attempt to spread the risk of production failures due to disease or other unforeseen events at Spawning Beach 4, the BRC has decided to continue using Spawning Beach 3.

Spawning Beach 3 is now operated as an unattended facility. In recent years, low flows in Channel Creek have led to concerns regarding the adequacy of water being supplied to the beach in dry years. A special-use permit issued by the USFS to Puget requires that Spawning Beaches 1, 2, and 3 be formally decommissioned when they are no longer needed (letter from J. Phipps, Forest Supervisor, MBSNF, USFS, Mountlake Terrace, WA, to L. Pernela, Manager of Licensing, Energy Production and Storage, Puget, Bellevue, WA, dated July 22, 2002). As Spawning Beach 3 remains in operation, no actions have been taken toward decommissioning.

Since the spawning beaches began operation, an average of about 1,355,000 sockeye fry have been produced each year at these facilities.

The Sulphur Creek Facility and Voluntary Fisheries Programs

The Sulphur Creek facility, located downstream of Upper Baker dam along Sulphur Creek, was constructed in the 1970s. It is used for sockeye, coho, and rainbow trout propagation. The facility consists of a large rearing pond, five raceways, five circular ponds, and several work/storage sheds. Puget and WDFW staff operate the facilities.

One of the activities conducted at the Sulphur Creek facilities is the voluntary sockeye rearing program. This supplementation program was initiated in response to declining sockeye runs. Since 1986, aside from some years in which the IHN virus was a concern, a portion of the fry produced at the spawning beaches (generally 60,000 to 130,000) have been raised in net pens at Lake Shannon or at the Sulphur Creek facility as a means of increasing sockeye smolt production (SSC, 1996; Puget annual fish reports 1987 to 2002). Until 1996, these fish were primarily reared at the Lake Shannon net pens and released as smolts, although rearing in the net pens was discontinued due to IHN virus outbreaks. Since that time, about 130,000 sockeye fry have been reared for supplementation each year at the Sulphur Creek facility. These sockeye are released in the spring and fall as sub-yearlings. Because of concerns regarding the IHN virus, sockeye fry were not released in 1997, 1999, and 2000, although the program was resumed in 2001.

Puget has also been voluntarily rearing coho salmon since 1981. In the early years of the program, coho fry were transferred from WDFW's Marblemount hatchery on the Skagit River and raised in the raceways at the Sulphur Creek facility. Beginning in 1987, the program was expanded to also include coho rearing in the net pens on Lake Shannon. From 1990 to 2001, an average of about 52,420 coho smolts was released from the net pens each year (Puget annual fish reports 1991–2002). In recent years, approximately 50 percent of adult fish returning to the Baker River system have been from the voluntary coho rearing program.

Beginning in the early 1990s, Puget and WDFW began using naturally reproduced coho adults from the Baker River system as broodstock for the voluntary coho rearing program. The eggs are incubated at the Sulphur Creek facility, and the resulting fry are either transported to fry release sites in the basin or reared in the net pens until release as smolts.

In addition, a cooperative rainbow trout stocking program has been conducted voluntarily between WDFW and Puget since 1968. WDFW provides the rainbow trout fingerlings and Puget rears them at the Sulphur Creek facility. These fish have primarily been of non-native Goldendale stock with limited use of other stocks including Nisqually, Tokul, and Cowlitz (used earliest in the program). Since 1990, an average of about 26,700 rainbow trout has been released annually prior to the July 4 weekend. In the past, these fish were primarily planted in Baker Lake, with small numbers occasionally released in Lake Shannon and Depression Lake. Beginning in 2002, all of the rainbow trout produced (18,792) were released into Depression Lake to avoid potential adverse interactions with native fish in Baker Lake.

The Skagit System Cooperative, in conjunction with Puget, also conducted a voluntary steelhead rearing program from 1987 to 1998. The program used steelhead fry transported from Skagit River hatcheries. These fish were raised at the Lake Shannon net pens until they were released as smolts. While the program was in operation, an average of approximately 52,500 steelhead smolts were released each year (Puget annual fish reports 1988–1998). The program was discontinued in 1998 due to budgetary constraints.

In 2002, Puget and WDFW constructed an egg incubation building at the Sulphur Creek facility as part of a sockeye supplementation pilot program and to safeguard against production losses from IHN-related mortality at the spawning beaches. The structure is approximately 27 feet long by 12 feet wide and uses water from the same spring as Spawning Beach 4. The facility uses approximately 0.07 to 0.08 cfs. Funding for the facility is provided by Puget, and the WDFW oversees operations (personal communication, K. Kurras, Hatchery Specialist, WDFW, Concrete, WA, and M. Daily, Fisheries Biologist, Meridian Environmental, Seattle, WA, on March 13, 2003).

The purpose behind the incubation program is to provide an additional option for sockeye production in years when the spawning beaches do not meet production goals in the event of an IHN virus outbreak. The program would produce 1 million sockeye fry. If full spawning beach production goals are met and no IHN virus is detected, then one-half of the fry produced would be released in Lake Shannon and one-half in Baker Lake. If the IHN virus is detected, then 70 percent of the fry produced at the incubation facility would be released in Baker Lake and 30 percent released in Lake Shannon. These fish would be released as unfed fry (BRC, 2002b).

5.6.1.5 Fish Harvest

Anadromous fish from the Baker River are subject to all of the same fisheries affecting Skagit River stocks, from terminal area fisheries in the Skagit River and Skagit Bay to Pacific Ocean fisheries. However, there is limited information that relates directly to the commercial harvest of Baker River fish, as estimates tend to be for the Skagit River basin as a whole. For example, the Pacific Fishery Management Council (PFMC) estimated that between 1990 and 2000 commercial net catches in the Puget Sound took an average of about 7,750 coho, 1,340 Chinook, and 263,000 pink salmon that originated from the Skagit River (PFMC, 2003). By comparing Skagit River coho escapement estimates and Baker River adult trap returns with harvest numbers, we estimate that an average of approximately 840 Baker River coho were harvested each year in the Puget Sound commercial fishery from 1990 to 2000 (WDFW, 2002; PFMC, 2003). However, this rough estimate does not account for coho returning to the Baker River trap that may have been strays from the Skagit River, although straying rates of coho in the system have been shown to be rather low (letter from G. Sprague, Major Projects Section Manager, Habitat Program, WDFW, Olympia, WA, to C. Freeland, Licensing Program Manager, Puget, Bellevue, WA, dated June 3, 2003). Past and ongoing commercial harvest of Baker River salmonid stocks is considered another important factor that has contributed to declines in abundance.

In addition to commercial catches, Tribal fishing on the Skagit River has been an important influence on adult returns. From 1936 to 1970, the Tribal net fishery in the Skagit River and Skagit Bay took an average of about 1,000 sockeye (Puget, 1983b). The usual and accustomed fishing places of the Swinomish, Upper Skagit, and Sauk-Suiattle Tribes include the Baker River. The SSC, the fisheries management agency for these Tribes, has co-management authority with WDFW over the Baker River fisheries (USFS, 2002a).

Recreational angling is also an important component affecting Baker River fisheries. The recreational fishery generally comprises sockeye, kokanee, rainbow trout, and residualized coho and occurs on both Lake Shannon and Baker Lake. As discussed in the species descriptions above, kokanee and rainbow trout are planted in the basin specifically for recreational harvest.

Since 1987, Puget has conducted angler surveys on both reservoirs, normally during the opening day of fishing season. These surveys have found that in Baker Lake, kokanee and residual sockeye comprise the vast majority of the fishery, generally ranging from about 85 to 98 percent of the catch. Coho are the second most caught species in Baker Lake comprising about 1 to 5 percent of the catch in most years. Rainbow trout catches were also observed in most years, but at substantially lower numbers than coho, kokanee, and residualized sockeye. The Lake Shannon fishery displays the same basic species catch distribution. Kokanee and residualized sockeye generally make up about 85 to 95 percent of the fishery, followed by coho at about 1 to 15 percent, and then rainbow trout. In both reservoirs, Chinook salmon, cutthroat trout, and native char are also caught in low numbers. The catch per unit effort (CPUE) for anglers on Baker Lake has ranged from 0.35 to 2.08 fish/angler-hour, while Lake Shannon CPUE has ranged from 0.34 to 2.79 fish/angler-hour.

Since the 1970s, WDFW has also conducted periodic angler surveys at Baker Lake; however, these data have not been formally compiled and the raw data sheets could not be summarized for this analysis.

5.6.2 Environmental Effects

5.6.2.1 Effects of Project Operations

The effects of reservoir level management and Project releases on aquatic resources in the Baker Project area are described below. Of note is that the following effects analyses rely heavily on analyses and figures presented in sections 5.4.2.1, *Effects of Project Operations*, in *Water Quantity* and 5.5.2.1, *Effects of Project Operations*, in *Water Quality*.

Reservoir Level Management

As discussed in section 5.4.2.1, reservoir water levels fluctuate as a result of current Project operations (No-action Alternative) and would also fluctuate under the Draft Action. These fluctuations have the potential to affect water quality, such as DO concentrations, water temperature, TDG, and turbidity in the reservoirs, as well as in the Lower Baker River and Skagit River downstream of the Baker River confluence. Changes in water quality and bank erosion can affect aquatic habitat quality and quantity and also fish spawning.

Three measures included in the Draft Action would affect reservoir elevations. PME 6.3 is based on aquatic, recreational, cultural, and terrestrial resource needs, as well as human health and safety, property and Project economic and operational issues. PME 5.1 is associated with flood control and is based on Puget's flood control agreement with the ACOE. PME 3.5.2 restricts drafting Lake Shannon below an elevation of 383.75 feet (NAVD 88) to limit the likelihood of resuspending fine sediments that have deposited in the reservoir. Refer to appendix B for the full text of these measures.

Figures 5-8 through 5-12 in section 5.4.2.1 show that operating the Project under the Draft Action would typically result in an earlier drawdown and later refill of Project reservoirs in comparison with current conditions. Input received during the collaborative relicensing process highlighted the importance of reducing the resuspension of fine sediments (water quality issue) in Lake Shannon and reducing redd-dewatering (fish habitat issue) at tributary mouths of Baker Lake caused by reservoir drawdown. Therefore, we present effects analyses for reservoir level management with regard to effects on water quality and fish habitat.

Water Quality—Reservoir level fluctuations can affect water quality by increasing bank erosion and resuspending fine sediments that have accumulated at the bottom of reservoirs. Reservoir fluctuations can also affect DO concentrations, turbidity levels, and water temperatures (section 5.5, *Water Quality*).

Effects Analysis

Based on the analysis and information presented in sections 5.3.2.1, 5.4.2.1, and 5.5.2.1 and on data included in Puget (2003n), it is not known on a quantitative basis to what extent the Draft Action would affect erosion and turbidities, DO concentrations, water temperatures, or TDG when compared with current operations. However, it is suspected that turbidity events would be less frequent and TDG in the Lower Baker River would be reduced compared with existing conditions. This would be beneficial to aquatic resources, because elevated TDG concentrations can negatively affect juvenile fish survival and elevated turbidity could cause siltation of salmonid spawning grounds in the Middle Skagit River, which could reduce egg survival. Elevated turbidity could also cause chronic and acute stress response in fish species, lower juvenile fish survival, interfere with adult migration, and cause direct mortality at very high levels.

The 3-year water quality monitoring program associated with the Draft Action would allow for the continued study of and early identification of potential water quality problems caused by the Project and would facilitate remedies to these problems. Therefore, effects on aquatic resources under the Draft Action would be minimized and avoided to the extent that potential water quality problems could be addressed by operational or technical solutions.

Fish Habitat—Reservoir fluctuations in Baker Lake may affect salmonid spawning habitat for bull trout, coho, and sockeye salmon. Redds constructed in tributary delta areas may be subject to dewatering caused by reservoir drawdown, scour during channel migration, or inundation during subsequent reservoir refill (FWS, 2001; SSC, 1996).

Although the majority of native char (bull trout and Dolly Varden) spawning is thought to occur in tributary streams located a considerable distance above Baker Lake, it is believed that some char spawn in the deltas of tributaries that flow into Baker Lake (Puget, 2003q). During November 2000, one native char was observed holding near a redd in the area subject to inundation and was considered to be within the drawdown zone of Baker Lake (FWS, 2001). Fourteen other tributaries to Baker Lake have habitat in the drawdown zone that native char could potentially use for spawning, but only a few tributary delta areas provide potential char spawning habitat in Lake Shannon (Puget, 2003q).

Excess sockeye salmon adults that are not transferred to the artificial spawning beaches are released into the Baker Lake system to spawn naturally. The Skagit System Cooperative (1996) conducted a study in 1994, when 12,653 adult sockeye were released into Baker Lake, and found that 26 percent of natural sockeye spawning in Baker Lake occurred within the drawdown zone and the Upper Baker River delta. Skagit System Cooperative (1996) estimated that at least one-third of all redds constructed in the drawdown zone were dewatered.

Effects Analysis

Skagit System Cooperative (1996) suggested that if Baker Lake is drawn down to its minimum surface elevation prior to sockeye spawning (mid-September), lake-spawning sockeye would have the only habitat that would remain continually wetted for spawning, which would substantially reduce the potential for sockeye redd dewatering. The Draft Action would typically result in earlier drawdown of reservoir levels than under current operations. However, for an average water year (see figure 5-10 in section 5.4.2.1), Baker Lake reservoir levels (mid-November through May) would be more than 20 feet below spawning levels (mid-September through November). This spawning and incubation timing also is applicable for bull trout and a portion of the coho spawning season (October through January). Based on the analysis presented in section 5.4.2.1, the Draft Action provides equal redd-dewatering protection when compared with current operations for naturally spawning sockeye salmon, bull trout, and coho salmon. Therefore, under the Draft Action, existing conditions would be maintained with respect to salmonid spawning habitat and reservoir-level management effects. Effects on other habitats, such as non-game fish habitat, and salmonid rearing and foraging habitats are unknown, as fish use of habitats in the Project reservoirs is not currently quantified.

Project Releases

As discussed in section 5.4, *Water Quantity*, operation of the Baker Project alters the flow regime in the Lower Baker River and Skagit River downstream of the Baker River confluence. Flow alterations associated with Project operations can affect the wetted channel width, alter water quality, and reduce fish spawning and rearing habitat. Project-induced flow fluctuations (Project ramping) can also result in the stranding of fish in shallow areas and off-channel habitat (resulting in immediate or delayed mortality); temporary loss of habitat; and the dewatering of fish redds, amphibians, aquatic invertebrates, and plant life (Hunter, 1992). In most cases, the faster the reduction in water surface elevation (stage), and the frequency and magnitude of flow reduction, the greater the likelihood that fish and other aquatic organisms would be stranded or adversely affected. As part of current operations, releases from the Project to the Lower Baker River are voluntarily regulated. Currently, the voluntary critical flow for ramping is set at 18,000 cfs and down-ramping cannot exceed 2,000 cfs per hour.

The Draft Action includes a flow regime measure (PME 3.3.1) that would set the minimum instream flows downstream of Lower Baker dam at 300 cfs (measured at the Baker River at Concrete gage) for all months of the year, and Project ramping would be no greater than 650 cfs reduction per hour or 6 inches per hour total reduction as measured at the Skagit River near Concrete gage. Critical flow for ramping restrictions would be 18,000 cfs, and changes in stage in the Skagit River by virtue of the Baker Project would not exceed 2 feet on a daily basis (measured at the Skagit River near Concrete gage). The objective of this measure would be to increase stability of flows in the Lower Baker and Middle Skagit rivers to improve fish habitat and reduce fish and aquatic organism stranding. See appendix B for the full text of this measure.

The effect of flow changes on aquatic habitat can be evaluated by studying fish habitat requirements and estimating the changes in habitat at various flows using hydraulic models. Several studies are currently evaluating flow/fish habitat relationships in the Lower Baker and Middle Skagit rivers, and final results are as yet unavailable. Following is a summary of each pertinent study objective and current status. Results of these studies will be incorporated into analyses of Project releases when available.

- Study A02, *Lower Baker River Habitat Mapping*—Quantify existing fish habitat conditions, collect data to support sediment transport evaluations, qualitatively evaluate fish use and identify special habitat areas in the Lower Baker River downstream of Lower Baker dam.

  Status: Draft report expected to be submitted at a fall 2003 ARWG meeting.

- Study A09.A, *Middle Skagit River Habitat Models*—Describe the mainstem Middle Skagit River habitat and flow/habitat relationships. Conduct field surveys of habitat conditions, fish use and flow/habitat relationships in the mainstem Skagit River. Assess the potential environmental effects associated with Baker Project operations.

  Status: Initial results by August 15, multiple scenario outputs to follow as requested; PHABSIM and side-channel results by September 19, multiple scenario outputs to follow; backwater slough results by August 15.

- Study A09.B, *Salmonid Redd Selection and Maintenance in the Middle Skagit in Response to River Fluctuation from Hydropower*—Determine if salmon and steelhead abandon redd sites as a result of downramping but later return and complete redds as flows are increased during Project peaking. The purpose of this study is to determine how fish are reacting in selection and maintenance of spawning sites with regard to fluctuating flows due to Project operations.

Status: Draft report expected at a fall 2003 ARWG meeting.

- Study A09.C, *Distribution, Timing, and Depth of Salmonid Redds*—Evaluate the timing, location, and depth of salmonid redds and carcasses in the Middle Skagit River during the spawning period.

  Status: Chinook redd dewatering analyses to be recalculated using transect stage to flow relationships by July 18. Revised report and proposed spawning periodicity to be transmitted by August ARWG meeting.

- Study A09.D, *Distribution and Timing of Salmonid Fry*—Conduct electrofishing surveys of mainstem margin and off-channel areas conducted at selected sites within the Middle Skagit River to identify the start of fry emergence and early growth of various salmonid species.

  Status: Draft report and proposed juvenile periodicity to be transmitted by August ARWG meeting.

Following are preliminary analyses of flow alterations and fluctuations with respect to Baker Project operations.

Flow Alterations—Flow alterations are changes in river flow over long periods (weeks or months) resulting from the storage of water, water diversion, or reduction of flows due to water conveyance from a dam to a powerhouse (usually through a pipeline or canal). Flow alterations generally refer to major changes in the unregulated yearly hydrograph, such as reduction of the total quantity of water delivered to the stream channel through water diversion, or changes in flow derived from seasonal storage for hydropower production. The following is a summary of flow alterations regarding the Baker Project from Puget (2003o) unless otherwise noted.

Seasonal storage of water at the Baker Project has resulted in flow alterations of the Lower Baker River and Skagit River downstream of the Baker River confluence. Although the mean annual discharge for the Baker and Skagit rivers is essentially the same when comparing regulated with unregulated conditions (without the Baker Project), the Baker Project alters seasonal runoff components, particularly in the fall, winter, and spring. In general, evacuation of the reservoir storage during September and October results in higher average daily flows in the Baker and Skagit rivers compared with unregulated conditions. Flood control operations result in capture and gradual release of flood flows, which decreases the magnitude of peak flows, but the duration of the event is increased. Reservoir refill reduces flows in the Baker and Skagit rivers from April through June as compared with unregulated conditions. Once the reservoir reaches full pool in July, outflows are generally similar to inflows and are therefore similar to pre-Project conditions.

Although current operation of the Baker Project alters seasonal runoff patterns, mean daily flows for each month remain within the unregulated range of variability throughout most of the year, except during May when refill regularly reduces daily flows in the Baker River to the extent that the average daily flow is less than the unregulated range of variability. In addition, the range of flows under regulated conditions is shifted downward (i.e., the magnitude of change between high and low flows may be similar to unregulated conditions, but high and low flows are less as compared with unregulated conditions throughout the spring and early summer).

Effects Analysis

Section 5.4.2.1 describes flow alterations for current operations and the Draft Action. Minimum flows in the Lower Baker River would increase from approximately 80 cfs to 300 cfs under the Draft Action. Minimum flows in the Skagit River would increase only slightly throughout most of the year, although HYDROPS indicates that the minimum flow for July in the Skagit River would be reduced by approximately 25 percent under the Draft Action. In addition, under the Draft Action, average flows for August and September would be increased somewhat and average flows for May and June would be reduced in comparison with current operations; Skagit River resultant changes would be small in comparison with overall flow levels. Several studies are currently underway to assess flow/fish habitat relationships in the Lower Baker and Middle Skagit rivers. The results of these studies will be incorporated into this analysis upon completion.

Recent data suggest that the existing flow regime in the Lower Baker River (No Action) may slightly benefit Chinook egg-to-migrant survival by reducing Skagit River peak flows. Seiler et al. (1999) reported a strong inverse relationship ($R^2 = 0.96$) between the maximum daily mean discharge (measured at the Mount Vernon gage) during incubation season and wild Chinook egg-to-migrant survival for the Skagit River where as high peak flow events decrease, egg-to-migrant survival increases. For every 9,355-cfs reduction in the maximum daily mean discharge during incubation, an additional 1 percent of all spawned eggs survive to the migrant stage. For example, based on this relationship, reducing the peak incubation flow from 80,000 to 60,000 cfs (25 percent reduction) would increase egg-to-migrant survival from approximately 7.5 to 9.6 percent (28 percent relative increase).

Under current operations, the Baker Project actually reduces the Skagit River average annual 3-day maximum flow (downstream of the Baker River confluence) by approximately 3 percent compared with unregulated conditions (i.e., without the Skagit and Baker Project influence). Therefore, reducing the peak flow from 80,000 to 77,600 cfs (3 percent reduction) would increase egg-to-migrant survival from approximately 7.5 to 7.8 percent (3 percent relative increase) for Chinook spawning located downstream of the Baker Project influence. Under the Draft Action, the 10 percent exceedance flows in the Skagit River would be approximately the same as under current conditions as measured at the Skagit River near Concrete gage (see figure 5-15). In addition, flood storage and operations stipulated in the ACOE flood control agreement would remain unchanged under the Draft Action. Therefore, it is likely the Draft Action would continue to provide a minor benefit to Chinook salmon egg-to-migrant survival in the Middle Skagit River.

At this time, it is not known to what extent the Draft Action may affect water quality. Even though the effects of flow alterations on water quality parameters are unknown, a reduction of turbidity events and TDG concentrations are suspected to occur under the Draft Action (see section 5.5.2.1, *Effects of Project Operations*, in *Water Quality*). Actual effects would be determined during the 3-year water quality monitoring program specified in the Draft Action.

Flow Fluctuations (Ramping)—Project-induced flow fluctuations (ramping) can result in unnaturally rapid changes in the flow over periods of minutes, hours, or days. Flow fluctuations can be measured either by change in flow or by change in stage over a specific time interval. Both measures are needed to understand potential effects associated with flow fluctuations; however, the biological effects of flow fluctuations are most directly related to changes in stage (water surface elevation). The following descriptions of potential flow fluctuation effects are summarized from Hunter (1992), which is the basis for the WDOE interim ramping rate criteria, unless otherwise noted.

As discussed previously, flow fluctuations can cause direct mortality of aquatic organisms or have indirect and delayed biological effects. Negative effects are generally thought to be most severe during down ramping (flow reduction); therefore, down-ramping is the focus of this effects analysis. Following are analyses of several potential effects associated with flow fluctuations including stranding, redd dewatering, spawning interference, fish habitat use, fish migration, and aquatic invertebrate impacts.

Stranding—The most widely studied biological impact associated with ramping is stranding, primarily of fish. Stranding is the separation of aquatic organisms from flowing surface water as a result of declining river stage. Stranding can occur during any drop in stage. It is not exclusively associated with substantial dewatering of a river and can occur in unregulated as well as regulated river systems. In addition to hydropower operations, stranding can occur as a result of other events, including natural declines in flow, ship wash, municipal water withdrawals, and irrigation withdrawals. Stranding can be generally classified as either "beaching" when fish flounder out of water on the substrate or "trapping" when fish become isolated in pockets of water or in side channels that become disconnected from free-flowing surface water as stage drops.

Fish stranding associated with hydropower operations has been widely documented in the Pacific Northwest and has been documented in the Skagit River (Beck and Associates, 1989). Stranding mortality can occur many miles downstream of a powerhouse, and stranding mortality is difficult or impossible to estimate. The fish species and life stage, substrate type, channel morphology, ramping rate and range, critical flow, ramping frequency, season, and time of day all affect the incidence of stranding. Following are descriptions of how these variables may influence stranding potential.

Life Stage—Juvenile salmonids are more vulnerable to stranding than adults. Salmonid fry that have recently emerged from the gravel are the most vulnerable (Bauersfeld, 1978, 1977; Beck and Associates, 1989; Stober et al., 1982; Olson, 1990); however, even larger juveniles can be susceptible to stranding, especially during the winter months (Bradford et al., 1995). Salmonid fry are relatively poor swimmers and settle along shallow margins of rivers and often occupy interstitial spaces in rock and cobble substrates (Hartman, 1965; Hillman et al., 1987). These fish may be extremely susceptible to stranding during flow reductions, because they may not be able to detect changes in flow and water levels while occupying interstitial spaces in the substrate. In addition, salmonid fry appear to burrow deeper into the substrate as stage decreases. Hamilton and Buell (1976) documented adult stranding as a result of hydropower fluctuations, although it is less common.

Species—Fry and juveniles of some species of fish are more vulnerable to stranding than others. Beck and Associates (1989) determined in the Skagit River that the rate of chum and pink salmon fry stranding was higher than for Chinook salmon fry, when comparing proportions of fry stranded within each species. Coho salmon fry stranding may be less than other species, such as Chinook, due to the species' propensity for spawning and rearing in smaller headwater and tributary habitats. However, coho juveniles have a long freshwater residence time that may increase the potential of stranding for parr and smolts, especially considering their use of backwater and side-channel habitats. Bradford et al. (1995) found the incidence of stranding for rainbow trout juveniles to be less than half the stranding rate for coho salmon juveniles under the same ramping rates. Bauersfeld (1977) found that the incidence of stranding for Chinook salmon was higher than for trout, coho, and chum salmon in the Columbia River.

Substrate Type—Most documented observations of stranding have occurred on gravel/cobble bars; however, stranding has also occurred in mud, sand, and vegetation. Substrate type was statistically the most significant factor contributing to stranding of Chinook and steelhead fry in a study conducted by Monk (1989); cobble substrate led to the highest incidence of stranding, and stranding potential decreased with finer substrates.

Channel Morphology—The river channel morphology is a major factor in the incidence of stranding. Alluvial river channels, such as the Skagit River, with many side channels, potholes, and low-gradient bars are thought to have a much greater incidence of stranding than rivers confined to single channels with steep banks. Large numbers of small fry can die from beaching on gravel bars when unnatural flow fluctuations occur. In general, stranding potential increases as gravel bar slope decreases. Long side channels with intermittent flows can also trap fish even under unregulated flow regimes. As water recedes from river margins, juvenile salmonids may also become trapped in pools called potholes, which may be formed at high flows by scouring around boulders and rootwads.

Beck and Associates (1989) extensively studied pothole stranding in the Skagit River. Among the conclusions were: (1) only a small fraction of the potholes in a river channel posed a threat to fish if fluctuations are limited in range; (2) the incidence of stranding was independent of the rate of stage decrease; and (3) the incidence of stranding was inversely related to the depth of water over the top of each pothole at the start of the decline in stage. Experiments performed by Bradford et al. (1995) showed no appreciable difference in stranding rates for coho and rainbow trout juveniles between a simple (gravel substrate) microhabitat or a complex (small pools and woody cover) microhabitat; however, stranding rate decreased as gravel bar slope increased.

Season—Salmon fry are most vulnerable to stranding, although they are only present in rivers at certain times of the year (Bauersfeld, 1978, 1977; Beck and Associates, 1989; Stober et al., 1982; Olson, 1990). Chinook, coho, pink, and chum fry emerge during late winter and early spring while steelhead emerge in late spring through early fall. Parr, smolts, and adults are vulnerable to stranding during various seasons depending on the species and stock. Winter appears to be a very critical time for juvenile salmonid stranding potential due to low flows (for watersheds dominated by snowmelt and glacial runoff, such as the Skagit River) and daytime concealment behavior of salmonid juveniles (Bradford et al., 1995).

Time of Day—For some species, the incidence of stranding is influenced by the time of day. In winter or when water temperatures drop below 4–8°C, juvenile salmonids exhibit concealment behavior during the daytime (Hartman, 1963; Chapman and Byornn, 1969; Taylor, 1988; Hillman et al., 1992). They burrow into the interstitial spaces in rocky substrates for cover. Griffith and Smith (1993) found that all concealed juvenile fish were located within 3.3 feet of the river margin in water depths of less than 1.6 feet. However, at night juvenile salmonids leave the substrate and swim in the water column to forage (Campbell and Neuner, 1985; Heggenes et al., 1993; Contor and Griffith, 1995), which may make them less susceptible to being stranded during flow decreases. If stage decreases dewater substrate during the daytime, a large portion of fish that are concealed in the dewatered substrate could become stranded and die regardless of ramping rate (Bradford et al., 1995). For example, Bradford et al. (1995) reported stranding rates for coho salmon juveniles at over 40 percent during the day, but only approximately 1 percent at night at a ramping rate of approximately 2.3 inches per hour. Some studies concluded that steelhead fry are less vulnerable to stranding during the daytime (Stober et al., 1982; CH2M Hill, 1990), but these studies were either not conducted during the winter or had few daytime samples.

Ramping Range—The ramping range (total continuous drop in stage or total flow fluctuation magnitude) affects the incidence of stranding by influencing the total area of exposed gravel bar and total number of side channels and potholes that may become isolated from surface flow (Beck and Associates, 1989). Ramping range was found to have a greater influence on stranding potential than ramping rate in the Skagit River (Beck and Associates, 1989). In fact, Beck and Associates (1989) found that stranding was independent of ramping rate. All ramping studies reviewed for this analysis, which included ramping range analysis, found a correlation between ramping range and stranding rate; however, not all studies found a correlation between ramping rate and stranding rate.

This suggests that total flow fluctuation influences stranding rate to a greater degree than does ramping rate, especially during winter daytime periods. This can be explained by juvenile fish concealment behavior during winter daytime periods. If juvenile fish respond to flow fluctuations by burrowing into the substrate instead of moving out through surface flow to deeper water, then stranding rate would only be a function of total surface area of dewatered substrate. Total surface area of dewatered substrate is a function of ramping range (total flow fluctuation) and is independent of ramping rate.

Ramping Rate—The ramping rate is the rate of change in stage resulting from regulated discharges and is usually referred to in terms of flow decline and measured in inches per hour. It is generally thought that the faster the ramping rate, the more likely fish are to be stranded. Bradford et al. (1995) found experimentally that stranding rate increased very rapidly with ramping rate increase, but then decreased slightly at very high rates of ramping. However, in the Skagit River, Beck and Associates (1989) found that stranding was independent of the ramping rate.

In laboratory experiments, ramping rates of less than 1 inch per hour appear to substantially limit stranding, and stranding potential dramatically increases as ramping rates increase beyond 1 inch per hour, especially during winter daytime periods. Bradford et al. (1995) reported daytime stranding rates for coho salmon juveniles at over 40 percent and 80 percent on a 2 percent slope at ramping rates of 2.3 and 11.8 inches per hour, respectively. Stranding rates for juvenile rainbow trout were reported at approximately 6 percent and 27 percent at the same ramping rates and bar slope (Bradford et al., 1995). Substantial numbers of stranded juvenile rainbow trout and Pacific salmon were observed after the daytime downramping of the Seton River, British Columbia, at an average downramping rate of 4.7 inches per hour (Bradford et al., 1995). Thousands of salmonids were stranded in the Bridge River, British Columbia, during downramping ranging between 0.5 to 3.6 inches per hour (Higgins and Bradford, 1996).

Although many hydropower mitigation settlements specify ramping rates to protect fish, some research has indicated that ramping rates cannot always protect fish from stranding. Woodin (1984) determined that all daytime ramping regardless of rate stranded Chinook salmon fry. Beck and Associates (1989) could find no correlation between ramping rate and the incidence of pothole trapping or steelhead fry stranding during the summer. Stranding occurred in both cases regardless of ramping rate.

Ramping Frequency—Natural flow fluctuations can strand fry in off-channel habitats. Fish populations have evolved with natural flow fluctuations and under normal circumstances, the natural population should be able to sustain a small loss of fish several times a year due to stranding. However, a hydropower facility may cause repeated flow fluctuations that are substantially more frequent than would be expected under unregulated conditions. Fish losses from repeated flow fluctuations caused by ramping could accrue to a substantial cumulative loss compared with what might be expected under unregulated conditions or different operational scenarios. The following example shows that flow fluctuations can be much more frequent in a regulated river compared to a non-regulated river.

Unregulated rivers have been shown to rarely experience drops in stage (i.e., water surface elevation) in excess of 2 inches per hour, except during floods. Hunter (1992) summarized river gage data for the Sauk River (unregulated) and Upper Skagit River (regulated by the Skagit Project, but without Baker Project influence) for nearly 2 years of data (October 1, 1989 to September 19, 1991; 17,244 observations). For the Sauk River (Skagit River tributary), only 1 record of decline in a stage of 2 inches or greater per hour occurred in the lower 90 percent of the flow range; however, 97 observations of declines in a stage of greater than or equal to 2 inches per hour occurred in the highest 10 percent of the flow range. In contrast, the Upper Skagit River gage (Marblemount), regulated by the Skagit Project, recorded 391 events of stage decline greater than or equal to 2 inches per hour in the lower 90 percent of the estimated natural flow range, including 4 events in the lowest 10 percent of the natural flow range.

Critical Flow—Stranding potential is near zero if all of the stream substrate remains wetted. The flow at which the vast majority of stream substrate remains wetted is termed "critical flow." The critical flow occurs at the inflection point on a "wetted surface area versus river flow curve." In other words, the critical flow occurs at the point where for ever increasing flows, there is little if any increase in wetted surface area. Ramping restrictions generally are not imposed if flows remain above the critical flow at the end of a downramping cycle, as the substrate remains substantially wetted after downramping. However, all ramping below the critical flow has the potential to strand fish.

Stranding Duration—Fish generally do not survive long out of water; therefore, beaching is usually fatal, unless the fish can flounder back to water. Juvenile salmonids trapped in side channels and potholes can survive for hours, days, or months under favorable conditions. However, trapped fish may die from predation and water quality degradation (e.g., increased water temperature, decreased DO). Some salmonid species or stocks may be adapted to seasonal off-channel stranding and fish using these habitats may grow substantially larger than fish that remain in the river environment even though overall survival may be less (Baker and Bayley, 2002).

Effects Analysis

Project operations under the Draft Action would continue to result in ramping. Ramping frequency would not be altered when comparing existing conditions with the Draft Action, because the Project would continue to be operated in a load-following mode. However, ramping rates would be reduced under the Draft Action.

As discussed in section 5.4.2.1, the flow fluctuation magnitude is similar under the Draft Action when compared with current operations. Figure 5-17 (section 5.4.2.1) shows that the frequency that a flow fluctuation (magnitude in cfs) is equaled or exceeded from January to May is very similar under the Draft Action compared with existing operations. January to May corresponds to most of the salmon fry emergence timing in the Skagit River downstream of the Baker River confluence. Reduced ramping rates associated with the Draft Action could reduce juvenile fish stranding to some degree over existing conditions. However, maintaining flow fluctuation magnitude under the Draft Action in the winter may offset potential reductions in salmon fry stranding due to the reduction in ramping rate. *A more detailed comparison of ramping rates, frequency, range, and duration between existing conditions and the Draft Action will be incorporated into this analysis when additional data are available.*

The Draft Action identifies 18,000 cfs (measured at the Skagit River gage near Concrete) as the critical flow; ramping restrictions would take effect at flows less than or equal to this discharge to minimize fish stranding potential. This critical flow of 18,000 cfs is also used under existing conditions. Preliminary data gathered at 24 cross-sections representing multiple habitat types in the Middle Skagit River suggest that the critical flow may be higher than 18,000 cfs (measured at the Skagit River near Concrete gage). Based on the "wetted surface area to Middle Skagit River flow" relationship, a critical flow of 18,000 cfs would provide approximately equal fish stranding protection to a critical flow of 5,000 cfs (unpublished data presented at the Instream Flow Technical Working Group meeting on June 30, 2003). Although ramping at any flow has the potential to strand fish, critical flow is established to limit Project operations and flow ranges where the risk of stranding fish is greatest. Because the critical flow is the same under the Draft Action as occurs under current operations, stranding potential based on critical flow levels would be approximately the same under the Draft Action as compared with current operations.

Redd Dewatering—The general life history of Pacific salmon involves adult migration into rivers to bury eggs in gravely nests called "redds." The eggs incubate in the gravel environment for several months before emerging as fry at various times of the year, generally from late winter through summer, depending on the species. During the incubation period, the eggs may be susceptible to dewatering during certain flow fluctuations that may be caused or exacerbated by hydropower project operations, although dewatering caused by natural hydrograph fluctuations also occurs. Redds constructed on the river margin are most susceptible to the effects of dewatering. Redds constructed near the center of the river channel are protected from low-flow dewatering, but are more susceptible to scour during high-flow conditions. Research has documented the lethal effect of redd dewatering on salmonid eggs and alevins. However, redds may be able to tolerate some degree of flow fluctuation, as salmonid eggs and alevins can survive under some situations in subsurface, inter-gravel flow.

Effects Analysis

Many salmonids of various species are known to use the 32 miles of mainstem Skagit River below the Baker River confluence for spawning. These species include Chinook, pink, chum, and coho salmon and steelhead (Puget, 2003p). The peak count of Chinook spawning during the fall of 2002 in the Middle Skagit reach was 704 redds (Puget, 2003p). The peak count of chum spawning was 925 redds for the winter of 2002 in the same reach (Puget, 2003p). Because substantial numbers of salmonid spawning takes place downstream of the Baker Project, there is potential for Baker operations to affect salmonid spawning.

Baker Project operations contributed to redd dewatering during a very low water year in the Skagit River during the spawning season of 2000, which occurred as a result of combined flow fluctuation effects from operation of the Skagit and Baker River projects and natural low flows. WDFW estimated that 80 percent of the total number of Chinook salmon spawning located downstream of the Baker Project in the mainstem Skagit River was influenced by the combined operations of the Skagit and Baker projects, but only production from approximately 16 percent of all Lower Skagit River Chinook spawning was lost due to dewatering (Puget, 2002a). Of note is that most Chinook spawning occurs upstream of the Baker Project influence.

Independent effects, which the Baker or Skagit projects or natural flow variation may have had on redd dewatering, were not determined for the 2000 spawning year, nor was it reasonably possible to estimate based on the data available at the time (Puget, 2002a).

Therefore, it is not currently known to what degree the Baker Project potentially influences redd dewatering in the Lower Baker and Skagit rivers; however, the Baker Project represents approximately 17 percent of the Skagit River mean annual discharge at the Skagit River near Concrete gage. Therefore, the Skagit Project likely influences redd dewatering to a greater extent than does the Baker Project. Study A09 is currently assessing redd dewatering/flow relationships for the period from 1991 to 2002. This study will provide information on proportion of redds dewatered for those years. Study A09, using HYDROPS post-processing output, will further estimate potential redd dewatering under current operations and under the Draft Action for comparison purposes. Results from Study A09 will be incorporated into this analysis when available.

Spawning Interference—Bauersfeld (1978) reported that repeated dewatering of spawning areas caused Chinook salmon to abandon attempts to spawn and move elsewhere, often to more crowded locations. However, other researchers reported that Chinook salmon successfully spawned in areas that were dewatered several hours a day (Chapman et al., 1986; Stober et al., 1982).

Effects Analysis

The extent that current operations or the Draft Action may interfere with spawning is not currently quantified. Results from Study A09 will address this issue and will be incorporated into this analysis when available.

Fish Habitat Use—Riverine community structure is strongly influenced by habitat stability and availability (Bain et al., 1988). Changes in aquatic habitat stability and availability would presumably affect an individual organism's ability to find and use its optimal habitat. Hydropower peaking can decrease habitat stability and can change the quantity and quality of available habitat over short-time intervals. A study by Pert and Erman (1994) examined rainbow trout habitat use and preference under daily fluctuations in discharge from a hydropower peaking operation. The most important finding was that rainbow trout used different habitats under fluctuating flows; however, not all individuals within the population responded similarly to changing stream flow (Pert and Erman, 1994). In general, for adult rainbow trout, mean water column velocity and focal point velocity in the habitat used increased with each successive increase in discharge (Pert and Erman, 1994). The increase in use of higher velocity water may negatively influence the fish's energy budget and reduce energetic efficiency (Fausch, 1984; Jenkins, 1969; Everest and Chapman, 1972).

Effects Analysis

Study A09 is underway and will provide information about habitat availability for various life stages and species of fish in the Lower Baker and Middle Skagit rivers under current conditions and under the Draft Action. Results from Study A09 will be incorporated into this analysis when available.

Fish Migration—Flow fluctuations have been shown experimentally to influence juvenile Chinook to emigrate downstream (McPhee and Brusven, 1976). However, the affect flow fluctuations may have on fish migration is not currently quantified.

Effects Analysis

It is unknown to what extent current operations or the Draft Action would affect fish migration with respect to Project releases. This issue has not been identified as a historical problem associated with current operations.

Aquatic Invertebrates

Flow fluctuations have been shown to reduce invertebrate diversity and total biomass and can change species composition. A study on the Skagit River found that flow fluctuations had a greater adverse effect on the aquatic invertebrate community than a substantial reduction in average flow (Gislason, 1985). A reduction in the aquatic invertebrate forage base can negatively affect fish production potential. Flow fluctuations can affect aquatic invertebrates through stranding (similar to fish stranding), increase drift response, and may reduce aquatic invertebrate forage.

Effects Analysis

Similar to the effects analysis for stranding, a detailed comparison of ramping rates, frequency, range, and duration between current conditions and the Draft Action will be incorporated into this analysis when available. It is anticipated at this time that increasing the minimum flow release from 80 cfs to 300 cfs under the Draft Action would increase aquatic invertebrate habitat and production in the Lower Baker River to an unknown degree.

5.6.2.2 Upstream Fish Migration

The Baker River Project blocks connectivity of migrating fish species to spawning grounds, other fish or forage populations, and/or other sites of activity upstream of the dams. Upstream fish passage has been provided at the Project since Lower Baker dam was completed. The current trap-and-haul system has been in operation since 1957 and functions year-round, aside from brief periods of maintenance and repair.

The Fish Passage Technical Working Group, created for the Baker River relicensing efforts, has evaluated a number of potential options for upstream fish passage including volitional and assisted facilities and programs. After an extensive review of a wide range of volitional and assisted passage options, the Fish Passage Technical Working Group agreed that a trap-and-haul concept similar to the existing facility would be the most effective and efficient upstream passage strategy for the Baker River system. The following description represents the working discussions of the Fish Passage Technical Working group, to date.

Under the Draft Action, Puget would provide and operate passage facilities for upstream migratory fish at the Lower Baker Development (PME 3.2.1). The facility design, construction, testing and operations and maintenance would be approved by the BRCC and satisfy specific

Section 18 authorities of the FWS and NOAA Fisheries. Upstream passage would be provided using trap, sort and haul facilities located on the Baker River in Concrete as agreed to by the Fish Passage Technical Working Group. The facilities may use the existing site and some or all existing facilities as agreed to by the parties.

No longer than 2 years after license acceptance, Puget would develop complete plans and specifications for construction of attraction, capture, and upstream transport facilities at the Lower Baker Development. Such plans would be developed in consultation with the BRCC–Aquatic Subgroup (BRCC-AS) and in particular representatives from FWS, NOAA Fisheries, WDFW, and Tribal interests. In addition to construction plans, Puget would also develop a response plan for addressing operational contingencies and emergencies. This plan would be presented to the BRCC-AS for review.

Puget would create a program to monitor, evaluate, and report on the operations of the trapping, sorting, and hauling facilities. Each year Puget would provide a report to the Commission and the BRCC describing operations of the facility over the previous year. The report would include the numbers and species of fish captured in the trap and the disposition of those fish. The report would also include a description of potential problems and remedies associated with facility operations. Puget would develop a schedule for reporting and establish a mechanism for auditing facility operations.

Puget would provide annual funds for modification of the upstream passage facility to address changing needs and account for improving technologies. Allocation of this fund would require agreement by the BRCC-AS. Refer to appendix B for the full text of these measures.

Effects Analysis

Puget would provide upgraded fish passage facilities for upstream migratory fish at the Lower Baker Development. This system would be constructed to meet the design and operation criteria for upstream fish passage facilities developed by the state and federal resource agencies (NOAA Fisheries, FWS, WDFW).

Although a final design has not been described, it is anticipated that by meeting agency design criteria the new facility would reduce effects on both juvenile and adult fish encountering or entering facility structures. The new system will likely include more effective screens on water intakes and fish channeling and transport systems, use water-to-water transfer methods when handling fish, and provide increased or more effective attraction flows to the trap system.

Until this new facility is built and tested, the level of increased protection afforded affected fish populations can only be assumed. Based on the less than 0.5 percent adult handling mortality observed at the existing facility, it is not expected that the new structure would increase acute mortality rates significantly.

Additionally, as data are not available on fish behavior at or near the trap, it is unknown whether a change in attraction flows would result in more adult fish entering the system. The use of criteria screens on all water intakes at the collection site should provide the maximum protection possible for juvenile fish encountering or entering the facility. However, as data are not available on juvenile mortality for the existing system, any increase in survival would be speculative.

5.6.2.3 Connectivity Between Baker Lake and Lake Shannon

Current and proposed upstream fish passage facilities at the Baker River Project collect fish below Lower Baker dam and transport them to Baker Lake, bypassing Lake Shannon. There is currently no mode of upstream transport between Lake Shannon and Baker Lake. Therefore, migratory fish inhabiting Lake Shannon are isolated from the Upper Baker River basin.

The Fish Passage Technical Review Group sought to address the need for connectivity between Lake Shannon and Baker Lake. The Draft Action contains measures for the investigation of facilities and/or programs for other migratory needs at Upper Baker to address species population connectivity between the reservoirs (PME 3.2.2). However, after 50 years of isolation, there is uncertainty that migratory issues and behaviors exist between the two reservoirs.

To assess the need for connectivity between the reservoirs, the Draft Action proposes that within 3 years of license acceptance, Puget in consultation with the BRCC-AS would conduct a study to determine ways to address connectivity between Baker Lake and Lake Shannon. Specific study methods would be determined by Puget and the BRCC-AS.

Results of the study would be used to determine whether facilities or programs are needed to co-mingle isolated groups of fish to provide connectivity. If the BRCC-AS decides that essential fish passage continuity could be provided through a trap-and-haul facility at the base of Upper Baker dam, then Puget will plan and construct a prototype facility in consultation with the BRCC-AS. If the prototype facility proves effective, then Puget and the BRCC-AS would develop plans for a permanent trap-and-haul facility.

If the BRCC-AS decides that a trap-and-haul facility would not appropriately achieve connectivity, then Puget and the BRCC-AS would explore other methods for achieving continuity, such as seining or other capture and release techniques. Refer to appendix B for the full text of this measure.

Effects Analysis

The primary action proposed by Puget is a study to determine the facilities or programs needed to restore connectivity between fish populations between Lake Shannon and the upper portion of Baker Lake. Beneficial effects of this measure would depend on study results and subsequent actions. Any adverse effects of this action would be minimal and relate primarily to the handling associated with tagging and monitoring of test specimens. Until the results of this study are complete, the methodologies for establishing population connectivity, facilities to be built and their probable effectiveness can only be hypothesized. Therefore, no further analysis of this action is presented.

5.6.2.4 Downstream Passage Continuity for Migratory Fish Species (Anadromous, Adfluvial, Fluvial, Resident)

The Baker River Project interrupts connectivity of migrating fish species to downstream locations. Since completion of the Upper Baker Development, downstream juvenile fish passage has been provided by juvenile attraction and FSCs installed at the downstream ends of each reservoir. Recent migratory investigations indicate that existing FSC facilities at the Upper Baker Development are effective at causing fish to approach a passage facility, and past evaluations indicate that approximately 50 to 75 percent of juvenile outmigrants are captured and transported downstream. Studies of the collection facility at Lake Shannon suggest that the system in that reservoir is much less effective. However, the existing technology is more than 50 years old, and technological advances in fish passage capabilities have been developed.

Therefore, the Fish Passage Technical Working Group has extensively reviewed a wide range of volitional and assisted juvenile passage options for the Baker River Project. The group generally agrees that conventional juvenile fish passage technology, well suited for rivers with flowing water, may not be appropriate for a fluctuating reservoir environment, as such systems may not be effective. Therefore, at this point, the Fish Passage Technical Working group is focusing on redevelopment of the FSC systems currently in place.

The Draft Action includes a five-stage development of downstream passage facilities based on FSC technology with an adaptive management decision incentive for early resolution of migratory facility development (PME 3.2.3). In consultation with the BRCC-AS, Puget would design an FSC with a flow capacity of 250 cfs (roughly twice the existing gaged operating flow) to be installed at Upper Baker. The FSC would be designed in a modular format to permit adaptive management development of the passage technology, including expanded flow capability. The facility would be designed to accept three extension modules for increased flow capacity of 250 cfs, which would be added in three subsequent testing phases as necessary to a total attraction flow of 1,000 cfs, or approximately 20 percent of operational flow. Modules would be designed to permit installation within a single off-season period in preparation for the following season. The FWS, NOAA Fisheries, WDFW, and the Tribes would be consulted throughout the design process to ensure that regulatory requirements would be met.

The base module with an attraction flow of 250 cfs would be installed first and tested for at least 2 years. If the BRCC-AS decides that the 250 cfs module is not adequate for juvenile collections, then modifications would be made after year 2 and tested in year 3. If operations are still not satisfactory, then the second module (total attraction flow of 500 cfs) would be installed in year four and tested for 2 years. If needed, module three (total attraction flow of 750 cfs) would be installed in year 7 and tested for 2 years. The final module (total attraction flow of 1,000 cfs) would be added by year 10, if the BRCC-AS decided that attraction flow continued to limit collection efficiency after testing module three. At any time throughout the testing phases, if the BRCC-AS finds that collection efficiencies have reached their goal, then an equivalent facility would be constructed at Lake Shannon. In addition, if the facility was accepted after the installation, of either modules 1, 2, or 3, then 20 percent of the cost avoided in succeeding unconstructed modules would be added to the HERC Fund for use in fish programs administered by the BRCC (see section 5.6.2.7). However, if after year 12 the BRCC-AS is still not satisfied with operations of the Upper Baker collection facility, then alternative technologies would be investigated. Refer to appendix B for the full text of this measure.

In addition, Puget would design and install, in consultation with the BRCC-AS, a new exclusionary guidenet system to provide a continuous and durable fish barrier. Trap, sort and haul modifications would also be made to the Upper Baker trap.

Juvenile acclimation facilities would be sited and constructed at Concrete near the confluence of the Baker River with the Skagit River. Specifics pertaining to acclimation facilities would be developed in consultation with the BRCC-AS.

Monitoring, evaluation, and reporting would be an integral component of this adaptive approach to juvenile fish trapping, sorting, hauling, and acclimation facilities. Each year Puget would provide a report to the Commission and the BRCC describing the operation of the facilities over the previous year. The report would include the numbers and species of fish captured and the disposition of those fish. The report would include a description of problems associated with the facilities and decisions made by the BRCC-AS to deal with such difficulties. A complete description of the Draft Action's proposal for juvenile fish passage and timing of adaptive management decisions pertaining to module development, implementation, and testing is included in appendix B.

Effects Analysis

Currently, downstream migrating fish (both adults and juveniles) are able to pass Project facilities through turbines, spillways and fish collection facilities located at Baker Lake and at Lake Shannon.

Recent investigations of these facilities indicate that between 50 to 75 percent of the marked coho juveniles released into Baker Lake are successfully collected, transported and released below the Project. In contrast, the collection efficiency for coho at the Lake Shannon (Lower Baker FSC) system has been estimated at approximately 23 percent. In the past, about 0–2 percent of the marked fish released into Baker Lake have been collected at the Lower Baker FSC on a yearly basis. These data indicate that some upper basin juveniles survive passage through Project reservoirs, turbines and spill. It is currently unknown what proportion of the fish not collected in the Lower Baker FSC passes the Project and arrives safely in the Lower Baker River.

Because of the age and the relatively low fish collection efficiency of the two juvenile fish passage systems, Puget proposes a 5-step program spanning up to 12 years to improve facility performance. This program attempts to build on the success of the existing systems by increasing FSC attraction flows, eliminating louver systems, adding modern fish screens, improving the guide net system, and adding acclimation facilities, as well as other improvements identified over time as part of the proposed adaptive management program.

The modernization of these facilities would likely reduce fish stress and injury from passage through both systems. Well-designed juvenile fish passage systems exhibit injury rates less than 0.5 percent (NMFS, 2000a). However, data collected at the Upper Baker FSC show that juvenile mortality rates for collected fish are as good as or better than the 0.5 percent value described by NOAA Fisheries. These values apply to both resident fish species such as bull trout, as well as anadromous species such as coho.

Because the 5-step approach does not currently identify performance criteria for the new facilities, expected fish benefits from facility improvements cannot be quantified at this time. As noted above, the current collection efficiency estimates of the two systems range from 23–75 percent. Thus, the range of improvement possible from the 5-step program could range from 25-77 percentage points.

For this analysis, it is assumed that an increase in juvenile collection efficiency and survival would result in an increase in overall fish population abundance, especially for anadromous species. For example, the average coho return to the Baker River adult trap has been approximately 6,000 fish. If the new collection facilities increased yearly juvenile production from the system by 50 percent, adult runs may average 9,000 fish over time. Whether more adults would return to the Baker River if passage facilities were improved would be heavily dependent on environmental conditions both within and outside of the Project area during the term of any new license issued. Poor ocean productivity, flood events, intra- and inter-specific competition, and change in harvest rates all affect the number of fish produced from, and returning to, the Baker River.

If collection effectiveness were to increase with the implementation of new facilities, fish entrainment through Project turbines and spillways would decrease, thereby reducing Project effects on both resident and anadromous fish species. The level of survival improvement to local fish populations would be dependent on the resulting collection efficiency of the new systems. Higher collection efficiencies would result in increased overall survival rates for migrating fish as they would be prevented from entering higher mortality passage routes such as turbines. Regardless of the collection efficiency level achieved by the new fish passage systems, some Project related mortality would always occur due to the handling required to collect and transport fish, inability to collect fish during flood flows, and from the presence of the reservoirs.

The juvenile acclimation facilities would be designed to alleviate fish stress associated with collection, transport and release. It has been shown from studies conducted on the Columbia River that fish plasma cortisol levels become elevated when fish are handled (NMFS, 2000b). This change in fish physiology could cause transported fish to become more susceptible to predation or disease resulting in decreased survival. The use of acclimation facilities allows fish to recover, as evidenced by a lower plasma cortisol level, prior to being released into the river.

Whether the use of acclimation facilities would result in an increase in fish survival or abundance is unknown. The effectiveness of these facilities would be monitored as part of the adaptive management plan if agreed to by the BRCC.

One benefit of the acclimation facility is that it would allow Puget biologists the ability to measure short-term survival rates for transported fish. Operators would be able to quickly detect problems with the collection and transport system, and make changes as appropriate before impacts to fish survival become excessive.

5.6.2.5 Physical Habitat

Fluvial Geomorphic Management

Sediment originates on hillslopes and is delivered to stream channels via erosion or mass wasting. Dams form permanent impoundments that interrupt the downstream movement of sediment as transported material settles in the deep, low velocity reservoirs. Trapping of materials within the impoundment reduces sediment yield to downstream reaches and may result in sediment starvation accompanied by bed armoring and incision, depending on the channel type and morphological characteristics. Conversely, if downstream sediment inputs are high and flow regulation associated with power production and flood control reduces the magnitude of flood flows, undesirable amounts of sediment may accumulate within the stream channel.

This disruption of sediment transport and alteration of the hydrograph could reduce gravel accumulations, potentially limiting available spawning habitat for salmonids. Connectivity of off-channel habitats can be reduced both by lower frequency of flood events and by the reduced rate of channel migration. This reduction in off-channel habitat can limit available spawning gravels, as these secondary channels are locations where gravels are frequently deposited (Puget, 2003n).

The Project, under existing conditions, disrupts sediment transport and results in an annual reduction of approximately 12,500 tons of gravel and 2,500 to 4,300 tons of cobble delivered to the Skagit River from the Baker River in comparison to modeled unregulated conditions (Puget, 2003n) (see subsection *Lake Shannon* in section 5.6.1.1, *Aquatic Habitat Conditions*). Overall, the total sediment load (suspended solids and bedload) delivered from the Baker River is reduced by 86 to 88 percent over unregulated conditions (Puget, 2003n). However, evidence suggests that the mainstem Skagit River channel may not be experiencing a sediment deficit. Evaluation of aerial photographs from 1942 revealed that the historical extent and configuration of gravel bars and islands in the Middle Skagit River downstream of the Baker River confluence was very similar in 1942 to conditions observed today. The findings also suggested that there is no evidence that in-channel sediment deposits have substantially decreased in the mainstem Skagit River. Recent ACOE analyses found that the Skagit River downstream of RM 24.5 has actually aggraded by approximately 1.5 feet since the mid-1960s (Puget, 2003n). It is not known whether this aggradation is due to a reduction in sediment transport capacity resulting from flow regulation associated with the Skagit and Baker River projects or whether timber production and other human development has led to an increase in sediment delivered to the Skagit River even with the reduced contributions from the Baker River. Therefore, it is not known whether sediment interruption caused by the Baker River Project is actually limiting aquatic habitat in the Middle Skagit River. Information associated with the instream flow study (A-09a), to be completed in fall 2003, will provide additional data regarding potential Project effects on spawning habitat in the Middle Skagit River.

Under the Draft Action, Puget would transport sediment from the Baker River system downstream of the Baker River Project and undertake actions to enhance the channel morphologic function of the Lower Baker River alluvial fan, as determined appropriate by the BRCC-AS (see PME 3.4.1). Puget would develop and implement the channel enhancement actions in consultation with the BRCC-AS and the Commission, within 2 years of acceptance of the final license order. Puget and the BRCC-AS would also develop a plan for potential gravel augmentation in the Skagit River below the confluence with the Baker River. The plan would define procedures for monitoring conditions in the Skagit River to determine whether gravel augmentation was warranted; outline procedures for determining the amount of gravel to be placed annually; and include specifics regarding the timing, locations, permitting, and monitoring of gravel placement. Refer to appendix B for a full description of this measure.

Under this measure, Puget would undertake actions to enhance the Lower Baker River alluvial fan. *Study A-16, Feasibility Assessment of Potential Protection, Mitigation, and Enhancement Measures for Lower Baker Alluvial Fan, is underway and will define and analyze alternatives for habitat enhancement activities in the Lower Baker alluvial fan.*

Effects Analysis

Large alluvial channels such as the Skagit River typically achieve a long-term state of "dynamic equilibrium" under which the sediment transport capacity and sediment supply of the stream are approximately equal. Long-term increases in sediment yield or reductions in the sediment transport capacity can result in aggradation, fining of the bed, increased channel width and potentially a shift from meandering to braided morphology. Reductions in total sediment load would be expected to result in coarsening of the bed material (increased proportion of larger substrate) and could also lead to channel incision and bar channel erosion (Puget, 2003n).

As discussed above, the Skagit River currently is thought to be experiencing aggradation, although the factors leading to this phenomenon are not fully understood. The monitoring and analysis associated with the measure would assess the Skagit River channel morphological characteristics. This monitoring would aid in determining the extent and severity of channel aggradation in the Skagit River and whether additions of spawning gravels in the Middle Skagit River would provide the desired spawning habitat benefits.

Thus, although sediment and gravel inputs to the Skagit River from the Baker River system have been reduced due to the Baker River Project, the aquatic habitat of the Skagit River may not be limited by available gravels. If gravel were added to the channel when it is already aggrading, there would not likely be adequate sediment transport capacity to move the materials to create additional spawning areas. In addition, fine sediments in the aggrading channel would likely fill the interstitial spaces between the introduced gravels, making them less suitable as spawning habitat.

If the results of the proposed monitoring efforts indicate to Puget and the BRCC-AS that aquatic habitat in the Skagit River would benefit from gravel augmentation then such efforts would be undertaken and financed using the HERC Fund. Therefore, under this measure, spawning gravel conditions in the Middle Skagit River would either be maintained at existing conditions, if the study found that gravel augmentation would not currently be necessary, or improved if the study found that gravel placement would be warranted. Puget and the BRCC-AS would determine specific locations of potential gravel placement.

Puget's study of potential enhancement and restoration options in the Lower Baker alluvial fan currently is considering a number of options, including the following:

- placing sufficient gravel to increase the channel slope of the Lower Baker River such that riverine habitat conditions suitable for salmonid spawning would be maintained at low flows;
- placing anchored LWD or rock structures within the existing Lower Baker River channel to increase hydraulic complexity at low flows;
- constructing a series of weirs or steps within the Lower Baker River channel to increase hydraulic complexity and retain gravels;
- reconfiguring the Lower Baker River channel; and
- developing the Little Baker River area and the southwest portion of the Lower Baker River alluvial fan to be backwater sloughs fed by groundwater.

The study and planning of these alternatives is being closely coordinated with the Skagit Fisheries Enhancement Group efforts to restore the historical Little Baker River channel.

Specifics pertaining to each of the alluvial fan alternatives are under development; therefore, the effects of such potential actions on aquatic habitat and fisheries resources cannot be evaluated at this time but are all intended to improve existing conditions. *Additional analyses of these potential actions will be conducted upon completion of Study A-16 in winter of 2004.*

Large Woody Debris

Woody debris is an important link between the terrestrial and aquatic environments in riverine systems. Woody debris traps gravel and sediment, forms pools, provides cover, retains organic matter, and increases habitat diversity by changing hydraulic conditions. Woody debris also provides microhabitat that virtually all juvenile salmonids use at some point during their maturation (Chapman, 1966; Murphy et al., 1984; Bjornn and Reiser, 1991; Swanston, 1991, as cited in Puget, 2003d). Aquatic productivity also has been linked to LWD, because it retains organic matter that macroinvertebrates process and ultimately increases food sources for juvenile salmonids (Bilby and Likens, 1980, as cited in Puget, 2003d).

The movement of the majority of LWD in the Baker River system has been prevented by Project dams. Prior to hydroelectric development, LWD would have moved to the Lower Baker and Skagit rivers during flooding events. The potential effects on aquatic productivity, and in particular salmonid production, due to the lack of LWD that was historically delivered from the Baker River system have not been studied.

Under existing conditions, a total of 528 pieces of LWD are delivered to Baker Lake annually and 246 pieces are delivered to Lake Shannon (Puget, 2003d). None of this large wood currently is passed downstream of Lower Baker dam. Under existing conditions, Puget only removes LWD from the Project reservoirs when necessary to ensure safe Project operations. It is not known whether LWD availability currently is limiting aquatic productivity in either the Lower Baker River or the Middle Skagit River. It is possible that other tributary streams may be supplying sufficient amounts of large wood to the Skagit River to offset the reduction in LWD delivery from the Baker River.

The Draft Action includes a measure to provide for study and monitoring of existing LWD conditions in the Baker River and Middle Skagit River in order to identify opportunities for enhancement over time (see PME 3.4.2). A plan for the management of LWD in the Baker River system would then be drafted. If deemed necessary by Puget and the BRCC-AS as part of the plan, LWD that enters Baker Lake and Lake Shannon would be transported downstream for use in the Baker River, Skagit River, and possibly other stream systems. Puget and the BRCC-AS would complete the LWD management plan within 1 year of license acceptance. The plan would address pieces of wood over 12 inches in diameter and over 8 feet long. In the first 5 years of plan implementation, an annual inventory of wood in each reservoir would be conducted. After the first 5 years, inventories would be conducted at 5-year intervals or after major flow events in the Skagit River basin.

Puget would remove wood from the Project reservoirs to be stockpiled and made available for activities associated with the Baker River Project license, other Baker and Skagit River restoration activities identified by the BRCC-AS, and for actions conducted by other entities that are deemed appropriate by the BRCC-AS. To accommodate the need for LWD, Puget would first remove wood from the Project forebays, and then logs floating in the southern and central portions of each reservoir. Wood in existing log rafts or embedded in sediments would not be removed unless for safety reasons.

Under the plan, each year, Puget would cover the cost of collection and transport of up to 27 pieces between 24 and 35 inches, and 8 pieces larger than 35 inches to staging areas near the Skagit River. Puget may also transport LWD to other areas in the Baker River basin for actions approved by the BRCC-AS. LWD for activities in other locations would be stockpiled and made available for pick-up by entities approved by the BRCC-AS. Refer to appendix B for the full text of this measure.

Effects Analysis

The annual number of pieces and size groupings to potentially be delivered to staging areas along the Skagit River would be based on modeling of wood that would be delivered to the Skagit River after 40 years, if the Baker River Project were to be removed. This number also represents the approximate equilibrium state in which the quantity of LWD entering the Baker River system would be roughly equal to the amount that would be delivered to the Skagit River on an annual basis (Puget, 2003d).

The function and importance to Skagit River aquatic habitat of LWD from the Baker River system currently is not well understood. Compared with small streams, pieces of LWD in large river systems (>60 feet wide) are less of an influence on channel dynamics. In large systems, LWD pieces tend to be unstable, are usually confined to the banks instead of within the wetted channel, are quite small compared to the size of the river, and do not adequately influence channel hydraulics to form reach-scale elements of habitat complexity (Bilby and Bisson, 1998; Lassettre and Harris, 2001). The Skagit River below the confluence with the Baker River is quite large, with channel widths greater than 500 feet (Puget, 2003n). As a result, the majority of individual pieces of LWD delivered to the Skagit River are likely transported downstream during annual high flows or are deposited along the channel margin. Historically, very large channel-spanning raft jams developed in the Lower Skagit River (Puget, 2003n). Currently, the majority of LWD that remains in the Middle Skagit River is present along the streambanks where it provides cover and velocity breaks for fish during high flows. These areas of wood accumulation are potentially important habitat components, as abundance of juvenile coho and Chinook salmon has been found to have a significant positive correlation with the amount of LWD in a stream (Beamer and Henderson, 1998, as cited in Puget, 2003d).

If Puget and the BRCC-AS decide that LWD is deficient in the Baker or Skagit rivers, LWD would be allocated to projects that involve anchoring of wood in the stream channel. If LWD is limiting in the system, these activities would improve existing conditions, because LWD currently is not delivered to the Lower Baker or Skagit rivers from upstream of the Baker River Project. The BRCC-AS may also choose to fund LWD enhancement activities upstream of the Baker River Project; in which case, the HERC Fund would be used for mobilizing and placing the wood in specified locations. It is not yet known whether aquatic habitat quality in the system is limited by LWD accumulations; thus, no specific actions have been proposed, thereby limiting the ability to analyze the potential benefits of such activities at this time.

In general, LWD provides a number of habitat functions. For example, studies have found that in some systems, LWD can account for up to 50 percent of sediment storage (Lassettre and Harris, 2001). This storage potential can help reduce fine sediments in spawning gravels and can also aid in the accumulation of spawning gravels, thereby increasing potential spawning habitat. House and Boehne (1986) observed a 25-fold increase in gravel bar area in a stream in Oregon following LWD placement. However, the role of LWD in sediment accumulations is less profound in large streams, such as the Skagit River, than in smaller streams.

Increased LWD could substantially increase nutrients available to the aquatic environment. Trotter (1990) found that reaches containing large wood stored twice as much organic matter as reaches without LWD. Studies have also found that LWD can play a major role in trapping salmon carcasses and ensuring that the marine-derived nutrients (MDN) they contain are not flushed from the system. Cederholm and Petersen (1985) observed that the distance salmon carcasses traveled downstream was inversely related to the amount of LWD in the stream. These nutrients increase aquatic productivity and ultimately lead to increases in fish production. Again, such effects resulting from LWD tend to be less profound in larger systems, such as the Skagit River.

LWD also directly benefits fish, namely salmonids, because it provides breakwater areas that minimize energy expenditure and instream cover and prime areas for food foraging (Lassettre and Harris, 2001). Such direct benefits can ultimately lead to increases in fish production.

Thus, the LWD transport and placement activities that could occur under the Draft Action would likely benefit the aquatic environments of the Skagit River and Baker River, where such activities were conducted. Again, the opportunity for the enhancement of LWD transport over existing conditions is currently unknown; consequently, it is not possible to fully address the context and magnitude of these potential benefits.

5.6.2.6 Fish Propagation and Enhancement

As part of the existing license for the Baker River Project, Puget has constructed and funded operations of the existing artificial sockeye spawning beaches. In addition, Puget has voluntarily reared other salmonid species for the enhancement of area fisheries resources (refer to section 5.6.1.4). Artificial production of sockeye and other salmonids has succeeded in maintaining fish runs, although the strategy could also result in unintended effects on native fish populations through competition for food and space, predation, disease outbreaks, genetic alteration, and harvest. These interactions may result in the loss or reduction of wild native fish population abundance and diversity. Although the interactions between artificially produced and wild fish have been documented in other stream systems, the relative effect of artificial production operations and releases on the long-term fitness of wild stocks is unknown and continues to be a topic of much debate within the fisheries scientific community.

The Draft Action includes a fish propagation and enhancement measure (PME 3.1.2) wherein Puget would continue operation of the sockeye spawning beach (Beach 4), initially restore and eventually decommission Beaches 2 and 3, and implement supplementation programs to enhance salmonid populations. Refer to appendix B for the full text of this measure. We discuss the three components of this measure in the following subsections.

Spawning Beach 4 Improvements

Under this measure, Puget would modify Spawning Beach 4 to improve functionality and productivity. The existing Hypalon fabric curtain walls that separate the spawning beach segments would be replaced with permanent concrete walls. In addition, the water supply and drains for the spawning beach segments would be isolated, and the existing water alarm system would be improved.

Within 6 months of completion of the facility modifications, Puget would produce an operations manual for the spawning beach facility. The manual would include the following information: (1) flow distribution schematic and plan; (2) emergency response plan; (3) call-out procedures; (4) security plan; (5) management protocol; (6) reporting procedures; (7) operations plan; (8) equipment list and supplier; (9) fish distribution plan; (10) spill containment plan; and (11) hygiene plan for disease control.

The BRCC-AS would define spawning beach activities (e.g., loading densities, release strategies) as part of the operations plan portion of the facility manual. Members of the BRCC-AS would include representatives from Puget and the other signatories to a Project settlement agreement. Operations at the spawning beach facility would be managed adaptively, allowing for changes in protocol that adjust according to changing fisheries conditions in the Baker River system.

As part of the operations manual for the spawning beach facilities, Puget and BRCC-AS would: (1) study and develop improved sockeye fry release strategies; (2) identify several release sites to be used in addition to West Pass dike; (3) investigate time-of-day release strategies to determine whether such measures affect predation rates and stress on released fry; and (4) investigate the possibility of eliminating non-native kokanee releases in Lake Shannon and replacing them with sockeye fry releases from the spawning beaches.

Additionally, Puget would annually audit the spawning beach operations, based on a June 1 to May 31 operating year, and provide the assessment to the BRCC-AS for review by December 31 of each year.

Effects Analysis

Installation of permanent concrete would strengthen the walls between each segment of the spawning beaches, minimizing the potential for intermixing of water between beach segments. The isolation of the water supplies for each segment would be an improvement over existing conditions, because it would simplify water distribution for each segment, which is currently from a single pipeline for the entire spawning beach. Separating the water supply would also add flexibility to each individual segment to provide for flow adjustments that could accommodate differing sockeye loading densities in each segment.

Improvement of the existing alarm system would reduce the potential effects of water supply failures or substantial turbidity increases that could result in reduced sockeye production. Separation of the drains from each beach segment would aid in controlling the possible spread of disease from segment to segment. These improvements would decrease the likelihood of sockeye production losses and would especially minimize the potential for losses of an entire brood year's production due to disease or water supply issues.

The drafting and implementation of a formal operations manual for the spawning facility would be a substantial improvement over existing conditions. There is currently only an informal operations manual for the spawning beach facilities, and protocol is generally determined on an ad-hoc basis by the BRC. A formal operations manual would ensure that there are set protocols for specific events, such as emergencies, spills, and disease outbreaks, and would also facilitate public review of the fish management protocols at this facility. Specified reporting procedures would help to ensure that the records and data from the spawning beach were presented in a consistent and comprehensive manner that would provide for long-term monitoring of production trends, operations efficiency, and overall effectiveness of the spawning beach program.

Adaptive management of the sockeye facilities through the BRCC-AS would provide for management alterations based on past experiences and would be geared toward maximizing the benefit to the Baker River sockeye population. In particular, the BRCC-AS would study and develop improved sockeye fry release strategies. Several release sites would be used in addition to the current ones, and usually would be limited to two or three spanning the upper, middle, and lower portions of Baker Lake. Puget and the BRCC-AS would also study whether the time of day of fry release affects survival. It has been suggested that night releases could reduce predation and stress on artificially produced fish (Bonneville Power Administration [BPA], 1990). *More information about the potential benefits of alternative release strategies will be available upon completion of the Inventory of Unnatural Predation Opportunity (A-25).*

The BRCC-AS would examine the elimination of non-native kokanee releases in Lake Shannon. Eliminating non-native kokanee releases in Lake Shannon and replacing them with sockeye fry releases from the spawning beaches would remove the potential adverse interactions of non-native kokanee and wild stocks in the watershed. This step is especially important under the measure, because the possibility of releasing returning adult salmonids into Lake Shannon would be investigated and could be implemented during the course of any new license issued. Non-native kokanee could compete with native stocks and inhibit production of native fish. Studies have found that adverse species interactions are more likely with fish that were not historically present in an area compared with the reintroduction of fish that were once native (Hearn, 1987). Therefore, stocking sockeye rather than non-native kokanee would benefit native fish production in the system.

A formalized audit process would aid in evaluating the success and efficiency of spawning beach operations and provide the type of information needed by the BRCC-AS to adaptively manage the spawning beach facility for the maximization of sockeye production (PME 3.1.2). Such a formal auditing process would be a substantial improvement over the informal reporting on spawning beach operations to the existing BRC, as is the current practice. In addition to the annual auditing of the facility, the contracted operator of the beach facility would also provide an annual final report that would contain information regarding facility operations, problems, facility status, future needs, and annual results of the program. The proposed annual report would be more detailed than the current summary of operations that is prepared for the Commission. This detailed operations report would also increase the ability of Puget and the BRCC-AS to modify spawning beach operations to increase success.

This measure, however, does not outline survival rate or overall sockeye production goals for the spawning beach facility; instead the goal of the measure is to operate the facility as efficiently and effectively as possible. Therefore, it is not possible to quantify how these proposed improvements may result in increased survival rates or overall sockeye production in the Baker River system. The BRCC-AS would be responsible for reviewing sockeye production and evaluating the success of the proposed improvements. It can be assumed that the improvements would be beneficial to spawning beach operations and would at least maintain production at current levels and would likely result in production increases in comparison with existing conditions, which already provide substantially higher egg-to-fry survival rates than demonstrated on natural spawning grounds.

Restore and Decommission Beaches 2 and 3

Under this measure, Spawning Beaches 2 and 3 would be retained on an interim basis while other measures are implemented. To ensure that these beaches function properly, Puget would make necessary modifications (e.g., reduce leakage, modify water supply) as deemed necessary in consultation with the BRCC-AS.

After the improvements at Spawning Beach 4 have been completed and production at the facility is acceptable to the BRCC-AS, Puget would proceed with the decommissioning of the Upper Baker spawning beaches in accordance with the USFS special-use permit for the facility. As part of decommissioning the Upper Baker spawning beach facility, the stream channel of Channel Creek would be restored to a natural meander and would be configured to optimize coho salmon habitat, because the stream provides important low-gradient spawning and rearing habitat for coho salmon and rainbow and cutthroat trout. All structures would be removed from the area and disturbed areas would be replanted with native vegetation. A supplementation program focusing on coho and/or sockeye would be temporarily instituted to initiate returns to the rehabilitated site.

In addition, a pilot nutritional enhancement program would be developed for Channel Creek in an effort to increase rearing capacity for salmonids and would likely consist of planting carcasses or other nutrient sources (i.e., fertilizers). Sockeye adults from the spawning beaches, coho broodstock from the proposed supplementation program, or surplus strays from the Skagit River that enter the Lower Baker River trap could supply the carcasses. The BRCC-AS would determine the specifics regarding the nature of the nutrient enhancement program, which would be based upon the best available science to reduce potential adverse effects (e.g., pathogen introduction), while maximizing nutrient benefits.

Effects Analysis

Continued short-term operation of Spawning Beaches 2 and 3 would help to increase overall sockeye production until the BRCC-AS determines that the sockeye run size is sufficient, and the resources used to maintain and operate Beaches 2 and 3 could be redirected elsewhere. Sockeye adults entering the Lower Baker River trap would be distributed between Spawning Beach 4 and the Upper Baker beaches. Consequently, if there were a catastrophic failure (e.g., water supply interruption) at any one of the beaches, the complete year of sockeye production would not be lost. Thus, the short-term operation of Spawning Beaches 2, 3, or both would help to spread the risk of potential adverse effects on sockeye production while improvements are made to Spawning Beach 4. Restoration of the Channel Creek stream channel following decommissioning of Spawning Beaches 2 and 3 would be a substantial improvement over current conditions by increasing habitat quantity and quality below the Baker Lake Highway, which has been reported to block access to the upper reaches of Channel Creek (USFS, 2002a).

The goal of the pilot nutritional enhancement program would be to increase productivity in Channel Creek by providing additional nutrients that spawning salmonids may have historically provided. Studies have found that MDN from anadromous salmonids can have a substantial positive effect on the productivity of aquatic and riparian environments (Naiman et al., 2002). The majority of the growth of anadromous salmonids occurs in the marine environment, where they accumulate up to 95 percent of their body mass (Groot and Margolis, 1991; Chaloner and Wipfli, 2002). Thus, anadromous fish are a contradiction to the general perception that materials and nutrients flow from land to freshwater and then to the sea. Each year, salmon runs provide a massive transport of organic material and nutrients from marine water to the freshwater and terrestrial ecosystems. The vast majority of anadromous salmonids are semelparous (i.e., they die after spawning), and the carcasses in the streams after spawning are a substantial source of nutrients (Naiman et al., 2002; Cederholm et al., 1999).

MDN from anadromous salmonids may be especially important in watersheds, such as the Baker River system, in which nutrients may be limiting aquatic productivity. Studies have found that MDN can increase macroinvertebrate abundance, which can benefit juvenile growth and survival. Juvenile salmonids in streams where MDN is present have been found to experience statistically significant increases in forklengths and condition factors in comparison with fish in areas without spawning salmon (Gresh et al., 2000; Bilby et al., 1996; Bilby et al., 1998). Increased length and condition factor is closely correlated to improved overwintering, outmigration, and adult-to-smolt survival (Bilby et al., 1998; Wipfli et al., 1999; Bilby et al., 1996). Therefore, a pilot nutrient program in Channel Creek consisting of the addition of salmon carcasses or fertilizers that would mimic carcass nutrients may increase primary productivity and, ultimately, improve habitat conditions and production potential for salmonids. In addition, some of the nutrients added to Channel Creek would also be carried downstream to Baker Lake, thereby benefiting production in the reservoir as well.

The BRCC-AS would determine whether the use of salmon carcasses or fertilizer would be most suitable for this program. Carcasses have the potential to spread disease, although such effects are reduced when adults native to the system are used (Cederholm et al., 1999). The use of fertilizers for such programs has mostly been implemented in lakes, and it is unknown whether such methods would be effective in a stream environment where fertilizers may be carried rather quickly downstream.

Supplementation Programs

The measure also includes a supplementation program to enhance salmonid populations. The supplementation programs are designed to enhance salmonid populations and address the potential continuing effects of the Baker River Project on aquatic resources. Coho, steelhead, Chinook, rainbow trout, and possibly sockeye salmon would be reared at the Sulphur Creek facility and released in an effort to increase salmonid production in the watershed. The goal would be to rear a sufficient number of juveniles of the target species to support returns of fish equal to or in excess of the average number returning to the Project since completion of Upper Baker dam in 1959. Specifically, the measure calls for: (1) 20,000 coho smolts (10 to 15 per pound) per year to be reared and released for the duration of any new license issued; (2) 25,000 steelhead smolts (6 to 8 per pound) per year to be released; (3) 25,000 spring Chinook smolts (at 10 to 15 per pound) per year to be reared and released or Chinook rearing programs offsite for the Skagit River basin to be supported; (4) 10,000 catchable-size rainbow trout or another preferred sport fish species to be reared and released into Depression Lake; and (5) sockeye production in the basin to be increased.

Coho—The 20,000 smolts would likely be raised at the Sulphur Creek facility or the Lake Shannon net pens, and broodstock would be taken from coho adults returning to the Lower Baker River trap. These fish, along with those produced naturally in the basin, are anticipated to produce approximately 4,600 returning coho adults or more. The 4,600 value is the average number of coho adults that have returned to the Baker River since the Upper Baker Development began operation in 1959. The supplementation efforts along with fish passage improvements, flow regime modifications, and potential riverine habitat improvements should provide for sufficient coho production in the Baker River system to sustain the adult return goals.

Consistent with the recommendations of the Hatchery Scientific Review Group (HSRG), one of the goals of this coho production program is to use low-impact methodologies. The HSRG is a panel of independent scientists that has reviewed hatchery practices in the Puget Sound area, including the Skagit River basin, and has made recommendations for future artificial production operations. The WDFW and the Northwest Indian Fisheries Commission support the efforts of the HSRG (HSRG, 2003).

The HSRG stated in its recommendations that one of the keys of a successful supplementation program is to not over-emphasize the hatchery component in stock production. This is a key concern because competition for habitat locations has been found to be highly density dependent (Hearn, 1987). Therefore, the greater number of hatchery fish introduced to the system, the higher the likelihood that hatchery and wild fish competition for microhabitat locations would result. However, studies have found that differences in run timing can help to minimize the potential for habitat competition, because salmonids tend to shift their microhabitat preferences as they grow. Under the measure, artificially produced coho salmon would only be introduced to the Baker River system as smolts; therefore, they would not be expected to persist in the system for more than a few weeks. However, a portion of the coho released would likely residualize and rear for extended periods in Baker Lake and may compete with wild salmonids for food in the reservoir.

In addition to competing for food, residualized coho may also be a predation risk to other salmonids in the Baker River system. Studies conducted in Alaska and British Columbia have found that coho salmon can substantially affect sockeye populations in lakes. For example, in Chignik Lake, Alaska, coho consumed as much as 59 percent of the average population of sockeye fry (Pearsons and Fritts, 1999). Residual coho may also prey on other salmonid juveniles, including Chinook salmon and bull trout (Pearsons and Fritts, 1999). However, the rather low numbers of coho salmon proposed for release would be expected to preclude substantial predation effects from occurring.

The release of hatchery fish could also lead to genetic variations in the naturally spawning Baker River coho population. In other systems, shifts in population genetics due to hatchery production have been attributed to effects, such as loss of genetic specializations for the natural environment, decreased spawning success, and poor survival due to hatchery adaptations (Flagg et al., 2000; Campton, 1995). However, the original Baker River coho stock is believed to have been extirpated. Therefore, there is no longer a true "wild" coho stock in the watershed that would potentially experience adverse effects from hatchery introductions. In addition, the proposed 20,000 artificially produced coho smolts is a low number of hatchery produced fish, which would minimize the potential for adverse genetic effects on the existing naturally spawning coho population. Furthermore, broodstock for the program would likely be taken from naturally produced coho returns to the Lower Baker River trap. Therefore, the artificially produced fish would have the same genetic composition as the naturally spawning coho in the system. Other measures, such as spawning fish throughout the run timing, spawning fish of random sizes and ages, and minimizing the male to female broodstock ratio, would help to alleviate potential genetic shifts in the Baker River coho population due to artificial production.

Thus, the proposed supplementation of 20,000 coho smolts should provide adequate smolt production to meet adult return goals, while minimizing the potential for adverse effects associated with hatchery production. The measure is also consistent with the HSRG recommendation for the Baker River, which suggests that artificial production of coho salmon should be kept at a low level.

Steelhead—The origin of the 25,000 juveniles to be reared would be determined by the BRCC-AS, but would likely be from Skagit River stock. Since 1959, average steelhead returns to the Baker River have been about 230 fish. Therefore, the smolt-to-adult survival rate of the 25,000 steelhead smolts would only have to be about 1 percent to achieve the adult return goal of 230 steelhead, annually. The Baker River is not currently thought to support a self-sustaining population of steelhead trout; therefore, the use of hatchery fish in the Baker River system would not compromise existing wild steelhead production in the system. The measure is consistent with the HSRG recommendation of 6 fish to the pound (HSRG, 2003).

According to the HSRG recommendations (HSRG, 2003), hatchery production of steelhead in the Skagit River basin should be predominantly for the purpose of harvest. Therefore, the Skagit River hatchery stock run timing has been manipulated to minimize potential adverse interactions and interbreeding with wild fish. Use of the Skagit River hatchery broodstock would help to minimize potential adverse effects from steelhead released in the Baker River, even if these fish were to stray to other streams in the Skagit River basin. The BRCC-AS would be responsible for defining management goals for the steelhead program and whether adult returns would be released into Baker Lake or solely used as broodstock for continued operations of the artificial production program.

There would be potential for a portion of the 25,000 steelhead smolts to residualize and remain in the Baker River system for prolonged periods. Residual steelhead could pose a predation risk to sockeye fry and other salmonid juveniles including Chinook salmon and bull trout. Studies of residual hatchery steelhead in northeast Oregon found that predation on salmonid fry can be as high as 0.49 to 0.84 salmonid per day per steelhead, although such predation rates are unusual (Whitesel et al., 1994; Jonasson et al., 1994, 1995, 1996). A similar study conducted in the Salmon River, Idaho, found that hatchery steelhead only consumed approximately 0.00148 Chinook salmon fry per smolt (Cannamela, 1993). A study in the Cedar River, Washington, also found that hatchery steelhead did not actively feed on sockeye fry, although wild steelhead did (Beauchamp, 1995). These studies suggest that while there is the potential that some of the artificially produced steelhead smolts may prey upon other juvenile salmonids in the Baker and Skagit rivers, the levels of predation would likely be low. Furthermore, the overall low number of artificially produced steelhead smolts proposed under the Draft Action would help to minimize predation potential associated with artificial steelhead production.

Chinook Salmon—These fish would most likely be reared at the Sulphur Creek facility, or as an alternative, Puget may provide financial support for other Skagit River Chinook salmon programs during the course of the license. The BRCC-AS would study the potential adverse effects and benefits to determine whether rearing Chinook in the Baker River system or supporting other Skagit River programs would be most beneficial to overall Skagit River spring Chinook production.

If Chinook were reared at the Sulphur Creek facility, the program would substantially increase current Chinook presence in the Baker River. Fall Chinook returning to the Baker River trap are now transported back to the Skagit River, and only potential returns from an experimental WDFW spring Chinook program are provided access to Baker Lake. Since 1959, an average of about 340 adult Chinook have returned each year to the Baker River, although the majority of these returns are thought to be strays from the Skagit River or other drainages.

A Baker River Chinook program would also be consistent with the HSRG recommendations, because it would expand the range of spring Chinook in the Skagit River basin. This expansion of the range would minimize the possibility that a catastrophic event in a specific area could lead to extirpation of the Skagit River spring Chinook stock. Adult returns from the spring Chinook program would also provide additional MDN, which could result in long-term benefits to aquatic productivity in the Baker River system.

Because there is not a wild spring Chinook spawning population currently present in the Baker River system, there would not be a concern of potential adverse genetic interactions with wild spring Chinook. The stock for the program would be taken from the Skagit River; therefore, if spring Chinook produced in the Baker River system were to stray to other areas in the Skagit River basin, they would not likely have an adverse effect, because their genetic composition would be equivalent to fish already present in the Skagit River.

Furthermore, predation potential of these spring Chinook smolts would be minimized, because they would be released at the Baker River trap. Therefore, even if portions of the release were to residualize, they would not be able to prey upon Baker River fish above the barrier dam. Residuals from the spring Chinook releases would, however, have the potential to prey on fish in the Lower Baker and Skagit rivers. Preliminary studies in the Lewis River, Washington, found that hatchery spring Chinook consumed approximately 0.91 fall Chinook juvenile per day (Hawkins, 1998). These fish could also prey on other resident salmonid juveniles in the area. However, due to the low numbers of smolts to be released, these potential effects would not be expected to produce a significant adverse effect on fish populations in the Lower Baker and Skagit rivers.

Rainbow Trout—The rearing and release of rainbow trout would be solely for the purpose of sport harvest. Depression Lake was chosen as the release site, because it would minimize the potential for adverse species interactions between the hatchery rainbow trout and wild fish in Baker Lake. The West Pass dike separates Depression Lake from Baker Lake, and there is no surface water connection between the two water bodies. There is a possibility that small numbers of hatchery rainbow trout could be introduced into Baker Lake during pumping operations from Depression Lake or to Lake Shannon via an overflow channel that drains to the reservoir, although the likelihood of such events is low and would not be expected to pose a significant threat to wild fish production in Baker Lake or Lake Shannon.

Sockeye Salmon—The potential for increases in sockeye production would be evaluated based upon Study A-26, *Baker Lake Aquatic and Sockeye Salmon Productivity*. It is not known at this point what measures may be implemented to achieve an increase in production and such activities would likely be negotiated post licensing within the BRCC-AS.

5.6.2.7 Ongoing Resource Monitoring and Management

Many of the provisions proposed in the Draft Action require ongoing evaluation and decision-making during the course of the license. Puget acknowledges this by proposing several measures that would provide for continued collaboration with parties to any settlement agreement reached prior to license application to ensure that Puget and other resource interests can adapt to changing conditions in the Baker River system. Under current conditions, Puget voluntarily participates in the BRC, which is responsible for making management decisions pertaining to the aquatic resources of the Baker River system.

Under the Draft Action, Puget along with parties to an anticipated licensing settlement agreement would form the BRCC (see PME 6.2). The BRCC would have an expanded membership compared with the existing BRC and would deal with a variety of resources, not solely aquatics. The BRCC would manage license implementation and resource management issues over the course of the license. Several subcommittees, including the BRCC-AS, would be formed to focus on specific resource issues. The BRCC-AS would be responsible for studies and monitoring required for implementation of the license and to address any other aquatic resource needs that may arise during the license period.

The BRCC-AS would implement adaptive management principles. Results of monitoring and studies of fisheries resources would be continually reviewed, and the group would determine how the resource should be managed in the future, based on the findings and experience of past activities (see PME 6.1). The BRCC-AS would only move forward on an issue once consensus on a subject has been reached, thereby avoiding dominance of a single party in resource decisions.

One of the responsibilities of the BRCC-AS would be to administer the HERC Fund, an annual discretionary fund to be used for aquatic resources-related activities that are in excess of the mandatory license conditions. The purpose of this fund would be to address potential effects of the Baker River Project and provide for enhancement of aquatic resources in comparison with existing conditions. An annual discretionary fund would allow the BRCC-AS to address ongoing aquatic resource needs over the course of the license. The annual amount Puget would contribute to the HERC Fund is yet to be determined through continued collaboration between the parties of the Baker River licensing proceedings.

In administering the HERC Fund, the BRCC-AS would give highest priority to potential habitat improvement projects in the Baker River basin, including the acquisition of interests in land, such as conservation easements or other habitat conservation measures (see PME 3.1.1). Potential projects in the Middle Skagit River would be given second priority, followed by projects elsewhere in the Skagit River basin.

Puget proposes in this measure that the HERC Fund may be used to address some of the following topic areas, as deemed appropriate by the BRCC-AS:

- a native resident salmonid program and recreational fishing opportunities;
- non-native and invasive aquatic animal species;
- water quality enhancement;
- riparian habitat enhancement;
- stream channel improvements/modifications; and
- noxious weed control.

Whenever possible, the BRCC-AS would look to support projects that include matching funds from other entities. Dispensation of the funds would be flexible to provide for accumulation of funds or use of 50 percent of the next year's funds to provide for more expensive projects that the BRCC-AS decides should be initiated. Puget would provide an annual financial report pertaining to HERC Fund spending. Refer to appendix B for the full text of these measures.

Effects Analysis

Establishment of the BRCC-AS would ensure a long-term collaborative approach to aquatic resource management in the Baker River basin. The BRCC-AS would provide for the representation of a variety of interests in aquatic resource management. Creation of the BRCC and the aquatics subgroup also would help to ensure that all license provisions were fully implemented. The adaptive management principles that would guide the BRCC would provide the management flexibility needed to manage environmental resources, which are in a constant state of flux. Thus, the BRCC-AS would provide a long-term benefit for aquatic resources of the Baker River system by creating a structured, yet adaptive management framework.

Establishment of the HERC Fund would also be an improvement compared with existing conditions in which there is no formal funding source for aquatic habitat conservation, restoration, and enhancement. The fund would aid in ensuring that the potential effects of the

Baker River Project were mitigated and that resources would be available to deal with ever-changing environmental conditions. The HERC Fund is precisely the type of vehicle needed to effectively implement adaptive management of aquatic resources. A discretionary fund allows the BRCC-AS to address uncertainty by providing the resources to study issues of interest, implement pilot projects, monitor and evaluate results, and modify programs as warranted, based on scientific principles.

5.6.2.8 Secondary Effects of Proposed Measures

Lower Baker Power Plant Modifications

The Lower Baker power plant modifications under the Draft Action would be conducted as described in section 3.2.1. Construction would last approximately 24 months and would involve some instream work. Instream work would be limited, to the extent required, to uncovering the existing foundation of the abandoned Units No. 1 and 2 powerhouse and installing bridge pilings. The purpose of the power plant modification would be to provide the physical capability to deliver ramping rates and minimum flows included in PME 3.3.1 for aquatic resource protection. This power plant modification could temporarily affect water quality and fish habitat by increasing erosion and sedimentation and could disrupt fish migration during construction.

Effects Analysis

Fish migration disruptions caused by construction activities, such as instream work and blasting, would be minimized because the construction and blasting would be located upstream of the fish barrier dam. Adult upstream migrating fish, such as coho and sockeye salmon, would be passed around the construction site to Baker Lake through the existing trap-and-haul program. Therefore, construction machinery or noise would not directly harass or harm adult upstream migrant fish. Downstream migrant fish would also be passed around the construction site though the existing trap-and-haul system. The only fish that could be directly harassed or harmed would be downstream migrants that fail to be captured in the trap-and-haul system and that ultimately survive passage through the reservoir system or any resident fish located in the reach. Such potential would be addressed in consultation with federal and state fisheries agencies and affected Indian Tribes. In addition, WDFW would specify appropriate in-water work windows to minimize effects on aquatic resources.

Water quality may be affected temporarily during construction, primarily through increased erosion and sedimentation. However, these effects can be minimized and avoided by implementing best management practices (e.g., installing silt fencing and other sediment trapping devices on land and silt curtains in water) and covering exposed soil until permanently stabilized. Puget would be required by federal, state, and county regulations to develop sediment and erosion control plans as part of the construction process. Chemical spills could also occur during construction, but development of a pollution prevention plan in accordance with appropriate federal, state, and county requirements would minimize the effects of such an occurrence. Typically, a pollution prevention plan would specify areas for equipment maintenance and refueling, spill prevention and emergency response strategies, and requirements for keeping emergency response spill containment kits onsite and for having trained personnel be onsite during construction. Other measures could include installing bridge pilings with equipment located landward of surface waters or using temporary cofferdams to isolate in-water work.

Through the construction permitting process, plans would be developed to minimize and avoid temporary construction-related effects to the extent feasible using best management practices that are similar, but not limited to, the previously mentioned actions. No long-term negative effects on aquatic resources are anticipated to result from construction. However, through plant modification, the ability to finely adjust Project ramping and instream flows would be a net benefit to aquatic resources in the Lower Baker and Skagit rivers.

Recreational Measures

Dispersed Camping—The Baker River Project reservoirs provide an attraction and opportunity for dispersed camping and recreation in the Project area. Under existing conditions, such activities have taken place informally and have resulted in minor damages to aquatic resources in localized areas, namely in the form of modifications to riparian areas and increased angling effort.

Under the Draft Action, Puget would fund 50 percent of the capital improvement costs for designated dispersed recreational areas in appropriate locations and would also fund operation and maintenance activities. Puget would also provide funds for management of potential dispersed recreational effects. Under existing conditions, dispersed recreation occurs in several areas without management, maintenance, or inventory of such areas.

Effects Analysis

The Draft Action would increase management of dispersed recreation, which would help to minimize potential adverse effects on aquatic resources, associated with modifications to the reservoir shoreline and angling effort. Dispersed recreational sites would be located away from fish release sites to minimize potential sport fish pressure and stress on released fish. This formal designation and management of dispersed recreational sites should effectively minimize potential adverse effects on aquatic resources.

Trails and Trailheads—The Baker River Project area attracts many day-use and overnight recreationists. The current trail system in the area appears to be inadequate to meet current and future demand. Therefore, Puget proposes a number of trail developments near Baker Lake and Lake Shannon (see section 5.10.2.4).

Effects Analysis

Access to many parts of the Project reservoirs and tributary streams is currently limited. Expansion and improvement of recreation trails in the area under the Draft Action would provide for increased human presence in several locations, thereby increasing the potential for increased angling pressure in specific areas of the reservoir and tributary streams. In addition, small bridges over tributary streams would likely be required on some trails, resulting in minor losses of riparian habitat and the potential for slight increases in sediment delivery. However, these potential effects under the Draft Action would be minor to negligible and would not be expected to significantly adversely affect aquatic resources in the Baker River.

5.6.3 Cumulative Effects

Skagit Project operations when combined with current Baker Project operations produce an adverse cumulative effect on fish habitat availability, redd dewatering, and fish stranding in the Middle Skagit River. This cumulative effect has the potential to affect anadromous salmonids, resident species, and aquatic macroinvertebrates in the Middle Skagit River. Study A09 is currently underway and will provide quantified estimates of cumulative effects on fish habitat quantity and redd dewatering resulting from the combined operation of the Skagit and Baker Projects for current operation and the Draft Action. In addition, the HYDROPS post-processing analysis will provide additional information, which will be used to compare ramping frequency, duration, and range to assess fish stranding potential. This information will be incorporated into this analysis when available.

Cumulative effects on aquatic habitat could also arise through increased land development and urbanization throughout the Lower Skagit River watershed. Recreational and commercial fish harvest may cumulatively affect fish populations. However, we have no information about fish harvest projections with which to assess potential cumulative effects. Skagit River Watershed restoration planning is currently underway. Watershed restoration activities, in combinations with instream flow requirements and ramping restrictions, may have a cumulative benefit for aquatic resources in the Skagit River basin; however, specific watershed restoration projects have not been evaluated. No other major land-use or construction projects are known that in combination with Project operations may cumulatively affect aquatic resources.

5.6.4 Unavoidable Adverse Effects

Stranding of fish in the Lower Baker and Middle Skagit rivers is an unavoidable adverse effect of continued Project operations under any load-following scenario, including current operations and the Draft Action. Ramping at any rate and magnitude has the potential to strand some fish and aquatic invertebrates. Generally, it is thought that stranding increases with ramping rate, frequency, and magnitude; however, quantifying actual stranding for various species is difficult. Stranding could range from a few fish to several thousand fish per ramping event based on actual field studies, as listed previously, and can affect all species in the affected reach.

There is potential to dewater some number of salmonid redds under any Project operation scenario in the Middle Skagit River downstream of the Baker River confluence and in Baker Lake given the Project's load-following operations and the ACOE flood control agreement. Of note is that stranding and redd dewatering also occur naturally in unregulated systems, although it is thought to a lesser extent than for regulated systems.

Trapping, handling, and transporting adult and juvenile fish past Project structures would result in some mortality that cannot be avoided through the implementation of Draft Action measures or under current operations. However, such mortality would be negligible given the substantial benefits of passing fish to and from the Upper Baker River basin.

5.7 Terrestrial Resources

5.7.1 Affected Environment

The following sections describe the existing vegetation and wildlife resources in the Baker River Project vicinity, including cover types, distribution of vegetation and wildlife, and special status species. Information sources include Puget's surveys and study reports, USFS data and reports from the Mt. Baker Ranger District, and WDFW data on priority habitats and species.

We provide information about federally threatened and endangered species in section 5.8, *Federally Listed Threatened and Endangered Species and Essential Fish Habitat*.

Past actions from a variety of sources have affected certain key wildlife habitats in the Baker River basin. Key habitats identified through scoping and studies include mature and old-growth coniferous forest, deciduous forest, riparian habitats, and wetlands. In the following section, the description of the existing condition for these key habitats is expanded to include discussion of past actions that have led to the current status of the habitat in an effort to better describe existing conditions.

5.7.1.1 Plant Communities and Wildlife Habitats

The Baker River Project is located within the western hemlock (*Tsuga heterophylla*) zone of the Northern Cascades Province (Franklin and Dyrness, 1988). Mt. Baker (elevation 10,778 feet msl), Mt. Shuksan (elevation 9,127 feet msl), and other high mountain peaks rise up from the Baker River and the Project reservoirs on the west, north, and east sides. Along these slopes, vegetation transitions to higher elevation assemblages including the Pacific silver fir (*Abies amabilis*), mountain hemlock (*Tsuga mertensiana*), parkland, and alpine zones. The glaciers and snowfields associated with the high peaks and ridges funnel cold air down into the Baker River basin. This effect is particularly strong on the western side of Baker Lake, where several plant species typical of higher elevations occur at unusually low elevations (USFS, 2002a).

Events of both natural and human origin have modified forest stands in the Baker River basin. Natural disturbance events include wind storms, wildfire, and avalanches. Human disturbance of vegetation has occurred through timber management activities, fire, limited residential and recreational development, and the development of the Baker River Project.

The northern portion of the Baker River basin is a mosaic of forest stand ages, containing large tracts of both old-growth and second-growth coniferous forest. Most of the area is federally managed as National Forest System and National Park System lands, and timber harvest is currently restricted. The southern portion of the basin supports extensive, ongoing management of private and state timberlands. Little old-growth forest remains, and the area is dominated by second- and third-growth stands of Douglas fir (*Pseudotsuga menziesii*), western hemlock, western redcedar (*Thuja plicata*), red alder (*Alnus rubra*), and other less common species.

Figures 5-20, 5-21, and 5-22 (appendix A) show the cover types in the Baker River Project area (defined as the area within the FERC Project boundary). Table 5-20 presents the acreages of each cover type by reservoir subarea. The Project area was mapped through aerial photograph interpretation and ground verification of cover types and polygons. Detailed information about the vegetation mapping of the Project area is contained in Puget (2003f).[18] The Project area includes approximately 8,207 acres, including about 2,102 acres of reservoir at Lake Shannon and 4,815 acres of reservoir at Baker Lake (both at near full pool elevations).

Table 5-20. Baker River Project area cover types (in acres).[a] (Source: Puget, 2003f)

Cover Type/Structure Class	Lake Shannon Subarea	Baker Lake Subarea	Total Project Area	Percent of Total (terrestrial)
Coniferous Forest				
Old-growth	24	53	76	5.9
Mature	31	238	269	20.9
Mid-successional	1	49	50	3.9
Pole	0	13	13	1.0
Mixed Coniferous/Deciduous Forest				
Mid-to-late seral Stage	88	146	234	18.1
Young seral stage	0	0	0	0.0
Deciduous Forest				
Mid-to-late seral stage	121	247	367	28.5
Young seral stage	4	16	20	1.5
Shrub	10	28	38	3.0
Grass/Forb				
Grass/forb	5	82	87	6.7
Rock/Talus/Bare Soil				
Rock/talus	0	0	0	0.0
Cliff	1	2	3	0.2
Unvegetated upland	0	1	1	0.1
Disturbed/Modified Cover Types				
Residential/developed	20	1	21	1.7

[18] The Puget (2003f) estimates of habitat in the Project area have not been adjusted to reflect the shift to the NAVD 88 and may differ from figures used elsewhere in this document (refer to section 3.1.1, *Existing Project Facilities*).

Cover Type/Structure Class	Lake Shannon Subarea	Baker Lake Subarea	Total Project Area	Percent of Total (terrestrial)
Project facilities	6	64	69	5.4
Other disturbed	10	9	19	1.5
Roads	6	16	21	1.7
Total Terrestrial Cover Types	325	965	1,290	100.0
Reservoir	2,102	4,815	6,917	
Total Terrestrial And Reservoir	2,427	5,780	8,207	

[a] The Puget (2003g) estimates of habitat area in the Baker River basin have not been adjusted to reflect the shift to NAVD 88 and may differ from figures used elsewhere in this document (refer to section 3.1.1, *Existing Project Facilities*).

Figure 5-23 (appendix A) presents the cover types present within the Baker River watershed. This map was created from a variety of sources including USFS vegetation maps, private timber company maps, and detailed Project area maps. Each mapping source used slightly different vegetation cover types and map unit criteria, which were grouped into comparable categories for this map (Puget, 2003g). For this reason, the cover type categories and structure classes on figure 5-23 and the corresponding table 5-21 are not identical to those presented for the Project area in figure 5-21 and table 5-20.

Table 5-21. Baker River basin major cover types (in acres). (Source: Puget 2003g)[a]

Cover Type/Structure Class	Skagit County Subarea	Whatcom County Subarea	Total Baker River Basin	Percent of Total
Coniferous Forest				
All classes	27,383	79,304	106,687	56.0
Deciduous Forest				
All classes	3,237	2,356	5,592	2.9
Shrub				
Shrub	1,906	8,165	10,072	5.3
Grass/Forb				
Grass/forb/sparse vegetation	2,539	23,666	26,205	13.8
Wetlands				
All wetlands[b]	392	1,099	1,491	0.8
Rock/Talus/Bare Soil				
Rock/talus/bare soil	384	18,944	19,328	10.1

Cover Type/Structure Class	Skagit County Subarea	Whatcom County Subarea	Total Baker River Basin	Percent of Total
Disturbed/Modified Cover Types				
All types	61	0	61	0.0
Water				
Reservoir	1,999	4,815	6,814	3.6
Snow/ice	0	14,311	14,311	7.5
Total	37,901	152,660	190,561	100.0

[a] The Puget (2003g) estimates of habitat area in the Baker River basin have not been adjusted to reflect the shift to NAVD 88 and may differ from figures used elsewhere in this document (refer to section 3.1.1, *Existing Project Facilities*).
[b] Above reservoir, including natural lakes.

The Whatcom County subarea referenced in table 5-21 includes the majority of the Baker Lake basin surrounding Baker Lake; the Skagit County subarea includes the southernmost portion of Baker Lake and all of the lands surrounding Lake Shannon.

Coniferous and Mixed Coniferous/Deciduous Forest

Coniferous forests capable of exhibiting great biomass and longevity dominate the Baker River basin (USFS, 2002a). Old-growth coniferous forests are characterized by very old and large overstory trees. Many additional structural attributes contribute to the high value of old-growth stands for wildlife, including variation in tree size and spacing, broken and deformed tops, multiple canopy layers, canopy openings, variation and patchiness of understory composition, and large-diameter standing dead and downed trees. This complex habitat supports a large number of plant and animal species, some of which are found only in late seral forests. Mature forests typically exhibit some, but not all, of the components of old-growth forests.

Elevation influences the species composition and biomass of coniferous forests. In the Baker River basin, lower elevation forests in the western hemlock zone are capable of high productivity and very high standing biomass. These forests are dominated by Douglas fir, western hemlock, and western redcedar, including some of the oldest and largest trees on the MBSNF (USFS, 2002a). The higher elevation silver fir and mountain hemlock zones are less productive than the lower elevation forests because of differences in soil composition and environmental factors. The distribution of late seral stands across the landscape also influences their quality to wildlife. Large stands are better able to support those species that require large contiguous patches of interior forest. Travel corridors between stands are important for some interior forest species that move long distances; corridors provide pathways for dispersal of young and allow access between seasonal habitats, high- and low-elevation ranges, and along riparian zones.

Species closely associated with late seral coniferous forest include the northern spotted owl, marbled murrelet, pileated woodpecker, northern goshawk, American marten, Johnson's hairstreak butterfly, certain terrestrial mollusks, and several vascular plants, lichens, and mosses.

Naturally occurring events that have shaped the age and structure of the Baker River basin forests include wildfire, landslides, wind storms, avalanches, and lava flows. Human activities profoundly influenced the age and distribution of forest stands during the past 100 years. The first sawmill in the Middle Skagit River valley was established near Birdsview in 1878, and timber harvest within the Baker River basin was in full swing by 1922 (Puget, 2002c). Timber harvest has occurred on private, state, and National Forest System lands within the basin. Road building and limited residential and industrial development have also influenced the forest stands.

The Lower Baker Development was constructed at a time when logging was actively occurring along the Lower Baker River. Creation of Lake Shannon contributed to timber harvest volumes, providing over 100 million board feet of timber; it also interrupted commercial timber harvest, forcing the relocation of the primary rail line to the east side of the proposed reservoir. The Baker Lake area was largely harvested immediately prior to inundation. However, the filling of the reservoir also served to block access to National Forest System and private (Scott Paper Company) lands on the east side of the basin, including some being logged near Noisy Creek at the time of inundation. Approximately 4,984 acres of coniferous and mixed coniferous-deciduous forests of varying ages (Puget, 2003h; personal communication M. Vaughn, Biota Pacific Environmental Sciences, Inc., Bothell, WA, and K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, on September 15, 2003) were harvested or inundated by the Project reservoirs. Because commercial timber harvest was a primary land-use activity in the basin, much of this land would have been harvested prior to the early 1990s, if the Project had not been constructed. Timber harvest slowed dramatically in the basin during the 1990s, as a result of changes in management direction for the protection of spotted owls and other old-growth dependent species.

Private and state timberlands surrounding Lake Shannon are dominated by second- and third-growth coniferous forest, and currently support little or no old-growth forest (Puget, 2002c) (figure 5-24, appendix A). The USFS estimated that 39 percent of coniferous forested habitats on National Forest System lands in the Baker River watershed are currently in early to mid-seral stages, primarily as a result of timber harvest (USFS, 2002a).

Mature and old-growth coniferous forest stands remain primarily in the northern portion of the watershed. The USFS estimated that 10,541 acres of mature coniferous forest and 41,735 acres of old-growth coniferous forest remain on National Forest System lands in the watershed (USFS, 2002a). This represents 61 percent of all coniferous forest habitats on National Forest System lands. Remaining mature and old-growth forest at low to mid-elevations on the west side of Baker Lake have been highly fragmented due to timber harvest and road building. Fragmentation of mature and old-growth stands has occurred to a lesser extent on the east side of Baker Lake. Currently, about 579 acres of mature and old-growth coniferous and mixed coniferous/deciduous forest are present within the Project area. The majority of this acreage

(76 percent) is located around Baker Lake. Puget (2003f) includes detailed habitat information about tree species composition, diameter class, canopy cover, coarse woody debris, and snags for sample sites within these habitats.

Puget owns a limited amount of land surrounding the Project reservoirs and does not currently implement specific management measures for late seral forest habitat.

The USFS has implemented specific management practices to protect late seral coniferous forest and the species that depend on this habitat. The Northwest Forest Plan (USFS and BLM, 1994a, as amended) established a system of late successional reserves (LSRs) to provide habitat capable of supporting viable populations of species associated with late successional and old-growth forest. The Baker LSR is about 82,100 acres and almost completely surrounds Baker Lake. Designated Conservation Area (DCA) WD-21 was established in 1992 for the protection of northern spotted owls under the ESA (FWS, 1992). It encompasses roughly 104,000 acres of National Forest System lands on the Mt. Baker Ranger District, including 29,750 acres not included in the Baker LSR. The Northwest Forest Plan, as amended (USFS and BLM, 1994b, 2001) provides for special survey and management requirements for selected old-growth associated species. Commercial timber harvest activity has been at a standstill on the Mt. Baker Ranger District since the early 1990s.

Washington State Forest Practices Rules specify standards for commercial timber harvest on non-federal lands. Included in the Forest Practices Rules are specific requirements for lands supporting listed fish and wildlife species. State and private timberlands surrounding Lake Shannon are managed under these rules. Additionally, state-owned timberlands in the watershed are managed in accordance with a Habitat Conservation Plan (HCP) prepared by the Washington Department of Natural Resources (WDNR) under the provisions of Section 10 of the ESA. The HCP has a number of management provisions specific to the protection of habitat for late-seral wildlife.

State and private lands surrounding Lake Shannon are expected to be managed for timber resources in the future, resulting in continued rotation of forest stand ages, within the requirements of Washington State Forest Practices Regulations and the WDNR HCP. The ongoing management designations on National Forest System lands surrounding Baker Lake, including LSRs, DCA, Riparian Reserves, Wilderness and Recreation reserved areas, and administratively withdrawn lands, are expected to provide protection to old-growth and mature forest values in the future.

Deciduous Forest and Shrub Habitats

In the Baker River Project vicinity, deciduous forest stands characterize sites with relatively recent and/or frequent ground disturbance, such as timber harvest, landslides, avalanche chutes, and riparian zones of low to moderate gradient streams and rivers. Red alder is the dominant recolonizer of disturbed soils within the western hemlock zone; it is also common within riparian zones. Big-leaf maple (*Acer macrophyllum*) is common in riparian zones and in openings in coniferous forest. Black cottonwood (*Populus balsamifera* spp. *trichocarpa*) is the dominant overstory species along riparian zones with moderately to well-developed floodplains. Within areas of frequent disturbance, such as avalanche chutes and riparian zones, deciduous shrub communities may persist; these are typically dominated by willows (*Salix* species), vine maple (*Acer circinatum*), and salmonberry (*Rubus spectabilis*).

Deciduous forest stands along riparian zones can provide locally unique wildlife habitat when certain structural features are present. Locally unique features can include variation and patchiness of understory vegetation, snags and downed logs, seasonal canopy cover, and stream shading. Species closely associated with deciduous forest and shrub habitats include willow flycatcher, yellow warbler, MacGillivray's warbler, black-capped chickadee, red-eyed vireo, olive-sided flycatcher, and ruffed grouse.

Timber harvest has affected the distribution of deciduous forests in a number of ways over the past 100 years. The amount of deciduous and mixed forest in the watershed increased over the first half of the twentieth century because cutover lands were typically burned and allowed to regenerate naturally. Red alder became particularly abundant due to its ability to rapidly colonize disturbed soils and out-compete slower growing conifers. In the second half of the twentieth century, advances in silviculture and increased emphasis on the growth of high-value conifer species resulted in the conversion of many acres of alder forest to conifers, and the active suppression of young alders in regenerating conifer stands. While the total area of deciduous forest has decreased in recent decades, it still remains higher overall than existed prior to European settlement. The general distribution of deciduous forest has also changed. Following the original Project construction, the total amount of lowland riparian deciduous forest decreased slightly due to inundation of Lake Shannon and Baker Lake, while the amount of upland deciduous forest (particularly red alder) has increased for the reasons discussed above. Current state and federal regulations prohibit timber harvest directly adjacent to perennial streams in the watershed, so the amount of deciduous forest in these riparian areas is expected to decrease over the next 100 years, eventually approaching the pre-settlement condition.

It is estimated that construction of the Baker River Project affected approximately 90 acres of upland deciduous forest habitats and an additional 269 acres of riparian deciduous forest and shrub (Puget, 2003h).

Currently, deciduous forest habitats are present on about 5,592 acres in the Baker River basin and about 387 acres in the Project area. Most of these sites are disturbed timber lands, or disturbed lands along the northern shorelines of Lake Shannon and the northwestern shore of Baker Lake. Deciduous shrub habitats comprise about 38 acres within the Project area, primarily along the western shorelines of the Project reservoirs. Puget (2003f) includes detailed habitat information on tree species composition, diameter class, canopy cover, coarse woody debris, and snags for sample sites within these habitats.

The USFS and state of Washington do not implement specific management guidelines for the protection of deciduous forest and shrub habitats. Many of these habitats are currently protected, and are expected to be protected in the future, under riparian zone management regulations and policies (described in the following section).

Riparian Habitats

Riparian habitats are located at the interface between terrestrial habitats and aquatic environments. In the Baker River basin, deciduous forest and shrub habitats are characteristic along the active channel of low gradient waterways with well-developed floodplains. Mixed coniferous/deciduous and coniferous forests extend back into the less frequently disturbed portions of the floodplain. Riparian zones narrow with increasing stream gradient, leading to stands of mixed coniferous and deciduous species. Along the narrowest, highest gradient streams, coniferous tree species dominate the overstory. Many wildlife species of riparian habitats are associated with deciduous forest and shrub habitats, as described in the preceding section. Wildlife indicative of riparian habitats, but not necessarily tied to deciduous plant species, include mink, red-legged frog, Yuma myotis, and harlequin duck.

Timber harvest has affected riparian zones in the Baker River basin through clearing of vegetation, road and railroad construction, and modification of drainage. The original development of the Baker River Project affected riparian zones along an estimated 57 miles of streams, including 16 miles of the Baker River (USFS, 2002a). Pre-project vegetation mapping delineated the broad floodplain of the Baker River and its vegetation (Puget, 2003h). An estimated 2,223 acres of riparian habitats were affected by inundation, including 1,114 acres of coniferous forest, 841 acres of mixed coniferous/deciduous forest, 203 acres of deciduous forest, and 65 acres of shrub habitat.

Under current conditions in the Baker River basin, more than 1,410 miles of stream and 32 miles of reservoir shoreline are present. Eighty-seven percent of the streams in the basin are small, higher gradient streams (USFS, 2002a; Class 3 and 4 streams) with very narrow riparian zones. The riparian habitats in the Project area are not readily distinguishable from surrounding vegetation at the mapping scale used for the basin, and riparian habitats were not delineated on maps. Riparian zones characterized by mixed coniferous/deciduous forest, deciduous forest, or deciduous shrub were mapped under those cover types, and their habitat features are discussed in the preceding sections.

The USFS manages the land adjacent to streams, lakes, reservoirs, and wetlands as Riparian Reserves, per the direction of the Northwest Forest Plan (USFS and BLM, 1994a, as amended). The allocation of Riparian Reserves is intended to provide adequate habitat protection for riparian species, provide travel and dispersal corridors for wildlife, and maintain water quality. State and private timberlands are managed under the Washington State Forest Practices Rules, which specify stream, wetland, and riparian zone protection. The Washington State Shoreline Management Act regulates development and other activities along significant shorelines of the state (streams with a mean annual flow of $\geq$ 20 cfs and lakes with a total area $\geq$ 20 acres).

Implementation of federal and state regulations and policies for management of riparian zones is expected to continue in the future, providing long-term protection for these habitats.

Wetlands and Open Water Habitats

Wetlands in the Baker River basin include forested, scrub/shrub, emergent, and open water habitats of small ponds. The most common tree species associated with forested wetlands are red alder, black cottonwood, and western redcedar. Shrub wetlands in the basin are characterized by various willow species, salmonberry, vine maple, and spiraea (*Spiraea douglasii*). Emergent wetlands in the basin support a variety of sedges, forbs, and grasses, including the common invasive species reed canarygrass (*Phalaris arundinacea*). Wetlands provide valuable plant, fish, and wildlife habitat, and are also valued for their hydrologic functions.

Timber harvest has affected wetlands through clearing of vegetation, ground-disturbing activities, road building, and modification of natural drainage patterns. The majority of the Lake Shannon subwatershed, and significant portions of the Baker Lake subwatershed, were harvested prior to implementation of management policies protecting wetlands.

The original development of the Baker River Project affected wetland habitats associated with the Baker River floodplain, the riparian zones of tributary streams, and isolated wetlands and ponds. The USFS estimates that 172 acres of wetlands were inundated by Baker Lake, as well as streamside riparian areas that may have contained wetlands (USFS, 2002a). Pre-project cover type mapping (Puget, 2003h) indicates that approximately 290 acres of wetland habitats, 15 acres of ponds, and 549 acres of lake (historical Baker Lake) were affected when Baker reservoir was inundated. Inundation of Lake Shannon affected 66 acres of wetlands and 3 acres of pond habitat.

Construction of the Project also created the large open-water habitats of the Project reservoirs. Emergent wetlands persist within the reservoir boundaries and the reservoirs contribute to the hydrology supporting many of the adjacent wetlands along portions of the shorelines.

We summarize current wetland habitats within the Project area in table 5-22. This evaluation included wetlands within the intermittently inundated portions of the reservoirs as well as those located above reservoir full pool elevation (Puget, 2003f).[19] These values likely under-represent actual wetland acres in the basin because they are based on aerial photography interpretation of vegetation. Forested wetlands and small, non-forested wetlands are often mis-classified as upland or riparian forest when determinations are based solely on remote data.

[19] The Puget (2003f) estimates of habitat area have not been adjusted to reflect the shift to NAVD 88 and may differ from published figures used elsewhere in this document (refer to section 3.1.1, *Existing Project Facilities*).

Table 5-22. Baker River Project area wetlands (in acres).[a] (Source: Puget, 2003f)

Wetland Type	Lake Shannon Subarea	Baker Lake Subarea	Total Project Area
Palustrine (above reservoir full pool)			
Forested wetland (PFO) and PFO mosaics	2	18	20
Scrub/shrub wetland (PSS)	0	16	16
Emergent wetland (PEM)	0	12	12
Stream and aquatic bed	25	20	45
Lacustrine (below reservoir full pool)			
Upper perennial—emergent	0	28	28
Intermittently inundated—emergent	68	161	229
Upper perennial—non-vegetated	644	581	1,225
Intermittently inundated—non-vegetated	171	1,659	1,831
Lower perennial lacustrine (reservoir)[b]	1,218	2,386	3,604
All Wetlands	**2,129**	**4,881**	**7,010**

[a] The Puget (2003g) estimates of habitat area have not been adjusted to reflect the shift to NAVD 88 and may differ from published figures used elsewhere in this document (refer to section 3.1.1, *Existing Project Facilities*).

[b] Reservoir surface area near minimum pool as interpreted from aerial photography dated March 4 and March 6, 2001.

The majority of palustrine forested, scrub/shrub, and emergent wetlands are located at the northern end and along the western side of Baker Lake. Over 16 acres of scrub/shrub wetlands are present and are dominated by salmonberry and/or Sitka willow. Forested wetlands and mosaics total 18 acres and include red alder dominated sites, mixed conifer-deciduous sites (typically characterized by red alder and western hemlock), and wetland/upland mosaic sites (typically dominated by red alder with western hemlock and western redcedar). Less than two acres of forested wetland are located near Lake Shannon. Herbaceous emergent wetlands total about 11 acres at Baker Lake; the majority of these contained the invasive species reed canarygrass. One emergent wetland located in the Little Sandy Creek wetland complex contained many bog features, including understory cover dominated by sphagnum moss (*Sphagnum* spp.), and stunted western hemlock and western redcedar trees (Puget 2003f).

An estimate of the source of supporting wetland hydrology was made for each palustrine wetland site, based on field observations. Of 33 wetlands evaluated at Baker Lake, 6 were categorized as being supported solely by Baker Lake, 8 were rated as being supported solely by shallow groundwater and/or groundwater discharge, and 18 were thought to be supported by a combination of Baker Lake and groundwater hydrology. At Lake Shannon, 9 wetlands were evaluated, 4 were categorized as being supported solely by shallow groundwater and/or groundwater discharge, and 5 were thought to be supported by a combination of Lake Shannon and groundwater hydrology.

Lacustrine emergent wetlands are present within both the Lake Shannon and Baker Lake reservoirs; within-reservoir emergent wetlands total 189 acres at Baker Lake and 68 acres at Lake Shannon. Large expanses of intermittently exposed bare ground are present within the reservoir at Baker Lake (2,240 acres), mostly along the shallow delta area at the northern end and along the western perimeter. Bare ground exposed at lower pool elevations at Lake Shannon totals 815 acres, most of which is located in the northern half of the reservoir.

We summarize general wetland types within the Baker River basin in table 5-23. Approximately 345 acres of forested wetlands, 289 acres of scrub/shrub wetlands, and 248 acres of emergent wetlands are present in the basin.

Table 5-23. Baker River basin wetland acreages. (Source: Puget, 2003g)[a]

Wetland Type	Modifier	Total Baker River Basin (acres)	Percent of Total
Palustrine			
	Forested (PFO)	345	23.2
	Scrub/shrub (PSS)	289	19.4
	Emergent (PEM)	248	16.6
	Aquatic bed	3	0.2
	Open water	62	4.1
Riverine			
	Upper perennial	275	18.5
Lacustrine			
	Natural lakes	269	18.0
Subtotal		1,491	100.0
	Reservoir	6,917	
Total		8,408	

[a] The Puget (2003g) estimates of habitat area have not been adjusted to reflect the shift to NAVD 88 and may differ from published figures used elsewhere in this document (refer to section 3.1.1, *Existing Project Facilities*).

Reservoir elevations fluctuate on a daily and seasonal basis at Baker Lake. Normal full pool for Baker Lake is 727.77 feet msl (NAVD 88). For purposes of flood storage, Baker Lake is maintained at or below 724.50 feet msl by November 1 and at no more than 711.56 feet msl (NAVD 88) under normal operating conditions from November 15 to March 1, under current agreement with the ACOE. Minimum reservoir levels typically occur from November through

March or early April. Baker Lake is maintained at or near full pool during the summer. Based on the past 20 years of monthly median values, Baker Lake was within 10 feet of full pool from June through October, and, at its minimum, about 30 feet below full pool during March (see table 5-9). Water level may vary several feet on a daily basis.

Lake Shannon full pool is 442.35 feet msl (NAVD 88). Over the past 20 years, monthly median water levels were within 10 feet of full pool between June and December, and within 5 feet of full pool for the months of July, August, September, and November (see table 5-9). The lowest monthly median level was approximately 33 feet below full pool during March.

Puget implements a number of measures to protect wildlife habitats associated with the Project reservoirs. Surveys of bald eagle use of the reservoirs during wintering and breeding seasons were initiated in 1980. These surveys were expanded to include observation of waterfowl use of the reservoirs and osprey nesting use of the reservoirs. Monthly surveys have been performed during December through September since 1980. Puget has installed several osprey nest structures to replace decayed snags and stumps in Lake Shannon. Other wildlife activities have included developing an osprey-safe screening material for excluding herons from the trout rearing ponds. Management measures for the protection of an existing bald eagle nest on Baker Lake have been implemented, including road closure, signing of the sensitive wildlife site, and scheduling of Project-related activities to occur outside of the nesting period.

Puget does not implement specific management measures for the protection of wetlands at this time.

The USFS manages the land adjacent to streams, lakes, reservoirs, and wetlands as Riparian Reserves, per the direction of the Northwest Forest Plan (USFS and BLM, 1994a, as amended). The allocation of Riparian Reserves is intended to provide adequate habitat protection for riparian species, provide travel and dispersal corridors for wildlife, and maintain water quality. State and private timberlands are managed under the Washington State Forest Practices Rules, which specify stream, wetland, and riparian zone protection. The Washington State Shoreline Management Act regulates development and other activities along wetlands that fall within or are contiguous with shorelines of the state.

Implementation of federal and state regulations and policies for management of wetlands, water quality, riparian areas, and shorelines of the state is expected to continue in the future, providing long-term protection for these habitats.

Other Non-Forested Habitats

Other non-forested habitats in the Project area include grass/forb habitats, unvegetated (disturbed) uplands, and cliffs/talus/rock outcrops (table 5-20). Rock faces, cliffs, and talus slopes may provide habitat for wildlife species, such as the peregrine falcon, golden eagle, and big brown bat.

Grass/forb habitats total approximately 87 acres within the Project area, most of which are located along the western shoreline of Baker Lake. Three acres of cliffs and 1 acre of unvegetated upland were mapped in the Project area. Because of their small size and steep slopes, cliffs, rock outcrops, and small talus fields in the Project area were likely underrepresented by the vegetation mapping (Puget, 2003f). Field observations of these habitats were recorded (Puget, 2003f) and totaled 14 cliff areas, 15 talus sites, and 2 talus sites with rock outcrops.

In the Baker River basin, grass/forb/sparsely vegetated cover types total over 26,000 acres, the majority of which are located in high elevation meadows and slopes. Rock/talus/bare soil totals 19,328 acres, primarily at high elevation in the Baker Lake subbasin. The mapping category "water" includes snowfields and glaciers, as well as reservoirs, totaling 21,125 acres in the watershed.

Puget does not specifically manage the non-forested habitats described above. No federal management designation is given to these habitat types. The WDFW manages specific non-forested habitats for their wildlife value, including cliffs/talus (section 5.7.1.2). Within the Baker River basin, most of these habitats are located within LSRs or other management designations with high levels of protection from human activity other than recreation.

Project Facilities

There are 69 acres of land associated with Project facilities, excluding the surface area of the reservoirs and associated Depression Lake (table 5-20). The Lower Baker Development includes the Lower Baker dam and powerhouse at the southern end of the Lake Shannon reservoir and associated facilities.

The Upper Baker Development includes the Upper Baker dam and powerhouse, West Pass and pumping pond dikes, downstream fish passage facilities, and other associated facilities. Sockeye Spawning Beaches 2 and 3 are located at the head of the lake, west of the Baker River. Sockeye Spawning Beach 4 is located at the northern end of Lake Shannon on the western shore.

Additional office facilities for the Baker River Project are located within the Town of Concrete; these areas were not delineated independently of the residential/developed category on figure 5-20 (appendix A).

5.7.1.2 Plant Species and Habitats of Special Concern

Special Status Plant Species and Habitats

This section describes the documented occurrences of special status plant species in the vicinity of the Baker River Project. Special status plant species include Washington State threatened, endangered, candidate, and sensitive species; USFS sensitive species (USFS, 1999a); and USFS survey and manage species (USFS and BLM, 1994a, as amended). WDFW priority habitats are also noted. Species protected under the ESA, as well as federal candidates for protection, are discussed in section 5.8, *Federally Listed Threatened and Endangered Species and Essential Fish Habitat*. No federally listed, proposed, or candidate plant species or species of concern are known or are expected to occur in the Project area.

A wide range of habitats support rare plants in the Baker River basin, including emergent, shrub, and forested wetlands; mature and old-growth coniferous forest; deciduous forest; streambanks; talus slopes; and alpine meadows. Timber harvest, road building, and hydroelectric development have cumulatively affected forest and wetland habitats at low to mid-elevations in the basin. Refer to section 5.7.1.1, *Plant Communities and Wildlife Habitat*, for a discussion of cumulative effects on specific habitat types. The USFS estimates that potential suitable habitat for 13 Region 6 sensitive plant species was affected by inundation of the Baker Lake reservoir (USFS, 2003a), although no direct evidence exists of the presence of the plants in the Project area prior to inundation.

Surveys for rare plants were conducted in June through September 2002 at Project-related dispersed recreational sites and in wetlands that are hydrologically influenced by the Project reservoirs (Puget, 2003i). Other sources of information include USFS rare plant surveys and Washington Natural Heritage Program (WNHP) records. No Washington State endangered, threatened, or candidate plant species are known or suspected to occur in the vicinity of the Baker River Project. Additional surveys will be conducted in the Project area in 2003.

Nine species listed as state sensitive have been documented in the Project vicinity. These include lance-leaved moonwort (*Botrychium lanceolatum*), bristly sedge (*Carex comosa*), yellow sedge (*Carex flava*), long-styled sedge (*Carex stylosa*), northern rice root (*Fritillaria camschatcensis*), boreal bedstraw (*Galium kamtschaticum*), Canadian St. Johnswort (*Hypericum majus*), ground pine (*Lycopodium dendroideum*), and canyon bog-orchid (*Platanthera sparsiflora*). The *Baker River Watershed Analysis* (USFS, 2002a) indicates that the identification of northern rice root is uncertain. With the exception of lance-leaved moonwort and Canadian St. Johnswort, the above-listed species are also listed as sensitive by the USFS Region 6 (USFS, 1999a).

Lance-leaved moonwort has been observed at four sites in the basin. The species inhabits open woods, sandy clearings, meadows, and western redcedar forests from mid- to high elevations (Pojar and McKinnon, 1994). The species was removed from the USFS sensitive list in 1999, because survey data indicate a larger population and greater distribution of this species than previously believed (USFS, 2002a). The species has not been documented in the Project area.

Bristly sedge has been reported from a single location just outside the Baker River basin near Grandy Lake.

Yellow sedge was observed at a single site during 2002 surveys at Baker Lake. Five plants were observed growing amidst reed canarygrass at the northwest end of the lake near the full pool elevation. Subsequent site visits in 2003 have identified several hundred plants at the site (personal communication, A. Fuchs, Staff Biologist, Puget, Bellevue, WA, and K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, September 15, 2003).

Long-styled sedge has been recorded from one site on the Sulphur Creek lava flow. It is a wetland species found in marshes, bogs, and wet meadows and along shorelines at low to upper elevations (Pojar and McKinnon, 1994).

Boreal bedstraw has been documented at several sites in the basin. This species inhabits moist streambanks, slopes, and coniferous forests from northern Washington north to Southeast Alaska. It is considered at the edge of its range at Snoqualmie Pass, Washington (USFS, 2002a). This species has not been recorded in the Project area.

Canadian St. Johnswort was reported by the USFS at one site near Shannon Creek. This species inhabits wet sites and is likely near the southern edge of its range in the Project vicinity (Hitchcock et al., 1969).

Ground pine inhabits moist to dry sites in North American boreal forests from Alaska to Newfoundland, extending into southern Washington (Flora of North America Editorial Committee, 1993). A large population of several thousand stems is present on the Sulphur Creek lava flow. It has also been observed at several other sites in the Baker River basin and may be present within the Project area.

Canyon bog-orchid has been documented at a single site near the mouth of Noisy Creek. This orchid ranges from extreme southwestern Oregon to Baja and is considered at the northern edge of its range in northern Washington (Hitchcock et al., 1969; USFS, 2002a).

Round-leaved rein orchid (*Platanthera orbiculata*) is a USFS survey and manage species inhabiting moist, mossy sites on the floor of coniferous forests (Hitchcock et al., 1969). This species has been documented at numerous sites in the Baker River basin, including sites near the Baker River Trail and Shannon Creek Campground.

Four USFS survey and manage non-vascular plant species were observed during 2002 surveys of dispersed campsites and wetland habitats in and near the Project area. *Schistostega pennata* was observed at an informal recreational site near the outlet of Swift Creek. It was also observed at five wetlands sites near the Project reservoirs, and has been recorded by the USFS at many higher elevation sites in the basin. During the 2002 surveys, the species was observed in wetland-upland mosaic or forested wetlands varying from young mixed riparian forest to old-growth open conifer forest. *S. pennata* was found growing on mineral soil within the root mass of upturned trees.

Hypogymnia duplicata was observed at a dispersed recreational site near the outlet of Welker Creek in an open coniferous forest with a deciduous component.

Tetraphis geniculata was observed at one location during the 2002 surveys. The plant was growing on the moist vertical face of a rotting log within an old-growth forest wetland in the Little Sandy Creek wetland complex.

Platismatia lacunosa was observed at the Little Sandy Creek wetland complex during Project surveys in 2002. Three thallus bodies were located on downed red alder branches within a mid- to mature-aged red alder forested wetland. Additional plants may have been present in the canopy of the red alder trees.

Table 5-24 includes USFS records of observations of additional survey and manage species in the Baker River basin, outside of the Project area.

Several WDFW priority habitats are present in the Project area and the Baker River basin: old growth/mature forest, riparian habitat, wetlands and deepwater habitats, cliffs and talus, and snag/log habitat (table 5-25). The occurrence and distribution of these habitats are discussed in section 5.7.1.1, *Plant Communities and Wildlife Habitats*.

Future management of federal and private lands is expected to continue providing protection for special status species and habitats per current regulations and policy. The USFS and Bureau of Land Management propose to discontinue the survey and manage species Mitigation Measure Standards and Guidelines under the Northwest Forest Plan. These species would be protected under other elements of the Northwest Forest Plan and existing sensitive species and special status species programs (USFS and BLM, 2002). A final environmental impact statement (EIS) and record of decision for the management of survey and manage species are expected but were not available at the time of printing.

Noxious Weeds and Other Invasive, Non-Native Plant Species

Washington Weed Law (Chapter 17.10 RCW) requires that noxious weeds be controlled to limit adverse economic effects on agricultural, natural, and human resources of the state. Noxious weeds are plants that, when established, are highly destructive, competitive, or difficult to control by cultural or chemical practices. The State Noxious Weed Control Board updates its list of noxious weeds annually and categorizes the species into three classes. The State Board coordinates noxious weed control activities throughout the state via County Weed Districts and County Noxious Weed Control Boards. Management goals for noxious weed species may range from complete eradication to containment of the species within a currently infested area.

Class A species are those noxious weeds not native to the state that are of limited distribution or are unrecorded in the state. Eradication of all Class A species is required by state law. State Class A species are listed on all County Class A weed lists.

Class B species are those noxious weeds not native to the state that are of limited distribution or are unrecorded in a region of the state, and that pose a serious threat to the region. These species are treated differently in different regions of the state, based on their distribution. In regions where a Class B species is of limited distribution or unrecorded, the species is designated for control under state law (Class B designate species). Prevention of seed production is required for Class B designates. In regions where a Class B species is already widespread, control is an option of the local weed board.

Table 5-24. Special status plant species in the Baker River basin.

Common Name	Scientific Name	Federal Status	State Status	Habitat Requirements	Occurrence in Baker River Basin
Vascular Plants					
Lance-leaved moonwort	*Botrychium lanceolatum*	--	State Sensitive	Open woods, sandy clearings, meadows and western redcedar forests at mid- to alpine elevations[a]	4 sites, including Noisy Creek, Park Creek[b,c,d]
Bristly sedge	*Carex comosa*	USFS Sensitive	State Sensitive	Marshes, lakeshores, wet meadows[e]	1 site just outside of basin, near Grandy Lake[d]
Yellow sedge	*Carex flava*	USFS Sensitive	State Sensitive	Wet, usually sandy meadows, sometimes on calcareous soils, low to mid elevations[f]	1 site: North end of Baker Lake, northeast shore[g,h]
Long-styled sedge	*Carex stylosa*	USFS Sensitive	State Sensitive	Bogs, fens, marshes, wet meadows, streambanks, shorelines, low to high elevations, coasts[a]	1 site: Sulphur Creek lava flow[h]
Northern rice root	*Fritillaria camschatcensis*	USFS Sensitive	State Sensitive	Moist open places, meadows, streambanks, shorelines and saltmarsh edges, sea level to subalpine[a]	1 site: Sulphur Creek lava flow[d,h]; ID uncertain[b]
Boreal bedstraw	*Galium kamtschaticum*	USFS Sensitive	State Sensitive	Moist coniferous forest (especially alluvial), streambanks, grassy or mossy talus slopes, low to middle elevations[a]	Several sites: Marten Lake Road, upper Shannon Creek, Boulder Ridge, Jackman Creek drainage[d,g]
Canadian St. Johnswort	*Hypericum majus*	--	State Sensitive	Moist open sites[e]	1 site[b,d]

Common Name	Scientific Name	Federal Status	State Status	Habitat Requirements	Occurrence in Baker River Basin
Ground pine	*Lycopodium dendroideum*	USFS Sensitive	State Sensitive	Moist to fairly dry, deciduous and coniferous forests, thickets, openings and bog edges, low to middle elevations[a]	Several sites: Morovitz Pond, Noisy Creek, Sulphur Creek lava flow, Shadow of Sentinels Trail[b,c,d,h]
Round-leaved rein orchid	*Platanthera orbiculata* *(Habenaria orbiculata)*	Survey/ manage	--	Dry to moist coniferous forests, meadows, riverbanks at low to middle elevations[a]	14 sites: Sulphur, Park, Shannon, Noisy, Boulder, Anderson, Welker, and lower Rocky creeks, Shannon Creek Campground, Park Creek Campground, Maple Grove Campground, Morovitz Pond, east shore Baker Lake, Shuksan Lake trailhead, Baker Lake Trail, Baker Lake Road.[b,h]
Canyon bog-orchid	*Platanthera sparsiflora*	USFS Sensitive	State Sensitive	Wet, mostly boggy areas, extreme SW Oregon to Baja[e]	1 site: Noisy Creek[b,c,d,h]
Fungi, Lichens, Liverworts and Mosses					
	Dendriscocaulon intracatulum	Survey/ manage	--		2 sites: Sulphur Creek lava flow[h]
Liverwort	*Herbertus aduncus*	Survey/ manage	--		1 site near Concrete[b]
Lichen	*Hypogymnia duplicata*	Survey/ manage	--		3 sites: Marten Lake, Sulphur Creek lava flow, Welker Creek[b,g,h]
Lichen	*Nephroma occultum*	Survey/ manage	--		1 site: Sulphur Creek[b]
Lichen	*Pannaria saubinetii*	Survey/ manage	--		1 site: Lower Rocky Creek[h]

Common Name	Scientific Name	Federal Status	State Status	Habitat Requirements	Occurrence in Baker River Basin
Lichen	*Pilophorus nigricaulis*	Survey/ manage	--		3 sites: near Artist's Point, Sulphur Creek[b]
Lichen	*Platismatia lacunosa*	Survey/ manage	--		1 site: Little Sandy Creek outlet[g,h]
Lichen	*Pseudocyphellaria rainierensis*	Survey/ manage	--		2 sites: near Shadow of the Sentinels Trail, along Baker Lake Road near Boulder Creek[h]
Moss	*Rhizomnium nudum*	Survey/ manage	--		2 sites: Schreibers Meadow, Sulphur Creek[b]
Fungus	*Sarcosoma latahense*	Survey/ manage	--		1 site: Sandy Creek[b]
Moss	*Schistostega pennata*	Survey/ manage	--		Numerous sites: Schreibers Meadows, Boulder Ridge, Park Creek Campground, Panorama Point Campground, Little Sandy Creek outlet, West Pass Dike, Swift Creek south of Baker Lake Road[b,g,h]
Moss	*Tetraphis geniculata*	Survey/ manage	--		1 site: Sandy Creek outlet[g,h]
Liverwort	*Tritomaria quinquedentata*	Survey/ manage	--		1 site: Swift Creek[b]
Fungus	*Tylopilus pseudoscaber*	Survey/ manage	--		1 site: East shore Baker Lake[b]

Common Name	Scientific Name	Federal Status	State Status	Habitat Requirements	Occurrence in Baker River Basin

Notes: H – Historical records only (pre-1980).

Federal Status:

Endangered – Species in danger of extinction throughout all or a significant portion of its range; protected under ESA.

Threatened – Species likely to become endangered within the foreseeable future throughout all or a significant portion of its range; protected under ESA.

Candidate – Species considered for possible addition to the list of endangered and threatened species.

Species of concern – Species for which the FWS does not have sufficient information to support a listing proposal at this time.

USFS sensitive – Species listed by the USFS Regional Forester (USFS, 1999a).

Survey and manage – Species designated for survey under the Northwest Forest Plan as amended (USFS and BLM, 1994 as amended, 2001).

State Status:

Endangered – Any taxon in danger of becoming extinct or extirpated from Washington within the foreseeable future if factors contributing to its decline continue.

Threatened – Any taxon likely to become endangered in Washington within the foreseeable future if factors contributing to its population decline or habitat degradation continue.

Sensitive – Any taxon that is vulnerable or declining and could be come endangered or threatened in the state without active management or removal of threats.

[a] Pojar and MacKinnon (1994).
[b] USFS (2002a).
[c] Puget (2002c).
[d] WNHP (2003).
[e] Hitchcock et al. (1969).
[f] Hurd et al. (1998).
[g] Puget (2003i).
[h] USFS (2003c).

Table 5-25. Washington State WDFW priority habitats in the Baker River basin.[a] (Source: WDFW, 2003b)

Priority Habitat	WDFW Definition (abbreviated)	Occurrence in Baker River Basin
Old-growth and mature forests	At least two species, at least 20 trees/hectare >32 inches in diameter at breast height (dbh), plus large snags and downed logs. Mature forests: average dbh > 21 inches, typically 80 to 200 years old.	Present in Project area and basin. Refer to section 5.7.1.1, *Plant Communities and Wildlife Habitats*
Riparian	Area adjacent to aquatic ecosystems containing elements of both aquatic and terrestrial ecosystems.	Present in Project area and basin. Refer to section 5.7.1.1, *Plant Communities and Wildlife Habitats.*
Freshwater wetlands and fresh deepwater	Wetlands per federal and state definition. Deepwater habitats are permanently flooded lands below wetlands.	Present in Project area and basin. Refer to section 5.7.1.1, *Plant Communities and Wildlife Habitats.*
Snags and logs	Snags: dbh ≥ 20 inches, height ≥ 6.5 feet; logs: dbh 12 inches at large end, length ≥ 20 feet.	Present in Project area and basin as components of major habitat types. Refer to section 5.7.1.1, *Plant Communities and Wildlife Habitat*
Cliffs/talus	Cliffs >25 feet high, below 5,000 feet elevation; talus: homogeneous areas of rock rubble 0.5 to 6.5 feet in size.	Observed in Project area; numerous sites present higher in the Baker River basin

[a] Priority (habitats) – Habitats or elements with unique or significant value to a diverse assemblage of species.

Class C weeds may be widely established in Washington, or may be of species interest to the agricultural industry. Control of these species, and of Class B non-designates, is a local weed board option.

The state of Washington also maintains a monitor list of non-native species. Species may be included on the list for a variety of reasons including the need for information on distribution and biology, the need to verify occurrence, and the need to monitor reoccurrence. There is no regulatory or legal authority associated with the monitor weed list.

The major federal authorities for management of non-native plants are the Plant Protection Act (Title IV of the Agricultural Risk Protection Act of 2000), the Amendment to the Federal Noxious Weed Act of 1974, and Executive Order 13112 on Invasive Species of 1999. The USFS implements measures to prevent the introduction and control the spread of noxious weeds on National Forest System lands. USFS management must comply with the objectives, standards, and guidelines of the MBSNF Land and Resource Management Plan (LRMP) (USFS, 1990), as well as federal law and direction. Regional USFS direction (USFS, 1988, 1989) is currently being updated and clarified in a draft EIS about management of non-native and invasive plants, scheduled to be released in 2003.

A forest-wide EA was completed for the MBSNF in 1999 (USFS, 1999b). This EA addresses site-specific treatment for known weed infestations and includes a comprehensive appendix outlining best management practices for prevention of noxious weeds. The best management practices have been incorporated as Amendment #14 in the MBSNF LRMP (USFS, 1990, as amended).

The EA recommended control measures for several Japanese knotweed sites in the vicinity of the Baker River Project.

Weed species known to occur in the Baker River Project vicinity are shown in table 5-26. This information is compiled from existing data provided by Skagit and Whatcom counties, USFS, and Puget plant surveys conducted in 2002. Weed surveys of the Project area are scheduled to be conducted during summer 2003.

No Class A weed species are known or suspected to occur in the Baker River Project vicinity. At this time, no Class B weed species designated for control in either Skagit or Whatcom counties are known to occur. A hawkweed (*Hieracium* sp.) was recorded at one location in the Project vicinity, but was not identified to species. This genus contains some species on the Class A and Class B designate lists. Surveys to be conducted in 2003 will include identification of this genus to the species level.

Table 5-26. Noxious weeds and invasive, non-native plant species in the Baker River Project vicinity.

Common Name	Scientific Name	State Status[a]	Skagit County Status[b]	Whatcom County Status[c]	USFS 1999 Status[d]	Occurrence in Baker River Basin
Class A Weed Species		**Class A**	**Class A**	**Class A**		None known to occur
Class B Designates		**Class B Designate**	**Class B Designate**	**Class B Designate**		None known to occur
Class B Weeds, Non-Designates						
Scot's broom	*Cytisus scoparius*	**Class B**	**Class B,** Priority Status	**Class B,** targeted for educational or biological efforts	**Proposed for Treatment**	East shore of south end of Lake Shannon near boat ramp[e]
Wild carrot	*Daucus carota*	**Class B**	**Class B,** Priority Status	Not Listed	Not Listed	East shore of south end of Lake Shannon near boat ramp[e]
Herb Robert	*Geranium robertianum*	**Not Listed**	**Class B**	Not Listed	**Proposed for Treatment**	Baker Lake Road near junction with Forest Road 12[f]; Depression Lake, east of Upper Baker dam, several sites around Baker Lake, west shore of southern Lake Shannon[e]
Smooth hawkweed[g]	*Hieracium laevigatum*	**Class B**	**Class B,** Priority Status	Class B, targeted for educational or biological efforts; target species for 2003	Not Listed	Near Upper Baker dam[g]
Hairy cat's-ear	*Hypochaeris radicata*	**Class B**	**Class B**	Not Listed	Not Proposed for Control	Upper Baker dam, various sites around Baker Lake and Lake Shannon[e]

Common Name	Scientific Name	State Status[a]	Skagit County Status[b]	Whatcom County Status[c]	USFS 1999 Status[d]	Occurrence in Baker River Basin
Oxeye daisy	*Leucanthemum vulgare*	**Class B**	**Class B**	Not Listed	Not Proposed for Control	Depression Lake, Upper Baker dam, various sites around Baker Lake; Lake Shannon at Thunder Creek, near Upper Baker dam, near boat ramp[e]
Japanese knotweed	*Polygonum cuspidatum*	**Class B**	**Class B,** Priority Status	**Class B,** targeted for educational or biological efforts	**Proposed for Treatment**	Junction of Baker Lake Road and Forest Road 1106, Little Sandy Creek, and near Sandy Creek[f;] Baker Lake Road at Grandy Creek[g, h]
Giant knotweed	*Polygonum sachalinense (P. glandulifera)*	**Class B**	**Class B**	**Class B,** targeted for educational or biological efforts	Not Listed	Baker Lake Road near Shannon Creek[f]
Tansy ragwort	*Senecio jacobaea*	**Class B**	**Class B,** Priority Status	**Class B,** target species for control 2002	**Proposed for Treatment**	Baker Lake Road at junction of Forest Road 1118[e]; Anderson Point[e, f]
Class C Weed Species						
Canada thistle	*Cirsium arvense*	**Class C**	**Class C,** selected for control	**Class C,** targeted for educational or biological efforts	**Proposed for Treatment**	Various sites along Baker Lake Road[f]; Baker Lake near Little Sandy Creek wetlands; Lake Shannon at Thunder Creek, west shore near Upper Baker dam, southeast shore near boat ramp[e]

Common Name	Scientific Name	State Status[a]	Skagit County Status[b]	Whatcom County Status[c]	USFS 1999 Status[d]	Occurrence in Baker River Basin
Field bindweed	*Convolvulus arvensis*	**Class C**	**Class C**	**Not Listed**	Not Listed	Southeast shore Lake Shannon near boat ramp[e]
St. Johnswort	*Hypericum perforatum*	**Class C**	**Class C**	**Class C,** targeted for educational or biological efforts	**Proposed for Treatment**	Depression Lake, Upper Baker dam, numerous sites around Baker Lake; Lake Shannon at Thunder Creek, southwest shore, southeast shore near boat ramp[e]
Reed canarygrass	*Phalaris arundinacea*	**Class C**	**Class C**	**Class C,** targeted for educational or biological efforts	Not Proposed for Control	Perimeter of Baker Lake and adjacent areas[f, i]; Numerous sites around Baker Lake and Lake Shannon[e]
Common tansy	*Tanacetum vulgare*	**Class C**	**Class C**	**Class C,** targeted for educational or biological efforts	Not Listed	Southeast of Upper Baker dam on Baker Lake, Southeast shore Lake Shannon near boat ramp[e]
Monitor Weed Species						
Watercress	*Rorippa nasturtium-aquaticum*	**Monitor**	Not Listed	Not Listed	Not Listed	Southeast of Upper Baker dam on Baker Lake[e]
Other Invasive Non-Natives						
Butterfly bush	Buddleia sp.	Not listed	Not listed	Not listed	Not listed	
Unidentified Species Within Weed Genera						
Hawkweed	*Hieracium sp.*					Baker Lake Road, near Koma Kulshan Guard Station[f]

Common Name	Scientific Name	State Status[a]	Skagit County Status[b]	Whatcom County Status[c]	USFS 1999 Status[d]	Occurrence in Baker River Basin

[a] Washington State Noxious Weed Control Board (2003).
[b] Skagit County Noxious Weed Control Board (2003).
[c] Whatcom County Noxious Weed Control Board (2003).
[d] USFS (1999b).
[e] Puget (2003i).
[f] USFS (2003b).
[g] Personal communication, L. Shiner, Control Agent, Whatcom County Noxious Weed Control Board, Bellingham, WA, and K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, April 4,, 2003.
[h] USFS (2002a).
[i] Personal communication, W. Rogers, Control Agent, Skagit County Noxious Weed Control Board, Mount Vernon, WA, and K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, February 18, 2003.

The following Class B non-designate and Class C species present in the Project area were selected by one or both counties for control efforts in 2003: Scot's broom (*Cytisus scoparius)*, wild carrot (*Daucus carota*), smooth hawkweed (*Hieracium laevigatum*), Japanese knotweed (*Polygonum cuspidatum*), tansy ragwort (*Senecio jacobaea*), and Canada thistle (*Cirsium arvense*). Scot's broom was reported at one site near the Lake Shannon boat ramp at the southeastern end of Lake Shannon. Wild carrot was reported at the same location. Smooth hawkweed was tentatively identified from one site near Upper Baker dam. Japanese knotweed has been reported at four sites on the west side of the Project reservoirs, including the Baker Lake Highway near Grandy Creek, Sandy and Little Sandy creeks, and Forest Road 1106 near the Upper Baker dam. Tansy ragwort was reported along the Baker Lake Road at Forest Road 1118 (to Horseshoe Cove) and at Anderson Point on the east shore of Baker Lake. Canada thistle was reported at several sites along the Baker Lake Highway and along the shorelines of Baker Lake and Lake Shannon.

Class B and Class C species targeted for educational or biological efforts, or not specifically selected for control by Skagit or Whatcom counties, include: herb Robert (*Geranium robertianum*), hairy cat's-ear (*Hypochaeris radicata*), oxeye daisy (*Leucanthemum vulgare*), giant knotweed (*Polygonum sachalinense*), field bindweed (*Convolvulus arvensis*), St. Johnswort (*Hypericum perforatum*), reed canarygrass, and common tansy (*Tanacetum vulgare*). Herb Robert was documented at several sites around Baker Lake, Baker Lake Highway, and Lake Shannon. This weed species is tolerant of shade and can invade forested habitats. Hairy cat's-ear and oxeye daisy were documented at several sites around Baker Lake and Lake Shannon. Giant knotweed was recorded at one site along Baker Lake Highway near Shannon Creek. Field bindweed was documented on the southeastern shore of Lake Shannon near the boat ramp. St. Johnswort was recorded at numerous sites around Baker Lake and Lake Shannon. Reed canarygrass is widespread around both reservoirs, occupying portions of the inundation zone and adjacent shorelines. Common tansy was observed at one location each on Baker Lake and Lake Shannon.

The Washington State monitor species watercress (*Rorippa nasturtium-aquaticum*) was observed on Baker Lake southeast of the Upper Baker dam.

USFS direction for the management of non-native invasives is currently under development for Region 6, including the MBSNF. The most recent, site-specific, management proposal prepared by the MBSNF is the 1999 Forest-Wide Assessment (USFS, 1999b).

5.7.1.3 Wildlife

This section describes the occurrence and distribution of wildlife species in the Project vicinity. The Baker River basin supports over 164 species of birds, 60 species of mammals, and numerous additional species of amphibians, reptiles, mollusks, and insects. Puget (2002c) provides lists of the wildlife species that are known or suspected to occur in the habitats of the Project vicinity.

The wildlife information in this section is based in part on the results of visual surveys that Puget biologists conducted near the two Project reservoirs. Puget conducted monthly wildlife surveys on Baker Lake and Lake Shannon in December through August from 1980 to the present. The surveys were focused primarily on waterfowl, osprey, and bald eagle, but included incidental sightings of other species as well. Data collected during the surveys include species, number, location, sex/age (where possible), and occasional notes on habitat use and behavior. This information has been supplemented by incidental observations of wildlife during other field activities, such as fisheries studies and Project maintenance activities. Information about wildlife occurrence in the Baker River basin also was provided by Puget relicensing studies, USFS inventories, WDFW reports, and National Park Service (NPS) inventories. Written species accounts were prepared for 38 wildlife analysis species selected by the Baker River Terrestrial Resources Working Group. The species accounts include the life histories, habitat requirements, distribution, and local occurrence for each analysis species (Puget, 2003j).

Reptiles and Amphibians

Nineteen species of reptiles and amphibians are known or suspected to occur in the Project vicinity (Puget, 2002c). Reptiles likely to inhabit the area include the western terrestrial garter snake, common garter snake, and northern alligator lizard.

Surveys of amphibian habitats were conducted in 2001 and 2002 for the Baker River Project (Puget, 2002h; Puget 2003k). A total of 11 species of amphibians were documented: Pacific giant salamander, northwestern salamander, western long-toed salamander, northern rough-skinned newt, western red-backed salamander, tailed frog, western toad, Pacific chorus frog, northern red-legged frog, Cascades frog, and the non-native bullfrog. The most frequently observed adult amphibians were western toad and northwestern salamander. The Cascades frog was the most numerous juvenile stage observed (9,340 larvae/tadpoles). The bullfrog, which feeds on native amphibians, was observed at only one site, Vogler Lake. Surveys for the Oregon spotted frog failed to detect this species in the watershed. Oregon spotted frog, a federal candidate for listing, is discussed in section 5.8, *Federally Listed Threatened and Endangered Species and Essential Fish Habitat*.

Mollusks

Surveys for mollusks were conducted within 100 feet of the high water mark on Baker Lake during the fall of 2001 and the spring of 2002 (Puget, 2002i). The methods followed the Survey Protocol for Terrestrial Mollusk Species from the Northwest Forest Plan, Version 2.0, dated October 29, 1997. During the 73 survey visits, which covered approximately 270 acres, five species of mollusk were confirmed. These included the banana slug, robust lancetooth, Pacific sideband, Northwest hesperian, and beaded lancetooth. Two slug species were tentatively identified: evening field slug and warty jumping slug. The USFS currently lists these two species as Survey and Manage species.

Birds

Over 164 species of birds are known or are potentially present in the Baker River Project Watershed (Puget, 2002c). The species composition includes waterfowl, shorebirds, waterbirds, game birds, raptors, songbirds, and other birds.

The Project reservoirs provide habitat for many species of waterfowl. Common species that are known to breed in the Project area include Canada goose, mallard, and common merganser. Common goldeneye, bufflehead, American wigeon, green-winged teal, and ring-necked duck are frequently observed during the winter and spring. The trumpeter swan is also a regular winter visitor, using Lake Shannon and Baker Lake during November through February.

Shorebirds and waterbirds observed on the Project reservoirs include American dipper, belted kingfisher, and ring-billed gull. The great blue heron is observed year-round in small numbers. Western grebe and double-crested cormorant are present primarily in the fall and winter months. Common loons have been observed in all seasons, but are not known to nest in the Project area. Marbled murrelets have been observed flying in the basin and are suspected to nest east of the Baker Lake. Additional information on the ESA listing of the marbled murrelet can be found in section 5.8, *Federally Listed Threatened and Endangered Species and Essential Fish Habitat*.

The primary species of game bird in the Project vicinity is the ruffed grouse, which is found in mixed deciduous/coniferous forest and along secondary roads in forested habitats. White-tailed ptarmigan are present at high elevations in the basin and band-tailed pigeons are found in mature forested areas.

Two raptor species, bald eagle and osprey, are closely associated with the Baker River Project reservoirs and use several breeding territories every summer. Bald eagles also are present during the winter. Golden eagles occasionally use a single nesting territory west of Baker Lake, although they have not been observed in the basin since 1995. Several raptor species use the forests and other upland habitats in the Baker River basin. Northern spotted owl and northern goshawk have been documented in mature and old-growth forests in the upper portion of the Baker River basin. Barred owl, great horned owl, and western screech owl use forest stands of mixed species composition and age. Other species, such as the red-tailed hawk, American kestrel, and the short-eared owl, frequent open habitats, meadows and recent clear cuts. The Baker River basin is at the extreme southern edge of the range of the great gray owl, which is an occasional visitor during the winter. Peregrine falcon is an uncommon visitor to the basin and is not known to nest in the Project vicinity.

At least 87 species of songbird and other types of birds are known or suspected to use the Project vicinity during breeding, wintering, or migration. Species strongly associated with conifer stands include pileated woodpecker, red-breasted sapsucker, hairy woodpecker, varied thrush, chestnut-backed chickadee, red-breasted nuthatch, winter wren, and brown creeper. Open shrub habitats, clear cuts, and meadows provide habitat for birds that forage on the ground, including song sparrow and American robin. Aerial insect feeders, such as tree swallows, violet-green swallows, and northern rough-winged swallows, frequent open habitats over land and water. Riparian habitats supporting deciduous trees and shrubs provide habitat suitable for red-eyed vireo, yellow warbler, willow flycatcher, and Swainson's thrush.

Mammals

Large mammals in the Baker River Project vicinity include black-tailed deer, elk, black bear, mountain lion, and mountain goat. Grizzly bear and gray wolves may be occasional visitors in the high elevation areas of the Baker River basin, but are not resident in the Project vicinity. Canada lynx and wolverine are present in small numbers in the region, and may be occasional visitors to the Upper Baker River basin.

Furbearer species frequently observed in the Project vicinity include river otter, beaver, raccoon, American marten, mink, and coyote. Common small mammals in the Project vicinity are Townsend chipmunk, Trowbridge shrew, deer mouse, snowshoe hare, Douglas squirrel, and northern flying squirrel. One documented sighting of a Townsend's big-eared bat was recorded in the basin (Perkins, 1988); other bats that may inhabit the vicinity include big brown bat, little brown myotis, long-eared myotis, and silver-haired bat.

5.7.1.4 Special Status Wildlife Species

Special Status wildlife species known or potentially occurring in the Project vicinity are listed in table 5-27. The list includes federal species of concern, USFS Region 6 sensitive species (USFS, 1999a), USFS management indicator species (MIS), federal survey and manage species, WDFW priority species, and Washington State listed, candidate, monitor, and sensitive species.

Wildlife species protected under the ESA, including federally listed, proposed, and candidate species, are discussed in section 5.8, *Federally Listed Threatened and Endangered Species and Essential Fish Habitat.*

Table 5-27. Special status wildlife species known or potentially occurring in the Baker River basin.

Common Name	Scientific Name	Federal Status	State Status	Occurrence in Baker River Basin
Birds				
Black-backed woodpecker	*Picoides arcticus*	USFS MIS	Candidate	Potential breeding species; not documented.
Common loon	*Gavia immer*	USFS sensitive	Sensitive	Documented; migrant, non-breeding[a,b,c]
Eared grebe	*Podiceps nigricollis*	USFS sensitive	--	Documented; migrant[a]
Golden eagle	*Aquila chrysaetos*	--	Candidate	Documented; breeding territory west of Baker Lake[a]

Common Name	Scientific Name	Federal Status	State Status	Occurrence in Baker River Basin
Great blue heron	*Ardea herodias*	--	Monitor	Documented; breeding status unknown[a, b, d]
Great gray owl	*Strix nebulosa*	--	Monitor	Documented occasional winter visitor[c]
Greater yellowlegs	*Tringa melanoleuca*	USFS sensitive	--	Potential migrant or winter visitor
Harlequin duck	*Histrionicus histrionicus*	Species of concern	Priority	Documented; potential breeding species[a]
Merlin	*Falco columbaris*		Candidate	Potential winter visitor; not documented
Northern goshawk	*Accipiter gentilis*	Species of concern	Candidate	Documented; within 1 mile of Project area (March)[a, c, e]
Olive-sided flycatcher	*Contopus cooperi*	Species of concern	--	Potential breeding species
Osprey	*Pandion haliaetus*	--	Monitor	Documented; breeding territories at Baker Lake and Lake Shannon[a]
Peregrine falcon	*Falco peregrinus*	Species of concern; USFS sensitive	Sensitive	Documented; migrant[b]
Pileated woodpecker	*Dryocopus pileatus*	USFS MIS	Candidate	Documented; resident[a]
Vaux's swift	*Chaetura vauxi*	--	Candidate	Documented; breeding species[a,c]
Western grebe	*Aechmophorus occidentalis*	--	Candidate	Documented; wintering, migrant[a]
Wood duck	*Aiz sponsa*	--	Priority	Documented; potential breeding species[a]
Mammals				
American marten	*Martex americana*	USFS MIS	Priority	Resident game species
Black-tailed deer	*Odocoileus hemionus columbianus*	USFS MIS	Priority	Resident game species

Common Name	Scientific Name	Federal Status	State Status	Occurrence in Baker River Basin
Elk	*Cervus elaphus*	USFS MIS	Priority	Resident game species
California wolverine	*Gulo gulo luteus*	Species of concern; USFS sensitive	Candidate	Suspected visitor; documented sightings at Acme, Sauk River, Cascade Pass[b]
Long-eared myotis	*Myotis evotis*	Species of concern	Monitor	Potential resident
Long-legged myotis	*Myotis volans*	Species of concern	Monitor	Potential resident
Mountain goat	*Oreamnos americanus*	USFS MIS	Priority	Documented resident game species[b]
Pacific fisher	*Martes pennanti pacifica*	Species of concern; USFS sensitive	Endangered	Rare resident
Pacific Townsend's big-eared bat	*Coryhorhinus townsendii townsendii*	Species of concern; USFS sensitive	Candidate	Documented; single individual, Baker Lake basin[f]
Yuma myotis	*Myotis yumanensis*	Species of concern	–	Potential resident
Amphibians				
Cascades frog	*Rana cascadae*	Species of concern	Monitor	Documented; resident[g]
Northern red-legged frog	*Rana aurora*	Species of concern	–	Documented; resident[g]
Tailed frog	*Ascaphus truei*	Species of concern	Monitor	Documented; resident[g]
Western toad	*Bufo boreas*	Species of concern	Candidate	Documented; resident[g]
Insects				
Beller's ground beetle	*Agonum belleri*	Species of concern	Candidate	Potential resident
Hatch's click beetle	*Eanus hatchii*	Species of concern	Candidate	Potential resident

Common Name	Scientific Name	Federal Status	State Status	Occurrence in Baker River Basin
Johnson's hairstreak butterfly	*Mitoura johnsonii*	–	Candidate	Potential resident
Mollusks				
Evening field slug	*Deroceras hesperium*	Survey/ manage		Unverified observation[h]
Warty jumping slug	*Hemphillia glandulosa*	Survey/ manage		Unverified observation[h]

Notes: **Federal Status:**

Species of concern – Species for which the FWS does not have sufficient information to support a listing proposal at this time.

USFS sensitive – Species listed by the Regional Forester.

Survey and manage – Species of lichen, bryophytes, fungi, arthropods, and mollusks associated with late seral forests for which survey and protection. Measures are specified in the Northwest Forest Plan (USFS and BLM, 1994a, as amended; 1994b; 2001).

State Status:

Endangered – Any taxon in danger of becoming extinct or extirpated from Washington within the foreseeable future if factors contributing to its decline continue.

Threatened – Any taxon likely to become endangered in Washington within the foreseeable future if factors contributing to its population decline or habitat degradation continue.

Sensitive – Any taxon that is vulnerable or declining and could be come endangered or threatened in the state without active management or removal of threats.

Candidate (animals) – Taxa under review for listing.

Monitor (animals) – Taxa requiring management, survey, or data emphasis.

Priority (animals) – Fish and wildlife species requiring protective measures and/or management guidelines to ensure their perpetuation.

[a] Puget (2002j).

[b] USFS (2002a).

[c] WDFW (2003b).

[d] Personal communication, A. Fuchs, Staff Biologist, Puget, Bellevue, WA, and K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, September 15, 2003.

[e] FWS species list for the Baker River Project, attachment to letter from K.S. Berg, Manager, Western Washington Fish and Wildlife Office, FWS, Olympia, WA, to K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, dated February 13, 2003.

[f] Perkins (1988).

[g] Puget (2003k).

[h] Puget (2002i).

Birds

Black-backed Woodpecker—The black-backed woodpecker is an uncommon species of mountainous coniferous forests and open coniferous forests of northern North America. Its preferred habitat is among spruce, fir, lodgepole pine, and/or ponderosa pine, with adequate snags. Black-backed woodpecker may nest at higher elevations of the Baker Lake basin and may be an occasional visitor to the Project area during irruptive events. Black-backed woodpecker is a Washington State candidate species and a USFS MIS.

Common Loon—Common loon is a Washington state sensitive species and a USFS Regional Forester's sensitive species. Breeding pairs are known from a limited number of locations in Washington. Habitat loss and susceptibility to disturbance and predation are the primary factors thought to be responsible for low numbers of breeding pairs. Adult loons are commonly observed on the Project reservoirs during the winter, spring, and summer. However, nesting loons have never been observed in the Project area (Puget, 2003j, 2002j).

Eared Grebe—Eared grebe is a USFS sensitive species that has been documented on the Project reservoirs on several occasions during the winter and spring. In Washington, colonies of breeding eared grebes are found primarily in freshwater lakes in the eastern portion of the state (Wahl and Paulson, 1981).

Golden Eagle—Golden eagles are opportunistic predators and scavengers of open habitats and forested mountain terrain. In Washington, golden eagle is a state candidate species. A golden eagle breeding territory is located about a mile west of Baker Lake. The territory has been used intermittently over the period of survey by Puget (1980–2002); the last verified use was in 1995, with one chick observed in the nest during July (Puget, 2002j). The site has been inactive over the past 7 years and is possibly abandoned. The WDFW database reports the existence of two other nest sites in the basin: in the upper Thunder Creek and Jackman Creek drainages.

Great Blue Heron—Great blue heron is a WDFW monitor species. Small numbers of herons are regularly observed along the shorelines of the Project reservoirs (Puget, 2002j). No heron rookeries have been documented in the Baker River basin per the WDFW priority and habitats species database (WDFW, 2003b). However, during a 2003 Puget aerial survey of raptor nests, a heron rookery was observed to the west of the Upper Baker Development (personal communication, A. Fuchs, Staff Biologist, Puget, Bellevue, WA, and K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, on September 15, 2003).

Great Gray Owl—Great gray owl is a WDFW monitor species. This large owl inhabits northern boreal forests, occasionally ranging into northern Washington and Idaho during the winter. One observation of a great gray owl has been recorded in the Baker River basin (WDFW, 2003b); the owl was observed in the Jackman Creek drainage.

Greater Yellowlegs—Greater yellowlegs is a large species of sandpiper that nests in northern muskegs and winters in coastal wetlands. The USFS considers the species to be sensitive. No observations of greater yellowlegs have been recorded in the WDFW database for the Baker River basin (WDFW, 2003b).

Harlequin Duck—Harlequin duck is a FWS species of concern and a WDFW priority species. During the breeding season, April to June, harlequin ducks use forested and dense shrub cover along rapidly flowing streams. Harlequin ducks winter primarily along the Strait of Georgia. Harlequin ducks have been observed on the Project reservoirs (Puget, 2002j). The Baker River upstream of the Project may provide suitable breeding habitat for this species.

Merlin—The merlin is a Washington State candidate species. These falcons inhabit open habitats, including open woodlands and savannah. Merlin may occasionally pass through the Baker River basin during migration.

Northern Goshawk—The northern goshawk is a federal species of concern and a state candidate species. Goshawks inhabit mature to old-growth coniferous and mixed forests and open woodlands. A few sightings of adult and young goshawks have been reported in the Baker River basin (WDFW, 2003b), including one observation on March 23, 1993, near the Baker Lake reservoir (Puget, 2002j).

Olive-sided Flycatcher—The olive-sided flycatcher is a FWS species of concern. These insectivorous birds typically nest along forest edges and openings, in areas where there are tall trees and snags for singing and foraging perches. Coniferous trees are often used for nesting, with nests located high in the tree and away from the trunk. The reasons for recent decline in the species population are unknown, but are suspected to be related to habitat loss in wintering areas. This species may use the reservoir edges or other openings in the Project vicinity.

Osprey—Osprey is a Washington State monitor species. These migratory raptors nest adjacent to rivers, lakes, and saltwater in western Washington, feeding almost exclusively on fish. The Baker River Project reservoirs provide high-quality habitat for breeding osprey, typically supporting five or more pairs each year on each reservoir. Puget has conducted monthly surveys of the reservoirs between December and August since 1980 and has recorded nest occupancy and number of chicks each breeding season.

Baker Lake has approximately 10 natural osprey nesting territories. Each territory is not used every year, and many of the territories have multiple alternate nest sites. During the last 9 years, an average of seven osprey nests have been occupied at Baker Lake during the July survey (Puget, 2002j).

During the 1980s, Lake Shannon had several natural nest sites located on large snags created by the inundation of the reservoir. Over time, the snags deteriorated and ospreys were forced to nest on short snags and stumps vulnerable both to harassment by boaters and to flooding by the fluctuating reservoir. Few natural snags were available adjacent to Lake Shannon due to timber management; therefore, Puget replaced deteriorated nest snags with pole-mounted artificial nest structures. Currently, three natural sites and nine artificial nesting structures are present in Lake Shannon. An average of seven osprey nests have been occupied at Lake Shannon during July of the last 9 years (Puget, 2002j).

Production at the osprey nests is difficult to assess because of inaccuracies in chick counts performed from below the nests during boat surveys and the fact that fledgling osprey are nearly indistinguishable from adults. An average of six and seven chicks were observed during July in the Baker Lake and Lake Shannon nests, respectively, over the last 9 years (Puget, 2002j). Given that osprey are long-lived, production at the Project area nests is believed to exceed that necessary to sustain the local population.

Peregrine Falcon—Formerly classified as federally endangered, the American peregrine falcon was delisted in August 1999. The *Washington State Status Report for the Peregrine Falcon* (Hayes and Buchanan, 2002) notes the falcon is still listed as state endangered, but will likely be reclassified as sensitive in the future. No peregrine falcon nest sites are known from the Baker River Project vicinity, and annual surveys of the Project area during bald eagle and osprey nesting have not detected peregrine falcons. Use of the Project vicinity is likely limited to occasional migratory falcons. One observation of a peregrine falcon was reported from the Baker River drainage in April 1985 (USFS, 2002a).

Pileated Woodpecker—Pileated woodpecker is a Washington State candidate species and a USFS MIS. These woodpeckers are closely associated with mature and old-growth forests, using large diameter snags for nesting and roosting. The late- and old-successional forests in the Baker Lake and Baker River basin provide high-quality habitat for pileated woodpecker. Because of the extent of timber harvest activity near Lake Shannon, suitable habitat at this reservoir is restricted to occasional, typically small, stands of mature or old-growth forest.

Vaux's Swift—This species is a candidate for listing in the state of Washington. It inhabits coniferous and mixed coniferous/deciduous forests, typically selecting large diameter, hollow trees or woodpecker holes as nesting and roost sites. It is also known to occasionally nest in chimneys. Foraging occurs above the forest canopy, in forest openings, and over water. Mature and old-growth coniferous and mixed forest stands in the Project vicinity provide suitable habitat for Vaux's swift. Vaux's swifts have been observed during surveys of the Project reservoirs (Puget, 2002j). An active Vaux's swift nest site was reported in the Sandy Creek drainage in 1991 (WDFW, 2003b).

Western Grebe—The western grebe is a candidate for listing in the state of Washington. This water bird has been observed occasionally at the Baker Project reservoirs, primarily during the fall, winter, and spring. Suitable nesting habitat for western grebe requires emergent wetland vegetation, such as tule or reeds, which are not present at the Project reservoirs.

Wood Duck—Wood duck is a WDFW priority species. Wood ducks have been observed at Lake Shannon (Puget, 2002j) and may breed in the Baker River basin.

Mammals

American Marten—American marten is a WDFW priority species and a USFS MIS. Marten is a resident game species in the Baker River basin, and is closely associated with late successional and old-growth forests.

Black-tailed Deer—Black-tailed deer is an important game species in Washington State and is a USFS MIS. Game Management Unit (GMU) 418 extends from the Skagit River north to the Canadian border and from west of the NCNP to State Route 9. Harvest data for the GMU indicate an average of 90 deer harvested in 1996 and 1997, a 68 percent decrease from earlier in the decade (WDFW, 1999). The state objectives for management of black-tailed deer include maintenance of current population levels, achievement of a ratio of 15 or more bucks per 100 does in the post-hunting season, and maintenance of a ratio of a minimum of 45 fawns per 100 does.

The extensive forested habitats of the Baker River basin do not provide optimal deer habitat, and deer were not likely historically abundant. Openings created by natural disturbances and logging can temporarily increase the quality of forage habitat. Black-tailed deer are present in the Baker River basin and are most commonly observed in the lower elevation, managed timberlands surrounding Lake Shannon, where forage is more abundant.

Elk—Elk is an important game species in the state of Washington and is a USFS MIS. The North Cascade elk herd, also referred to as the Nooksack herd, is described in detail in a recent WDFW elk herd management plan (Davison, 2002). The Nooksack herd is the smallest of 10 herds in the state of Washington. It is considered to be a reintroduced population of Rocky Mountain elk (*C. elaphus nelsoni*) released in 1912 and 1948 and Roosevelt elk (*C. elaphus roosevelti*i) released in 1946. The range of the Nooksack herd includes portions of Whatcom, Skagit, Snohomish, and King counties between the Skykomish River and the Canadian border and from the Cascade crest west to State Route 9. The core area for this herd occupies about 492 square miles and extends from the western side of the Baker River watershed to just east of State Route 9 north of Highway 20.

The population in the Nooksack GMU decreased from an estimated 1,700 animals in 1984 to 300 animals in 2000. The population objective for the Nooksack GMU is 1,450 animals. In the North Cascades, mortality rates between 1993 and 2000 have been reduced by: (1) severely restricted hunting seasons (closed since 1993), (2) extensive road access restrictions, and (3) reduced hunter effort.

Suitable habitat for elk in the Baker River basin includes both mid- to high-elevation summer range and lower-elevation transitional range. Elk may use low-elevation land along the west of Baker Lake between September and May, depending on weather and snow depth. During mild winters, elk may use the lower portions of Rocky, Sulphur, Sandy, Little Sandy, Boulder, and Park creeks. During periods of deep snow, elk move to important winter range areas located near the Skagit River. Elk use the west side of Lake Shannon year-round.

California Wolverine—Wolverine is a FWS species of concern, a USFS sensitive species, and a candidate for listing in Washington State. Suitable habitat for wolverine, open, high-elevation forests and alpine zones, is present in the upper reaches of the Baker River basin. No wolverine have been recorded in the basin; the nearest verified sighting was in the town of Acme in the late 1990s (USFS, 2002a).

Long-eared Myotis—The long-eared myotis is a federal species of concern and a Washington State monitor species. This species is strongly associated with forested habitats and forest edges, including Douglas fir, true fir, spruce, and subalpine forests. It also uses deciduous shrubs and forests of riparian zones. Suitable habitat for long-eared myotis may be present in the Project vicinity. The USFS did not detect long-eared myotis during its bat survey of the Baker Lake basin (Perkins, 1988).

Long-legged Myotis—The long-legged myotis is a federal species of concern and a state monitor species. This species is closely associated with coniferous forests and uses cliff crevices, caves, and abandoned buildings for roosting. Suitable habitat for long-legged myotis may be present in the Project vicinity. The USFS did not detect the long-legged myotis during its 1988 bat survey of the Baker Lake basin (Perkins, 1988).

Mountain Goat—Mountain goat is an important native game species in Washington State and is a USFS MIS. The Baker River basin provides suitable year-round habitat for the species. A population survey in 1960 estimated 650 goats on the Mt. Baker Ranger District (Johnson, 1977). A 1995 aerial survey of the Mt. Baker area resulted in a population estimate of between 59 and 212 mountain goats (USFS, 2002a). As a result of this low population estimate, the Mt. Baker area was closed to sport hunting in 1995. The most recent aerial survey was performed in 2001 and resulted in a population estimate of 183 to 484 goats (USFS, 2002a).

Recreational activity may negatively affect goat populations. Trail and off-trail hiking and camping may disturb goats foraging on their summer range in the high elevations of the Baker River basin.

Pacific Fisher—The Pacific fisher is a federal species of concern, USFS sensitive species, and Washington State endangered species. Fishers inhabit coniferous and mixed deciduous/coniferous forests with closed canopies and large diameter snags and logs. They use riparian zones, lakeshores, and ridges, often maintaining very large home ranges for foraging. The mature and old-growth coniferous and mixed forests of the Project vicinity may support fisher.

Pacific Townsend's Big-eared Bat—The Pacific subspecies of Townsend's big-eared bat is a federal species of concern, a USFS sensitive species, and a state candidate for listing. The species is an insectivore that inhabits forested regions primarily west of the Cascade Mountains. Townsend's big-eared bats are primarily cavity-dwellers, typically selecting roost sites in caves or abandoned mines; they also use human-made structures such as barns, attics, and bridges, as long as human disturbance is very low. They require different sites with specific microclimatic conditions for roosting, hibernation, and reproduction. Caves have reportedly been used as maternal roost sites and hibernacula; bridges have also been documented as maternal sites.

Suitable habitat for long-eared myotis foraging is present in the Project vicinity. The USFS conducted a bat survey of the Baker Lake basin and detected a single Pacific Townsend's big-eared bat (Perkins, 1988). Perkins speculated that the hibernacula may be located along Chuckanut Creek, west of the Project vicinity. Limestone formations are present near the Lower

Baker dam, and caves in these formations could potentially be suitable sites for big-eared bat hibernacula.

Yuma Myotis—This bat species is closely associated with water and typically forages for insects close to the surface of open water bodies. It is associated with a wide variety of habitats, ranging from forest stands to dry, open shrub communities. Yuma myotis roosts in caves, mines, and human-made structures, such as sheds, barns, and bridges. They are susceptible to human disturbance, but may be locally abundant where suitable roosting habitat is present. The USFS did not detect the Yuma myotis during its bat survey of the Baker Lake basin (Perkins, 1988).

Amphibians

Cascades Frog—The Cascades frog is a federal species of concern and a state monitor species. In Washington, the Cascades frog occurs at mid- to high elevations in the Cascades and the Olympic mountains (Leonard et al., 1993). The species is most commonly found in small pools in subalpine meadows and also inhabits sphagnum bogs, forested swamps, small lakes, ponds, and marshes near streams.

Amphibian surveys in the Project area resulted in detections of Cascades frog adults or tadpoles at 29 sites (Puget, 2002h; Puget, 2003k). All but three of the sites were permanent lakes or ponds, and the majority of detection sites were in or near forested habitats dominated by red alder.

Northern Red-legged Frog—The northern red-legged frog is a federal species of concern that occurs at low to moderately high elevations in western Washington. It typically uses small ponds, pools, and swamps within forest stands. During the breeding season, the species is most abundant in ponds and pools that are seasonally, rather than permanently, flooded. Red-legged frogs breed in winter, attaching the egg masses weakly to emergent vegetation or underwater branches. Newly metamorphosed frogs, as well as mature adults, are more terrestrial than aquatic, inhabiting shrub and forested areas near permanent water.

Amphibian habitats were surveyed in the Baker River Project area in 2001 and 2002. Northern red-legged frogs were among the most frequently observed species in the Project area and were recorded at eight aquatic sites including both stream and reservoir areas. All sites had a silt/mud substrate, and emergent vegetation, primarily reed canarygrass, covered over 50 percent of the sites' margins.

Tailed Frog—The tailed frog is a federal species of concern and a state monitor species that occurs in cold, rocky streams from British Columbia to northern California. Tailed frogs inhabit streams from low to high elevation, spending several years as tadpoles. Adults are nocturnal and infrequently seen, emerging at night to feed on insects near the stream and in the adjacent forest. Adults can be found in summer, and tadpoles year-round, by turning over rocks in the stream.

Project area amphibian surveys detected the presence of tailed frogs at three sites, each of which was a natural, permanent stream with a silt/gravel, cobble and boulder/bedrock substrate. These sites had no emergent vegetation and were all located within the forest (Puget, 2003k).

Western Toad—The western toad is a federal species of concern and a Washington State candidate for listing. In Washington, western toad is found in all but the driest portions of the Columbia River basin (Leonard et al., 1993). The species has become uncommon in western Washington lowlands and in the mountain meadows of the North Cascades, possibly due to habitat alteration. Western toads are pond breeders and use marshes and small lakes from low to high elevations. They also travel cross-country for long distances, crawling and climbing through dry forests and thickets. Outside of the breeding season, western toads are nocturnal, emerging at night from refuges, including soil excavations, burrows of other animals, and hollows beneath woody material. Western toad tadpoles are gregarious, forming large schools. Newly metamorphosed toadlets are often observed in large numbers on forest floors or crossing roads.

Amphibian surveys performed in the Project area detected western toad at 27 different sites, primarily along the shores of Baker Lake (Puget, 2003k). No egg masses were detected during the surveys. Baker River Project personnel also reported that large congregations of toadlets were often seen along the shoreline of Baker Lake during the late summer (personal communication A. Fuchs, Staff Biologist, Puget, Bellevue, WA, and K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, March 12, 2003).

Insects

Beller's Ground Beetle—Beller's ground beetle is a federal species of concern and a state candidate for listing. It is a flightless beetle found in sphagnum bogs from southwestern British Columbia to northern Oregon. Beller's ground beetle has been reported in western Washington at sites from eastern Puget Sound to the Cascades. It typically is found in bogs among floating mats of sphagnum. Little is known about the population status of the species. One study in King County, Washington, estimated the population density of Beller's ground beetle at 15 adults per square meter.

One sphagnum bog wetland has been recorded in the Project area along the western shore of Baker Lake (wetland number WB-30; Puget, 2003f). This wetland may provide suitable habitat for Beller's ground beetle.

Hatch's Click Beetle—Hatch's click beetle is a federal species of concern and a state candidate species. The species inhabits lowland sphagnum bogs of northwest Washington and is associated with low, floating mats dominated by sphagnum. Little is known about the population of the species, but it is believed to have been reduced through habitat loss and alteration (Larsen et al., 1995).

Sphagnum bog wetland number WB-30, located on the western shore of Baker Lake, may provide suitable habitat for Hatch's click beetle.

Johnson's Hairstreak Butterfly—Johnson's hairstreak butterfly is a candidate for listing in the state of Washington. This is a rare species of butterfly known from southwestern British Columbia to central California, almost exclusively west of the Cascade and Sierra Nevada mountains (Puget, 2003j). Its larvae feed on dwarf mistletoe (*Arceuthobium* spp.); consequently, the butterfly is found only in or near Douglas fir and western hemlock stands that are infected with mistletoe. Adult butterflies feed on nectar of mistletoe and understory plants. Forest industry prescriptions to eradicate mistletoe and the spraying of *Bacillus thuringiensis* (Bt) to eliminate introduced gypsy moth have affected Johnson's hairstreak.

Hemlock dwarf mistletoe (*Arceuthobium tsugense*) occurs commonly in western hemlock in the Baker River watershed (USFS, 2002a). Mountain hemlock dwarf mistletoe (*Arceuthobium tsugense* spp. *mertensiana*) is protected as a survey and manage species under the Northwest Forest Plan and may occur in the basin. Suitable habitat for Johnson's hairstreak likely occurs throughout the watershed within mature and old-growth conifer stands exhibiting mistletoe infections.

Mollusks

Evening Field Slug—The evening field slug is a USFS survey and manage species and a state monitor species. In Washington, the evening field slug inhabits low- to mid-elevation sites from the Cascades to the Pacific Ocean. The species is associated with litter, debris, rock crevices, and various types of low vegetation.

Surveys for mollusks were conducted over 73 survey visits covering approximately 270 acres of potential habitat in the Project area (Puget, 2002i). One sighting of a mollusk suspected to be an evening field slug was recorded but was not verified.

Warty Jumping Slug—The warty jumping slug is a USFS survey and manage species and a state monitor species. The range of the warty jumping slug in Washington extends from the western Cascades to the Pacific coast. The species prefers moist coniferous forests and is associated with conifer logs and heavy ground cover of low vegetation, litter, and debris.

Surveys for mollusks were conducted over 73 survey visits covering approximately 270 acres of potential habitat in the Project area (Puget, 2002i). One sighting of a mollusk suspected to be a warty jumping slug was recorded but was not verified.

5.7.2 Environmental Effects

5.7.2.1 Effects of Project Operations

Reservoir Level Management

Current operations of the Baker River Project would result in fluctuation of the water surface levels in both Project reservoirs. Reservoir fluctuations have the potential to affect a number of terrestrial resources, including amphibian breeding habitat and in-reservoir snags, which may support cavity-nesting birds or osprey nests. Water-level fluctuations may also influence the ability of certain species to breed in the Project area. Common loons are frequently observed on the Project reservoirs but may be precluded from nesting in part due to reservoir fluctuations. Changing water levels and the occurrence of weedy plant species along portions of the reservoir shorelines may influence the plant communities surrounding the reservoirs.

Under the Draft Action, Puget would implement a reservoir level management and operations plan (PME 6.3; see section 5.4.2.1 for a discussion of effects on reservoir elevations). The plan would not change the general pattern of seasonal reservoir levels, which historically has consisted of average low water surface elevations during the winter and average high water surface elevations during the late spring and summer. Refer to appendix B for the full text of this measure.

Effects Analysis

Under the Draft Action, Baker Lake would fill slightly later in the spring and would begin to be drawn down in September rather than October; however, during the hottest and driest months of July and August, the reservoir would be maintained within 3 feet of full pool, which is higher than historical monthly minimums (table 5-9). Wetlands that are hydrologically connected to Baker Lake would be protected by summer water levels that are similar to historical median values and higher than historical average minimums. The lower spring and fall water levels on Baker Lake would support growth of aquatic and emergent vegetation in portions of the drawdown zone and would allow wildlife to forage in these habitats.

Water levels in Lake Shannon would be more constant than under the current condition. Lake Shannon would be maintained within 3 feet of full pool during the summer, which is consistent with historical median summer levels.

Implementation of this plan is not expected to change the characteristics of plant communities surrounding the reservoirs relative to the current condition.

PME 6.3 would provide substantial protection of known amphibian breeding sites (see section 5.7.2.5 below).

Other measures designed to protect terrestrial resources from, or offset effects of, reservoir operations are presented in the following section. Measures that respond in whole or in part to specific reservoir operations concerns include PMEs 1.1.2, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.4.1, 1.4.2, and 1.5.1.

Project Releases

The Lower Baker River extends 1.2 miles from the Lower Baker dam to the confluence with the Skagit River. Between the dam and the powerhouse (RM 0.9), the river is located in a narrow, bedrock-controlled canyon. Between the powerhouse and the barrier dam (RM 0.6), the river is narrow and confined by steep sideslopes. From the barrier dam to the Skagit River, the Baker River is dominated by hardened streambanks and a confined channel.

Flow in the dam to powerhouse reach is limited to about 55 cfs of leakage through the dam, except during spill events. Daily load-following operations cause the flows in the Lower Baker River downstream of the powerhouse to fluctuate up to 4,200 cfs within several hours. This pattern of releases is expected to continue under current operations and the Draft Action.

Effects Analysis

There is little potential for riparian vegetation to develop or persist in the narrow, confined reaches of the Lower Baker River as the majority of the shoreline is unvegetated bedrock, steep rocky slopes, or hardened streambank. Therefore, no significant effects on riparian vegetation are expected to occur as a result of Project releases, and no specific measures to protect riparian vegetation in the Lower Baker River are proposed.

5.7.2.2 Plant Communities and Wildlife Habitats

General Habitat Types

Current operation of the Project is not expected to have any direct adverse effects on existing habitats. Indirect effects may occur through the influence of fluctuating reservoir water levels and human disturbance from maintenance or Project-related recreational activities.

Under the Draft Action, effects on these habitats could occur through recreational and aquatic resource facility development. The specific locations and designs of such facilities have not been developed at this time, and specific effects determinations cannot be made. The Draft Action includes a proposal for rehabilitation of the original powerhouse at the Lower Baker Development. Up to 1 acre of young deciduous riparian habitat is expected to be permanently cleared during construction of this facility (refer to *Lower Baker Power Plant Modifications* in section 5.7.2.7, *Secondary Effects of Proposed Measures*).

The effects of human disturbance on wetland habitats known or suspected to support rare plants would be avoided or mitigated under Draft Action through the implementation of the rare plant protection plan (PME 1.4.1), described in section 5.7.2.3, *Special Status Plant Species*, below.

An analysis performed under the direction of the WTRWG (Puget, 2003c) showed the quantities of habitat types that could re-establish in the Project area in the future if a new license were not issued. Some of these habitats are naturally uncommon in the Baker River basin, including deciduous forest, forested wetland, shrub wetland, and wet meadow.

The Draft Action includes a habitat management measure (PME 1.1.1) that would involve the acquisition of land or establishment of conservation easements to protect the following types and amounts of habitat:

- young deciduous forest—88 acres
- forested wetland—81 acres

- shrub wetland—26 acres
- wet meadow—21 acres

Refer to appendix B for the full text of this measure.

The objective of this measure is to protect several habitats that are relatively uncommon in the basin. The assumptions used to develop these quantities of habitat are based on Scenario 2 of Puget (2003c): no new license would be issued, the Project would be modified to eliminate the Lower Baker facility, and the Upper Baker facility would continue to be operated for flood control. The number of acres of each habitat type proposed for acquisition and management exceeds the number of acres currently present in the Project area (refer to tables 5-20 and 5-22).

Effects Analysis

Implementation of the habitat management program would lead to the protection of 216 acres of habitats, including 88 acres of deciduous forest, 81 acres of forested wetland, 26 acres of shrub wetland, and 21 acres of wet meadow during the term of any new license issued. Protection of these habitats would benefit a large number of plant and animal species, including at least seven of the analysis species selected by the WTRWG for the Baker River Project: red-eyed vireo, ruffed grouse, yellow warbler, willow flycatcher, black-tailed deer, savannah sparrow, and elk. Rare plants also would benefit from the protection of wetland habitats. Habitat acquisitions would occur within the Baker-Skagit drainage. The habitat acquisition program is expected to be of sufficient scope to mitigate for effects on these types of habitats caused by recreational and aquatic resource developments (extent of effect to be determined) and the rehabilitation of the original powerhouse at the Lower Baker Development (approximately 1 acre of young deciduous riparian forest).

The specific locations of these habitat acquisitions have not been determined. The WTRWG has not determined specific actions to enhance the value of the habitats.

Fluctuation Zone Vegetation

Normal operation of the Project for power generation and flood control results in expanses of non-vegetated habitat in the fluctuation zones of both reservoirs. Over 2,000 acres of non-vegetated habitat are present above the minimum generating pool elevation on Baker Lake, and over 800 acres of non-vegetated habitat are present above the minimum generating pool level on Lake Shannon (acres approximate, based on table 5-22). Vegetated habitats within Baker Lake total approximately 227 acres; within Lake Shannon, vegetated habitats total approximately 79 acres. Non-vegetated habitat is of lower value than vegetated habitat for many wildlife species, including pond-breeding amphibians and may be susceptible to colonization by noxious weed species. A few native and non-native species persist in the reservoir fluctuation zones, but little is known about the specific tolerances and requirements of these species.

Current operations of the Baker River Project would result in minimum average reservoir water elevations during winter months and maximum average levels from May through

September. This pattern of reservoir management would continue to alternately expose and inundate large portions of the drawdown zone, promoting growth of aquatic and emergent vegetation in some areas and maintaining other areas in a non-vegetated condition.

Under the reservoir management plan included in the Draft Action, Baker Lake would fill slightly later in the spring and would begin to be drawn down in September rather than October; however, during the hottest and driest months of July and August, the reservoir would be maintained within 3 feet of full pool, which is higher than historical monthly minimums (table 5-9). The lower spring and fall water levels on Baker Lake would support growth of aquatic and emergent vegetation in portions of the drawdown zone and would allow wildlife to forage in these habitats.

Under the Draft Action, Puget would undertake a study to test the suitability of native, locally occurring species for growth and persistence under the reservoir fluctuation regime (PME 1.1.2). A number of species would be tested under controlled conditions to determine their tolerances to periodic inundation and exposure. No specific revegetation objectives are proposed at this time; however, any species identified as suitable through testing could be used as part of implementation of other PMEs, such as amphibian breeding habitat enhancement, wetland enhancement, and grizzly bear forage enhancement. Refer to appendix B for the full text of this measure.

Effects Analysis

The Draft Action would promote the maintenance of existing vegetation in the reservoir fluctuation zones. Implementation of a study to evaluate the potential for establishing beneficial vegetation in the fluctuation zone (PME 1.1.2) would provide data regarding the ability of native plant species of local origin to survive and persist in the fluctuation zones of Project reservoirs. This information would be available for future use in Project enhancement and protection activities as indicated through the adaptive management process.

5.7.2.3 Special Status Plant Species

Several special status plant species are known to occur in the Project area and Baker River basin. Many of these species are designated special status due to their rarity in the region.

Current operations of the Project could negatively affect populations of special status plant species through recreational activities at both developed and dispersed sites, water-level fluctuations, and ground-disturbing activities associated with Project operations and maintenance.

Under the Draft Action, the Project could negatively affect populations of special status plant species through the same types of activities. The Draft Action includes a measure for the development and implementation of a special status plant management plan (PME 1.4.1). Under the plan, Puget would: (1) survey all sites of proposed ground disturbance/activity with the potential to affect special status plants; (2) develop site-specific management plans for special status plant populations that may be affected by Project activity/disturbance; (3) develop a process for assessing and preventing conflicts between special status plants and Project-related activities that emerge during the term of any new license issued; and (4) develop a monitoring and evaluation program for threatened and endangered species plant locations within the area affected by the Project. Refer to appendix B for the full text of this measure.

Under the Draft Action, the habitat management plan (PME 1.1.1) would also contribute to protection of rare plants through acquisition and management of 128 acres of wetland habitats. These habitats may provide suitable habitat for some species of rare plants.

Effects Analysis

Implementation of a special status plant management plan (PME 1.4.1) would meet or exceed USFS, other federal, and state law and/or policy regarding protection of special status plants during the term of any new license issued. Any sites of proposed facility modification or expansion would be surveyed prior to ground disturbance. Special status plants that could be affected by Project-related activities would be managed under site-specific management plans. This measure would promote the protection of special status plant populations within the area affected by the Project. In addition, implementation of the habitat management plan (PME 1.1.1) would ensure the protection of 128 acres of wetland habitats, which could potentially provide rare plant habitat.

The WTRWG has not defined the "area affected by the Project." This area may include all or part of the Project area and portions of the Baker River basin. Definition of the area within which PME 1.4.1 would be implemented is necessary for full evaluation of the effects of the Draft Action.

5.7.2.4 Noxious Weeds and Invasive Non-native Plant Species

Noxious weeds and invasive non-native plant species are known to occur in the Baker River basin. These species can be aggressive, out-competing native plant species, reducing the value of wildlife habitat, and affecting waterways and aquatic habitats.

Roads, trails, boat launches, and other areas of vehicle, pack animal, and foot traffic are typical sites of initial establishment of weed populations. Disturbed soils are susceptible to colonization by weedy species, including non-native invasives. The Baker River Project access roads, recreational facilities, and other Project facility sites may have contributed to the occurrence of weed species in the basin. Currently, Puget implements weed control activities at Project facilities at both Upper and Lower Baker dams, West Pass dike, and selected boat ramps and campgrounds.

Current operations of the Project would continue to provide avenues for weed introduction and establishment along access roads, recreational facilities, boat launches, and the unvegetated portions of the Project reservoir fluctuation zones.

Under the Draft Action, weed introduction, establishment, and spread as a result of Project activities would be reduced. Puget would develop and implement a noxious weed management plan (PME 1.4.2). This plan would expand upon current Project-related weed control activities. The goals of the plan would be to: (1) prevent the establishment of new noxious weeds in the Project area; (2) control the spread of Class A, B, and C noxious weeds in the area affected by the Project; (3) eradicate Class A- and B-designate weeds within the area affected by the Project; and (4) evaluate other invasive species periodically to determine if control and/or eradication is warranted. The plan would be consistent with USFS, other federal, state, and county weed regulations and policy. Refer to appendix B for the full text of this measure.

Effects Analysis

Implementation of the noxious weed management plan would expand Puget's current weed management activities to provide an integrated weed management program to manage noxious weed populations in the area affected by the Project. This measure would reduce the incidence of establishment of new weed populations and help to control the spread of weed species in the basin. This measure would contribute to the enhancement and protection of native plant and wildlife habitats in the Project area and the basin.

The WTRWG has not defined the "area affected by the Project." This area may include all or portions of the Project area and portions of the Baker River basin. Definition of the area within which PME 1.4.1 would be implemented is necessary for full evaluation of the effects of the Draft Action.

5.7.2.5 Wildlife and Special Status Wildlife Species

Elk Foraging Habitat

The Nooksack Elk Herd provides recreational, aesthetic, spiritual, and subsistence values to residents of northwestern Washington. The herd is the smallest in Washington and has decreased in size over the past 15 years. Foraging habitat may not be a limiting factor to the herd at present, but the availability of forage in the future is a concern. Timber harvest ceased on National Forest System lands within the herd's range in the early 1990s, eliminating an important source of early seral forest foraging habitat. Private timber lands in the range would continue to provide foraging habitat while managed for timber; changes in management of these lands could result in loss of additional forage habitat for elk.

The Baker River Project is located on the eastern edge of the Nooksack herd's range. Human activity associated with ongoing operation of the Project has the potential to disturb elk, displacing them temporarily or permanently from otherwise suitable habitats surrounding the Project.

Under the Draft Action, human activity associated with the Project could disturb elk that may be foraging or traveling through the area. The Draft Action includes a measure to establish 575 acres of elk foraging habitat within the range of the Nooksack Elk Herd (PME 1.2.1). The quantity of habitat to be provided reflects the amount of elk foraging habitat that could become available in the Project area if the new license were not issued (Scenario 2, Puget [2003c]), plus additional acreage intended to offset the amount of habitat potentially subjected to Project-related human disturbance.

At least 50 percent of the foraging habitat would be located within the Baker River basin. At least 25 percent of the habitat would be in “permanent” (10 consecutive years) forage patches; with the remainder in “temporary” forage patches (1 to 10 years duration). Habitat would be provided beginning no later than 5 years after issuance of a new license. Refer to appendix B for the full text of this measure.

Effects Analysis

Current Project-related activities have the potential to cause temporary disturbance of elk foraging or traveling through the Project area. No high use areas have been identified as subject to significant effects at this time (refer to Study T-21, in preparation). No specific measures to reduce disturbance are indicated. If high value areas with need for protection from disturbance are identified, the access management plan (PME 6.4) would be a mechanism for protecting these areas.

Implementation of the elk forage enhancement action (PME 1.2.1) would ensure the availability of 575 acres of good quality elk foraging habitat for the term of the new license. The measure includes provisions for appropriate size and distribution of forage plots and specific requirements for forage quality and plot duration. This measure would contribute significantly to the development of a sustainable population of elk in the Nooksack herd, by providing a reliable source of elk forage, appropriately distributed with respect to cover habitat and seasonal ranges. This measure would contribute to the objectives of the WDFW Nooksack Herd management plan (Davison, 2002) through maintaining elk habitat capability on non-state lands and through enhancing habitat quality on primary elk range.

Specific locations of forage plots have not been determined; locations would be identified based on the results of the elk forage study, Study T-21, which is currently underway. The elk study funded by Puget also contributes to the objectives of the Nooksack Herd management plan (Davison, 2002) by expanding the scope of the nutritional ecology study to include the Baker Basin.

Mountain Goat Summer Habitat

Analysis of recent data collected by the USFS suggests that the mountain goat population in the Baker River basin is depressed. A shortage of usable summer habitat has been proposed as a factor contributing to this status. Summer foraging habitat comprises alpine shrubs and grasses; this habitat is believed to have decreased in area over the past 100 years due to encroachment by closed-canopy mountain hemlock forest. Goats may be restricted from using remaining suitable habitat by the presence of high-country recreationists.

The Baker River Project area does not include mountain goat summer range. However, existing Project-induced recreation may account for a portion of the recreational use impact believed to be affecting mountain goats on their summer range. Ongoing operation of the Project is expected to continue to promote backcountry recreational activity at levels similar to current levels.

Under the Draft Action, backcountry recreational activity would continue at levels similar to or greater than current levels, providing potential for disturbance of goats on summer range. The Draft Action includes a proposal to enhance up to 844 acres of mountain goat summer habitat on National Forest System lands in the Baker River basin (PME 1.2.3). The proposal specifies that Puget would fund a portion of the cost of enhancement activities to reduce the tree canopy cover on the 844 acres of summer habitat; the specific methods for accomplishing the canopy thinning are in development. The enhancement program would provide summer foraging habitat in areas not traversed by trails or subject to heavy off-trail use by humans. The USFS would be responsible for environmental review, permitting, and post-implementation monitoring. Refer to appendix B for the full text of this measure.

Effects Analysis

Under the Draft Action, no direct effects on mountain goat summer habitat would occur, because the habitat is located well outside of the Project boundary. Hiking and other recreational activities at high elevations could disturb mountain goats on their summer range. Implementation of the mountain goat summer range enhancement measure would increase the amount of usable summer foraging habitat for mountain goats in the Baker River basin by as much as 844 acres.

The specific proportion of funding to be provided by Puget has not been determined.

Amphibian Breeding Habitat

Amphibian egg masses deposited in ponded areas within the reservoir drawdown zones are subject to flooding or desiccation due to reservoir fluctuation (Puget, 2003k). Wave action and high rates of water movement may also be detrimental to amphibian eggs, which are sometimes unattached or only weakly attached to submerged vegetation. Optimal breeding and rearing habitat for common northwest pond-breeding amphibians has low current velocity, relatively shallow depths (5 to 16 inches), and a relatively stable water surface elevation (less than 5-inch fluctuation over average depth) between January and May (Richter, 1995).

Current operations of the Project would continue to subject documented breeding sites and other potential suitable amphibian breeding habitat to the risk of fluctuating water levels, due to regulation of the reservoirs to meet flood control, power generation, fisheries, and/or recreational requirements.

Under the Draft Action, fluctuating water levels would not occur in the reservoir zones known to support breeding amphibians (under normal operating conditions). The reservoir level management and operations plan (PME 6.3) would protect known amphibian breeding habitats during breeding and early rearing seasons.

Also under the Draft Action, new or enhanced amphibian breeding habitat would be provided to offset other potential Project effects on amphibians, including reservoir fluctuation effects on amphibians that attempt to breed in ephemeral, "false-suitable" breeding habitats. PME 1.2.4 would provide 3 acres of pond-breeding habitat for amphibians through creation of new habitat or modification of existing habitat. Refer to appendix B for the full text of this measure.

Effects Analysis

During the key winter and spring periods for pond-breeding amphibians and their egg and juvenile stages, the Project reservoirs would be maintained below the level of documented successful amphibian breeding sites. On Baker Lake, known successful amphibian breeding sites are located at or above elevation 714 feet msl (NAVD 88). Under PME 6.3, the Baker Reservoir would be operated at or below elevation 711.56 feet msl (NAVD 88) between January and March 31. From April 1 to May 15, Baker would be at or below elevation 713.77 feet msl (NAVD 88), and from May 16 through 31 it would be at or below elevation 718.77 feet msl (NAVD 88).

PME 6.3 would also allow most aquatic and emergent vegetated habitat, which might be used by breeding amphibians, to be free of Baker Lake reservoir fluctuation effects during the breeding season. Geographic information system (GIS) analysis shows that about 221 acres of habitat, sparsely to densely vegetated with aquatic and/or emergent herbaceous vegetation, is present above elevation 713.77 feet msl (NAVD 88) in Baker Lake; only 6 acres of vegetated habitat is located below this elevation (personal communication J. Zablotney, GIS Analyst, R2 Resource Consultants, Redmond, WA, and K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, July 17, 2003).

At Lake Shannon, successful breeding amphibian sites have been documented at or above elevation 429 feet msl (NAVD 88). During January, Lake Shannon would be operated at or below elevation 441.75 feet msl (NAVD 88). From February 1 through May 31, Lake Shannon would be maintained at or below elevation 428.75 feet msl (NAVD 88). Habitats with aquatic and/or emergent vegetation, which might be used by breeding amphibians, total 6 acres below and 73 acres above elevation 428.75 feet msl (NAVD 88).

The intent of holding the reservoirs at these levels would be to allow wetlands and ponds in the upper reaches of the reservoirs to support amphibian breeding, without risk of inundation or desiccation due to reservoir fluctuation. Because of the natural variation in rainfall and temperature, these sites may not support successful breeding every year; however, failures would not be the direct result of reservoir fluctuations.

PME 1.2.4 would provide three acres of pond-breeding habitat for amphibians through creation of new habitat or modification of existing habitat in the Project area and/or the Baker River basin. Methods to accomplish the creation/enhancement are under development, but may include creating small impoundments to increase the duration of ponding and increasing the cover and species diversity of emergent plants, which provide attachment sites for eggs and cover for juveniles. Both of these factors would contribute to the quality of breeding habitat for pond-breeding amphibians (Leonard et al., 1993; Richter, 1995; WDFW, 1997). The quantity of habitat is based on Scenario B of Puget (2003c), reflecting removal of the Upper Baker facility and reservoir, and operation of the Lower Baker facility for flood control. Wetlands would be designed to support open, shallow-water habitats and emergent, semi-aquatic and aquatic vegetation favored by amphibians.

Implementation of PME 6.3 would ensure that known in-reservoir amphibian breeding sites would be protected from reservoir fluctuations during key breeding and rearing periods under normal operating conditions. It also would protect other potential suitable breeding habitat in the upper reservoirs from the effects of reservoir water level fluctuations. This measure would promote stable, sustainable populations of pond-breeding amphibians in the Project reservoirs.

Implementation of PME 1.2.4 would provide 3 acres of additional pond-breeding amphibian habitat in the Project area and/or Baker River basin. This measure would offset potential effects on breeding amphibians that may occur in the reservoir fluctuation zones at elevations below the lowest documented breeding sites.

Osprey Nest Structures

Lake Shannon supports a relatively stable population of osprey, with an average of seven breeding pairs during the last 9 years (Puget, 2002j). Currently, nesting occurs on both natural snags and on artificial nesting platforms. Due to the limited availability of natural nest structures and the recent losses of in-reservoir snag nest sites from decay, artificial nest structures would be key to maintaining stable osprey populations at Lake Shannon in the future.

Current operations of the Project would result in continued implementation of Puget's informal artificial nest structure maintenance program. Currently, nine nest structures are installed at Lake Shannon.

Under the Draft Action, Puget would implement a formal, expanded nest structure maintenance program (PME 1.3.1). Under this measure, one additional nest platform would be installed within 1 year of license acceptance. All 10 artificial nest structures would be inspected on a 2-year cycle and maintained in condition suitable for use by nesting osprey. Puget would also accelerate the development of new natural nest sites by modifying 10 existing trees along the shoreline to promote their eventual use as osprey nest sites. Ten trees would be selected on lands managed by the Puget in sites suitable for osprey nesting; modification of the trees may include topping or killing, based on site-specific evaluation. Puget would monitor osprey nesting and productivity annually during the breeding season of April to September at both Lake Shannon and Baker Lake. Refer to appendix B for the full text of this measure.

Effects Analysis

Implementation of the nest structure maintenance program would ensure that osprey nest sites in excess of the current average number of breeding pairs would be available at Lake Shannon during the term of any new license issued. This would allow the average number of breeding pairs (seven) to be maintained. In addition, 10 existing trees surrounding the lake would be modified to promote the eventual development of natural nest sites for osprey. Annual productivity surveys at both Baker Lake and Lake Shannon would monitor osprey use of the Project reservoirs and nest structures and provide information for future adaptive management decisions.

Common Loon Floating Nest Platforms

Common loons are frequently observed on Project reservoirs but have never been observed nesting. The absence of loon nesting may be related to the lack of suitable nest sites along the reservoir shorelines, effects of reservoir fluctuations, and/or human disturbance.

Current operations of the Project would not result in substantive changes in the suitability of nesting conditions for loons on the Project reservoirs. Under current operations, no loon nesting would be expected to occur during the next license period.

The Draft Action includes a measure to increase the suitability of loon nesting habitat through installation of floating nest structures and implementation of human-use restrictions at nesting sites (PME 1.3.2). Floating nest platforms have been shown to be successful in some reservoirs (Piper et al., 2002), providing loons the predator protection and accessibility found in natural floating nests (Richardson et al., 2000). Within 1 year of license acceptance, Puget would install a total of three floating nest platforms in suitable locations in one or both of the Project reservoirs. Log booms, boundary buoys, or use restriction zones would be placed around each nesting platform to restrict public access. Nesting platforms and log booms/boundary buoys/use restrictions would be in place by April 1 and removed by July 31 each year. Puget would monitor the three platforms for 15 years. If breeding is attempted at any of the three platforms, an additional three platforms would be installed, and all six platforms would be maintained during the term of any new license issued. If no breeding attempts by loons have been observed by the end of the 15-year period, the loon nesting program would be terminated. Refer to appendix B for the full text of this measure.

Effects Analysis

Implementation of this measure would provide new, suitable nesting structures and enhanced nest site security for the common loon at Project reservoirs for a trial period of 15 years. If any nesting attempts are made, additional floating nest platforms would be installed at a total of six sites, and the nest site program would be maintained during the term of any new license issued.

Habitat for Riparian Cavity Dwellers

Snags provide nesting, roosting, and feeding habitat for a wide variety of native wildlife species and are considered a WDFW Priority Habitat. Many snags in and adjacent to Lake Shannon have deteriorated and fallen over time, reducing available habitat to species such as tree swallow. Much of the forested habitat surrounding Lake Shannon has been subject to timber harvest, and snag densities are relatively low compared to stands of late successional and old-growth stages.

Current operations of the Project would not substantially modify the rates of snag loss and recruitment in and around Lake Shannon.

Under the Draft Action, Puget would implement a comprehensive cavity nest/roost management program for Lake Shannon (PME 1.3.3). Puget would augment natural snag habitat for riparian cavity dwellers by installing 20 nest boxes for tree swallows and 10 nest boxes for wood ducks. These artificial cavity structures may be removed once riparian habitat surrounding the lake provides adequate natural cavity sites. Where natural rates of cavity development are insufficient to meet wildlife needs, live trees may be infected or killed to promote cavity development. Refer to appendix B for the full text of this measure.

Effects Analysis

Implementation of the cavity nest/roost management program would ensure that habitat for cavity nesters would be maintained at a minimum of 20 nest boxes for tree swallows and 10 nest boxes for wood ducks at Lake Shannon. Studies have shown that nest site availability is a limiting factor to tree swallows, which cannot excavate their own cavities (Stutchbury and Robertson, 1985). Wood ducks are known to readily accept artificial nest boxes in the absence of suitable natural cavities (Bellrose, 1980). Further actions to promote cavity development would eventually provide additional habitat to benefit these species and other cavity-dependent wildlife species.

5.7.2.6 Ongoing Terrestrial Resource Needs

Resource management objectives, habitat conditions, and wildlife enhancement and protection needs relative to the Baker River Project may change during the term of any new license issued. Individual measures incorporate a reasonable range of expected outcomes and management adjustments. A discretionary fund, under the management of Puget and Project area wildlife managers, could be used to respond to unforeseen outcomes, new resource management issues, and adaptive management decisions.

Under the Draft Action, Puget would establish a TERF (PME 1.5.1), an annual discretionary fund to be administered by the Terrestrial Subcommittee of the BRCC (PME 6.1). This fund would be used to support a range of studies, implement enhancements, and respond to adaptive management decisions (PME 6.2) during the term of any new license issued. Refer to appendix B for the full text of these measures.

Effects Analysis

Establishment of the TERF, with an associated discretionary fund and adaptive management program, would ensure that discretionary funding would be available to respond to new and unforeseen terrestrial resource management issues during the term of any new license issued.

The TERF funding level and requirements for allocation and expenditure have not been determined.

5.7.2.7 Secondary Effects of Proposed Measures

Lower Baker Power Plant Modifications

The Draft Action includes a proposal for rehabilitating the original power generating facilities at the Lower Baker Development that were destroyed by a 1965 landslide. The powerhouse upgrade would include a new turbine generator installed on an existing penstock within the concrete foundation of the original 1925 powerhouse located adjacent to and immediately north (upstream) of the existing Lower Baker powerhouse.

Vegetation along the Baker River shoreline in the vicinity of the power plant rehabilitation site consists of young deciduous riparian forest that regenerated after the 1965 slide. Red alder is the dominant species with minor components of black cottonwood and conifers (personal communication, A. Fuchs, Staff Biologist, Puget, Bellevue, WA, and K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, July 14, 2003). An area estimated to be less than 1 acre would be cleared of vegetation along the shoreline for construction of the access bridge and excavation of the former powerhouse site. The footprint of the new powerhouse, located on the former powerhouse site, would be about 0.2 acre. Equipment staging and excavated materials storage would occur on Puget properties at the Lower Baker Development and would not involve vegetation clearing.

Young deciduous riparian forest is a relatively uncommon habitat type in the Baker River basin and is valuable to a variety of wildlife species. The Draft Action includes a proposal for the acquisition and management of 88 acres of young deciduous forest (PME 1.1.1). This measure would compensate for effects to up to 1 acre of deciduous forest at the Lower Baker powerhouse site, while providing additional enhancement value.

Construction activity is expected to occur over a 24-month period. Instream work on the access bridge would occur during low-flow periods. Noise and human activity associated with the construction may disturb wildlife temporarily, precluding use of habitats in the immediate vicinity of the construction site. This temporary disturbance is not expected to significantly affect populations of any wildlife species.

Recreational Measures

Boating Hazard Management Plan—Implementation of PME 2.1.2 has the potential to conflict with the objectives of the cavity nest/roost management program, PME 1.3.3. Coordination of implementation would allow any negative effects of PME 2.1.2 to be mitigated through PME 1.3.3. Specific effects on cavity habitat would need to be determined on a site-specific basis, once hazard snags and treatment actions have been identified.

Fund Dispersed Campsite Improvement, Operation, and Maintenance—Implementation of PME 2.2.1 could potentially contribute to recreation-induced effects on terrestrial resources. Implementation of the corresponding PME 2.2.2, which specifies management of effects on dispersed camping sites, would serve to prevent or mitigate for effects to terrestrial resources.

The specific area of implementation of PMEs 2.2.1 and 2.2.2 and level of funding for PME 2.2.2 have not yet been defined.

Other Recreational Measures—The following recreational measures proposed under the Draft Action also have the potential to affect terrestrial resources at localized sites:

- create new trails (PME 2.4.1);
- enhance Bayview Campground (PME 2.5.1);
- provide access and development to Lake Shannon or another suitable lakefront site (PME 2.5.3);
- provide improvements to Kulshan Campground (PME 2.5.4);
- support redevelopment of Baker Lake Resort (PME 2.5.5);
- provide funding for a wildlife observation facility (PME 2.5.6); and
- provide and fund ADA compliance (PME 2.5.7).

The extent of potential effects on terrestrial resources would be based on the area of habitat to be disturbed at each site and the plant and wildlife species present. Puget used constraint mapping of sensitive resource areas (including wetlands, wetland buffers, riparian areas, old successional forests, grizzly bear spring core habitat, elk winter range forage, sensitive plant locations, and other priority habitats and species occurrences) in the planning process for the siting of new recreational developments. This process would promote avoidance of effects, where feasible. Other measures, including the rare plant protection program (PME 1.4.1) and the noxious weed management plan (PME 1.4.2), would contribute to protection of terrestrial resources in and near recreational facilities. Final recreational development proposals and trail locations have not been determined.

Access Management

Under the Draft Action, Puget proposes to lead the development and implementation of an access management program in cooperation with private, state, and federal landowners in the basin (PME 6.4). Implementation of the access management program would ensure that current and potential future effects on terrestrial resources related to land- and water-based activities would be considered and addressed. Refer to appendix B for the full text of this measure.

The specific area of implementation and funding level of the access management plan have not been determined.

Aquatic Measures

The following aquatic resources measures have the potential to affect terrestrial resources, depending on the siting and design of the facilities and the presence of plant and wildlife species:

- provide fish propagation and enhancement programs and facilities (supplementation programs) (PME 3.1.2);
- provide upstream passage continuity for migratory fish species (PME 3.2.1);
- provide downstream passage continuity for migratory fish species (acclimation ponds near mouth of Baker River) (PME 3.2.3); and
- develop and implement an erosion control and implementation plan (PME 3.4.3).

The extent of potential effects on terrestrial resources would be based on the area of habitat to be disturbed at each site, the plant and wildlife species present, and the applicability of other measures, including the rare plant protection program (PME 1.4.1) and noxious weed management plan (PME 1.4.2).

5.7.3 Cumulative Effects

5.7.3.1 Wildlife Habitats (Mature and Old-Growth Forest, Deciduous Forest, and Riparian Habitats)

Commercial timber harvest occurred on private, state, and federal lands in the forested stands of the Baker River basin prior to, during, and following the development of the Baker River Project. The original construction of the Baker River Project affected forested habitats, including harvested stands, mature and old-growth stands, and riparian habitats. In the 1990s, commercial timber harvest activity came to a virtual standstill on National Forest System lands in the basin, due to protections for species inhabiting late and old-successional forest. Currently, about 61 percent of the coniferous forested habitats on National Forest System lands are mature and old-growth coniferous forest. Lands surrounding Baker Lake and higher in the basin are predominately mature and old-growth forest, although remaining stands at low to mid-elevations on the west side of Baker Lake have been highly fragmented. Private and state timber lands surrounding Lake Shannon are dominated by second- and third-growth coniferous forest and currently support little or no old-growth. Deciduous forest stands that have developed in response to timber harvest are distributed throughout the managed timberlands. Riparian habitats, some of which are dominated by deciduous trees and shrubs, remain essentially undisturbed by human activity within mature and old-growth forests, and in varied condition within harvested areas.

The majority of late and old-successional forests, deciduous forests, and riparian habitats surrounding Baker Lake and higher in the basin are protected under the provisions of the Northwest Forest Plan (USFS and BLM, 1994b, 2001); these protections are expected to remain in place in the future.

State and private timberlands surrounding Lake Shannon are expected to be managed for timber resources in the future, resulting in continued rotation of forest stand ages. It is also possible that private timberlands would be converted in the future to residential sites. Deciduous forest stands that have developed in response to timber harvest are expected to continue to occur in the future on lands managed for timber production. Riparian habitats are currently protected under Washington State Forest Practices Regulations; these protections are expected to remain in effect in the future.

Several measures under the Draft Action would cumulatively contribute to the protection and enhancement of forested wildlife habitats. The habitat management program proposed under PME 1.1.1 would provide management of 88 acres of young deciduous forest, a relatively uncommon habitat in the basin. The elk forage enhancement program (PME 1.2.1) would provide 575 acres of elk foraging habitat, also an early seral stage, which is expected to decrease in occurrence in the basin in the future, due to the cessation of timber harvest on National Forest System lands. (Total acreage protected may be less than the sum of these two figures if parcels are managed that meet both PME objectives simultaneously.) Rare plants would be protected within forest stands potentially affected by Project-related activities, per specifications of PME 1.4.1. Noxious weeds would be controlled on lands affected by the Project under PME 1.4.2. Snags and cavities, both important elements of mature and old-growth forest, would be managed and enhanced in the harvested stands adjacent to Lake Shannon through PME 1.3.3.

Construction of new and expanded Project facilities, including recreational, aquatic resource, and generation facilities, has the potential to affect small areas of mature and old-growth coniferous, mixed coniferous-deciduous, and deciduous forest. Site-specific designs for recreational and aquatic resources facilities are not available at this time; however, no major construction is anticipated, and any effects on cumulatively affected wildlife habitats are expected to be minor. Powerhouse modifications at the Lower Baker Development are expected to remove up to 1 acre of young deciduous riparian habitat. Habitat acquisition and management measures included under PME 1.1.1 would compensate for this loss.

Wetlands

Cumulative effects on wetlands in the Baker River basin have occurred primarily through timber harvest activity, including clearing, modification of hydrology, and road construction. The quality and function of some basin wetlands have been reduced from historical conditions due to land management activities. The original development of the Baker River Project affected wetlands through inundation of an estimated 356 acres of vegetated wetlands plus additional open-water habitat. Some of the wetlands adjacent to the Project reservoirs rely, to an unknown degree, on hydrology provided by the reservoirs. Although reservoir water levels vary greatly over the short term, the long-term operating pattern of average low-water surface elevations during the winter months and average high-water surface elevations during the late spring and summer months have remained constant. Wetlands dependent on reservoir hydrology have been subjected to this hydrologic cycle since Project construction and are believed to have reached a relatively steady-state condition.

Wetland habitats remaining in the basin are largely protected by federal and state regulations; these protections are expected to remain in effect in the future. Under the Draft Action, wetland habitats that are relatively uncommon in the basin would be acquired and protected, including 81 acres of forested wetland, 26 acres of shrub wetland, and 21 acres of wet meadow (PME 1.1.1). Management to protect and enhance these habitats would improve their functions and values, including wildlife habitat value, over time.

The proposed reservoir level management and operations plan (PME 6.3) would follow the general pattern of historical operations, relative to the seasonality and duration of average low- and high-water surface elevations. Under this plan, Baker Lake water surface elevations would be slightly lower than historical median values during May; however, summer values would be maintained at levels higher than historical average minimums (table 5-9). Lake Shannon summer water levels would be comparable to historical levels. The reservoir operations plan is not expected to substantially alter the current functions and values of reservoir-influenced wetlands.

Construction of new and expanded Project facilities, including recreational and aquatic resources facilities, has the potential to affect small areas of wetland habitats. To comply with current regulations, any effects on wetlands would be mitigated. No wetland habitats are expected to be affected by construction work at the Lower Baker Development powerhouse rehabilitation site.

No net loss of wetland area, function, or value would occur under the Draft Action. Implementation of terrestrial resource measures would increase protection and quality of wetland habitats.

Rare Plants

No data regarding the occurrence of historical rare plant populations in the Baker River basin are available. Timber harvest and associated road construction on private, state, and federal lands in the basin likely affected rare plant habitats and populations over the last century. The original construction of the Baker River Project and inundation of the Project reservoirs may have contributed to cumulative effects on rare plant species. The USFS estimates that Project construction affected potential habitat for 13 sensitive species, although no direct evidence for the occurrence of the plants exists (USFS, 2003a).

Rare plants and state priority habitats occurring in the basin are protected to differing degrees by federal, USFS, and state regulations and policy. Protections are strongest for federally listed species, none of which have been documented in or near the Project area. These protections are expected to continue in the future.

The Draft Action would cumulatively contribute to the maintenance of rare plant populations through acquisition and protection of forested and wetland habitats as specified in PME 1.1.1. A specific program designed to protect special status plants, including survey, site-specific management plans, and monitoring would be implemented under PME 1.4.1. Potential rare plant habitat would be protected by controlling the spread of noxious weeds under PME 1.4.2.

Construction of new and expanded Project facilities, including recreational and aquatic resources facilities, has the potential to affect rare plants and/or their habitats. Ground-disturbing activities associated with the Project would be evaluated for effects on rare plants, and appropriate protection or mitigation actions would be implemented under PME 1.4.1. Project-related effects on rare plants would be avoided or mitigated within the area of implementation of PME 1.4.1, which is undefined at this time.

5.7.4 Unavoidable Adverse Effects

No significant, unavoidable adverse effects are expected to occur to terrestrial resources as a result of implementation of the Draft Action.

5.8 Federally Listed Threatened and Endangered Species and Essential Fish Habitat

The FWS provided a list of federally listed endangered, threatened, proposed, and candidate species that may occur in the Baker River Project area (letter from K.S. Berg, Manager, Western Washington Fish and Wildlife Office, FWS, Olympia, WA, to K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, dated February 13, 2003). NOAA Fisheries concurred with a list prepared by Puget pertaining to endangered, threatened, proposed, and candidate fish species under the agency's jurisdiction that may occur in the Baker River basin (electronic mail from T. Sibley, Northern Puget Sound Team Leader, NOAA Fisheries, Seattle, WA, to M. Daily, Fisheries Biologist, Meridian Environmental, Seattle, WA, dated June 11, 2003). Table 5-28 lists the fish and wildlife species known or suspected to occur in the Project vicinity. No listed, proposed, or candidate plant species are known or suspected to occur in the Project vicinity.

5.8.1 Affected Environment

This section describes the listing status of each fish and wildlife species, its occurrence in the Baker River basin and Project area, and current management activities directed toward protection and recovery of the species.

5.8.1.1 Chinook Salmon

NOAA Fisheries listed Chinook salmon in the Puget Sound ESU as threatened under the ESA (64 FR 14308). The ruling applies to all naturally spawned populations of Chinook salmon (and their progeny) in the Puget Sound region from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula. This listing includes both fall and spring Chinook that may be present in the Baker River system and the Skagit River below the Baker River confluence.

Table 5-28. Federally listed threatened, endangered, proposed, and candidate species known or potentially occurring in the Baker River Project vicinity.

Common Name	Scientific Name	Federal Status	Occurrence in Baker River Basin	Critical Habitat or EFH Designations
Plants			None known or suspected to occur[a]	
Fish				
Chinook salmon	*Oncorhynchus tshawytscha*	Threatened	Documented in Project area[b]	Critical habitat designation remanded. EFH applies to Baker and Skagit rivers[c]
Bull trout	*Salvelinus confluentus*	Threatened	Documented in Project area[a]	Not designated
Coho salmon	*Oncorhynchus kisutch*	Candidate	Documented in Project area[b]	EFH applies to Baker and Skagit rivers[c]
Pink Salmon	*Oncorhynchus gorbuscha*	Listing not warranted	Documented in Project area[b]	EFH applies to Baker and Skagit rivers[c]
Amphibians				
Oregon spotted frog	*Rana pretiosa*	Candidate	Not observed during surveys of potential habitat[d]	Listing warranted but precluded
Birds				
Bald eagle	*Haliaeetus leucocephalus*	Threatened (Proposed for delisting)	Documented; wintering, breeding territories on Baker Lake, Lake Shannon[a, e,f]	
Marbled murrelet	*Brachyramphus marmoratus*	Threatened	Documented; breeding[a,f]	Critical habitat designated in Baker River basin
Northern spotted owl	*Strix occidentalis spp. caurina*	Threatened	Documented, resident[a,f]	Critical habitat designated in Baker River basin
Mammals				
Canada lynx	*Lynx canadensis*	Threatened	Suspected; transient only	

Common Name	Scientific Name	Federal Status	Occurrence in Baker River Basin	Critical Habitat or EFH Designations
Gray wolf	*Canis lupus*	Threatened	Two sightings Baker Lake basin[f]	No critical habitat designated in western states
Grizzly bear	*Ursus arctos*	Threatened	Documented; 2 sightings Upper Baker River basin; 2 sites with tracks Baker Lake basin[f,g]	

Notes: **Federal Status:**

Endangered – Species in danger of extinction throughout all or a significant portion of its range; protected under the ESA.

Threatened – Species likely to become endangered within the foreseeable future throughout all or a significant portion of its range; protected under ESA.

Candidate – Species considered for possible addition to the list of endangered and threatened species.

[a] Letter from K.S. Berg, Manager, Western Washington Fish and Wildlife Office, FWS, Olympia, WA, to K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, dated February 13, 2003.

[b] Puget (2002c).

[c] EFH designation is required under the MSA. This applies to Chinook, coho, and Puget Sound pink salmon habitat, regardless of ESA status of the species.

[d] Puget (2002h, 2003k).

[e] Puget (2002j).

[f] WDFW (2003b).

[g] USFS (2002a).

Historically, adult returns for the Puget Sound Chinook salmon ESU have been estimated at about 690,000. Recently, the total average run size was estimated at approximately 240,000 adult Chinook. Myers et al. (1998) cited contributing factors, such as the degradation or loss of freshwater spawning and rearing habitat, variations in ocean conditions, poor hatchery practices, and overharvest for the decline of Puget Sound Chinook.

Overall Skagit River Chinook populations have displayed the same downward trend as demonstrated by the Puget Sound ESU. In recent years, Skagit River adult Chinook escapement has frequently been below the goals of 14,900 fall/summer Chinook and 3,000 spring Chinook adults (WDFW et al., 1994). Because of these declines, WDFW considers the fall Chinook run that inhabits the Lower Skagit River to be depressed.

As discussed in section 5.6.1.2, *Anadromous Fish Species*, Chinook salmon from the Baker River system historically contributed to Lower Skagit River fall Chinook production. Since construction of the Baker River Project, adult Chinook returns have averaged 220 adults. Because of these low numbers and poor Chinook productivity in the Upper Baker River, WDFW recently has directed that fall Chinook adults returning to the Baker River system be returned to the Skagit River. However, adult returns from an experimental spring Chinook run introduced to the Baker River in 1999 are transported to Baker Lake for spawning (see section 5.6.1.2, *Anadromous Fish Species*). As the program is relatively new, the status of these spring Chinook in the Baker River system is not known.

Potential strategies for restoring Chinook populations to the Skagit River System are currently under development. Section 4(f) of the ESA mandates that a recovery plan be drafted for listed species. The Skagit Chinook Workgroup, an association formed by agency representatives with interests in the basin, was created to guide the preparation of a Chinook salmon recovery plan for the Skagit River basin. When completed, this plan will outline recovery and management objectives for Chinook in the entire Skagit River basin, including the Baker River and the Skagit River below the Baker River confluence. A specific timetable for completion of the recovery plan has not yet been specified, but it is unlikely to be completed prior to the filing of the Baker River Project license.

NOAA Fisheries designated critical habitat for the Puget Sound Chinook salmon ESU on February 16, 2000, which included the Baker River watershed (65 FR 7764). This designation was vacated and remanded to NOAA Fisheries as part of a consent decree signed on March 8, 2002, and subsequently approved by the U.S. District Court for the District of Columbia on April 30, 2002. To date, NOAA Fisheries has not yet revised critical habitat designations for the Puget Sound Chinook salmon ESU. As such, there is no designated critical habitat for the Puget Sound Chinook in the Project area.

In February 2002, NOAA Fisheries received several petitions to delist ESUs of Pacific salmon that are currently listed as threatened or endangered. The ESUs at issue were those that have hatchery populations that were excluded from ESA protection at the time of listing. The Puget Sound Chinook salmon ESU was included in the petitions for delisting. NOAA Fisheries found that the petitioned actions may be warranted in view of a recent U.S. District Court ruling regarding NOAA Fisheries' prior treatment of hatchery fish in ESA listing determinations. NOAA Fisheries is currently revising agency policy regarding the consideration of hatchery fish in ESA status reviews. When the NOAA Fisheries evaluations of hatchery stocks are complete, the potential need to delist or otherwise modify the current listing, protective regulations, or ongoing recovery planning efforts will be evaluated (67 FR 6215). At this time, the Puget Sound Chinook salmon listing remains unchanged, and all naturally produced Chinook salmon in the Baker and Skagit rivers are fully protected as a threatened species.

5.8.1.2 Bull Trout

On November 1, 1999, the FWS issued a final rule announcing the listing of bull trout throughout the coterminous United States as a threatened species under the ESA (64 FR 58910). This rule was based upon the previous listing of Klamath River, Columbia River, and Jarbidge River population segments and the need to list Coastal-Puget Sound and St. Mary/Belly River population segments. Together, these population segments are thought to encompass the entire range of bull trout within the mainland United States (64 FR 58910). The Coastal-Puget Sound distinct population segment (DPS) comprises all Pacific coast and Puget Sound bull trout populations within Washington State, including the Skagit River and its tributaries. At the time of bull trout listing, the FWS did not list Dolly Varden as a threatened species. However, in 2001, the FWS proposed that the species be afforded protection under the similarity of appearance provisions of ESA (66 FR 1628). If the proposal is approved, then the same take prohibitions that apply to bull trout would be extended to Dolly Varden in areas where the two species overlap. The FWS has not made a final decision on the Dolly Varden proposal.

Bull trout have very specific habitat requirements and are more sensitive to habitat changes than other Pacific salmonid species. In the listing of bull trout, the FWS addressed numerous factors that have contributed to the depletion of bull trout populations, including: (1) the destruction and modification of bull trout habitat through effects from dams, forest practices, livestock grazing, agriculture, roads, and mining; (2) overharvest of bull trout for commercial and recreational fishing; and (3) inadequacy of existing regulatory mechanisms (63 FR 31693). In addition, bull trout readily interbreed with non-native brook trout, which may compromise bull trout production where brook trout are present (FWS, 1998).

As described in greater detail in section 5.6.1.3, *Resident Fish Species*, the Skagit River supports the Puget Sound's largest bull trout population, although specific population numbers are not available. Bull trout from the Baker River are considered to be related to the Lower Skagit River stock of bull trout, which the WDFW has classified as healthy (WDFW, 1998). The Baker River supports at least adfluvial and resident bull trout life histories. It is uncertain whether anadromous or fluvial bull trout inhabit the Baker River. Each year, adult bull trout are observed at the Lower Baker River trap. Formal records of adult captures at the trap were not kept until 1994, and since that time, an average of 18 bull trout have been collected and released into Baker Lake. Small numbers of juvenile bull trout have been captured at the juvenile collection facilities, but little is known about bull trout production in the Upper Baker River watershed. *Additional information pertaining to Baker River bull trout will be available upon completion of Study A38, Baker River Bull Trout Population Assessment and Risk Analysis.*

Critical habitat has not yet been designated for the Coastal-Puget Sound bull trout DPS, although a proposal is expected in September 2003, with a final rule to be issued in September 2004. A proposed recovery plan for the Puget Sound DPS is also expected sometime in 2004.

5.8.1.3 Coho Salmon

As discussed in section 5.6.1.2, *Anadromous Fish Species*, coho are the most abundant anadromous salmonid species in the Baker River system. Baker River coho salmon are part of the Puget Sound/Strait of Georgia ESU. Because of petitions for listing of this coho ESU, NOAA Fisheries reviewed Puget Sound/Straight of Georgia coho status in the early 1990s. On July 25, 1995, NOAA Fisheries found that the ESU did not currently warrant listing as threatened or endangered. However, the status review reflected the overall health of the ESU, which prompted NOAA Fisheries to designate the Puget Sound/Straight of Georgia coho salmon ESU as a candidate species (60 FR 38011). Candidate species are not required to be considered in Section 7 consultation under the ESA. However, EFH provisions apply to coho salmon in the Baker and Skagit rivers, as described below. Additional information pertaining to coho salmon in the Baker River system is provided in section 5.6.1.2, *Anadromous Fish Species*.

5.8.1.4 Pink Salmon

Pink salmon from the Skagit River System are part of the odd-year pink salmon ESU in Washington and southern British Columbia. NOAA Fisheries reviewed the status of this ESU and ruled on October 4, 1995, that odd-year pink salmon were not currently at risk of extinction; therefore, no ESA listing of the species was proposed (60 FR 51928). EFH provisions apply to Puget Sound pink salmon, including those inhabiting the Skagit River System, as described below.

5.8.1.5 Essential Fish Habitat

Congress enacted the Sustainable Fisheries Act in 1996 (PL 104-267), which amended the MSA, to establish new requirements for EFH. The MSA, as amended, defines EFH as those waters and substrate necessary for fish use in spawning, breeding, feeding, or growth to maturity. The MSA requires federal agencies to consult with NOAA Fisheries regarding activities that may adversely affect EFH. The implementing regulations for MSA allow for the integration of NEPA or ESA Section 7 reviews with the analysis of proposed Project effects on EFH. Therefore, the information contained in this EA has been drafted in accordance with the EFH consultation requirements defined by NOAA Fisheries.

Chinook, coho, and Puget Sound pink salmon are the only Pacific coast salmonid fish actively managed under the MSA. Freshwater EFH for coho and Chinook salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California. Freshwater EFH for pink salmon includes all currently or historically accessible waters in the Puget Sound. There are four major components of EFH for these species including: (1) spawning and incubation, (2) juvenile rearing, (3) juvenile migration corridors, and (4) adult migration corridors and adult holding habitat.

Relevant EFH for the Project extends from the Upper Baker River delta down to the confluence with the Skagit River. The Skagit River EFH below the confluence with the Baker River is also considered relevant to the Baker River Project. The general habitat characteristics for these reaches are described in section 5.6.1.1, *Aquatic Habitat Conditions*.

5.8.1.6 Oregon Spotted Frog

Oregon spotted frog is a candidate for federal listing and a Washington State endangered species. Four distinct populations of spotted frog were indicated to be warranted for listing in 1993, including the Pacific Coast population (58 FR 27260). Recently, the Pacific Coast population was determined to be a separate species, the Oregon spotted frog.

Historically, Oregon spotted frog was present in the Puget trough lowlands from southern British Columbia to northern California and east into the Cascade Mountains in southern Washington and Oregon. Eleven historical populations in Washington have been documented; in 1930, one of these populations was reported 2 miles northwest of the Town of Concrete (McAllister and Leonard, 1997). This site may have been located at the extreme south end of the Baker River Project area. Habitat loss, through modification of riparian and wetland habitat, is thought to be a major factor in the decline of the species throughout the state (McAllister and Leonard, 1997).

Currently, three populations of Oregon spotted frog are known in Washington State: one in the south Puget Sound, and two in the Cascade Mountains of south-Central Washington (McAllister and Leonard, 1997). One population is known from British Columbia and another 20 populations are documented in Oregon.

Suitable habitat for Oregon spotted frogs is shallow, emergent wetlands, typically in forested settings. Oregon spotted frogs rarely leave the aquatic environment and are usually found in standing, shallow water with abundant emergent or floating vegetation.

Puget conducted a survey for spotted frogs during summer 2001 in the Baker River watershed (Puget, 2002h). Twenty-two sites were sampled using three types of survey methods: visual observations, dip netting, and funnel traps. The survey methods followed the Oregon spotted frog protocol that Applegarth (1994) described. No Oregon spotted frogs were detected during the 142 hours of surveys. Puget also conducted general amphibian surveys of the Baker Lake Reservoir in 2002 (Puget, 2003k); no Oregon spotted frogs were detected during these surveys.

No specific habitat management measures are implemented by Washington State or federal agencies for the protection of Oregon spotted frog. Regulations and policies protecting wetlands and riparian habitats may serve to protect potential habitat for the species.

5.8.1.7 Bald Eagle

In 1978, the bald eagle was listed throughout the lower 48 states as endangered, except in Michigan, Minnesota, Wisconsin, Washington, and Oregon, where it was listed as threatened (43 FR 6233). Five recovery regions were established; the Pacific region published a recovery plan in 1986 (FWS, 1986).

Bald eagles are both predators and scavengers, feeding largely on fish and waterfowl. Bald eagles select nesting sites near open water bodies, including lakes, rivers, estuaries, and marine shorelines. Wintering eagles congregate in areas providing open water and food, perches, and suitable night roosts. Reasons for the decline in bald eagle populations include trophy hunting, poisoning of livestock predators, habitat loss, human disturbance, and perhaps most significantly, bioaccumulation effects of dichlorodiphenyltrichloroethane (DDT) and other organochlorine compounds.

The bald eagle population has shown dramatic recovery from its estimated low of 417 pairs in the lower 48 states in 1963; in July 1999, the number of nesting pairs was estimated at 5,748 (Stinson et al., 2001). By 1995, declassification goals had been achieved in states where bald eagle was listed as endangered, and the species was downlisted to threatened in all of the lower 48 states (60 FR 35999). In 1999, the bald eagle was proposed for removal from the list of threatened and endangered species, as recovery goals had generally been met or exceeded throughout the range of the species in the coterminous states (64 FR 36543).

Washington State supports a large number of breeding and wintering bald eagles. Prior to European settlement, the summer population of bald eagles in the state may have been as high as 6,500 (Stinson et al., 2001). A low of 105 documented breeding pairs was recorded in 1980. Protection measures, elimination of DDT use, construction of major reservoirs, and introduction of warm-water fishes, all have likely contributed to the increase in both breeding and wintering eagles over the past 20 years. In 1998, 664 occupied nests were recorded. It is currently thought that western Washington is approaching its carrying capacity of breeding bald eagles. Wintering eagles, largely from Canada and Alaska, have also increased in number. Surveys during the mid-1980s recorded 1,000 to 3,000 eagles in the state during the winter. Based on those trend data and on increases in breeding bird numbers, a total winter population of about 4,500 birds was predicted by the year 2000 (Stinson et al., 2001).

Bald eagles use the Baker River basin for nesting, foraging, and overwintering. The Baker River Project reservoirs support up to two pairs of breeding bald eagles each summer (Puget, 2002j). Between 1992 and 2002, two active nests were recorded during four breeding seasons, one active nest was recorded during three seasons, and no nests were active during four seasons. A total of three nesting territories have been documented in use. One territory is located near the head of Baker Lake and includes a single known nest site. A second territory is located near Panorama Point on Baker Lake and has included at least three different nest sites. During 2002, a new nest territory was occupied near Thunder Creek on Lake Shannon. Neither of the Baker Lake territories was occupied during 2002, and the nest at the head of Baker Lake had been blown out of the tree during the previous winter. One of the Baker Lake pairs may have shifted to the Lake Shannon territory during 2002.

It is not known whether bald eagles nested along the Baker River prior to construction of the Project reservoirs. Spawning steelhead could have provided a food source during the nesting season (USFS, 2002b). The reservoirs have likely improved the quality of breeding habitat for bald eagles by creating a more dependable summer food source of fish and waterfowl.

The nearest active bald eagle nest site outside of the Project vicinity is located on the Skagit River downstream of the Baker River confluence (letter from K.S. Berg, Manager, Western Washington Fish and Wildlife Office, FWS, Olympia, WA, to K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, dated February 13, 2003; WDFW, 2002).

Wintering bald eagles concentrate along the Skagit River from September to January to feed on salmon carcasses. Suitable wintering areas provide large, late-run salmon populations and/or abundant waterfowl. The Skagit River attracts a high number of bald eagles that feed primarily on chum but also coho and steelhead (Stinson et al., 2001). Winter bald eagle distribution and abundance along the Skagit River is highly associated with chum salmon abundance. Currently, mainstream Skagit River fall chum stocks are healthy and production levels are consistent with available habitat (WDFW et al., 1994).

In late winter, bald eagles move from the Skagit River to its tributaries to feed on late spawning coho salmon (USFS, 2002a). Puget survey data from 1992 to 2002 show the average number of bald eagle sightings on Lake Shannon increasing during December and January, and peaking during February (Puget, 2002j). Baker Lake data from the same period indicate peak bald eagle numbers in January. The greatest number of bald eagles recorded on a single survey date was 32 for Lake Shannon (24 adults and 8 juveniles) recorded on February 21, 1996. Baker Lake surveys showed a maximum number of eagles on January 1, 1992, with a total of 18 eagles (16 adults, 2 juveniles).

Bald eagles may roost communally near feeding areas during the winter. Roost sites are often located in mature or old-growth forest stands in proximity to feeding areas. There are no known night roosts in the immediate vicinity of the Baker River Project; however, potential communal night roost habitat is available in the basin (Puget, 2002c). A total of 3 bald eagle communal night roosts have been documented on the Skagit River within 2 miles of the mouth of the Baker River (WDFW, 2002).

Puget and the USFS have implemented protection measures at the bald eagle nest territory located at the upper end of Baker Lake to reduce the potential for human disturbance. An access road leading through the nesting territory is closed seasonally, and the area has been signed to inform visitors of the sensitive wildlife habitat behind the closed road.

Both federal and state regulations, which include the ESA, Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act, and the State ESA, protect bald eagles and their nest sites. In the event that the bald eagle is delisted, many of these protections will remain in effect. The FWS will continue to monitor bald eagle populations for at least 5 years (64 FR 36453). The USFS intends to designate the bald eagle a sensitive species (USFS, 2002a). The state of Washington will initiate a review of the state status of the species at the time of federal delisting; currently, the state of Washington recommends that the bald eagle be down-listed to state sensitive, rather than removed from the list, based on development trends in areas affecting bald eagle habitat (Stinson et al., 2001).

5.8.1.9 Marbled Murrelet

The marbled murrelet was designated as federally threatened in Washington, Oregon, and California on October 1, 1992 (57 FR 45328); it is also a Washington State threatened species. Critical habitat was designated for the species in 1996 (61 FR 26255) and a recovery plan was adopted in 1997 (FWS, 1997).

The marbled murrelet is a small seabird that feeds on marine waters but nests high in the canopy of old-growth coniferous forests. Large diameter trees with large diameter limbs, broken tops, witches' brooms, or other deformities are used for nest platforms; nests are not constructed but usually are located on a substrate of moss or lichen. Adult murrelets carry food from marine waters to the single offspring at the nest site, flying distances as great as 52 miles inland (Ralph et al., 1994). Factors that have contributed to the decline in marbled murrelet populations include over-fishing of its prey species, entanglement in fishing nets, oil spills, and loss of nesting habitat through timber harvest and development (WDFW, 1993). Recent population estimates for Washington State indicated approximately 5,500 murrelets (Ralph et al., 1995). Modeling for the Pacific Northwest population predicts an annual decline of 2 to 12 percent of the at-sea population of murrelets (ACOE, 2000a).

Critical habitat was designated for the marbled murrelet to provide suitable nesting habitat, located in proximity to marine foraging habitat, on lands not otherwise protected by existing regulations or land use designation. Most known nest sites were included in critical habitat designations, on both federal and private land. National Parks, Wilderness Areas, and National Wildlife Refuges were generally excluded from critical habitat designation. In the Baker River Project vicinity, critical habitat for marbled murrelet coincides with LSRs designated under the Northwest Forest Plan (USFS and BLM, 1994a, as amended) created for the management of northern spotted owl and other old-growth species. The Baker LSR is about 82,100 acres in size, and is adjacent to the Mt. Baker and Noisy-Diobsud wilderness areas, the Mt. Baker National Recreation Area, and the NCNP, each of which may provide additional suitable habitat. Murrelets generally use forest stands in the western hemlock and silver fir vegetation zones located below 3,200 feet elevation.

Surveys of the Baker River basin have documented marbled murrelets present during the nesting season, and presumably nesting. USFS surveys indicate that the northern half of the MBSNF accounts for 50 percent of the nesting habitat and 85 percent of the murrelet detections on the entire forest (USFS, 2002a). The WDFW priority habitats and species database shows 10 "occupancy" sites in the watershed, where occupancy is determined by the detection of flying behaviors and/or vocalizations believed to be associated with nesting (WDFW, 2003b). Surveys were performed for a number of small hydroelectric projects proposed for Anderson and Park creeks on Baker Lake during the early 1990s (Beak, 1992a, 1992b). These surveys were conducted in conjunction with the USFS. Occupancy was determined at three of six sites at Anderson Creek (southeastern side of Baker Lake) during 1992. At Park Creek, on the northwestern side of Baker Lake, occupancy was determined at four of eight sites in 1992. Surveys have not been conducted in recent years, and the current status of marbled murrelets in the basin is unknown.

At this time, most suitable marbled murrelet habitat in the Baker River basin is protected by designation as an LSR, within which timber harvest is restricted, or by other federal land use designation. Small amounts of suitable habitat may be present on privately owned timberlands.

5.8.1.10 Northern Spotted Owl

The northern spotted owl was federally listed as threatened in Washington, Oregon, and California in July 1990 (55 FR 26114); it is a Washington State endangered species. Factors that contributed to the federal listing were the declining population trends, the loss of suitable forested habitats throughout the species range, and the lack of adequate regulatory mechanisms to protect existing habitat for the species. Critical habitat was designated for the northern spotted owl in 1992 (57 FR 1796).

Spotted owls are strongly associated with mature and old-growth forests for nesting, foraging, and roosting. Nesting and roosting occur in a variety of coniferous forest types characterized by moderate to high levels of canopy closure; high density of standing snags; large diameter overstory trees with deformities, such as broken tops and witches' brooms; and abundant coarse woody debris on the forest floor (FWS, 1987a). Foraging occurs in nesting and roosting habitat, and in coniferous forest of younger age and less structural diversity, where key prey species are present. Important forage species in mesic Douglas fir forests include northern flying squirrel and woodrat species; these species occur at relatively low density and the spotted owl has a correspondingly large home range (FWS, 1992).

A final draft recovery plan for the spotted owl was prepared in 1992 (FWS, 1992); the plan was never formally adopted. Critical habitat for spotted owls in the Baker River basin is located on National Forest System lands surrounding Baker Lake. Congressionally reserved areas, including Wilderness and National Recreation Areas, are excluded from the critical habitat designation. The Northwest Forest Plan (USFS and BLM, 1994a, as amended) serves recovery plan functions through specific management requirements, standards, and guidelines. The Northwest Forest Plan established a system of LSRs to provide habitat capable of supporting viable populations of species associated with late- and old-successional forest, including the northern spotted owl and marbled murrelet. The Baker LSR is about 82,100 acres and almost completely surrounds Baker Lake. DCA WD-21 was established in 1992 for the protection of northern spotted owls (FWS, 1992) and contributes another 29,750 acres of protected lands. Additional habitat that may be suitable for spotted owl is located in adjacent wilderness areas, the Mt. Baker National Recreation Area, and the NCNP.

The Baker LSR and DCA WD-21 combined are projected to support 28 pairs of nesting spotted owls (USFS, 2002a). The Baker LSR/DCA is expected to be a major contributor to spotted owl recovery as a source of owls dispersing to the north, southeast, south, and east. The USFS (2002a) analyzed habitat suitability for spotted owl within the LSR/DCA. Approximately 67 percent of the area is in the western hemlock and Pacific silver fir vegetation zones; the remaining 33 percent is in the mountain hemlock or non-forested zones, which do not provide spotted owl habitat. Only 17 percent of the LSR/DCA is in the western hemlock zone, which is the lowest elevation, highest productivity forest. Approximately 70 percent of the LSR/DCA is late- and old-successional forest; about one-third of this amount is greater than 450 years old and provides optimum habitat for old-growth associated species.

The size of old-growth stands is also important to the quality of spotted owl habitat. Throughout the Baker LSR, most patches of late successional and old-growth forest are greater than 620 acres. Old-growth forest has been fragmented into smaller blocks in the Rocky, Sandy, and Dillard creek drainages.

Spotted owl surveys were conducted in the Anderson and Park creek drainages on Baker Lake during the late 1980s and early 1990s. Reproductive pairs of spotted owls were located in Anderson Creek during 1989, 1991, and 1992 (Beak, 1992c). Adult owls were located on Park Creek during the same years; however, reproductive status was not determined (Beak, 1992d). Pairs of owls were also recorded in the Swift, Shuksan, Little Sandy, Sandy, and Noisy creek drainages between 1989 and 1992 (WDFW 2003b). The NPS surveyed owls in the NCNP from 1993 through 1996 (Kuntz and Christopherson, 1996). A total of six spotted owl pairs and five single owls were located in the Park, which is located partially within the Baker River basin. WDFW data on priority habitats and species indicate eight spotted owl site centers within the Baker River watershed (WDFW, 2003b). Activity at these sites has not been verified in recent years, and the current status of the spotted owl population in the Baker River basin is largely unknown.

Currently, spotted owls and their habitat are protected by the requirements of the Northwest Forest Plan, as well as the ESA and Migratory Bird Treaty Act. Timber harvest on private lands is performed under the Washington State Forest Practices Act, which incorporates assessment of effects to listed species.

5.8.1.11 Canada Lynx

The Canada lynx is a federal and state listed threatened species. The lynx became a candidate for state listing in 1991 and was listed as a threatened species on November 14, 1993 (Stinson, 2001). The proposal for federal listing occurred in June 1998; lynx was listed as federally threatened in the 48 contiguous states on April 23, 2000 (63 FR 36994). A lynx recovery plan was published by the WDFW in March 2001 (Stinson, 2001). The primary reasons for the decline in lynx populations include alteration of habitat, overhunting, disturbance by humans, and competition with species, such as bobcat and coyotes, which have expanded their ranges (63 FR 36994).

Lynx are found mainly in the north central and northeastern portions of Washington State. In the Cascades, lynx inhabit primarily high-elevation forests with a strong component of subalpine fir (McKelvey et al., 1999; Stinson, 2001). Lynx populations are strongly correlated with snowshoe hare populations; high-quality foraging habitat occurs in early successional forest stands with high densities of hare. Thermal and security cover and denning habitat are provided by mature, closed canopy forests (Stinson, 2001). The Washington State population of Canada lynx is currently estimated at fewer than 100 individuals (Stinson, 2001).

The lynx is neither known nor suspected to be resident in the Baker River watershed (USFS, 2002a; Stinson, 2001). Based on USFS modeling of lynx habitat, no potential habitat is thought to be present in the Baker River watershed. Hair-snagging surveys performed in 1998 in the Rocky and Sulphur creek drainages did not detect the presence of lynx (USFS, 2002a). It is likely that transient lynx, dispersing from eastern Washington habitats, pass through the Baker River watershed on occasion (USFS, 2002a).

Six Lynx Management Zones (LMZs) have been established in areas that are occupied, or were recently occupied, by lynx (Stinson, 2001). The Baker River Project area is outside of the LMZs, which are located mainly east of the Cascade crest.

5.8.1.12 Gray Wolf

In 1978, the gray wolf was listed as endangered throughout the 48 coterminous states, except Minnesota, where it was listed as threatened (43 FR 9607). Critical habitat for the species was designated within the states of Michigan and Minnesota in the same ruling. On April 1, 2003, three DPSs for the gray wolf were established: the Western DPS, Eastern DPS, and Southwestern DPS (68 FR 15803). This ruling also reclassified the gray wolf from endangered to threatened within the Western DPS and Eastern DPS (except where already classified as threatened or as an experimental population). The Western DPS includes all of Montana, Wyoming, and Idaho, along with Washington, Oregon, California, Nevada, northern Colorado, and northern Utah. Gray wolves are currently listed as endangered in the state of Washington.

Gray wolves previously occupied most of the lower 48 states. Their populations declined with increased populations of European settlers across the mid-west and western states. Wolves were hunted for their furs and were killed in great numbers as part of predator control programs. They were extirpated from most of the lower 48 states by early in the twentieth century, although a small population remained in Minnesota.

The Northern Rocky Mountain Wolf Recovery Plan was published in 1980 and revised in 1987 (FWS, 1980, 1987b). This plan included all of Washington State; however, specific population goals for the state were not included. Recovery in the Rocky Mountain area relied on two reintroduced, experimental populations in central Idaho and Yellowstone National Park, and one site in Glacier National Park, Montana, that was reoccupied by wolves from Canada. At this time, the recovery criteria set in the 1987 plan have been exceeded, and the three individual populations are believed to be acting as a metapopulation. The FWS intends to propose to delist the wolf in the Western DPS in the near future (50 FR 15879).

A small population of gray wolves may be present in the North Cascades Mountains of Washington (WDFW, 2003a). Wolves have been seen regularly in southern British Columbia north of the NCNP and Ross Lake National Recreation Area since 1984. In 1990, wolves with pups were observed near Hozomeen at the north end of Ross Lake (NPS, 2003). Since then, three separate groups of wolves with pups have been observed in the Cascades. Wolves have been observed at McAlester Pass, the Pasayten Wilderness, Twisp River drainage, and Glacier Peak Wilderness, and near Steven's Pass. The WDFW database of priority habitats and species reports two observations of gray wolves in the Baker River basin in 1984 and 1992 (WDFW, 2003b). There are no estimates of wolf population for the North Cascades area.

Wolves feed primarily on ungulates but will also feed on small mammals. Both forested and open habitats are used when sufficient prey is present year-round, suitable den sites are present, and human exposure is limited. Wolf packs may consist of 2 to 12 animals, and home ranges average about 200 square miles in size. Ungulate populations in the Baker River basin are not large, and this may preclude the area from providing high-quality habitat for wolves. Wolves observed in the Baker River basin are likely transient wolves traveling through the area.

5.8.1.13 Grizzly Bear

The grizzly bear is a federally threatened and state-listed endangered species. The grizzly bear was listed as federally threatened under the ESA in the 48 contiguous states in 1975 (40 FR 31734). The primary causes of population decline are hunting, human disturbance, and habitat alteration. A recovery plan was prepared in 1982 (FWS, 1982), identifying the need for evaluation of the North Cascades area of Washington to determine habitat condition and status of bear population. The Interagency Grizzly Bear Committee completed this evaluation in 1992, concluding that a small number of grizzly bears inhabit the area and that suitable habitat to support about 200 to 400 bears is present (Almack et al., 1993). The grizzly bear recovery plan was modified in 1993 (FWS, 1993) and was supplemented with a chapter containing a recovery plan for the North Cascades Grizzly Bear Ecosystem (Servheen, 1997). In 1991, a petition was filed to reclassify the grizzly bear in the North Cascades area as endangered; the finding on this petition was that action was warranted but precluded by higher priority actions (56 FR 33892).

Grizzlies are omnivores that use a wide range of habitat types across a large home range. Home ranges of males can be 200 to 500 square miles, while those of females are in the range of 50 to 300 square miles (FWS, 1993). Habitat use varies with season, with lower elevation, snow-free areas used in early spring, mid-elevation habitats during summer, and mid- to high-elevation habitats during late summer and fall (Mace et al., 1999). Presence of roads and humans are negatively correlated with grizzly bear presence.

The grizzly bear is known to occur in the Upper Baker River watershed (USFS, 2002a; WDFW, 2003b). Historically, the North Cascades provided high-quality habitat; trapping records indicate that more than 3,700 grizzly bear hides were transported from forts in and near the region between 1827 and 1859 (Servheen, 1997). Grizzly bear numbers declined significantly by the late 1800s. Nine grizzly bears were recorded on the Mt. Baker National Forest, including the Upper Baker River, during 1929 (USFS, 2002a). Recent estimates of the North Cascades grizzly bear population range from 12 to 50 individuals (Almack et al., 1993; MacCracken and O'Laughlin, 1998). The most recent grizzly sightings in the Project vicinity include an observation of one adult and one young in the Baker River headwaters in 1991, over 10 miles from the Project area (WDFW, 2003b), and a grizzly bear track recorded in 1989 near Watson Peak, about 4.5 miles east of the Upper Baker dam (WDFW, 2003b).

The North Cascades Recovery Area, established in 1993, extends from the western edge of the Cascade foothills, east to the Okanogan, and south as far as Snoqualmie Pass. Three Bear Management Units (BMUs) border Lake Shannon and Baker Lake: Sisters BMU west of Lake Shannon, Baker BMU west of Baker Lake, and Welker BMU east of both reservoirs. A fourth BMU, Baker-Goodell, encompasses the Upper Baker River basin and the Goodell Creek watershed to the southeast. An assessment of grizzly bear habitat in the North Cascades Recovery Area was performed by the North Cascades Grizzly Bear Ecosystem Technical Team (USFS, 2002a). The results of the assessment are summarized briefly below.

Sisters BMU is 100,875 acres in size, with 45.9 percent located on federal lands. Remaining lands are predominantly managed as private timberlands; residential developments are also present. Early and late season core areas are each less than 50 percent of the BMU; preferred habitats in the seasonal core areas are well below the range believed to be necessary to support grizzly bear use. The Sisters BMU is considered to have low likelihood of successful occupancy by grizzly bears.

The Baker BMU is 82,380 acres in size, with 96.7 percent in federal ownership. Early and late core areas fall into the moderate class, with preferred seasonal habitats in the core areas at the low end of the evaluation range. The preferred habitats are within the range believed to be adequate to support occupied habitat, provided that the risk for mortality is low. This BMU experiences a high level of recreational activity, including a climbing route to Mt. Shuksan and other trails. Maintenance or improvement of the quantity and quality of the core area and habitats are objectives for this BMU.

Welker BMU exhibits moderate levels of both early and late season core area, and low (early season) and moderate (late season) levels of preferred habitats in the core areas. The amounts of seasonally preferred habitats are within the range believed necessary to support grizzly bear use, provided that mortality risk is low. Welker BMU is 78 percent federally owned. Recreational pressures are not as high as in the Baker BMU, and the Welker BMU has additional forage resources along over 7 miles of anadromous streams/rivers.

The Baker-Goodell BMU exhibits high amounts of both early and late season core areas and a very high amount of preferred habitat within the late season core. Early season preferred habitat levels were below the midpoint of the evaluation range. A small portion of the 100,821-acre BMU (0.05 percent) is in non-federal ownership, and is located near State Highway 20 and/or other roads.

5.8.2 Environmental Effects

5.8.2.1 Fish Species

In order to encompass the potential effects on listed fish populations and habitat and Pacific salmon EFH, the action area for this analysis includes the entire Baker River watershed and Skagit River downstream of the Baker River confluence.

Table 5-29 is based on *Matrix of Pathways and Indicators* (NMFS, 1996) and is designed to summarize existing environmental conditions and parameters for the action area (i.e., Baker River watershed and Skagit River downstream of Baker River confluence) and the influence that the Draft Action may have on these indicators. NOAA Fisheries recommends using this process to quantify and standardize the existing environmental baseline conditions for several environmental "pathways" or parameters and to determine the effects of a project on each relevant indictor. However, the matrix presented in table 5-29 was originally designed by the USFS for the evaluation of timber harvest activities on rangeland watershed. Therefore, not all of the parameters below are necessarily applicable to the broad spatial context of the Baker and Skagit rivers, although it is still a useful tool in characterizing the baseline conditions and summarizing the potential effects of the Draft Action. It is also important to note that the status of the existing environmental indicators is independent of current operations. For example, road density in the Lower Skagit River watershed may rate as "at risk" under existing conditions even though the Project may have no influence on this indicator. Following table 5-29, we describe each indicator and rationale for effects determination. See sections 5.3.1, 5.4.1, 5.5.1, and 5.6.1 for detailed descriptions of existing conditions.

Table 5-29. Checklist for documenting existing conditions and effects of the Draft Action on relevant indicators. (Source: adapted from NMFS, 1996)

Pathway Indicators	Existing Conditions			Effects of Draft Action on Existing Conditions		
	Properly Functioning	At Risk	Not Properly Functioning	Improved	Maintained	Degraded
Water Quality						
Temperature	--	X (1)	--	--	X (1)	--
Sediment	--	--	X (2)	--	X (2)	--
Chemical contamination/ nutrients	--	X (3)	--	--	X (3)	--
Habitat Access						
Physical barriers	--	X (4)	--	X (4)	--	--
Habitat Elements						
Substrate	--	--	X (5)	--	X (5)	--
Large wood	--	--	X (6)	--	X (6)	--
Pool frequency	--	Unknown (7)	--	--	Unknown (7)	--
Pool quality	--	Unknown (8)	--	--	Unknown (8)	--
Off-channel habitat	--	Unknown (9)	--	--	Unknown (9)	--
Refugia	--	X (10)	--	--	X (10)	--
Channel Conditions and Dynamics						
Width/depth ratio	--	X (11)	--	--	X (11)	--
Streambank condition	--	Unknown (12)	--	--	Unknown (12)	--
Floodplain connectivity	--	--	X (13)	--	X (13)	--
Flow/Hydrology						
Peak/base flows	--	--	X (14)	--	X (14)	--
Drainage network increase	--	X (15)	--	--	X (15)	--
Watershed Conditions						
Road density and location	--	X (16)	--	--	X (16)	--
Disturbance history	--	X (17)	--	--	X (17)	--
Riparian reserves	--	X (18)	--	--	X (18)	--

(1) The Baker River watershed generally has excellent water quality, and temperatures are generally less than 16°C. Peak reservoir temperatures approach 17 to 18°C. See section 5.4.1 for further details. The Middle and Lower Skagit River would be considered at risk for this indicator due to urbanization and development in the subbasin. In addition, water quality data from the Marblemount gage displays water temperatures up to 14.3°C, which are within the at risk range of water temperatures defined by NOAA Fisheries (Kimbrough et al., undated). However, the Marblemount station is upstream of

the Baker River confluence and may not be representative of Skagit River water temperatures downstream of the Baker River. The Draft Action would most likely not principally alter existing water temperatures in the action area. Therefore, the water temperature indicator should be maintained under the Draft Action.

(2) Although the Baker and Skagit projects restrict sediment input to the mainstem Skagit River, the mainstem Skagit River is accumulating sediment at an elevated level from other sources of sediment, such as road failures and timber harvest activities (see section 5.3.1). PME 3.4.1 would attempt to offset the effects of Baker Project operations on the sediment supply to the Lower Baker and Skagit rivers. Implementation of PME 3.4.1 would, at a minimum, maintain the sediment indicator and could improve the sediment supply regime. Therefore, the sediment indicator should be maintained under the Draft Action and could be improved to some degree.

(3) The Baker River watershed generally has excellent water quality. The Middle and Lower Skagit River would be considered at risk for this indicator due to urbanization and development risks and agricultural practices. Increasing recreational opportunities under the Draft Action has a slight potential to increase the indirect effect of chemical contamination of Project reservoirs from increased power boating and septic system installation. However, these activities would not likely principally alter chemical contamination and nutrient concentrations in the action area. Therefore, this indicator should be maintained under the Draft Action.

(4) The physical barriers indicator is at risk for the Baker River watershed. Upstream and downstream passage is provided by the Project, but juvenile collection efficiencies have been estimated at about 50 to 70 percent. In addition, there is no upstream passage to accommodate fish movement, particularly bull trout, between the Project reservoirs. There is likely some unavoidable handling stress and fish mortality associated with the trap-and-haul system. Connectivity between Baker Lake and Lake Shannon would be evaluated and addressed under the Draft Action (see section 5.6.2.3). Under the Draft Action, the downstream and upstream migrant collection facilities would be evaluated and likely improved (see sections 5.6.2.2, 5.6.2.3, and 5.6.2.4). Therefore, the physical barriers indicator would be improved under the Draft Action.

(5) As per the sediment indicator, the substrate indicator is not properly functioning in the Baker and Skagit rivers. The Draft Action would most likely not principally alter existing sediment regimes in the Baker and Skagit rivers in the action area. Therefore, the substrate indicator should be maintained under the Draft Action.

(6) LWD recruitment has been reduced in the Lower Baker and Skagit rivers by a variety of factors, including operation of the Baker and Skagit projects (see section 5.6.2.5). Under the Draft Action, LWD would be removed from Project reservoirs and stockpiled for potential use in the Baker and Skagit watersheds. However, there is no guarantee the stockpiled LWD would be placed in the Skagit or Baker rivers for habitat enhancement, or that the stockpiling of LWD would increase the number of potential LWD installation projects. Therefore, this indicator should be considered maintained under the Draft Action. If projects were undertaken to place LWD in the Baker or Skagit rivers, then the condition would be improved.

(7) Instream habitat variables are currently being assessed as part of Study A09. However, at this time, it is anticipated that the Draft Action would not principally alter pool frequency because pool frequency is primarily affected by channel forming flows, which Project operations marginally affect.

(8) Instream habitat variables are currently being assessed as part of Study A09. However, at this time it is anticipated that the Draft Action would not principally alter pool quality because pool frequency is primarily affected by channel forming flows, which Project operations marginally affect.

(9) Instream habitat variables are currently being assessed as part of Study A09. As discussed in section 5.6.2.1, the Draft Action would increase flow fluctuation magnitude from May through November; therefore, there is potential for the Draft Action to increase off-channel habitat disconnections. *Results from Study A09 will be incorporated into this analysis when available.*

(10) The Middle and Lower Skagit River should at best be considered at risk for this indicator due to urbanization and development risks. At this time, it is anticipated that the Draft Action would not principally alter the refugia indicator.

(11) Because peak flood flows (i.e., channel forming flows) have been reduced (see section 5.4.1) and the mainstem Skagit River is receiving increased sediment (see section 5.3.2.4), this indicator is likely not properly functioning in the Lower Baker and Skagit rivers. Because flood flows and the 10 percent exceedance flows would remain the same (i.e., channel forming flows) under the Draft Action (see section 5.4.2.1), the Draft Action should not affect width/depth ratios above existing conditions and, therefore, would maintain existing conditions.

(12) Although the status of this indicator is unknown, it is likely at risk in the Middle and Lower Skagit River due to urbanization and development risks. At this time, it is anticipated that the Draft Action would not principally alter the streambank condition indicator. Therefore, this indicator would be maintained.

(13) The floodplain connectivity indicator is not properly functioning in the Middle and Lower Skagit River due to diking and flood control management at the Baker and Skagit projects. This indicator would be maintained under the Draft Action.

(14) As described in section 5.4.2.1, peak and base flows are not similar to historical conditions. Therefore, this indicator is not properly functioning. Flows under the Draft Action, while somewhat different from existing conditions, would not be similar to unregulated natural conditions. Therefore, the not properly functioning status of this indicator would be maintained.

(15) The drainage network indicator would be considered at risk and is likely not properly functioning in the Lower Skagit River basin due to urbanization and development. No increase in drainage network is proposed under the Draft Action; therefore, this indicator would be maintained.

(16) The road density and location indicator would be considered at risk and is likely not properly functioning in the Lower Skagit River basin due to urbanization and

development. Construction of major roads is not proposed under the Draft Action. Therefore, this indicator would be maintained.

(17) The disturbance history indicator is not properly functioning, based on past development in the Lower Skagit River. At this time, it is anticipated that the Draft Action would not principally alter this indicator. Therefore, this indicator would be maintained.

(18) The riparian reserves indicator ranges widely from the Upper Baker River (likely properly functioning) to the Lower Skagit River (likely not properly functioning). At this time, it is anticipated that the Draft Action would not principally alter this indicator. Therefore, this indicator would be maintained under the Draft Action.

Chinook Salmon

Direct Effects—Table 5-29 shows that the Draft Action would maintain most environmental indicators and would likely improve the physical barriers indicator. Direct effects present under current operations would continue to occur under the Draft Action. As described in section 5.6.2.1, the current operations and Draft Action have the potential to cause some dewatering of Chinook redds in the Middle Skagit River; however, the extent is unknown at this time. Results from Study A09 will address this question and will be incorporated into this analysis when available. Current operations have the potential to cause some stranding of juvenile Chinook salmon in the Middle Skagit River; however, estimates of stranding are not available. Under the Draft Action, stranding would be expected to be similar to current operation. Adult Chinook salmon are captured at the Lower Baker River adult fish trap. As described in section 5.6.2.2, there is some potential adult mortality associated with fish handling; however, handling mortality is generally low. Some handling mortality could also occur under the Draft Action.

Indirect Effects—No indirect effects are known or suspected to occur under existing conditions or under the Draft Action.

Cumulative Effects—These effects would be the same as listed in section 5.6.3. The primary cumulative effects under existing conditions are caused by the operation of the Baker and Skagit projects that, when combined, cumulatively affect flow resulting in the potential for fish stranding, redd dewatering, and reduced aquatic habitat. This cumulative effect would continue under the Draft Action to a certain degree as ramping would also occur.

Conservation Measures—Under existing conditions, conservation measures include voluntary ramping restrictions and flow releases (analyzed in section 5.6.2.1) to protect salmon spawning and stranding. In addition, Puget is cooperating with WDFW in the experimental spring Chinook reintroduction program to the Baker River watershed (see section 5.8.1).

The Draft Action includes mandatory ramping restriction and flow releases (analyzed in section 5.6.2.1) and improved fish passage facilities (analyzed in sections 5.6.2.2 through 5.6.2.4). A new turbine to facilitate instream flow and ramping restrictions would be installed. LWD would also be stockpiled for potential habitat enhancement use under the Draft Action (analyzed in section 5.6.2.5). Refer to appendix B for the full text of these measures.

Effect Determination—Under the Draft Action, Chinook salmon redd dewatering, stranding, and handling mortality are unavoidable adverse effects. The Draft Action would potentially have an adverse effect on Chinook salmon and aquatic habitat availability. *Study A09 is estimating several potential effects on salmon, including Chinook, for the Draft Action. The final effects determination will be made when this study is complete.*

Take Analysis—*Study A09 is estimating the amount of redd dewatering that could potentially occur under the Draft Action. These results will be incorporated into this analysis when available.* Handling mortality associated with trap-and-haul operations is low, approximately 0.5 percent or less, and would likely continue to be low under the Draft Action (analyzed in sections 5.6.2.2 through 5.6.2.4). Actual numbers of fish stranded under current operations is not known, and cannot be estimated for the Draft Action.

Chinook EFH—Existing Project operations cause some dewatering of redds and salmon spawning habitat in the Middle Skagit River. This would continue under the Draft Action, however, to an unknown extent. *Study A09 will determine if the Draft Action would increase or decrease Chinook salmon spawning habitat in the Skagit River compared to existing conditions. Study A09 will also address effects on rearing habitat in the Lower Baker and Skagit rivers. Results from Study A09 will be incorporated into this analysis when available.*

Bull Trout

Direct Effects—As described in section 5.6.2.1, current operations and the Draft Action would have the potential to dewater some of the potential bull trout spawning habitat at tributary deltas in Baker lake and possibly Lake Shannon. In addition, flow fluctuations in the Lower Baker and Skagit rivers under existing conditions and Draft Action have the potential to strand bull trout; however, estimates of stranding are not available. Low numbers of adult bull trout are captured at the Lower Baker adult fish trap each year (see section 5.6.1). As described in section 5.6.2.2, some adult mortality associated with fish handling is possible; however, handling mortality is low. Some handling mortality would also occur under the Draft Action. Juvenile bull trout are captured in the downstream migrant traps and some degree of handling morality also likely occurs, but is thought to be minimal under existing conditions and the Draft Action.

Connectivity between Baker Lake and Lake Shannon for migratory fish does not currently exist. Therefore, if migratory bull trout pass over Upper Baker dam, they would not be able to return to Baker Lake tributaries to spawn. However, the need for connectivity is not known at this time, but would be evaluated and addressed as part of the Draft Action (see section 5.6.2.3).

Migratory bull trout caught at the Lower Baker River upstream migrant fish trap are passed upstream to Baker Lake under current operations (see section 5.8.1). However, it is not known if these fish intend to migrate to Baker Lake or are merely caught in the trap and are from another spawning population. This may be a beneficial effect for Baker Lake bull trout by potentially increasing genetic interactions with other Skagit River basin populations; however, other stocks would lose interactions with these spawners. Bull trout passage protocols for the

Lower Baker River upstream migrant fish trap are not defined under the Draft Action, and, therefore, cannot be evaluated.

Indirect Effects—No indirect effects are known or suspected to occur under existing conditions or under the Draft Action.

Cumulative Effects—These effects would be the same as listed in section 5.6.3. The primary cumulative effects under existing conditions are caused by the operation of the Baker and Skagit projects that combine to cause potential cumulate flow effects, which result in fish stranding and reduced aquatic habitat. This cumulative effect would continue under the Draft Action to a certain degree as ramping would also occur. The degree to which cumulative flow effects affect bull trout is not known.

Conservation Measures—Under existing conditions, conservation measures include voluntary ramping restrictions and flow releases (analyzed in section 5.6.2.1) to protect fish spawning and stranding.

The Draft Action includes mandatory ramping restriction and flow releases (analyzed in section 5.6.2.1) and improved fish passage facilities (analyzed in sections 5.6.2.2 through 5.6.2.4). A new turbine to facilitate instream flow and ramping restrictions would be installed. LWD would also be stockpiled for potential habitat enhancement use under the Draft Action (analyzed in section 5.6.2.5). Connectivity needs for bull trout between Baker Lake and Lake Shannon would be evaluated and addressed under the Draft Action (see section 5.6.2.3). See appendix B for the full text of these measures.

Effect Determination—Under the Draft Action, dewatering of potential bull trout spawning habitat at tributary deltas in Baker Lake and Lake Shannon, stranding in the Lower Baker and Skagit rivers, and handling mortality are unavoidable adverse effects. *Study A09 is estimating several potential effects on salmon in the Middle Skagit River for the Draft Action, some of which would apply to bull trout. In addition, Study R-A38, Bull Trout Population Assessment and Risk Analysis, is in the implementation process. The final effects determination will be made once studies A09 and R-A38 are complete*.

Take Analysis—Handling mortality is low, approximately 0.5 percent or less, and would likely continue to be low under the Draft Action (analyzed in sections 5.6.2.2 through 5.6.2.4). Actual numbers of fish stranded under current operations is not known, and cannot be estimated for the Draft Action. Bull trout redd dewatering appears to be minimal; only one bull trout was observed holding near a redd in the fluctuation zone of Baker Lake in 2001 (FWS, 2001).

Coho Salmon EFH

As listed for Chinook, the Project causes some dewatering of redds and salmon spawning habitat in the Middle Skagit River under existing conditions. This would continue under the Draft Action, however, to an unknown extent. *Study A09 will determine if the Draft Action would increase or decrease coho salmon spawning habitat in the Skagit River compared with* *existing conditions. Study A09 will also address effects on rearing habitat in the Lower Baker and Skagit rivers. Results from Study A09 will be incorporated into this analysis when available.*

Pink Salmon EFH

As listed for Chinook and coho, the Project causes some dewatering of redds and salmon spawning habitat in the Middle Skagit River under existing conditions. This would continue under the Draft Action, however, to an unknown extent. *Study A09 will offer additional information on this subject, and results from the study will be incorporated when available. Rearing habitat effects are not applicable for pink salmon since they migrate to the marine environment directly after fry emergence. Results from Study A09 will be incorporated into this analysis when available.*

5.8.2.2 Wildlife Species

The action area for the analysis of potential effects on wildlife species is the Baker River basin. The Draft Action includes interdependent and interrelated actions expected to occur. Evaluation of cumulative effects of future state, private, and local activities that are reasonably certain to occur in the basin is based on the following assumptions:

- National Forest System and National Park lands surrounding Baker Lake would be managed under current regulations and policies during the term of any new license issued (30 to 50 years). Lands would remain in LSRs and other land-use designations restrictive of commercial timber harvest. No net increase in density of open roads would be expected to occur.

- Private and state commercial timber lands surrounding Lake Shannon would remain in timber production during the term of any new license issued. No significant increase in density of open roads would be expected, as most of these lands are in second- or third-growth stands in roaded areas. There would be potential in the long term for conversion of private forestry lands to rural residential development along the west side of Lake Shannon. However, the lands are currently designated for forestry and mineral resource land uses in the Skagit County comprehensive plan. Much of the area is in unstable soil types on moderate-to-steep slopes. For these reasons, conversion to residential sites would not be considered reasonably certain to occur during the next license period.

- Regional and local population growth would be expected to increase the use levels of recreational sites during the term of any new license issued. Skagit County's population would be expected to increase by 52 percent, Whatcom County by 39 percent, and Washington State by 32 percent by the year 2020 (WOFM, 2001, as cited in Puget, 2002c).

Oregon Spotted Frog (Candidate)

We present the direct, indirect, and cumulative effects that would be expected to occur under the Draft Action in the following subsections. Conservation measures and the overall effects determination are also described.

Direct and Indirect Effects—No direct effects are expected to occur on the Oregon spotted frog as a result of implementation of the Draft Action. The Oregon spotted frog has not been documented in the Baker River basin since 1930 and is not suspected to occur. The Draft Action includes several measures intended to increase the quantity and quality of pond-breeding amphibian habitat in the Project area and the basin (see *Conservation Measures* below). Over time, these measures could improve the quality and quantity of potential habitat for the Oregon spotted frog and could benefit the species if present, or reintroduced, in the basin.

Cumulative Effects—The Draft Action includes measures to improve the quantity and quality of pond-breeding amphibian habitat and would offset some of the cumulative loss of amphibian breeding habitat in the basin. These measures could benefit potential habitat for the Oregon spotted frog. Recreational use of the basin would likely increase over time; however, a natural resources constraints process used to site new recreational developments would locate developed and dispersed recreation sites away from wetland habitats (Puget, 2003t). During the term of the new license, land use regulations are expected to remain protective of wetland habitats. No adverse effects on the potential habitat for Oregon spotted frog are expected to occur.

Conservation Measures—The Draft Action includes a number of measures that would enhance the quantity and quality of amphibian breeding habitat. A habitat management program (PME 1.1.1) would provide 128 acres of wetland habitats, which could support amphibians. Three acres of habitat for pond-breeding amphibians would be enhanced or created in the basin under PME 1.2.4. A reservoir level management and operations plan (PME 6.3) would protect known amphibian breeding habitats in the upper reservoir drawdown zones from reservoir fluctuations during the late winter and spring. These measures would improve conditions for breeding amphibians and could benefit the Oregon spotted frog if present, or reintroduced, to the basin. Refer to appendix B for the full text of these measures

Determination of Effect—Implementation of the Draft Action would not affect individuals or populations of Oregon spotted frog.

Bald Eagle

We present the direct, indirect, and cumulative effects that would be expected to occur under the Draft Action in the following subsections. Conservation measures and the overall effects determination are also described.

Direct Effects—The Draft Action includes a measure for modifying the Lower Baker powerhouse (refer to section 3.2.1 for a description of the modifications and to section 5.7.2 for a description of effects on terrestrial resources). Construction of the access bridge and reconstruction of the powerhouse structure would require clearing of up to 1 acre of young deciduous riparian forest dominated by alder. The construction activity would not be located near bald eagle nest sites and would not remove large overstory perch trees. Bald eagles have not been observed perching in trees at the powerhouse site, but they are known to use large perch trees on the right bank of the river opposite the powerhouse and to forage in the powerhouse reach of the river (personal communication A. Fuchs, Staff Biologist, Puget, Bellevue, WA, and

K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, July 23, 2003). Construction activity could temporarily displace bald eagles from foraging and perching habitat in the Lower Baker powerhouse vicinity. Because the displacement would be temporary and would affect a very localized portion of the available foraging and perching habitat in the basin, it would not likely adversely affect individuals or populations of bald eagles.

The Draft Action includes several measures for improving recreational facilities and sites near the Project reservoirs (PMEs 2.2.1, 2.2.2, 2.4.1, 2.5.1, 2.5.3, 2.5.4, and 2.5.5). Improvements to dispersed recreation sites include a specific measure to evaluate and manage effects on natural resources (PME 2.2.2). One area under consideration for trail development on the west side of Baker Lake is near a bald eagle nest site. Baker Lake Resort, which is proposed for redevelopment, is also near a bald eagle nest site. Specific plans for trail and resort development would be prepared under federal and state guidelines for protection management of bald eagles (FWS, 1986; Watson and Rodrick, 2002). Under these guidelines, nesting bald eagles would be protected from disturbance. Foraging and perching eagles may be subject to short-term disturbance from noise and human activity.

The Draft Action includes measures that would continue to supplement fish resources in the Project reservoirs (see *Conservation Measures* below) and would formalize requirements for several voluntary fish production activities. Measures to increase production of sockeye and Chinook and increase efficiency of downstream juvenile passage also are proposed. These measures are expected to maintain or increase current levels of fish in the Project reservoirs, which provide forage for bald eagles. Refer to appendix B for the full text of these measures.

Indirect Effects—Over time, increased recreational use of Project reservoirs and associated recreation sites may lead to increased levels of human disturbance of bald eagle nest sites. The Draft Action includes a specific measure to assist landowners in developing bald eagle nest site management plans that would protect nest sites from human disturbance during the term of the new license (see *Conservation Measures* below). An access management plan would also be developed to protect natural resources through management of recreational access.

Cumulative Effects—Bald eagle use of the Baker River basin is limited to the Project reservoirs and nearby forested habitats. The Baker River Project supports an average of two pairs of breeding bald eagles by providing two year-round water bodies with suitable food resources and adjacent nesting sites. Wintering bald eagles use the Project reservoirs in small to moderate numbers. Historical breeding and winter use data are not available for comparison with current use levels.

Future use of the basin would not likely modify bald eagle habitat or prey base. Lands surrounding Baker Lake would continue to be managed in the future for late successional and old-growth forest values. This management would protect forested habitats, perch trees, and fisheries resources. Lands surrounding Lake Shannon would continue to be managed for timber production; shoreline areas and streams would continue to be protected under state regulations. As discussed above, recreational pressure would likely increase in the future; however, future recreational development would be managed under specific Project measures.

Conservation Measures—Puget would provide support to landowners in the development of bald eagle nest site management plans under PME 1.3.4. The plans would be designed to protect nest sites from human disturbance during the sensitive nesting period per federal and state management guidelines (FWS, 1986; Watson and Rodrick, 2002). Dispersed recreational areas would be managed for protection of natural resources under PME 2.2.2. Continued supplementation of coho and steelhead, continued stocking of Depression Lake with rainbow trout, increased sockeye production, and a pilot Chinook production program would be provided under PME 3.2.2. These measures would maintain or increase the fish prey base for bald eagles within Project reservoirs. Downstream passage facilities would be provided for migratory fish, potentially increasing adult returns, under PME 3.2.3. An access management plan to protect natural resources from human disturbance associated with recreational use of the basin would be provided under PME 6.4. Refer to appendix B for the full text of these measures.

Determination of Effect—Implementation of the Draft Action may benefit bald eagles by increasing protection of existing nest sites and increasing production of fish prey base. Short-term, temporary noise and human disturbance of bald eagle foraging and perching habitats could occur during construction of the Lower Baker powerhouse and recreational facilities. During the term of any new license issued, increased recreational use would lead to increases in human activity at reservoirs and other recreational sites. These activities would be conducted under federal and state guidelines for protecting bald eagles. Conservation measures would be implemented to protect bald eagle nest sites from disturbance and manage human activity. The Draft Action may affect, but would not likely adversely affect, individuals or populations of bald eagles.

Marbled Murrelet

We present the direct, indirect, and cumulative effects that would be expected to occur under the Draft Action in the following subsections. Conservation measures and the overall effects determination are also described.

Direct Effects—Ten "occupancy" sites have been documented in the Baker River basin (WDFW, 2003b); the majority of these were recorded in the early 1990s and have not been resurveyed since that time. Two of the occupancy sites are located within approximately 0.25 mile of the Project boundary along the southeastern shore of Baker Lake; the remaining eight sites are greater than 1 mile from the Project boundary. The current status of murrelets in the basin is unknown. Critical habitat for the murrelet has been designated in the basin, coincident with the USFS LSRs.

Under the Draft Action, direct effects on marbled murrelets and their nest sites are not expected to occur. No actions have been proposed that would require removal or modification of nest trees or other trees in the vicinity of documented nest sites.

Reservoir operations and Project releases would not directly affect marbled murrelets. Murrelets feed in marine waters and do not use fresh water systems. Reservoir operations could influence murrelet critical habitat adjacent to the Baker Lake reservoir if mature trees are lost through individual mortality or erosion of the shoreline. However, vegetation surrounding the reservoir has likely reached a relatively stable equilibrium, based on almost 50 years of exposure to reservoir fluctuations. The proposed operating scenario would not likely result in substantive changes in vegetation characteristics relative to the current conditions. Thus, no significant effects on murrelet critical habitat would likely occur as a result of reservoir operations.

Modification of the Lower Baker powerhouse would not affect marbled murrelet critical habitat, because the lands surrounding Lake Shannon and the Lower Baker River are not located within the critical habitat designation. Up to 1 acre of young seral stage deciduous forest would be cleared for powerhouse construction (refer to section 5.7.2). Suitable nesting habitat for marbled murrelet consists of mature and old-growth coniferous forest (FWS, 1997); the vegetation that would be cleared at the Lower Baker powerhouse site is not suitable nesting habitat for marbled murrelet.

Under the Draft Action, several recreational sites would be upgraded and/or expanded, and a number of new trails would be developed (refer to appendix B for detailed descriptions of PMEs 2.2.1, 2.2.2, 2.4.1, 2.5.1, 2.5.3, 2.5.4, and 2.5.5). Based on information available at this time, none of the proposed recreational improvements would directly affect marbled murrelets or previously documented nest sites. A constraint evaluation process would be used for siting new recreational facilities and sites, including trails. Improvements to dispersed recreational sites include a specific measure to evaluate and manage effects on natural resources (PME 2.2.2); this measure would apply to the management of effects on murrelet critical habitat. Effects on critical habitat would include clearing of shrub and understory trees within already fragmented habitats surrounding Baker Lake. This activity would not likely affect vegetation characteristics of large diameter trees that provide suitable nesting habitat within designated critical habitat.

Indirect Effects—Indirect effects of Project-related human use would continue to occur in the basin under the Draft Action and would increase gradually over time. The extent to which human use currently affects murrelet nesting success is unknown. Murrelets nest high in the canopy and are reported to be not easily disrupted from nesting activity unless confronted at or near the nest (Long and Ralph, 1998). However, human activity near nest sites could increase the risk of predation of murrelets by ravens and Steller's jays (Marzluff et al., 2000, as cited in Puget, 2003j). Project-related human use would be managed through an access management plan (PME 6.4). Dispersed recreational sites would be managed using a specific measure to evaluate and control effects on natural resources (PME 2.2.2). Constraint evaluation would be used to site new recreational developments, such as trails. Based on information available at this time, recreational site improvements are not proposed for areas near previously documented murrelet nest sites. No significant effects on murrelets, murrelet nest sites, or critical habitat are expected to occur.

Cumulative Effects—Land uses in the Baker River basin are expected to remain the same during the term of the new license. Lands surrounding Baker Lake would continue to be managed for late successional and old-growth forest habitat, and commercial timberlands surrounding Lake Shannon are expected to remain under timber management. Road densities are expected to remain at or near current levels, due to current and proposed wildlife management measures. Recreation and human activity in the basin would likely increase gradually during the term of the new license. Project-related human use would be managed through an access management plan (PME 6.4) and through constraint evaluation of proposed recreational sites. Future land uses would not likely contribute to cumulative adverse effects on marbled murrelets or their critical habitat.

Conservation Measures—Under the Draft Action, several measures would be implemented that would provide protection to marbled murrelets and their habitat. An access management plan (PME 6.4) would be implemented to manage the levels and locations of Project-related human access and disturbance. Constraint evaluation would be used to site new recreational developments, such as trails. These measures would be used to avoid and protect known murrelet nest sites and high-quality suitable nesting habitat. Dispersed recreational sites would be managed using a specific measure to evaluate and control effects on natural resources (PME 2.2.2); specifically, garbage and waste management would reduce attractiveness of recreational sites to corvids and other potential predators of marbled murrelets.

Determination of Effect—Based on information available at this time, the Draft Action would not be expected to have significant adverse effects on marbled murrelets or documented murrelet nest sites. No significant effects on murrelet critical habitat would likely occur; minor clearing of understory vegetation in already fragmented habitats would occur. The Draft Action may affect, but would not likely adversely affect, marbled murrelet critical habitat.

Northern Spotted Owl

We present the direct, indirect, and cumulative effects that would be expected to occur under the Draft Action in the following subsections. Conservation measures and the overall effects determination are also described.

Direct Effects—Eight site centers for northern spotted owl have been documented in the Baker River basin (WDFW, 2003b); the majority of these were recorded in the early 1990s and have not been resurveyed since that time. All of the site centers are located greater than 1 mile from the Project boundary. The current status of northern spotted owl in the basin is unknown. Critical habitat for the spotted owl has been designated in the basin.

Under the Draft Action, direct effects on northern spotted owls and their nest sites are not expected to occur. No actions have been proposed that would require removal or modification of nest trees or other trees in the vicinity of documented nest site centers.

Reservoir operations and Project releases would not directly affect spotted owls, as they are unlikely to use reservoir habitats. Reservoir operations could influence spotted owl critical habitat adjacent to Baker Lake if mature trees are lost through individual mortality or erosion of the shoreline. However, vegetation surrounding the reservoir has likely reached a relatively stable equilibrium, based on almost 50 years of exposure to reservoir fluctuations. The Draft Action operating scenario would not likely result in significant changes in vegetation characteristics relative to current conditions. Thus, no significant effects on spotted owl critical habitat would be expected to occur as a result of reservoir operations.

Modification of the Lower Baker powerhouse would not affect critical habitat for northern spotted owl, as the lands surrounding Lake Shannon and the Lower Baker River are not located within the critical habitat designation. Up to 1 acre of young seral stage deciduous forest would be cleared for powerhouse construction (refer to section 5.7.2). Suitable nesting habitat for spotted owl consists of mature and old-growth coniferous forest (FWS, 1992); the vegetation that would be cleared at the Lower Baker powerhouse site would not be suitable nesting, roosting, or foraging habitat for spotted owl.

Under the Draft Action, several recreational sites would be upgraded and/or expanded, and a number of new trails would be developed (refer to appendix B for detailed descriptions of PMEs 2.2.1, 2.2.2, 2.4.1, 2.5.1, 2.5.3, 2.5.4, and 2.5.5). Based on information available at this time, none of the proposed recreational improvements would directly affect spotted owls or previously documented nest sites. A constraint evaluation process would be used for siting of new recreational facilities and sites, including trails. Improvements to dispersed recreational sites include a specific measure to evaluate and manage effects on natural resources (PME 2.2.2); this measure would apply to the management of effects on spotted owl critical habitat around Baker Lake. Effects on critical habitat would include clearing of shrub and understory trees within already fragmented habitats surrounding Baker Lake. This activity would not likely significantly affect vegetation characteristics of large diameter trees that provide suitable nesting habitat within designated critical habitat.

Indirect Effects—Indirect effects of Project-related human use would continue to occur in the basin, and would increase over time under the Draft Action. As noted above, under the Draft Action, several recreational sites would be upgraded and/or expanded, and a number of new trails would be developed. The extent to which human use currently affects spotted owl nesting success is unknown. The Mexican subspecies of spotted owl was shown to flush as a result of disturbance by hikers; a buffer of 180 feet was effective at eliminating the owl's flushing response (Swarthout, 2001 as cited in Puget, 2003j). Project-related human use would be managed through an access management plan (PME 6.4). Dispersed recreational sites would be managed using a specific measure to evaluate and control effects on natural resources (PME 2.2.2). Constraint evaluation would be used to site new recreational developments, such as trails. Based on information available at this time, recreational site improvements are not proposed for areas near previously documented spotted owl nest sites. No significant effects to spotted owls or their habitat are expected to occur.

Cumulative Effects—During the new license period, lands surrounding Baker Lake would continue to be managed for late successional and old-growth forest habitat. Commercial timberlands surrounding Lake Shannon are expected to remain under timber management. Road densities would likely remain at or near current levels, due to current and proposed wildlife management measures. Recreation and human activity in the basin would likely increase gradually during the term of any new license issued. Project-related human use would be managed through an access management plan (PME 6.4) and through constraint evaluation of proposed recreational sites. Future land uses are not expected to contribute to significant adverse effects on spotted owls or their habitats.

Conservation Measures—Under the Draft Action, several measures would be implemented to protect spotted owls and spotted owl critical habitat. An access management plan (PME 6.4) would be implemented to manage the levels and locations of Project-related human access and disturbance. Constraint evaluation would be used to site new recreational developments, such as trails. These measures would be used to avoid and protect known spotted owl site centers and high quality suitable nesting habitat. Dispersed recreational sites would be managed using a specific measure to evaluate and control effects on natural resources (PME 2.2.2).

Determination of Effect—Based on information available at this time, the Draft Action would not likely have significant adverse effects on spotted owls or documented spotted owl site centers. No significant effects on critical habitat for northern spotted owl would likely occur; minor clearing of understory vegetation in fragmented habitats would occur. The Draft Action may affect, but would not likely adversely affect, spotted owl critical habitat.

Canada Lynx

We present the direct, indirect, and cumulative effects that would be expected to occur under the Draft Action in the following subsections. Conservation measures and the overall effects determination are also described.

Direct and Indirect Effects—Canada lynx and its habitat are not present in the Baker River basin. No direct or indirect effects on lynx or lynx habitat would occur under the Draft Action.

Cumulative Effects—The Project has not contributed, nor would it contribute in the future, to cumulative effects on lynx or their habitats. Other actions expected to occur within the basin would not affect lynx, due to the lack of habitat.

Conservation Measures—No conservation measures are proposed for the protection of Canada lynx.

Determination of Effect—Implementation of the Draft Action would not adversely affect Canada lynx individuals or populations or their habitat.

Gray Wolf

We present the direct, indirect, and cumulative effects that would be expected to occur under the Draft Action in the following subsections. Conservation measures and the overall effects determination are also described.

Direct Effects—The Draft Action would not likely adversely affect gray wolves due to their infrequent occurrence in the Baker River basin. A small population of wolves in the North Cascades to the east of the Baker River basin may be the source of occasional transient wolves that travel to the Baker River basin. No permanent population in the basin is known or suspected.

Indirect Effects—The Baker River Project could potentially influence the distribution of deer and elk in the basin; these species are primary food items for gray wolf. Human disturbance of ungulates could occur as a result of Project operation and maintenance activities and Project-related recreational activity. This disturbance could cause displacement of deer and elk from the sites of human activity. The Draft Action includes a proposal to manage human access (PME 6.4) for protection of natural resources. In addition, a constraint evaluation process would be used for siting of new recreational facilities and sites, including trails. Under these measures, known high value and/or sensitive sites for deer and elk could be identified and protected from new and ongoing recreational disturbance.

The Draft Action also includes a proposal to acquire and manage 575 acres of elk forage habitat during the term of any new license issued (PME 1.2.1). Implementation of this measure would provide a reliable source of elk forage, appropriately distributed with respect to cover habitat and seasonal ranges, over the new license period. The action would contribute to the establishment of a sustainable elk herd in the region. Indirectly, this action could positively influence wolves by providing a stable food source in the Baker River basin (refer to section 5.7.2 for the evaluation of the effects of this measure).

Cumulative Effects—Future use of the Baker River basin would not likely reduce habitat suitability for wolves. Lands surrounding Baker Lake would continue to be managed for late successional and old-growth forests. Lands surrounding Lake Shannon would continue to be managed for timber production. Road densities are not expected to increase due to current and proposed wildlife management objectives. These lands would continue to support deer and elk which are primary wolf prey species. Potential improvements in the abundance and stability of elk populations could occur through implementation of elk forage habitat management on 575 acres in the basin (PME 1.2.1).

Conservation Measures—No conservation measures for the protection of gray wolves are proposed under the Draft Action. Measures to reduce disturbance and increase suitable forage habitat for wolf prey species are proposed under the Draft Action.

Determination of Effect—Implementation of the Draft Action would not likely adversely affect gray wolves in the Baker River basin. Existing and proposed management measures to control human access and disturbance would be implemented in the future. Populations of elk, a primary prey species for wolf, would be maintained or enhanced as a result of forage habitat enhancement to be performed for the term of the license.

Grizzly Bear

We present the direct, indirect, and cumulative effects that would be expected to occur under the Draft Action in the following subsections. Conservation measures and the overall effects determination are also described.

Direct Effects—The Draft Action would not likely directly affect grizzly bears due to their infrequent occurrence in the Baker River basin. Only two grizzly bear sightings have been documented over the past 15 years; both of these were greater than 4 miles from the Project and were likely transient bears.

Indirect Effects—Potential foraging habitat for grizzly bears could be affected by Project-related human activity. The Draft Action includes a measure to manage human access (PME 6.4) for protection of natural resources. In addition, a constraint evaluation process would be used for siting of new recreational facilities and sites, including trails. Under these measures, potential grizzly bear spring forage habitats or other high value sites could be identified and protected from new and ongoing recreational disturbance. The Draft Action also includes a measure to acquire and manage 244 acres of grizzly bear spring foraging habitat (PME 1.2.2; see *Conservation Measures* below).

Cumulative Effects—Future land uses in the Baker River basin are expected to remain consistent with current land uses. Lands surrounding Baker Lake would continue to be managed for late successional and old-growth forest habitat. Commercial timberlands surrounding Lake Shannon are expected to remain under timber management during the term of any new license issued. Road densities are expected to remain at or near current levels, due to current and proposed wildlife management measures. Recreation and human activity in the basin would likely increase gradually during the term of any new license issued. Project-related human use would be managed through an access management plan (PME 6.4) and through constraint evaluation of proposed recreational sites. Future land uses would not be expected to contribute cumulatively to adverse effects on grizzly bears. Provision of grizzly bear spring forage habitat under PME 1.2.2 could contribute to establishment of a grizzly bear population in the basin.

Conservation Measures—Under the Draft Action, grizzly bear spring foraging habitat would be provided on 244 acres of land owned or controlled by Puget (PME 1.2.2; refer to appendix B for the full text of the measure). The spring foraging habitat would be located within the Baker BMU. The location of the habitat could change during the term of any new license issued, but at least 50 percent would remain available in the same location(s) for at least 10 consecutive years, or until the end of the new license term, whichever occurs first. Under this measure, core area spring foraging habitat would have no motorized or non-motorized high intensity use of roads or trails within 0.3 mile between April 1 and June 15. Roads and trails would be gated or otherwise blocked as necessary to ensure against human use during this period. The spring foraging habitat would be provided no later than 5 years after the first determination of grizzly bear occupancy in the Baker BMU; occupancy would be determined by the presence of an adult female grizzly bear (with or without cubs) during the spring or summer for two consecutive years. Once provided, the spring foraging habitat would remain available through the term of the new license.

Project-related human use on potential grizzly bear spring foraging habitats would be managed through an access management plan (PME 6.4) and through constraint evaluation of proposed recreational sites. A reservoir management plan (PME 6.3) would provide extended periods of drawdown during the spring and fall, allowing wildlife access to fluctuation zone vegetation. This vegetation could potentially provide forage for grizzly bears.

Determination of Effect—The Draft Action may affect, but would not likely adversely affect, grizzly bears. Implementation of measures to manage human access and activity would protect grizzly bear habitats from high levels of human disturbance. A specific proposal to provide grizzly bear core area spring foraging habitat, once grizzly bear occupancy is established, would provide secure foraging areas and contribute to establishment of a grizzly bear population in the basin.

5.8.3 Unavoidable Adverse Effects

Unavoidable adverse effects on ESA-listed and MSA-managed fish species are the same as listed previously under *Take Analysis* for Chinook salmon and bull trout and presented in section 5.6.4.

5.8.4 Summary of Effect Determinations

In this section, we summarize our effect determinations, first for fish species and then for wildlife species.

Table 5-30 lists ESA-listed and MSA-managed fish species evaluated, gives their listing status, and presents the final effects determination for evaluated species, critical habitat, and EFH. The following effects determinations are for the Draft Action. Table 5-31 provides similar information for wildlife species.

Table 5-30. Summary for ESA and MSA fish species effect determinations.

Species	ESA Status (Listing Unit)	Designated ESA Critical Habitat	MSA-Managed	Final ESA Effects Determination	Final EFH Effects Determination
Chinook salmon (*Oncorhynchus tshawytscha*)	Threatened (Puget Sound ESU)	No	Yes	*Final effects determinations will be made after the completion of Study A09.*	*Final effects determinations will be made after the completion of Study A09.*
Bull trout (*Salvelinus confluentus*)	Threatened (Coastal / Puget Sound DPS)	No	No	*Final effects determinations will be made after the completion of Study A09.*	NA
Coho salmon (*Oncorhynchus kisutch*)	Candidate (Puget Sound / Strait of Georgia ESU)	NA	Yes	NA	*Final effects determinations will be made after the completion of Study A09.*

Species	ESA Status (Listing Unit)	Designated ESA Critical Habitat	MSA-Managed	Final ESA Effects Determination	Final EFH Effects Determination
Pink salmon (*Oncorhynchus gorbuscha*)	No status	NA	Yes	NA	*Final effects determinations will be made after the completion of Study A09.*

Notes: DPS – discrete population segment
EFH – essential fish habitat
ESU – evolutionary significant unit
NA – not applicable

Table 5-31. Summary of effects determinations for wildlife species.

Species	ESA Status	Designated ESA Critical Habitat	Final ESA Effects Determination
Oregon spotted frog (*Rana pretiosa*)	Candidate	No	No effect
Bald eagle (*Haliaeetus leucocephalus*)	Threatened (proposed for delisting)	No	Not likely to adversely affect
Marbled murrelet (*Brachyramphus marmoratus*)	Threatened	Designated critical habitat in Baker Basin	Not likely to adversely affect
Northern spotted owl (*Strix occidentalis* spp. *caurina*)	Threatened	Designated critical habitat in Baker Basin	Not likely to adversely affect
Canada lynx (*Lynx canadensis*)	Threatened	No	Not likely to adversely affect
Gray wolf (*Canis lupus*)	Threatened	No	Not likely to adversely affect
Grizzly bear (*Ursus arctos*)	Threatened	No	Not likely to adversely affect

5.9 Cultural Resources

Cultural resources represent past human behavior across the landscape. We interpret cultural resources within regional time periods that span from the prehistoric era into recent times. These resources consist of single artifacts, habitation and activity sites, structures, assemblages of sites and structures, spiritual and traditional cultural places, and human remains. Federal regulations require that cultural resources be inventoried and evaluated within the APE established for the Project to determine which, if any, are historic properties. We define historic properties as sites, structures, buildings, districts, traditional places, or objects that are listed or are eligible for listing in the National Register. To be considered eligible for listing in the National Register, properties must be at least 50 years old and meet one or more of the following criteria: (A) be associated with events that may have a significant contribution to the broad patterns of our history; (B) be associated with the lives of persons significant in our past; (C) embody the distinctive characteristics of a type, period, or method of construction or that (1) represent the work of a master, (2) possess high artistic values, or (3) represent a significant and distinguishable entity whose components may lack individual distinction; and (D) have yielded or may be likely to yield information important in prehistory or history (36 CFR 64.4).

5.9.1 Affected Environment

5.9.1.1 Area of Potential Effect

We define the Baker River APE for archaeological and historic resources to include: (1) all the area within the Project boundary; (2) area of all Project facilities (including roads, stockpiles, and buildings) and formal camping facilities that lie within the Project boundary and extend out beyond it; (3) the fluctuation zone of both reservoirs, i.e., the area extending from the high-water line into the area exposed by drawdown; (4) a zone extending from the full pool mark (high-water line) to approximately 130 feet beyond the mark; (5) all dispersed recreational sites that lie within a 0.25-mile zone beyond the reservoir full pool mark; (6) the area within a 100-foot-wide transect along the length of the Baker Lake Trail; and (7) the area delineated by drawing 328-foot polygons around the recreational sites, then drawing a line extending from the outlying edges of the polygons up to the Baker Lake Trail. The Washington SHPO concurred with this definition of the APE (letter to J. Piper, Regulatory Technical Specialist, Puget, Bellevue, WA, from R.G. Whitlam, State Archaeologist, Washington Department of Archeology and Historic Preservation, Olympia, WA, dated February 4, 2003). For ethnographic study purposes, consideration of traditional cultural properties encompasses the entire Baker River watershed. However, the process of identification and documentation of eligible properties focuses on the lands within the APE developed for archaeological and historic resources.

5.9.1.2 Archaeological Resources

There are no archaeological or historic sites within the Project's APE currently listed on the National Register. Puget conducted an intensive archaeological survey of the Project's APE and identified six early Holocene sites and two historic period sites that may be eligible for listing in the National Register (Miss et al., 2003). The survey focused on the drawdown zone, the reservoir rim, and dispersed campsites. Probable areas were identified based on slope. High and moderate probability areas were examined in their entirety. All accessible areas on the rim and 100 percent of the area within the exposed drawdown zones were examined if they did not present a safety hazard.

The potentially eligible archaeological sites consist of lithic scatters dating from the early Holocene period (10,800–5000 Before Present). Five of the sites (45-WH-647, 45-WH-584, 45-WH-586, 45-WH-587, and 45-SK-252) occur within the drawdown zones of Baker Lake and Lake Shannon. The remaining site (45-WH-636) extends from slightly above the maximum Baker Lake pool elevation. Northwest Archaeological Associates recommends these sites as eligible for listing in the National Register under criterion D, because of their potential to contribute to our understanding of prehistoric technology and land use (Miss et al., 2003). All of these archaeological sites are subject to the ongoing effects of shoreline erosion. At publicly accessible locations, surface collecting also is an ongoing problem affecting site integrity.

During the period when surveys were conducted in 2001 and 2002–2003, the drawdowns varied from about elevation 386 feet msl (NAVD 88) to elevation 441 feet msl (NAVD 88) at Lake Shannon and from about elevation 689 feet msl (NAVD 88) to elevation 717 feet msl (NAVD 88) at Baker Lake. Operation of the reservoirs has the potential to reveal additional sites in areas not accessible during the surveys. On Lake Shannon, many terraces that may contain cultural material either were covered with silt or were under water during the surveys. Several locations where lithic flakes were found in the cutbank during the rim survey (45-WH-650, 45-WH-651, 45-W-652, and 45-WH-563) are not considered eligible. However, these locations are considered highly sensitive for future planning and will be monitored (Puget, 2003u).

The two historic period sites include a domestic debris scatter (45-WH-580 and 581) dating from the late nineteenth century and a homestead site (45-SK-253) dating from the late nineteenth to early twentieth century. These sites also are recommended as eligible under criterion D. At extremely low elevations (such as during drought conditions), the existing Project reservoirs, Baker Lake and Lake Shannon, may reveal additional historical sites. The original Baker Lake shoreline contained the original site of the Baker Lake Resort (1935 to about 1960), which was developed on the Ruuth Homestead (1891). Along the south shore of the lake was the USFS Baker Lake Ranger and Guard Station situated on the John Eagletrout homestead, from 1911 to 1932. Near Noisy Creek was the Baker Lake Fish Hatchery, from about 1896 to 1940. During the period 1937–1938, a Civilian Conservation Corps camp was located near the fish hatchery to rebuild it after a fire.

The Mike Morovitz Homestead was located to the west of Baker Lake outside of the APE. A USGS map of 1915 shows a “Ranger Cabin” located along the east side of the Baker River south of Anderson Creek, above the current Upper Baker dam. This was the USFS Baker River Ranger Station that preceded the Koma Kulshan Guard Station (listed in the National Register). The Baker River Railroad Bridge (1908–1925) crossed the river gorge just north of the current Lower Baker dam. General Land Office plats and other historical maps dating from 1881 to 1952 show a number of cabins along the river, in areas that were inundated by Lake Shannon and the current Baker Lake. The Baker River railroad bridge, which was located across the river near the current Lower Baker dam, was inundated by its reservoir.

Remnants of early industrial and agricultural development could be associated with these historical archaeological sites or might be found in other locations. Most prominent would be the remains of logging operations, such as railroad grades, trestle bridges, or debris from logging-campsites. This debris would likely consist of trash dumps; broken and discarded tools; pieces of old cable and rigging equipment; and sawdust piles. The potential for discovering the remains of permanent buildings in logging campsites is very low because most of the buildings—cook shacks, barracks, maintenance sheds—were moved from camp to camp. In addition, the debris from mining operations, tailings and the presence of old mineshafts could be found.

5.9.1.3 Historic Buildings and Structures

Two historic structures within the Project's APE currently are listed on the National Register: the Lower Baker River Hydroelectric Power Plant; and the Baker River bridge.

The Lower Baker River Hydroelectric Power Plant was listed on May 4, 1976, as part of a multiple property nomination for hydroelectric power plants in Washington State from 1890 to 1928. The property represents an example of medium-head hydroelectric technology from the 1920s and meets criterion C. The nomination form identifies the dam, intake, main pressure tunnel, circular forebay or surge chamber, branch tunnel, and penstocks, all constructed between 1925 to 1929, as contributing elements. The existing powerhouse and equipment, which in 1968 replaced the original powerhouse destroyed by an earth slide, are not contributing elements. The nomination form did not address auxiliary resources to the power plant, including company housing and maintenance and warehouse facilities.

The Baker River Bridge (1916) was listed on July 17, 1990, as part of a multiple property nomination for Historic Tunnels and Bridge of Washington State. The bridge is an example of a long-span reinforced concrete arch that was used in highway bridge construction (USFS, 2002a). The bridge is located about 0.5 mile upstream of the confluence of the Baker and Skagit rivers.

Puget conducted an intensive historic resource survey of the Project's APE and identified 17 structures and buildings that contribute to three potential historic districts associated with the hydroelectric development, fisheries management, and the cement industry (Emmons, 2003). The Lower Baker dam would be included on two potential historic districts.

Baker River Hydroelectric Facilities

Puget Sound Power & Light Company (Puget Power, now Puget Sound Energy) developed the Baker River's potential for hydroelectric power when it built the Lower Baker Development from 1924 to 1925. This was in response to increasing development of the Puget Sound region and the need to meet peak demands while offering effective service and low rates. An earth slide destroyed a large part of the power plant in 1965, which Puget reconstructed from 1967 to 1969 with a building designed to withstand future slides.

World War II encouraged the growth of defense industries in Puget Sound, resulting in an increase in population and the development of infrastructure in Bellingham, Everett, Seattle, and Tacoma. To accommodate the need for additional generating capacity, Puget Power decided during the early 1950s to install a new 64,000-kW unit in the existing Baker River powerhouse, while also constructing a second hydroelectric project on the upper river. This expansion reflected a region-wide trend in water resources development. Work on the Upper Baker Development began in 1956 and was completed in 1959.

The Upper Baker Development consists of a straight concrete gravity dam, an earth-filled saddle dam, a powerhouse containing two vertical shaft generators and turbines rated at 94,400 kW, fish-handling facilities, and the Baker Lake reservoir. The Upper Baker Development will not reach the 50-year-age normally needed for National Register evaluation until 2009. Except for the fish handling facilities, the Upper Baker Development is not considered eligible for listing in the National Register because the complex is less than 50 years old.

Seven structures associated with the Lower Baker Development would merit inclusion in a potential Lower Baker River Project Historic District (Emmons, 2003). This proposed historic district would encompass the Lower Baker River Hydroelectric Power Plant, as well as two superintendent houses located at 7208 and 7214 Baker Lake Highway, the Baker River Road garage, the club house at 46724 East Main Street, the operator's house at 46207 East Main Street, and the operator's garage. These properties all fall within the same period of significance, from 1925 to 1929, and are all associated with the construction of Lower Baker Development. The superintendent houses are recommended as eligible individually under criteria A and C as remarkable and intact examples of Craftsman design.

Baker Fisheries

Active management of the Baker River fisheries dates back to the late nineteenth century when the Washington State hatchery, located on Silver Creek along the south shore of Baker Lake, began propagating sockeye in 1896. The original facility included several buildings. Three years later, the U.S. Fish Commission (now FWS) assumed control of this important and valuable facility. Biological investigations conducted at this facility were part of a regional effort to protect fisheries valuable for commercial and sport harvests. The hatchery burned three times during the early twentieth century. The hatchery ceased sockeye production in 1933, due to poor adult escapement, and closed in 1937.

Concerns about the future of the anadromous fish in the Baker and Skagit rivers resulted in the requirement that fish passage facilities be constructed as part of the Lower Baker Development. We discuss fish passage facilities in section 5.6.1.4, *Existing Fish Facilities and Programs*.

Ten structures would contribute to a potential historic district comprised of the Baker Project fish handling facilities (Emmons, 2003). The period of significance for the Baker River Fisheries Historic District would extend from the construction of the fish barrier dam in 1925 to completion of Channel Creek Spawning Beach 2 in 1959. The contributing structures would include the Upper Baker dam with its associated fish barge, and pass through pipeline, the Lower Baker dam with its associated fish barrier dams (1925 and 1957), fish trap, the ski-jump spillway, and pass-through pipelines, and the Channel Creek spawning beaches. Taken together, these facilities document the process of experimentation in fish handling resulting in a unique and innovative system to conserve and improve the salmon fishery in the Pacific Northwest. HRA (2000) provides an extensive account of this "working laboratory." The fisheries system at the Baker River Project is recommended as eligible for listing in the National Register under criteria A and C for its significant association with both American conservation and engineering.

Portland-Superior Cement Company

Amasa Everett's discovery in 1891 of clay and limestone deposits north of present-day Concrete led to the rapid development of the towns of Baker and Cement City (which in 1909 merged to form the Town of Concrete). The Washington Portland Cement Company, located on the east bank of the Baker River, operated from 1905 until circa 1920, when it was purchased by its local competitor, Superior Portland Cement Company and abandoned. During its period of operation, the Washington Portland Cement Company plant included a rotary kiln room, kiln bins, a grinding room, a ball mill room, crushers, a rotary dryer room, and a clay storage area. Conveyors transported materials between buildings, and to and from auxiliary buildings and rail lines. A powerhouse and boiler room were located just north of the complex, and offices, boarding rooms, and bunkhouses were sited on the northwest and southeast edges of the property. Washington Portland Cement Company was designed to incorporate one of the most important features of twentieth century cement production—the ability to provide a continuous flow of concrete within a plant (Emmons, 2003).

Although many of the resources associated with cement production have been removed, surviving resources retain sufficient integrity to convey their historic significance (Emmons, 2003). These resources are recommended as eligible for listing in the National Register for their significant association with American industry and engineering (criteria A and C). The period of significance extends from 1905, when the plant was developed, until circa 1920, when it was purchased and dismantled by its competitor. Four contributing components include the cement silos, warehouse, and concrete storage bin, and garage. Together, these resources compose the major components necessary for early twentieth-century cement production, and their existence directly influenced the settlement and growth of the Town of Concrete.

5.9.1.4 Traditional Cultural Properties and Sacred Sites

Traditional Use of the Baker River Valley

Several Indian Tribal groups have used areas within the vicinity of the Project. The Upper Skagit Indian Tribe comprises bands that lived along the Skagit, Cascade, and Baker rivers and their tributaries. Since 1915, these bands have constituted a single tribe. The Sauk-Suiattle live to the southeast, and the aboriginal territory of the Nooksack borders the Upper Skagit to the north. The N'lakapamux, or Thompson Indians, of British Columbia include a small portion of the Upper Baker River within their territory. The Project is in the ethnohistoric territory of the Northern Lushootseed speaking Upper Skagit.

Before contact with Euro-Americans altered the aboriginal lifestyle, Indian settlement and land use in the vicinity of the Project was based on a seasonal round of resource harvest, with salmon fishing playing the most important role, followed by hunting and plant gathering. Groups maintained permanent winter villages along major rivers at the mouths of tributaries. Each village consisted of one or more large longhouses made from split-cedar planks and a number of associated smaller buildings. Although the villages were primarily occupied during the colder months of the year, family groupings visited them frequently throughout the year to bring preserved foods they had harvested, and many of the villages were never entirely deserted.

Villages were home to extended family groups and represented an economic, social and political kinship unit. During the spring, summer, and fall, smaller family groups traveled to various locations to join groups from other winter villages in fishing, root harvesting, hunting, berry picking, and other economic pursuits (Hollenbeck, 1987). These activities were carried out from temporary camps that may have been reused seasonally (Collins, 1973; Blukis and Hollenbeck, 1981).

The large winter villages were politically autonomous, although cultural, linguistic and kinship ties existed among them. The largest and socially dominant upriver village of the Skagit Peoples was the S.baliqw centered around the current Town of Concrete, including Baker River and natural Baker Lake and extending along the Skagit River (Bush and Green, 2003). The common practice of intermarriage and the cooperative use of resource gathering areas resulted in relationships among villages in separate drainages. Kinship and marriage conferred rights to share in resource harvest in other areas, resulting in frequent travel along streams and ridge tops, between river valleys and even across the Cascade Mountains (Hollenbeck, 1987).

The spiritual life of the Upper Skagit Indians, like that of other northern Puget Sound groups, centered around beliefs in guardian spirits, other kinds of spirit beings, souls, and omens. Shamans were specialists in these affairs; however, any individual could undertake a quest to obtain a guardian spirit. During these quests, an individual would travel upriver and into the mountains, often to a particular place, for a specific period (Blukis and Hollenbeck, 1981). Although religion and ritual permeated everyday life, the most important rituals were associated with birth, puberty, marriage, and death.

Several resources were important for rituals, including cedar trees, a variety of medicinal and utilitarian plants, and specific foods. Cedar was especially important because it provided materials for most ritual activities. In addition to the species of plant, the location where it was gathered was also considered to influence the efficacy of the ritual. Some areas with particular plants were considered to have religious importance (Blukis and Hollenbeck, 1981).

These types of religious beliefs and practices have seen a recent revival among modern Indian groups (Blukis and Hollenbeck, 1981). Such beliefs and practices were once bound to specific territories, based on kinship rights. Tribal ownership of land has decreased because groups have ceded land and moved to reservations. Modern practitioners of Northwest Tribal religions often emphasize the significance of areas that today remain relatively unaltered but accessible by elders. Thus, Tribal members often use areas outside their aboriginal territories. Because these areas are limited, members from more than one tribe may use them. Federally recognized tribes in the Baker River Project area include the Upper Skagit Indian Tribe, the Sauk-Suiattle Indian Tribe, the Swinomish Indian Tribal Community, and the Samish Tribe.

Traditional Cultural Properties

No traditional cultural properties listed or recommended as eligible for listing in the National Register have been identified in the Project area (Equinox, 2003). However, Puget conducted a series of meetings with the Upper Skagit Indian Tribe, the Swinomish Indian Tribal Community, and the Sauk-Suiattle Indian Tribe to provide information concerning the identification and management of cultural resources and technical support for the implementation of the Tribe's oral history projects. As part of this process a comprehensive cultural archive was collated and is being provided to each Tribe. This archive served as the basis for the development of an ethnographic overview of the Baker River basin that provides a conceptual framework for identifying and managing traditional cultural properties in the Project area (Bush and Green, 2003).

The ethnographic overview lists archaeological site types and potential traditional cultural property site types that would be expected to occur in the Project area. Archaeological site types include lithic scatters, cultural depressions, culturally modified trees, rock art, earthworks, petroforms, human remains, and burials. Potential traditional cultural property site types include gathering areas for functional, medicinal, and food plants; private knowledge areas for ceremonial and spiritual activities; fishing areas for salmon, steelhead, and other fish; hunting areas for bear, beaver, deer, elk, mountain goat, grouse, and waterfowl; villages; social gathering areas; encampments for travel; trails; and burial sites (Bush and Green, 2003).

The overview includes management area definitions for sensitive and critical areas associated with the archaeological and traditional cultural property site types. Sensitive areas *may* have eligible properties within them; *may* require additional data collection; *may* require mitigation for development in the area; would require consultation for development to proceed; *may* have higher planning and development costs; and are difficult, but not impossible, to trade or multiuse. Critical areas *have* eligible properties within them, *require* additional data collection, may require mitigation of development to proceed, require close consultation, *have* higher planning and development costs, and are areas perceived to be impossible to trade or multiuse (Bush and Green, 2003). Each Tribe will develop and maintain custody of maps showing the sensitive and criteria areas in relation to developments in the Project area.

5.9.2 Environmental Effects

5.9.2.1 Effects of Project Operations

Reservoir Level Management

Original Project construction directly affected sites and structures located in the area between Baker Lake's original elevation and the current normal full pool elevation. The Project's reservoirs inundated an undetermined number of sites associated both with the earliest inhabitants of the area and with the pre-1925 industrial development in the area. The enlarged Baker Lake also inundated the location of the original Baker Lake Lodge.

Operation of the Project entails the fluctuation of the Baker Lake and Lake Shannon water surface levels. The fluctuation of water surface level causes erosion at sites located in the fluctuation zone, especially along submerged terraces, and along the shoreline. The archaeology survey report provides a detailed discussion of the process and effects of erosion on the cultural material contained in archaeological sites in the reservoir drawdown zone (Miss et al., 2003).

Three measures of the Draft Action would affect reservoir elevations: (1) implementation of a new reservoir management regime (PME 6.3) that takes into account terrestrial, recreational, aquatic, and cultural resource needs; (2) maintenance of the current level of flood control at the Upper Baker Development (PME 5.1); and (3) restrictions on drawdowns of Lake Shannon below elevation 383.77 feet msl (NAVD 88) to enhance water quality.

Figures 5-8 through 5-12 in section 5.4.2.1 show that operating the Project under the Draft Action typically would result in an earlier drawdown and later refill of the Project reservoirs in comparison to existing conditions.

Effects Analysis

The potential for erosion along the shoreline and in the drawdown zone under the Draft Action is analyzed in section 5.3.2.1. The analysis is based, in part, on the assumption that maintaining reservoir water levels at elevations below the edge of most terraces with "high" erosion potential along their edges would increase the potential for erosion. These elevations are 710 feet msl (NAVD 88) for Baker Lake and 420 feet msl (NAVD 88) for Lake Shannon.

The analysis on the effect of the change in reservoir operations indicates that under the Draft Action Baker Lake would be within 3 feet of normal pool 18 percent less frequently than under existing conditions. Reducing the frequency of time that the reservoir is near full pool would reduce the potential for wave action along the shoreline, which would slow down the erosion occurring at archaeological sites along the shoreline. However, the frequency of times when the lake levels are below elevation 710 feet msl (NAVD 88) would be about the same as under existing conditions and the erosion potential within the drawdown zone of Baker Lake would remain about the same and no benefit would result to archaeological sites located in the drawdown zone.

At Lake Shannon, under the Draft Action the reservoir would be within 3 feet of the normal full pool about 50 percent of the time, or about the same as under the existing conditions. However, operating Lake Shannon to meet a higher target minimum water level would reduce the frequency of time that the reservoir is held below the edges of terraces with sites within the drawdown zone categorized for "high" erosion. Under the Draft Action, water levels below 420 feet (NAVD 88) would occur less than half as often as under the existing conditions. There would also be a reduction in the magnitude and frequency of daily water level fluctuations. We conclude that there would be a reduction in the potential for erosion within the drawdown zone at the upper end of Lake Shannon and in the vicinity of Bear Creek confluences. This analysis suggests that the change in the reservoir water level management would slow down the process of erosion of some terraces and protect any cultural material they may contain.

Figure 5-2 provides a duration analysis of modeled water elevations for Baker Lake and Lake Shannon.

Project Releases

The magnitude of instream flows and the rate at which these flows change could affect historic properties.

Under the Draft Action, Puget would release a year-round instream flow of 300 cfs downstream of the Project as measured at the Baker River at Concrete gage and restrict downramp rates to no more than 650 cfs per hour. An instream flow of 300 cfs represents an increase of 220 cfs over the current instream flow release of 80 cfs.

Effects Analysis

Archaeological surveys identified one site downstream of the Upper Baker Development and no sites downstream of the Lower Baker Development. The archaeological report concluded that the single site downstream of the Upper Baker Development would not be eligible for listing in the National Register. Therefore, the Draft Action measure to increase instream flows and restrict downramp rates would not affect recorded historic properties and would not be likely to affect culturally sensitive areas.

5.9.2.2 Ongoing Cultural Resource Needs

The Draft Action would require ongoing identification, evaluation, and protection of historic properties during the term of any license issued for the Project. These efforts would be coordinated with the Tribes and other stakeholders concerned about the management of historic properties affected by the Project.

The Draft Action provides two separate but coordinated vehicles for ongoing cultural resources management: (1) implementation of the HPMP (PME 4.1.1), and (2) funding for cultural resources management (PME 4.2.1).

Historic Properties Management Plan

The Draft Action would provide for the implementation of a HPMP to address all aspects of cultural resources management.

The HPMP would provide for: (1) individual management measures for each historic property, including specific protective and mitigation measures, guidelines for maintaining historic buildings and structures, and measures for avoiding effects on traditional cultural properties; (2) clearly defined policies and programs that provide for all aspects of cultural resource management including Project review and planning, Tribal co-ordination, assessment of new actions, a listing of excluded actions, measures to be undertaken in cases of emergency or accidental discovery of cultural material or human remains, procedures for curation of cultural material and samples; (3) provisions for protection of known sites including annual monitoring and sponsorship of law enforcement training and presence; (4) provisions for training and education for Puget personnel about the cultural heritage of the Project and for outreach to the public; and (5) provisions for implementation of the management measures, policies, programs, and provisions, including (a) schedules with priorities for site mitigation and protection and other recommended measures and provisions; (b) reporting to the Commission and other agencies; (c) composition of a Cultural Resources Advisory Group (CRAG); (d) creation of a Cultural Coordinator position within Puget; and (e) dispute resolution and conflict management. The CRAG members would serve as the point of contact for communication related to cultural resources among Puget, the agencies, and the Tribes. Refer to appendix B for the full description of the HPMP.

Effects Analysis

The HPMP contains all the essential components of a plan designed to manage the effects of Project operations and environmental measures on historic properties in the Project area. Recommendations of the completed archaeological and historic resource surveys are incorporated into the HPMP and provide the basis for site-specific management recommendations as well as ongoing identification, evaluation, and protection activities during the term of any license issued to the Project. A deliberate program of on-going monitoring of recorded sites and sensitive areas, as detailed in the HPMP, would enable Puget to take protective actions when warranted by site-specific conditions. Table 5-32 summarizes the threats and management recommendations for sites considered eligible.

Table 5-32. Management recommendations for prehistoric and historic sites located within the Project's APE and considered eligible for National Register listing.

Perm. No.	Temp. No.	Site Description	National Register Status	Threats	Management Recommendation
Baker Lake					
45-WH-	060501-				
636	00065	Lithic scatter	E	Erosion and proximity to recreational site; unauthorized artifact collection	Data recovery with emphasis on surface collection
585	00068	Ruuth Homestead, Old Baker Lake Resort	P		Complete evaluation when reservoir is drawn down near minimum pool
642	00074	Road, bridge, Debris scatter	P		Complete evaluation
588	00077	Lithic scatter	NE	Erosion	NA
580/581	00078	Camp 1880–1925	P		Complete evaluation
647	00081	Lithic scatter	E	Erosion	Data recovery with emphasis on surface collection
582	00094	Lithic scatter	NE	Erosion	NA
584	00096	Lithic scatter	E	Erosion	Data recovery with emphasis on surface collection
586	00097	Lithic scatter	E	Erosion and vandalism	Data recovery with emphasis on surface collection

Perm. No.	Temp. No.	Site Description	National Register Status	Threats	Management Recommendation
587	00099	Lithic scatter	E	Erosion	Data recovery with emphasis on surface collection
Lake Shannon					
45-SK					
250		Domestic debris scatter	P		Complete evaluation
252		Weston homestead - logging camp	E	Erosion	Data recovery with emphasis on surface collection
253		Edgar Homestead	E	Erosion; unauthorized artifact collection	Monitor for erosion and vandalism
290		Isolate, stove leg, ceramic fragment	P		Complete evaluation

Notes: Erosion – Reservoir induced erosion
E – Eligible for listing in the National Register
NE – Not eligible for Listing in the National Register
P – Presently unevaluated

The HPMP sets forth a clear and concise process for Puget staff to determine if activities are considered undertakings, if additional surveys are required, and what actions would be necessary to avoid any adverse effects to historic properties. A list of activities that would not need to be reviewed is appended to the HPMP. Implementation of the HPMP would provide a predictable and definitive process that would minimize or avoid unnecessary harm to historic properties within the Project's APE. A well-defined process for cultural resource review typically facilitates project planning.

The HPMP provides for ongoing consultation with the Tribes and the future completion of traditional cultural property surveys in conjunction with the Tribes. Although no recommended eligible traditional cultural properties have been identified in the Project area to date, the HPMP has placeholders for incorporating the finding of the on-going surveys. More important, the Tribes have been provided an archive and a framework within which to evaluate the effects of Project-related activities on traditional cultural properties within sensitive and critical areas. Implementation of the HPMP, in conjunction with Tribal consultation, should minimize or avoid unnecessary harm to properties of cultural or religious significance to the Tribes.

Cultural Resources Management Fund

Under the Draft Action, Puget along with parties to a licensing settlement agreement would form the BRCC. The BRCC membership would represent broader interests than the BRC and would deal with a broader range of interests, including cultural resources. The Draft Action would create a CRMF to provide a firm commitment and a resource pool, distinct from the funds necessary to implement the HPMP, to address the ongoing needs for research and enhancement of cultural resources during the term of any new license issued. The CRMF would provide funds to support activities and programs beyond the scope of the HPMP both within the Project area and within the broader Baker River basin. A cultural resources subcommittee of the BRCC, the CRAG, would administer the CRMF. The CRAG would communicate with the BRCC to provide cultural resources perspectives in cross resource discussions, to remain informed about actions that might affect historic properties, to review funding proposals, and to assist Puget in developing a public outreach program involving cultural resources.

Effects Analysis

The HPMP is primarily focused on compliance with Section 106 of the NHPA and the mandate to account for historic properties (eligible properties) in any undertakings involving federal funds, permits, or licenses. Establishment of a fund for cultural resources activities and programs would enable Puget to support private and governmental programs to enhance a range of culturally important properties that may be beyond the scope of the HPMP. Examples might include support of local history programs of the Concrete Heritage Museum Association that would serve to enhance properties of historic value in the Town of Concrete on parcels adjacent or nearby the Lower Baker River Project area. The ethnographic overview takes a basinwide perspective on native history and notes that many of the properties of cultural or religious significance to the Tribes lie outside the Project area, but may be affected by the Project (Bush and Green, 2003). Likewise, the history and fisheries programs of the Middle Skagit River have ties to the Baker River basin and coordination with history and interpretive programs in this area would enhance our understanding of the culture and history of the larger region.

5.9.2.3 Secondary Effects of Proposed Measures

Lower Baker Power Plant Modifications

The Lower Baker power plant modifications, if implemented, would include: (1) rehabilitation of the original power generating facilities that were destroyed during the 1965 landslide; (2) installation of a new turbine generator on an existing penstock within the concrete foundation of the original 1925 powerhouse located adjacent to and immediately north of the existing Lower Baker powerhouse; (3) construction of a new reinforced concrete powerhouse on the footprint of the abandoned powerhouse to enclose the new turbine generator, transformer, and associated equipment; and (4) construction of a new access bridge adjacent to the west side of the existing powerhouse foundation.

Modifications to the Lower Baker power plant could affect the characteristics of the Lower Baker Development that qualified the property for listing in the National Register. The replacement powerhouse and equipment (1968) are not contributing elements of the Lower

Baker River Hydroelectric Power Plant properties. The auxiliary structures to the power plant, including company housing, warehouses, and maintenance are considered eligible for inclusion in a Lower Baker Development Historic District as contributing elements. Design review of the new powerhouse and the access bridge would ensure that they do not detract from the architectural characteristics of the potential historic district. The HPMP provides clearly defined procedures to review measures that could affect historic properties. The powerhouse area has been disturbed several times and no intact archaeological sites would be expected to occur, nor did the archaeological survey identify any sites. Therefore, the measure would not be expected to affect archaeological sites.

Terrestrial Measures

Beneficial Vegetation in the Drawdown Zone—The Draft Action would identify and evaluate native plants for re-vegetation and/or altering the vegetation of portions of the reservoir fluctuation zones (PME 1.1.2). If any plantings are proven successful, then through the adaptive management component of the Draft Action, plantings could potentially be implemented in the future in selected sections of the fluctuation zones. Implementation of this measure could affect potential historic properties. Archaeological surveys have identified recommended eligible sites in the fluctuation zones. These surveys did not cover the entire fluctuation zone. Completion of surveys in the fluctuation zone could identify additional archaeological sites in the future. Additional sites could also be exposed as a result of effects of erosion along reservoir shorelines.

Plantings would involve ground-disturbance that could affect recommended eligible or as yet unrecorded archaeological sites. The HPMP provides a review procedure for project undertakings that have the potential to affect recommended eligible sites and culturally sensitive locations. Adherence to this procedure would direct the planting program away from areas of known sites or areas of high probability for the existence of cultural material. The review process would help to avoid any effects on potential historic properties that could result from the ground disturbance associated with experimental plantings in the fluctuation zones.

Breeding Habitat for Amphibians—The Draft Action would create pond-breeding habitat for amphibians, either by creating new wetlands or modifying existing wetland habitat (PME 1.2.4). The measure indicates that wetlands potentially could be created in the reservoir fluctuation zones. The fluctuation zones contain recommended eligible archaeological sites that could be affected by ground-disturbance associated with the creation of new wetlands. The HPMP provides a process for reviewing proposed actions to ensure that they do not inadvertently affect recommended eligible sites. Coordination with the HPMP during the site selection process would help to avoid recommended eligible and recorded archaeological sites, areas with high site sensitivity, and critical and sensitive areas for traditional cultural properties.

Nest Structures for Osprey at Lake Shannon—The Draft Action would provide safe nesting for up to 10 pairs of osprey (PME 1.3.1). The measure calls for the eventual conversion of nesting from the man-made platforms to natural platforms. To provide natural platforms, existing trees/snags along the shoreline would be modified. Some species of trees and some individual trees may be culturally significant to Tribal members. This measure has the potential to affect culturally sensitive and critical areas. Coordination with the Tribes and adherence to the HPMP procedures during the tree/snag selection process would help to avoid effects on traditional cultural properties in critical and sensitive areas.

Recreational Measures

Water Recreation Safety Program—The Draft Action would implement a water safety program that would include the provision of floating booms with "no-boating" signage around developed swimming areas (PME 2.1.1). This measure is not sufficiently defined to determine if the floating boom would involve anchors or whether large equipment might be needed to launch the floating booms. To the extent that this measure involves ground-disturbance either through anchorage, or the use of heavy equipment, or other ground-disturbing methods, it has the potential to disturb cultural materials that may exist in lands under the reservoir. Adherence to the terms of the HPMP would allow potential effects to potential historic properties to be considered during implementation of the water safety program.

Boating Hazard Management Plan—The Draft Action includes a boating hazard management plan to ensure boating safety on the Project reservoir (PME 2.1.2). Implementation of the plan could result in the removal of tree stumps in the reservoir drawdown zones. Archaeological surveys have identified recommended eligible archaeological sites in drawdown zones at both Baker Lake and Lake Shannon. Removal of tree stumps in the drawdown zones would involve ground disturbance and would be subject to review under the terms of the HPMP.

Dispersed Camping—The Draft Action would improve management of dispersed camping sites along Baker Lake including general maintenance, rehabilitation of highly used sites, and installation of new signage (PME 2.2.1). This measure would involve limited ground disturbance. Any ground-disturbing activities have the potential to affect potential historic properties. The HPMP provides a procedure to determine if an activity constitutes an undertaking, and if so, if surveys have been completed in the area of the undertaking or if surveys are necessary prior to the implementation of ground-disturbing activities. Adherence to these procedures would minimize the potential for inadvertent damage to potential historic properties.

The Draft Action would close access to and decommission disperse camping sites that are located in environmentally or culturally sensitive areas, have been disturbed, are located in difficult to manage areas, or are no longer needed to support demand for dispersed camping (PME 2.2.2). Closure of dispersed camping sites in culturally sensitive areas could reduce Project effects on potential traditional cultural properties of significance to the Tribes. The Tribes maintain maps that identify culturally sensitive and critical areas. Coordination with the Tribes in the identification and selection of the candidate sites for closure could enhance traditional cultural properties that might be affected by the ongoing use of those sites.

Developed Recreational Sites—The Draft Action would complete the construction of the Bayview Campground, improve access to Lake Shannon (including a perimeter trail), improve the Kulshan Campground, support the redevelopment of the Baker Lake Resort, and construct a wildlife observation facility (PMEs 2.5.1, 2.5.3, 2.5.4, 2.5.5, 2.5.6). All of these measures would involve ground-disturbance and would increase recreational use of the Project area. Ground disturbance could disturb the integrity of any archaeological sites that may occur in the vicinity of the developed recreation sites. Increased recreational use would likely result from the improvements to these facilities as well as creation of new trails and could affect potential traditional cultural properties. Increased recreational use also could attract visitors to upland areas that have not been surveyed for cultural resources. The HPMP provides a project review procedure that would determine early in the planning process if implementation of these measures would require additional surveys and how any effects to recorded properties in culturally sensitive areas could be avoided or minimized. Coordination with the Tribes could help Puget and the USFS to avoid or minimize the effects of upgrading developed recreational facilities on potential traditional cultural properties.

Trails and Trailheads—The Draft Action would develop a comprehensive trail development plan (PME 2.4.1). Implementation of the plan would include the creation of new trails and associated signage in locations identified in the Trail Routing Study. Creation of new trails and installation of signage could involve ground disturbance in culturally sensitive areas. The HPMP provides a procedure to determine if additional surveys might be required along new trail routes. Increased use of existing trails and installation of new trails also have the potential to affect culturally sensitive areas. Coordination with the Tribes in the development of the comprehensive trail plan could minimize any effects on potential traditional cultural properties.

Aesthetics Management Plan—The Draft Action would develop and implement an aesthetics management plan for all Project-related facilities (PME 2.3.1). The Lower Baker Hydroelectric Plant area and the Baker River fisheries facilities are considered eligible properties. Implementation of the plan would involve ground-disturbance as well as the introduction of new elements to the landscape surrounding the Project facilities. Landscape improvements that are consistent with aesthetic standards of the MBS National Forest Plan should enhance the Project area. However, some modifications to the landscape and installation of fences or other auxiliary structures could affect the characteristics that qualify these properties for listing in the National Register. The HPMP provides a procedure to review activities that have the potential to affect historic properties. Adherence to the terms of the HPMP would minimize the potential for this measure to affect historic properties.

Access Management

Under the Draft Action, Puget would lead the development and implementation of an access management program in cooperation with private, state, and federal landowners in the Baker River basin (PME 6.4). Increased access to the Project area could affect historic properties and traditional cultural properties through ground-disturbing activities and the introduction of additional audio and visual elements. The measure provides for management of access to protect and/or manage cultural and historic properties within or outside of the Project area.

The HPMP includes clearly defined policies and programs that provide for all aspects of cultural resource management including project review and planning, Tribal coordination, assessment of new actions, a listing of excluded actions, and measures to be undertaken in cases of emergency or accidental discovery of cultural material or human remains. Coordination of the development and implementation of the management access plan with the provisions of the HPMP would ensure that historic properties and traditional cultural properties are not inadvertently harmed through development in the Project area.

Aquatic Measures

Fish Propagation Programs—The Draft Action would continue the operation of Spawning Beach 4 and decommission Spawning Beaches 2 and 3 (PME 3.1.2). Continued operation of Spawning Beach 4 would entail modifications to provide each segment of the beach with its own water source. Modification to Beach 4 would involve ground-disturbance to install water systems. Ground-disturbance could alter the location of cultural materials and affect the integrity of any archaeological sites that could be in the area. Early coordination through the HPMP review procedure would help to avoid or minimize affects on potential historic properties.

Fish Passage Improvement—The Draft Action would provide improved upstream fish passage using trap, sort, and haul facilities located on the Baker River in the Town of Concrete and downstream fish passage using fish attraction barge technology, with trap and haul and acclimation ponds (PME 3.2.1, 3.2.2, and 3.2.3). Implementation of these measures would require extensive modification to the existing fish passage facilities. The existing fish passage facilities are considered eligible for listing in the National Register as contributing elements of a Baker River Fisheries District. Inappropriate modifications to these facilities could affect the characteristics that qualify them for eligibility. Modification made in conformance with the Secretary of Interior's Standards for Rehabilitation of Projects could avoid or minimize the potential effects. These Standards recognize that historic properties may be modified over time to meet the needs of new technologies. Adherence to the HPMP review procedure would take the historic characteristics of the fish passage facilities into account during the development of conceptual and final design for the upstream and downstream fish passage facilities.

5.9.3 Unavoidable Adverse Effects

The fluctuation of Project reservoirs would continue to cause erosion and adversely affect submerged archaeological sites located in the fluctuation zones of Baker Lake and Lake Shannon during the term of any new license issued for the Project. Increased recreational use could result in increased vandalism to archaeological sites through surface collection of artifacts.

5.10 Recreational Resources

5.10.1 Affected Environment

The Baker River basin is accessible to more than 6.5 million people in northern Puget Sound and southern British Columbia via an approximate 2-hour drive (100 miles). The area is easily accessed by a system of county and USFS system roads, a considerable amount of which are paved. The mountainous terrain, Project reservoirs, and water courses offer spring, summer, and fall recreational opportunities including developed and dispersed camping, shoreline and bank fishing, picnicking, swimming, hiking, boating, mountaineering, environmental education and interpretation, and scenic driving. In the winter, Puget plows the main road leading to Baker Lake, and winter activities, such as cross-country skiing and snowmobiling, occur near the Project.

5.10.1.1 Regional Recreational Setting

More than 50 percent of the land within the Baker River basin and all of the land surrounding Baker Lake is publicly owned (national park, national forest, state forests, state parks, state boat launches, and county parks). Figure 5-25 (appendix A) shows public lands surrounding the Project area including the MBSNF to the north, east, and south of Baker Lake; NCNP to the east of MBSNF; and WDNR and other Washington State Agency Lands interspersed throughout the lower watershed near Lake Shannon. Special designations within the MBSNF include the Mt. Baker and Noisy-Diobsud Wilderness areas, Mt. Baker National Recreation Area and the Skagit Wild and Scenic River. The Mt. Baker Wilderness Area comprises more than 117,500 acres surrounding Mt. Baker. The Noisy-Diobsud Wilderness Area, southeast of the Project area and adjacent to the NCNP, encompasses 14,133 acres. The Mt. Baker National Recreation Area comprises 8,473 acres on the south slope of Mt. Baker, within the MBSNF, and adjacent to the Mt. Baker Wilderness. The Skagit Wild and Scenic River is upstream of Sedro-Woolley and includes 99 scenic designation river miles and 58.5 recreation designation river miles. Special designations within the NCNP include the Stephan T. Mather Wilderness and adjacent Ross Lake and Lake Chelan National Recreation Areas. The Mather Wilderness, Ross Lake National Recreation Area, and the Lake Chelan National Recreation Area complex total more than 634,000 acres.

MBSNF, NCNP, WDFW, Washington State Parks and Recreation Commission (WSPRC), county parks, and private campgrounds provide developed recreational facilities near the Baker River Project. These sites provide access to the water via boat ramps and hiking and camping along the numerous lakes, streams, and rivers in the region. Eight boat ramps provide access to the Skagit River, six of which are maintained by WDFW and two by the WSPRC. Volger Lake boat launch (3 miles from the Town of Concrete) and Grandy Lake County Park (approximately 1 mile west of Volger Lake) provide two additional boat ramps in the region. Figure 5-26 shows the developed recreational sites within the Baker River Project vicinity.

Regional hiking opportunities include developed trials within the NCNP, MBSNF, and state and county parks. The NCNP maintains more than 386 miles of trails within the Stephan T. Mather Wilderness. The MBSNF maintains 22 developed trails covering more than 64 miles within the Baker River basin. Other hiking opportunities are available within nearby Rasar State Park (3.7 miles of trails) and Rockport State Park (5 miles of trails) and along the Skagit County-owned Cascade Trail. Rasar State Park is approximately 7 miles west of Concrete, while Rockport State Park is 6 miles east of Concrete. The Cascade Trail is a 23.5-mile gravel, maintained trail paralleling State Route 20 from Sedro-Woolley to Concrete and is open to hiking, biking, and equestrian uses.

Developed campsites in the region offer both forested and waterside opportunities and are provided by the NCNP, MBSNF, state parks, county parks, and private entities. The NCNP maintains more than 100 trailside camping sites as well as dispersed opportunities (away from maintained facilities and trails) typically used by backpackers and climbers. The MBSNF maintains 8 campgrounds in the Baker River basin, 6 of which are adjacent to Baker Lake and discussed in detail below. The other two USFS campgrounds (Park Creek and Boulder Creek campgrounds) are within 0.5 and 1.5 miles of Baker Lake, respectively. Developed camping facilities are also available at Rasar State Park, Rockport State Park, Grandy Lake County Park, Howard Millar Steelhead County Park, and the privately owned Creekside Campground and Lake Tyee Campground. In addition to the developed camping facilities, the USFS estimates there to be more than 380 dispersed camping sites within the MBSNF.

5.10.1.2 Facilities and Opportunities in the Project Area

The Baker River Project offers many opportunities for recreation, including bank and boat fishing, swimming, lakeside trails, vistas, camping, and environmental education and interpretation. Developed recreational facilities associated with the Project include boat launches, designated swimming areas, a scenic vista, trails, campgrounds, a visitor center and fish handling facility, a resort, and a lodge/retreat facility. Table 5-33 summarizes the developed facilities associated with the Baker River Project. Six boat launch facilities provide boating access to Project waters**.** Puget manages two sites with boat ramp facilities (Baker Lake Resort and West Pass dike) at Baker Lake and one at Lake Shannon. The USFS manages three facilities with boat ramps on Baker Lake, located at Shannon Creek, Panorama Point, and Horseshoe Cove campgrounds. The boat ramp at Lake Shannon offers access to the Project waters via a gravel boat ramp and has a parking area that Puget maintains. Additional water access is available at two designated swimming beaches at Baker Lake, at Horseshoe Cove Campground and the Baker Lake Resort. Most of the boating activity on the reservoirs is associated with fishing. Consequently, most boating activity can be characterized as low-speed boating. Additionally, there is more boating use at Baker Lake than at Lake Shannon.

In addition to the boat ramps and beach access points associated with Baker Lake, Puget provides the Glover Mountain overlook site with a view of Baker Lake, the Upper Baker dam, and the surrounding national forest. The site has a 0.3-mile trail connecting the view platform to a gravel parking lot. Puget also operates the visitor center and fish handling facility, a developed facility associated with the Project near Lake Shannon. The visitor center and fish handling facility provide restrooms, interpretative displays, and a parking area just below the Lower Baker dam in the Town of Concrete.

The USFS maintains the 16-mile Baker Lake Trail along the east shore of Baker Lake and the 2.3 mile Baker River Trail located upstream of Baker Lake as the only developed hiking trails adjacent to the Project boundary. Nearby trails upland from Baker Lake include the MBSNF Shadow of the Sentinels Trail (less than 2 miles from Baker Lake) and several trails accessed from the Schreibers Meadow Trailhead (14 miles, by road, from Baker Lake). MBSNF records indicate that these trails are used by overnight campers staying at campgrounds within the Project area (USFS, 2002a).

Table 5-33 Summary of developed recreational facilities associated with Baker River Project. (Source: Puget, 2002c and USFS, 2002a, as modified by staff)

Facility Name	Operator	Type of Use	Number of Campsites/ Rooms	Additional Facilities
Panorama Point Campground	USFS	Overnight	16	2 day use sites, boat launch
Horseshoe Cove Campground	USFS	Overnight	35	7 day use sites, boat launch, swimming
Shannon Creek Campground	USFS	Overnight	20	2 day use sites, boat launch
Boulder Creek Campground[a]	USFS	Overnight	10	1 mile away from Baker Lake, group camp, restrooms
Park Creek Campground[a]	USFS	Overnight	12	0.5 mile away from Baker Lake, restrooms
Maple Grove Campground	USFS	Overnight	5	Hike or boat in only on east shore of Baker Lake
Bay View Campground	USFS	Overnight	8	Reservation-only/group campground with vault restrooms
Shadow of Sentinels[a]	USFS	Day use	NA	Approximately 1mile from Baker Lake, interpretative trail, restrooms, paved parking
Baker River Trailhead	USFS	Trailhead	NA	Gravel-surfaced parking area and vault restrooms
Schreibers Meadow[a]	USFS	Trailhead	NA	Approximately 14 miles from Baker Lake, trail, camping and picnicking allowed
Kulshan Campground	Puget	Overnight	116	75 recreational vehicle (RV) hookups, restrooms, picnic area, informational exhibit
Baker Lake Resort	Puget	Overnight	90	Day use site, boat launch, 11 cabins, group sites, store, swimming
Baker Lake Lodge	Puget	Overnight	9 rooms	2 cabins, tennis, volleyball, basketball courts
Glover Mountain	Puget	Day use	NA	Overlook with fenced viewing area of Upper Baker dam, 0.3-mile trail, parking

Facility Name	Operator	Type of Use	Number of Campsites/ Rooms	Additional Facilities
West Pass dike	Puget	Day use	NA	1 paved boat launch
Visitor center and fish handling facility	Puget	Day use	NA	0.2-acre paved parking area with restrooms, informational exhibits, and outdoor interpretive displays
Lake Shannon boat launch	Puget	Day and overnight use	Approximately 30	Boat launch and unpaved parking area used for dispersed day and overnight use

Note: NA – Not available
[a] Outside Project boundary.

The Project reservoirs offer developed lakeside camping and swimming facilities. The USFS and Puget operate eight developed campgrounds with 296 campsites in the Project vicinity; five of these campgrounds offer lakeside campsites. Puget operates the Kulshan Campground, which is approximately 1,000 feet back from the Baker Lake shoreline, and the USFS offers two campgrounds with forested camping: Park Creek Campground and Boulder Creek Campground, both less than 1.5 miles from Baker Lake. Facilities at Kulshan Campground include 116 campsites with approximately 75 water and sewer RV hookups on the south shore of Baker Lake near the Upper Baker dam. The USFS's Bay View Campground is not recognized as a developed facility because completion of this facility was postponed midway through construction. The USFS's Bayview Campground was improved in 2001 and opened as a reservation-only/group site. It has been operated in this capacity since then during the recreational season. It is operated by Recreation Resource Management (RRM), a USFS concessionaire. The site has vault restrooms and loop roads with two defined group camping areas. The USFS Maple Grove site, located on the east shore of Baker Lake, contains five developed campsites and is only accessible via hiking or boating. The Baker Lake Resort, about 6 miles north of Upper Baker dam and operated by Puget, has 90 campsites. There are also 10 dispersed sites at the Lake Shannon boat launch and 203 dispersed sites near Baker Lake that were inventoried as part of the R12 Dispersed Site Inventory in 2001. Most of the dispersed sites at Baker Lake are located on the shoreline or adjacent to tributaries near their terminus at Baker Lake. In addition to the camping opportunities, the Puget-operated Baker Lake Resort has 11 cabin units, a store, a swimming area, and mooring facilities, and the Puget-operated Baker Lake Lodge, located near the Upper Baker dam, offers a conference/retreat facility with a nine-room lodging facility and two separate cabins.

RRM, a concessionaire of the USFS, manages all of the campgrounds in the Baker River Project vicinity, except for Maple Grove, which the USFS manages. This arrangement allows a third party to collect the fees associated with a government-owned facility in return for performing annual operation and maintenance of the facility. The concessionaire compensates the federal government with a percentage of the revenue generated at the facility. A concessionaire may perform heavy maintenance or replace components of a concessionaire-operated facility in lieu of payment of the fees payable to the federal government under terms of this arrangement.

5.10.1.3 Facility Condition and Accessibility

Accessibility guidelines associated with the Americans with Disabilities Act have been developed for recreational facilities and play areas, and a final rule for their use has been made by the U.S. Architectural and Transportation Barriers Compliance Board (Access Board). Proposed guidelines for outdoor developed areas have been drafted and presented to the Access Board, but these guidelines have not been formally adopted. Although these guidelines are not recognized as being final, the USFS has issued an interim policy dated April 19, 2000, directing the agency to use the proposed guidelines for new facility construction and alterations to existing facilities. Accordingly, the developed recreational facilities are discussed relative to these guidelines.

The USFS constructed campgrounds and day-use areas in the 1950s and 1960s at Baker Lake. Some modifications and repairs have been completed since their construction, but most of the facility components consists of the original structures and the sites are laid out in the original design. The existing campgrounds are not designed according to current USFS standards, and they have short spurs and narrow access road width and turning radii that do not easily accommodate RVs and trailers.[20] Declining agency budgets for recreational facility operation and maintenance has curtailed the agency's ability to complete necessary heavy maintenance at the facilities, and this has contributed to the substandard condition of some of the facilities (USFS, 2000).

Because the USFS recreational facilities were constructed before accessibility became a consideration and because few improvements have been made since that time, the facilities, overall, do not meet accessibility guidelines. The restrooms that have been installed in the past few years at some of the facilities are accessible to persons with disabilities. Accessible picnic tables have also been installed in some locations. However, there are numerous barriers in the routes of travel between campsite features and inside many of the restrooms. There are also deficiencies related to accessibility with the water faucets, trash bins, signage, fire grills, tables, and campsite spurs. There are no sites designated for persons with disabilities, and there are no accessible routes to access the shoreline.

The recreational facilities that Puget owns have been maintained since their construction and are in good condition. There are components, particularly restrooms, that have reached or will soon reach the end of their useful life and will require replacement. Many barriers to accessibility exist at these facilities as well. There are no sites designated for persons with disabilities, and there are no accessible routes to access the shoreline.

[20] This assessment of the developed recreational facilities is based on observations made during a site visit with Puget on April 29, 2003.

5.10.1.4 Recreational Use Levels

Recreational use within the Baker River watershed is seasonal, with the highest amount of use occurring during the summer. Visitation use figures indicate that more than 50 percent of all use occurs on weekends, with July and August receiving the highest number of users. Use during July and August weekends typically accounts for 30 to 40 percent of the annual use (USFS, 2002a). Puget recreation survey data for the Project area indicate that 90 percent of recreationists visiting the Project area visit Baker Lake while the remaining 10 percent visit Lake Shannon. Nearly 66 percent of the people surveyed indicated they were staying overnight at Baker Lake and 24 percent were Baker Lake day users (Puget, 2003l). Eight percent of all respondents were Lake Shannon overnight visitors, and the remaining 2 percent were Lake Shannon day users. The average party size of recreationists in the Project area is 2.4 people (Puget, 2003l).

The majority of uses within the Project boundary include camping, fishing (shore and boat), RV camping, and sightseeing. Twenty-two percent of the people surveyed indicated auto/tent camping in developed sites as their primary recreational activity (Puget, 2003l). USFS campgrounds near Baker Lake average 125 days of operation during the recreational season running from mid-May through mid-September. Table 5-34 summarizes the annual overnight use within the Project vicinity. Estimated use at USFS campgrounds associated with the Baker River Project (including lakeside and forested campsites) is 10,500 overnight visits per year (USFS, 2002a). The estimated use at Puget-developed overnight facilities is 18,076 visits (6,168 at Kulshan Campground and 11,908 at the Baker Lake Resort) (Puget, 2002c). There are also an estimated 4,900 overnight visits at dispersed sites near the Project area (Puget, 2002c).

Table 5-34. Total annual overnight use within the Baker River basin (rounded). (Source: Puget, 2002c, as modified by staff)

Overnight Facility	Annual Visitors
USFS developed	10,500
Puget developed	18,076
Dispersed	4,900
Total	33,476

The USFS estimates 6,000 people fish at Baker Lake and its tributaries each year, and 3,000 people boat and bank fish at Lake Shannon per year (USFS, 2002a). Among the Baker Lake survey respondents who indicated they fish, approximately half fish from shore, 40 percent boat fish, and 10 percent shore and boat fish (Puget, 2003l).

Additional use in the Project vicinity includes hiking on the Shadow of the Sentinels Trial, the Baker Lake/River Trail, and the Schreibers Meadow Trailhead. The USFS estimates that annually 5,500 hikers use the Shadow of the Sentinels Trail and 4,900 hikers use the Baker Lake/River Trail. Specific estimates for the Schreibers Meadow Trailhead are not available.

Puget records indicate that approximately 25 percent of visitors using the high country trails surrounding the Project area are overnight visitors staying at Baker Lake (Puget, 2003l).

The USFS expects regional population growth to generate increased demand for the existing recreational resources within the Baker River Project vicinity. Evidence of these expectations includes recreational site development history, visitor-use statistics, and the rise in the number of dispersed campsites. Since 1960, visitor use at developed campgrounds has increased by 50 percent, while capacity at developed facilities has only increased by approximately 33 percent (USFS, 2002a). The USFS also reports the number of dispersed campsites within the vicinity of the Baker River Project has grown by approximately 18 campsites per year and demand for such sites is expected to grow between 7 and 15 percent by 2010 (USFS, 2002a).

Dispersed Recreation

Puget identified 213 dispersed sites in the Project area that can accommodate 2,456 people at one time. Fourteen percent of the sites are accessed by trails with the remainder, in approximate equal proportions, consisting of sites accessed by road, walk-in, and boat. Most of the sites are within 50 feet of the shoreline of a body of water with most of these sites occurring at Baker Lake (figure 5-26, appendix A). The types of resource effects noted by Puget include vegetation damage, vegetation loss, erosion, runoff/sedimentation, human and animal waste, and litter.

The occupancy rates for dispersed sites at Baker Lake was less than 20 percent and the sites at Lake Shannon were typically under 10 percent. It appears that a small number of the dispersed sites receive the majority of use through the recreational season. Consequently, most of the resource effects appear to occur at a small proportion of the dispersed sites.

Public Safety

A Whatcom County sheriff deputy and a USFS law enforcement officer provide law enforcement at Baker Lake. The USFS law enforcement officer generally responds to situations involving matters of natural resource damage, whereas the Whatcom County Sheriff Department generally responds to all other types of law enforcement situations. In USFS campgrounds under concessionaire operation, campground hosts are responsible for enforcing campground rules, and if they need assistance, they call on either the USFS law enforcement officer or the Whatcom County sheriff deputy, as appropriate. The Skagit County sheriff and the Town of Concrete provide law enforcement at Lake Shannon. A seasonal USFS employee provides additional law enforcement by patrolling and enforcing the forest regulations related to wilderness and campfire permits and woodcutting. Officers issue an average of 710 citations per year within the basin. The majority of the citations are for violations related to the Northwest Forest Pass program and woodcutting of the forest permit program with an average of 460 citations per year (USFS, 2002a). Law enforcement data indicate that the second highest number of citations recorded within the basin is for disorderly conduct (USFS, 2002a).

Communication within the Baker River Project area and surrounding areas is limited to radio and/or microwave-based telecommunication systems used by the USFS and Puget plant operators. The steep terrain surrounding the Project limits the use of cell phones at lower elevations, while they can be used at higher elevations. No public, landline phones exist within the Project area, but a telephone box is located at the main gate to the Puget Upper Baker Compound. The public can make 911 calls from this location.

Project Operations

Operation of the Baker River Project involves a seasonal drawdown of the reservoirs to accommodate power generation and flood control during winter and early spring (section 5.4.1.1, *Surface Water*). The reservoirs are held near full pool during the summer.[21] This operation directly affects the amount of exposed shoreline at Baker Lake and Lake Shannon and affects access to developed recreational resources, such as boat ramps, beaches, and dispersed shoreline campsites. Visitor use is potentially affected in the spring, as the spring runoff and the filling of the reservoirs can occur after the start of fishing season in late April. The boat launches at Baker Lake Resort and Horseshoe Cove Campground become usable when the water level falls to elevation 712.77 feet msl (NAVD 88) and 710.77 feet msl (NAVD 88), respectively. The boat launches at Panorama Point and Shannon Creek on Baker Lake become usable at approximately elevation 714.77 feet msl (NAVD 88) and 718.77 feet msl (NAVD 88), respectively. Puget's West Pass dike launch is the only boat launch at Baker Lake that is typically available year-round. At Lake Shannon, the boat launch is usable until the reservoir reaches elevation 380.73 feet msl (NAVD 88), and the ramp is usually usable year-round. The swimming beach at the USFS Horseshoe Cove is usable until Baker Lake elevations are less than elevation 719 feet msl (NAVD 88). The minimum usable elevation for the swimming beach at the Baker Lake Resort is elevation 712 feet msl (NAVD 88).

All of the boat launches at Baker Lake, except for West Pass dike, are located in one of the developed campgrounds at the Project. The current operating seasons for these facilities, depending on weather and snow-melt, are as follows:

- Shannon Creek and Panorama Point—one week before Memorial Day through the weekend following Labor Day;
- Horseshoe Cove—second weekend in May through the third weekend in September; and
- Baker Lake Resort—first weekend in May through the first weekend in October.

At the lower lake elevations, additional dispersed campsites at Baker Lake are available because more beach area is exposed. However, the long distances created at low reservoir elevations make some of the dispersed sites near the high-water mark unattractive. Because of this, visitors do not use some of the dispersed sites above the high-water mark during low reservoir levels.

[21] Full pool elevation for Baker Lake and Lake Shannon is 727.77 feet msl (NAVD 88) and 442.35 feet msl (NAVD 88), respectively.

5.10.2 Environmental Effects

5.10.2.1 Effects of Project Operations—Reservoir Level Management

Reservoir levels can affect recreational activities, such as boating and swimming, at the Project reservoirs. To safely launch boats, the level of the reservoir should be above the end of the boat launching lane. Also, reservoir levels at or near the high-water mark cover rocks and stumps at swimming beaches and maintain a suitable sandy shoreline for visitor use. The recreational season, which is when most swimming and boating occurs, falls between Memorial Day and Labor Day. Currently, the Project is operated to support recreational uses from July 4th to Labor Day weekend by maintaining the levels of Baker Lake and Lake Shannon at or above elevation 718.77 feet msl (NAVD 88) and elevation 404.75 feet msl (NAVD 88), respectively. The minimum elevations at which the six boat launches open to the Public at the Project are usable are listed in table 5-35.

Table 5-35. The minimum elevations at which the six boat launches and two swimming beaches at the Project are usable.

Location	Minimum Lake Elevation (feet msl) (NAVD 88)
Boat Launch	
Baker Lake	
West Pass Dike	678.77
Horseshoe Cove	710.77
Panorama Point	714.77
Baker Lake Resort	712.77
Shannon Creek	718.77
Lake Shannon	
Shannon Boat Ramp	380.75
Swimming Beach	
Baker Lake	
Horseshoe Cove	718.77
Baker Lake Resort	712

Gentle sloping areas are more readily exposed as reservoir levels lower than the portions of the shoreline that are steep. Consequently, as reservoir levels drop, stumps and rocks in shallow areas are exposed, which can create boating hazards. The long distances that develop between some dispersed campsites and the shoreline from lowering reservoir levels may cause some sites to be unattractive and decrease dispersed camping opportunities. The areas where reservoir depth causes concerns related to boating safety and dispersed camping opportunities include the elbow of Baker Lake, the west shoreline of Baker Lake, and the shoreline near the inlet of the Baker River.

The Draft Action includes measures to set target elevations for the reservoirs at different months of the year (PMEs 6.3, 5.1 and 3.5.2). Refer to appendix B for the full text of these measures.

Effects Analysis

See section 5.4, *Water Quality*, for a discussion about the HYDROPS data used in the following analysis. The effects of the Draft Action on reservoir levels on a monthly basis for different water-year types are discussed in section 5.4.2.1. For recreational uses, important points of reference are the elevations of the reservoir when the six boat ramps that are open to the public and the swimming beaches become unusable.

Considering the recreational season is between Memorial Day and Labor Day, the discussion about the effects of the Draft Action focuses on the months of May through September. Depending on weather, the months of April, October, and November may also be suitable for recreational use at the Project, and these months are also analyzed to consider the effects during this shoulder season. However, the campgrounds where all but one of the boat launch facilities are located are currently not operated during these months. Consequently, the effects of the reservoir elevations need to be considered in light of the time that the developed campgrounds are available for public use. Figure 5-27 below shows a comparison of the percentage of time during each month of a normal water year that four of the six boat launches are usable under the current operations and under the Draft Action. The Draft Action would not affect the percent of time that the West Pass dike and Lake Shannon boat launches are usable in a normal water year, and these launches are not included in the figure below.

During the peak recreational season (June through August) the Draft Action would not affect any of the boat launches during this time with the highest recreational use. At Baker Lake, the most pronounced effects in a normal water year would be at the Shannon Creek boat launch, which is the first ramp to be out of the water as the reservoir level drops. In March, April, and May, there would be 15, 70, and 54 percent, respectively, less time that the launch would be serviceable. The Draft Action would result in about 5 fewer days in March and 21 and 17 fewer days in April and May, respectively, when this boat launch would be usable. From June through August, the Draft Action would not affect the usability of the boat launch. In September, there would be a notable decrease of 81 percent of the time when the boat launch would be usable under the Draft Action, or about 24 days. In October and November, the Draft Action would cause there to be about 23 and 3 days, respectively, when this boat launch would not be usable. Except for the month of May, these effects would occur outside of the current operating season of the Shannon Creek Campground where the boat launch is located.

At Panorama Point, the Draft Action would not affect the usability of the boat launch in normal water years from June through October. During March, April, and May, there would be approximately 9, 23, and 10 fewer days, respectively, when the this boat launch would be unusable under the Draft Action; in November there would be about 3 fewer days. Except for the month of May, these effects would occur outside of the current operating season of the Panorama Campground where the boat launch is located.

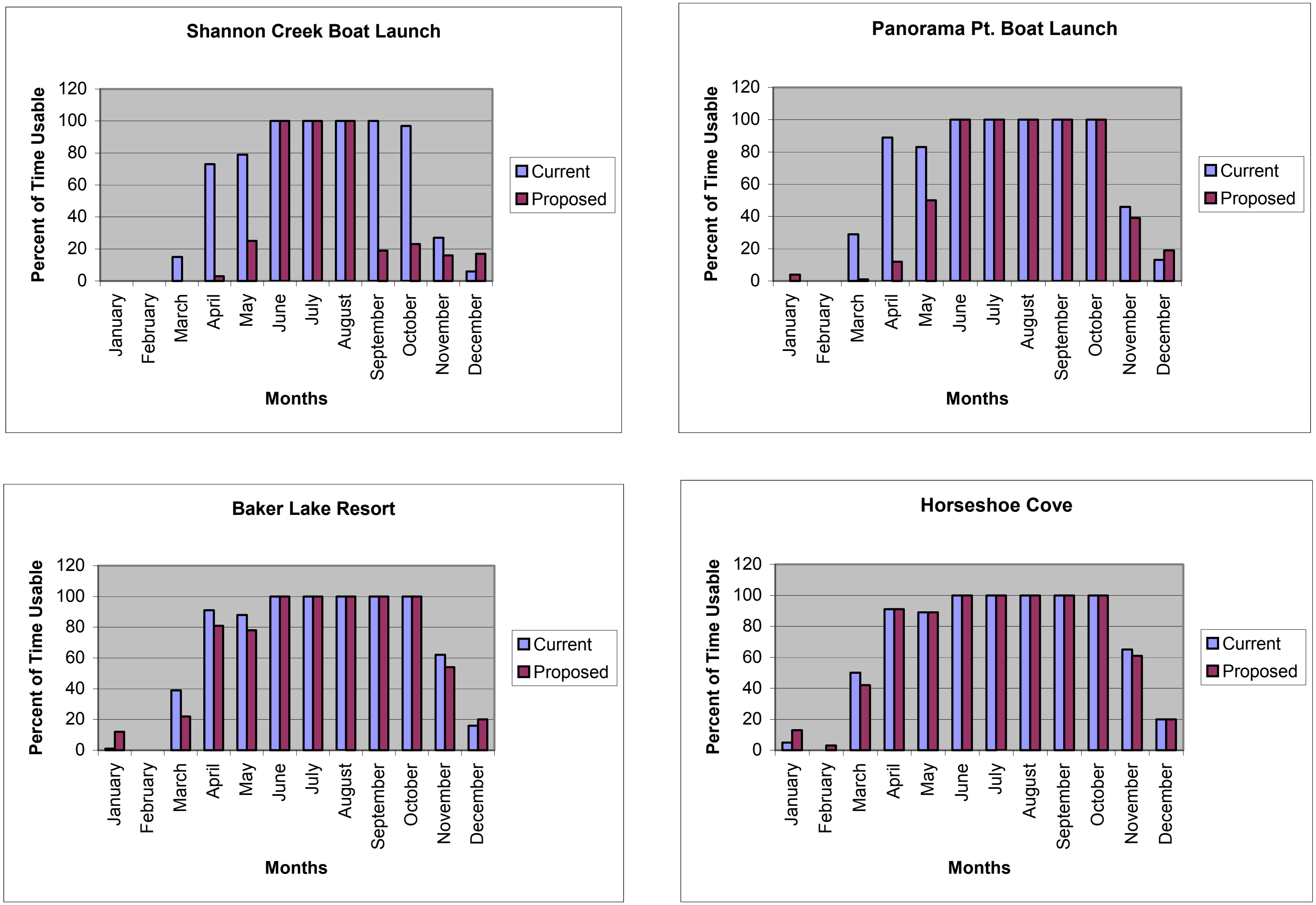


Figure 5-27. Comparison of the percentage of time in a normal water year that each boat launch is usable under current operation and the Draft Action.

Based on Interim HYDROPS Model Output (mid-July 2003)

At Panorama Point, the Draft Action would not affect the usability of the boat launch in normal water years from June through October. During March, April, and May, there would be approximately 9, 23, and 10 fewer days, respectively, when the this boat launch would be unusable under the Draft Action; in November there would be about 3 fewer days. Except for the month of May, these effects would occur outside of the current operating season of the Panorama Campground where the boat launch is located.

At Baker Lake Resort, the Draft Action would decrease the number of usable days in March, April, May, and November in a normal water year by about 5, 3, 3, and 2 days, respectively. The swimming beach at the Baker Lake Resort would become unsuitable at approximately the same reservoir elevation as the elevation that the Baker Lake Resort boat launch would become unusable. Accordingly, the effects in terms of the timing and number of days that the swimming beach would be unsuitable during a normal water year would be the same as those described for the boat launch. Except for the month of May, these effects would occur outside of the current operating season of the Baker Lake Resort where the facilities are located.

The Draft Action would affect the usability of the boat launch at Horseshoe Cove only in March and November, during the shoulder season. There would be approximately 2 fewer days in March and 1 less day in November when the public could use the boat launch in normal water years. The swimming beach at Horseshoe Cove becomes unsuitable at approximately the same reservoir elevation as the elevation that the Shannon Creek boat launch becomes unusable, and the effects in terms of the timing and number of days that the swimming beach would be unsuitable during a normal water year would be the same as those described for the Shannon Creek boat launch. In March, April, and May, there would be 15, 70, and 54 percent, respectively, less time that the swimming beach would be serviceable. The Draft Action would result in about 5 fewer days in March, 21 fewer days in April, and 17 fewer days in May when this swimming beach would be unsuitable. From June through August, the Draft Action would not affect the suitability of the swimming area. In September, there would be a notable decrease of 81 percent of the time when the swimming beach would be suitable under the Draft Action, or about 24 days. In October and November, the Draft Action would cause there to be about 23 and 3 days, respectively, when this swimming beach would not be suitable. Except for May and September, these effects would occur outside of the current operating season of Horseshoe Cove where the facilities are located.

Under both the current conditions and the Draft Action, the public would be able to safely launch a boat at both of the Project reservoirs during the recreational season. However, the Draft Action may slightly reduce the optional locations that visitors have to launch their boats during the shoulder season. If the campgrounds were open beyond their current operating seasons, there would be four usable boat launches instead of six. The swimming beaches would be mostly affected in April, May, September, and October, months of the year when most people would not visit a beach to swim because air temperatures are generally cool. Also, the facilities where the swimming beaches are located are generally not open in April and October. Consequently, the Draft Action would not greatly affect the usability of the Horseshoe Cove and Baker Resort swimming beaches.

The Draft Action would cause greater shoreline to be exposed along the north and western shores of Baker Lake. The effect would be most pronounced outside of the period between Memorial Day and Labor Day. During the shoulder season, some dispersed campsites may become less desirable because of their distance to the shoreline, thereby reducing dispersed camping opportunities at the Project. Exposed rocks and stumps at Baker Lake are potential boating hazards with or without the Draft Action. This effect would be most pronounced during the shoulder season. There is a narrow portion of Baker Lake, which at the lowest reservoir levels, transforms from flat water to a flowing channel. The lower reservoir levels in the shoulder season could restrict boat passage between the upper and lower portions of Baker Lake. Again, this effect would not occur during the months of the recreational season.

5.10.2.2 Developed Recreation

Baker Lake and Shannon Lake are Project features that attract visitors to the area. These Project reservoirs provide visitors with the opportunity to enjoy outdoor recreational activities, such as lake fishing, swimming, and boating. The land adjacent to the reservoirs serves as a host to overnight and day-use recreational activities, such as camping, picnicking, hiking, observing wildlife, hunting, shoreline fishing, and scenic driving. Developed facilities provide comfort and convenience for the public and protect environmental resources, such as soil, water, and vegetation. The demand for recreational experiences supported by developed recreational facilities would persist and increase into the future and the continued operation of the Project would help meet this demand by providing two large bodies of flat-water and associated developed recreational facilities. The existing facilities and services available to the public to accommodate recreational activities are less than adequate in terms of their condition or their ability to meet the existing or future demand for public recreational use. USFS staff participating in the relicensing process identified the need to reconstruct the agency's recreational facilities. They also indicated that their funding to operate and maintain the facilities is inadequate.

Although Baker Lake and Lake Shannon are located fairly close to each other, there are two differences between them that cause different patterns of and opportunities for recreational use. Baker Lake is located almost entirely on National Forest System lands managed by the MBSNF, whereas Lake Shannon is located mainly on privately owned land. The second difference between the two reservoirs is topography. The land around Baker Lake is gentle sloping, but Lake Shannon is mainly surrounded by steep hillsides. Consequently, Baker Lake is more accessible, because there are roads close to the shoreline that are open to the public and there are suitable sites to locate recreational facilities. This circumstance has resulted in development of many public recreational facilities at Baker Lake. Lake Shannon has few points along the reservoir where there is legal public access to the shoreline. The steep slopes and lack of public land near the reservoir restrict where recreational facilities can be sited. Consequently, there is currently little recreational development at this reservoir.

Bayview Campground

Visitors to the area include both small families with a group size of 1 to 6 people as well as those users that are visiting the area with a larger group, such as a church group or large family. The North and South Bayview Campgrounds were scheduled for construction in 1964, but they were never completed due to lack of funds. Regardless of their incomplete state, they are available for overnight group use by reservation only.[22] The tables and fire rings have been replaced, but the restrooms, signs, spurs, roads, gates, and traffic barriers are in poor condition. Although the public may use these sites, the facilities are not well known and receive little use. In fact, the USFS does not even acknowledge Bayview Campground in the list of developed recreation facilities in the *Baker River Watershed Analysis* (USFS, 2002a). Their contribution to supplying overnight capacity can be considered incidental compared to the other facilities.

Under the Draft Action, Puget would provide funding sufficient to rehabilitate the existing facilities at Bayview Campground (PME 2.5.1). Improvements to this campground would include reconstructed access roads and new tables, vault restrooms, spurs, fire rings, tent pads, and signs. The North Unit would be designed to accommodate group overnight use for approximately 30 to 50 persons and the South Unit would be designed for approximately 23 family camping units. Refer to appendix B for the full text of this measure.

Effects Analysis

Assuming that these sites currently offer only incidental overnight capacity, this measure would contribute additional capacity for approximately 138 people-at-one-time (PAOT) for overnight camping at Baker Lake. This site would provide additional capacity for overnight group-use site at this reservoir. This measure would respond to the demand for lakeside camping opportunities, which is projected to exceed the existing capacity within the next 10 to 20 years, and would allow for the renovation of this site to accommodate family and group overnight use.

USFS Campground Operation and Maintenance

Horseshoe Cove, Shannon Creek, Panorama Point, and Maple Grove are campgrounds at Baker Lake that provide lakeside camping opportunities for the public. The USFS constructed the campgrounds between 1960 and 1973 and continues to operate and maintain these facilities. Since their construction, the only other major development has been the addition of eight units to the Horseshoe Cove Campground in 1980. Over the last decade, the USFS has seen a decrease of about 9 percent in its recreation budget at the same time that wages and associated benefits, overhead, operating costs, and inflation have been on the rise. In the MBSNF, this situation created deferred maintenance and poorly functioning recreational facilities (USFS, 2002a). One response to this problem was to turn operation and maintenance of all five road-accessible campgrounds over to a concessionaire; however, this action did not alleviate the problem of deferred maintenance at the recreation facilities. Visitor surveys conducted by Puget indicate that the existing users are somewhat dissatisfied with some services and facilities available at the campgrounds. In particular, most of the dissatisfaction expressed by those interviewed is related to restrooms and potable water availability.

Under the Draft Action, Puget would reconstruct Horseshoe Cove, Shannon Creek, Maple Grove, and Panorama Point campgrounds and annually provide funding to the USFS to

[22] This assessment of the developed recreational facilities is based on observations made during a site visit with Puget on April 29, 2003.

support operating and maintaining the facilities during the term of any new license issued (PME 2.5.2). Recognizing that the revenue generated at these sites is a source of funding available to operate and maintain the recreational facilities (i.e., USFS Fee Demonstration Project or concessionaire management), the basis to calculate the funding to be provided by Puget would be reduced by any costs covered by the revenue received at the sites. In effect, the funding provided by this measure would supplement operation and maintenance funding that is generated from user fees. Specific activities that would be funded by Puget's annual funding include: site safety and security, fee collection, grounds maintenance, facility cleaning and maintenance, facility repair or component replacement to maintain existing condition, resource restoration /mitigation and vegetation management. Refer to appendix B for the full text of this measure.

Effects Analysis

This measure would not create additional overnight capacity; however, it would improve the visitors' experience at these campgrounds. The visitor surveys indicated that noise and rude behavior is a problem at the USFS campgrounds. Additional annual funding provided to the USFS would increase patrols of the sites, which would increase the public's sense of security during their visit and provide prompt response time to deal with problems.

This measure would likely increase public safety at the Project. Actions, such as resurfacing and clearing vegetation for sight distance, would reduce the potential of falls, car accidents, or other injuries at the recreational facilities. An active vegetation management program would reduce the risk of wildland fires at the recreational facilities.

The costs for annual operation and maintenance at the concessionaire-operated campgrounds should be covered under the contract with the USFS whereby the concessionaire collects the fees at the site and in return agrees to operate and maintain the facility. Consequently, the effects of the portion of the measure that would provide funding for annual operation and maintenance of the campgrounds would mainly benefit the Maple Grove Campground, which is not operated by a concessionaire.

The long-term effects of the Draft Action to provide replacement funding for facilities would improve visitor safety and user satisfaction at all of the USFS campgrounds located at Baker Lake. Replacing worn or damaged infrastructure at campgrounds that are operated under Fee Demonstration authority and by a concessionaire can be funded with a portion of the fees collected at these sites. The annual funding provided by Puget may supplement this funding thereby assuring that deferred maintenance needs would not occur at the campgrounds during the term of any new license issued.

During reconstruction or other major maintenance activities at the campgrounds, there could be some short-term effects. These effects could include visitor displacement, if facilities are closed or unavailable during the summer, and noise from construction activity. These effects would be minimized if reconstruction and major maintenance activities were scheduled outside of the peak summer-use period. Similarly, reconstruction could be scheduled in phases to minimize visitor displacement. Although ground disturbance would occur as part of the campground reconstruction, these sites currently have recreational facilities and their reconstruction would be consistent with the USFS's designation of this land for public recreation use.

Lake Shannon Access and Development

Currently, public access to Lake Shannon is across private land, and there are minimal recreational facilities and services available to the public at this reservoir. The main point of public access is at the Lake Shannon boat launch. This site has no formally developed facilities; however, Puget currently provides portable restrooms and dumpsters at the site. Most of the site is an open, dirt-surfaced area with minimal shade where visitors park RVs to camp. Some users at this site also camp in tents, primarily on a grassy peninsula located to the south of the boat ramp where there is some tree cover. The boat launch site is also close enough to the Town of Concrete and other nearby communities to make it convenient for day use as well as overnight use, and much of the use is from local residents. Other than servicing the restrooms and refuse service, there is no active management of recreational use at this site. Consequently, there are instances of people staying for extended periods, being inconsiderate of other visitors, and causing resource damage. The visitor surveys indicated low satisfaction with the access roads, availability of potable water, cleanliness of the area, facility maintenance, and the quality of the parking area. The lack of developed facilities at this site means that the users must provide for their own comfort and convenience when visiting Lake Shannon.

The Draft Action would include a measure for acquiring a public easement for roaded access to the Lake Shannon boat launch or another suitable site and creating a hiking trail up to 1 mile in length along the shoreline to provide additional public access to Lake Shannon (PME 2.5.3). One family campground with 24 sites, one group campground that can accommodate 20 PAOT, and a designated boat trailer parking area would also be developed at the boat launch under this measure. These facilities would include vault restrooms, potable water, wildlife resistant trash containers, fire rings, tables, barriers to control vehicle access, and a visitor information kiosk. A day-use area would also be provided with a picnic shelter and 4 day-use sites with tables and fire grills. An onsite host would actively manage these improvements to provide grounds and facility maintenance; enforce rules of the campground, including the length of a visitor's stay; and collect user fees.

Effects Analysis

This measure would respond to existing and projected recreation needs by creating recreational facilities for day-use and overnight use at the Project. The broad open area at the boat launch can currently accommodate approximately 38 vehicles and 32 trailers; however, the actual capacity at any given time depends on how visitors choose to park. Formalizing the site with parking spaces and designated-use areas would maximize the capacity of the site by making efficient use of the site and separating the areas for overnight and day use. The overall capacity for overnight use would be approximately 164 PAOTs. Puget observed the highest number of users, 178, on opening day of fishing season. When comparing these two use figures, it appears the capacity of the area at the boat launch may be reduced under the Draft Action. However, the site has experienced resource damage in the form of soil compaction and vegetation damage and removal, which are indicators that the site experiences use levels that are probably beyond its capacity. The Draft Action may reduce the number of people that use the site at one time; however, this use level would probably be more consistent with the level of use that the site can sustain and the soil and vegetation at the site can be protected.

Additionally, the existing occupancy rate for the spring, summer, and fall is estimated to be 65, 16, and 8 percent, respectively, so it appears that, in general, the Draft Action would provide enough capacity to accommodate an increase in use at Lake Shannon. One exception to this may be on the opening weekend of fishing season, which is when the highest recreation use occurs.

Although it is important to characterize the effects of the Draft Action in terms of capacity, a more critical aspect of this measure is the effect on the quality and type of recreational experience available at the Project. Considering the visitors at Lake Shannon had the highest level of user dissatisfaction of all sites that were surveyed, the Draft Action would greatly improve the quality of the recreational experiences available at Lake Shannon. These facilities would increase user comfort by providing campsite components, such as fire rings, tables, and potable water. Adding these components and formalizing the site would bring organization to the site with defined areas for visitor use, and regular cleaning and maintenance of the facilities would probably create greater enjoyment for visitors. The need to accommodate overnight group use would be met, and visitors may also have an increased sense of security with a host present and increased patrols of the area. There may be existing users that favor less development who may be displaced if formal campgrounds and day-use sites are constructed. Additionally, implementing a user fee may displace users; however, it may also deter socially unacceptable behavior, vandalism, and resource damage. Fees generated at the site could be used for operation, maintenance, and facility replacement, which would help ensure the quality of the facilities during the term of any new license issued.

The Draft Action would provide the first and only developed recreational facilities at Lake Shannon. The recreational development outlined in the Draft Action appropriately responds to a recommendation in the Skagit County Comprehensive Parks and Recreation Plan to consider providing enhanced recreational facilities at Lake Shannon. Development of recreational facilities as described in the Draft Action would also be consistent with the level of development that exists at other nearby recreational facilities in Skagit County.

Considering the lack of legal access to Lake Shannon, the Draft Action would greatly improve the public's ability to use the reservoir. Although the public is not currently prevented from using the existing roads to access the reservoir during most of the year, a permanent right of access does not exist for the public. Periodically during the year, the landowner restricts public access by posting closure signs on the road. An easement would ensure that the public can access the reservoir at least during the term of any new license issued and possibly indefinitely. Development of a trail would create a new means of public access to the reservoir as well as respond to a need for trails as identified by projected recreational demand and in the responses to the visitor surveys.

The Draft Action may have a short-term effect of visitors who may be displaced during construction and when major maintenance is needed after the site is constructed. This effect may be minimized by scheduling activities outside of the peak recreational use season.

Kulshan Campground

Kulshan Campground is located on land owned by Puget, and it has 116 campsites, a day-use area, and information kiosk. This campground was a former housing site for construction crews, and its current design reflects this former industrial use with small narrow spurs that are densely spaced in a linear manner within the site. There is minimal distance and vegetative screening between sites at the campground. The existing occupancy level for this campground is generally the lowest of all of the campgrounds at Baker Lake. The current estimated occupancy at this campground can be characterized as low, ranging from 18 to 29 percent during the summer season between 1998 and 2001. The existing users expressed low satisfaction with facilities or services related to showers, wheelchair access, and level of the existing development at the site.

Under this measure, Puget would redesign and reconstruct the campground to increase spacing between sites. There would be an approximate 20 percent reduction in the number of campsites at Kulshan Campground. Other improvements would include sites with RV hookups, showers, pedestrian paths, landscaping, paving access roads and restroom replacement (PME 2.5.4). Refer to appendix B for the full text of this measure.

Effects Analysis

This measure would reduce the existing capacity of developed overnight facilities at Baker Lake by approximately 21 campsites, or 126 PAOTs (assuming a maximum of 6 persons may occupy a site). However, because the existing estimated occupancy is low, the site would still have enough capacity to absorb the projected increase in use. The relatively flat topography at Kulshan Campground makes this a very suitable location for RV camping. Providing additional RV sites at this site would respond to projected increased RV use in the future.

Other improvements included in the measure would serve to freshen the appearance of the campground, which would be consistent with visitor desires and expectations. In particular, the addition of showers at the campground responds to the primary need identified by the users. Redesigning the campground would make the area more attractive to users who would prefer more privacy, and these improvements would likely increase the occupancy at the site.

Paved access roads and paths would improve user comfort. This measure would also increase accessibility of the site to persons with disabilities and create new walking and biking opportunities in the vicinity of Kulshan Campground.

Baker Lake Resort

The Baker Lake Resort is a recreational development located on National Forest System land approximately 6 miles north of Upper Baker dam. This site was operated as a commercial resort by a private operator under a special use permit from the USFS on the shore of Baker Lake prior to Project construction. The resort was relocated to the current site when the Project was constructed which inundated the original site of the resort. In 1998, Puget acquired the permit to operate the resort, which includes a family campground, group campground, cabins, playground, boat launch, store and marina with boat rentals.

Currently, the cabins are the only accommodations of the resort that could be considered heavily used or overused with occupancy rates of greater than 70 percent in July and August. The RV campsites have occupancy rate of about 50 percent in July and August while the standard family campsites appear to be at or below 40 percent. The capacity of the campground at the resort (90 campsites) is approximately equivalent to the entire capacity of the campgrounds owned and operated by the USFS at Baker Lake. Overall, the resort currently has additional capacity to accommodate substantially more use during the peak season of July and August.

The facility has aged and worn components that have a high annual cost to operate and maintain. Puget has operated the facility at a loss since it acquired the special use permit in 1998. The gentle sloping land along the shoreline of Baker Lake makes this an attractive, suitable site for recreational development. The poor condition of the facility and associated high cost of operating the resort raises the question of how this site should be operated into the future. The special use permit for this resort expires in 2008.

Under this measure, Puget would develop and implement a plan to rehabilitate the resort (PME 2.5.5). Although the specific actions to rehabilitate the site would be presented in the plan, a fundamental change in the services and facilities provided at the site would change to make the site more economical to operate while still providing recreational facilities for the public. In general, the structures including the cabins, store, boat dock, boat house, and generator building would be removed. The site would be redesigned as a public campground where the utilities would be removed or relocated, disturbed areas would be rehabilitated with native vegetation, and campsites would be constructed with spurs, tables, and fire rings. Potable water and restrooms would be available. Refer to appendix B for the full text of this measure.

Effects Analysis

Under this measure, Puget would eliminate the cabins that serve as overnight accommodations for the public but would increase the number of lakefront camping sites that are available at Baker Lake. All cabins would be eliminated, and campsites with equivalent capacity would likely be constructed in their place. Additional overnight capacity could be gained by siting campsites in locations where buildings were removed. Because the existing overall occupancy of the resort site is low, the site would have enough capacity to absorb projected increase in overnight use that could occur at this campground in the future. If, as projected, the occupancy at Panorama Point and Horseshoe Cove campgrounds reach their capacity, additional campsites at Baker Lake Resort would probably accommodate displaced visitors from these campgrounds.

Rehabilitation of the site would improve the aesthetic qualities of the site in that power lines would be removed from trees, and there would be an orderly appearance to centrally located water faucets, restrooms, and access routes. Newer recreational facilities could attract visitors who may have intended to use other campgrounds at Baker Lake, so occupancy could increase after the site is rehabilitated.

The removal of the buildings would serve to reduce overall operation and maintenance costs of operating the site. User fees could also be implemented to provide a source of funding for ongoing operation and maintenance as well as facility replacement. The concern for public health and safety would also be reduced if the buildings and their associated deficiencies were removed. Accessibility of the site to persons with disabilities could be improved with new restrooms and other facility considerations that should be taken into account in designing the campground.

The measure would eliminate the opportunities for visitors to rent boats, purchase supplies, or dock their boats overnight while they are camping at the Baker Lake Resort site.

During reconstruction or other major maintenance activities at the site, there could be some short-term effects, including visitor displacement, if facilities are closed or unavailable during the summer, and noise from construction activity. These effects would be minimized if reconstruction and major maintenance activities were scheduled outside of the peak summer-use period. Similarly, reconstruction could be scheduled in phases to minimize visitor displacement. Although ground disturbance would occur as part of the campground reconstruction, this site currently has a recreational facility and its reconstruction would be consistent with the USFS's designation of this land for public recreational use.

Wildlife Observation Facility

A growing level of participation in non-consumptive wildlife-related recreational activities is expected during the term of any new license issued. Currently, there are no specific facilities provided for these activities at Baker Lake and visitors enjoy viewing wildlife from their campsite, the lake surface, their cars while driving along roads or hiking along the various trails in the area. Agency staff participating in the relicensing process identified the need to develop facilities to support these activities.

Under this measure, Puget would create a facility located and designed to provide visitors with an opportunity to view wildlife (PME 2.5.6). The facility would have walkways, screening, an observation platform, interpretative displays, and parking area. The facility would be designed to consider accessibility for persons with disabilities. Refer to appendix B for the full text of this measure.

Effects Analysis

This measure would provide visitors with a formalized facility to enjoy viewing wildlife. Visitors enjoy this activity, and because it is expected that there will be more people participating in this activity during the term of any new license issued, this measure would increase the existing opportunity at Baker Lake for visitors to view wildlife. Because its design would incorporate accessibility standards, this facility would also increase the opportunities for persons with disabilities to participate in recreational activities at the Project.

Visitor education and interpretation can also be accomplished with this measure. Educating the visitors at Baker Lake about terrestrial and aquatic resources may cause visitors to be more careful and thoughtful about their actions relative to the environment during their visit. This could benefit the area by reducing noise, litter, damage to vegetation, soil erosion, water pollution, and disturbance to wildlife that can be associated with recreational use.

Americans with Disabilities Act Compliance

Providing public recreation facilities that are accessible to persons with disabilities is required by the ADA, and it is an important element in the Commission's review of license applications. The existing facilities were built, in some cases, decades ago prior to the ADA and there are many deficiencies associated with campsites, day use areas, boat ramps, restrooms, paths of travel, water faucets, trash receptacles, signage, and parking areas.

This measure has two elements (PME 2.5.7). First, a fishing platform would be developed at Depression Lake to provide recreational fishing access for persons with disabilities. Second, a transition plan would be developed for all recreation facilities for the Project to identify site modifications needed to comply with the ADA, a schedule for making the site modifications and implementation of the needed modifications. The transition plan would be developed within 2 years of license issuance. Refer to appendix B for the full text of this measure.

Effects Analysis

This measure would increase the fishing opportunities available at the Project for persons with disabilities. The Depression Lake site is well suited to this development with its proximity to campground, boat launch and day-use facilities. Another positive attribute of this site is that fish are stocked here and visitors would have a good chance to catch fish at this location.

Developing a transition plan for the recreational facilities at the Project would be a reasonable approach to complying with the ADA. The USFS uses this same approach with its own facilities, and this plan could be developed to reflect priorities and site-specific needs that the USFS would identify. Currently, the facilities have many challenges related to accessibility so that persons with disabilities must seek out certain locations that may now exist in the form of a level site that is close to a restroom, path, or other recreational improvement. Through implementation of the plan, the recreational facilities would be more accessible to persons with disabilities, and there would be accessible routes connecting the features located within the various developed campgrounds, day-use areas, trails, and boat launches.

5.10.2.3 Dispersed Recreation

As previously described in section 5.10.2.2, Baker Lake and Lake Shannon are Project features that attract visitors who enjoy overnight and day-use recreational activities, such as camping, picnicking, hiking, observing wildlife, hunting, shoreline fishing, and scenic driving. In addition to the developed recreational sites that provide facilities for user comfort and convenience for the public, there are areas with no such facilities provided near the reservoir shorelines where visitors may choose to camp or picnic. The locations and patterns of use at some of these areas cause concern for water quality, cultural resources, erosion, and vegetation damage. Many types of resource damage were identified in the Dispersed Site Inventory, including erosion, hatchet marks and nails in trees, and trampled vegetation. It is common to find evidence of improper disposal of human and animal waste in the area surrounding dispersed-use sites because restrooms are not provided. Litter is also a problem at these sites, because there is no refuse service provided. The presence of litter and human waste creates health and safety concern for the public visiting the area. User-created fire rings that are not properly located or constructed may pose a risk of wildland fire from an escaped campfire.

The demand for dispersed recreational opportunities is projected to slightly increase over the next 20 years. Continued operation of the Project would help meet this demand by supplying opportunities for lakefront camping and day use. Baker Lake provides the majority of opportunities for dispersed use, because it is located mainly on public land managed by the MBSNF. Dispersed use at Lake Shannon is limited by steep topography and the predominance of private land surrounding the shoreline.

Dispersed Camping Impact

The reservoir shoreline attracts recurrent recreational use that, in some cases, damages natural resources. At Baker Lake, where this type of use is currently allowed on public land, there is a need to manage this dispersed camping to avoid damage to natural resources and to protect the health and safety of the visitors to the Project.

This measure would consist of evaluating the areas with dispersed use to identify areas for continued use or for closure based on a set of criteria related to resource protection, need, and management efficiencies (PME 2.2.2). Site closures, restricting access, restoration, revegetation, signage, and public education are suggested treatments included in this measure for dealing with unacceptable dispersed use. Because the sites are located on public land, Puget proposes to share funding of this effort with the MBSNF. Under this measure, Puget would provide 50 percent of the funding necessary to identify and implement dispersed sites closures and provide and distribute public education materials related to low-impact camping practices. Refer to appendix B for the full text of this measure.

Effects Analysis

From the dispersed site assessments and information from MBSNF staff, the relicensing participants may agree that there are areas where dispersed use may not be appropriate and should be eliminated. If this occurs, the capacity for dispersed recreational use at Baker Lake would be reduced. Without a site-specific evaluation, there is no way to quantify the reduction. Most notably this measure would decrease the opportunity for visitors to locate an area for dispersed overnight use along the shoreline. Visitors who have been coming to the area for years may find their favorite site closed. They would have to find somewhere else to camp, and they may be less satisfied with their experience. This situation could cause people to seek out and establish new dispersed campsites in the area.

Area closures and site restoration would improve the appearance of the area while protecting natural resources. Litter and sanitation problems would be reduced and potentially eliminated at areas closed to dispersed use which would improve health and safety for visitors. Eliminating dispersed use would also reduce the risk for wildland fires that could originate from escaped campfires.

Visitor education would also be accomplished with this measure. Educating the visitors to Baker Lake about low-impact camping practices may cause visitors to be more careful and thoughtful about their actions relative to the environment during their visit. This could benefit the area by reducing noise, litter, damage to vegetation, soil erosion, water pollution, and disturbance to wildlife that can be associated with recreational use.

Fund Campsite Improvement, Operation, and Maintenance

The reservoir shoreline attracts recurrent recreation use that, in some cases, damages natural resources. At Baker Lake, where this type of use is currently allowed on public land, there is a need to manage this use to avoid damage to natural resources and to protect the health and safety of the visitors to the Project.

This measure complements PME 2.2.2 that is discussed in the preceding section. This measure proposes a strategy to manage the areas that would remain open for dispersed recreational use (PME 2.2.1). User-made improvements determined to be inconsistent with the MBSNF LRMP or other guiding policies would be removed; trash removal would be established; and vault restrooms, signage, and fire rings would be installed to formalize the sites. PME 2.2.1 also includes funding for annual operation and maintenance and replacement of the improvements. Because the sites are located on public land, Puget proposes to share funding of this effort with the MBSNF. Under this measure, Puget would provide 50 percent of the funding necessary to install the necessary infrastructure and to operate and maintain the improvements. A program to collect a dispersed camping fee at these sites would be developed and implemented to provide an additional funding source for annual operation, maintenance and replacement needs. Use levels, use patterns, and physical conditions at dispersed sites would also be monitored. Refer to appendix B for the full text of this measure.

Effects Analysis

If this measure is undertaken, there could be visitors that would be both more and less satisfied with their visit, depending on the level of development they seek for their activities. In general though, this measure would likely improve visitor satisfaction for many users, because 44 percent of the visitors who were surveyed said that it was important to them to have a nearby restroom. The existing users appear to choose these locations for proximity to the shoreline and privacy, and these site attributes would not likely change by adding restrooms and fire rings.

Litter and sanitation problems would at least be reduced in dispersed-use areas, improving health and safety for visitors and certainly improving user satisfaction. Installing fire rings would reduce the risk for wildland fires that could originate from escaped campfires and would be an added comfort for visitors to enjoy.

Visitor education would also be accomplished with this measure by posting and maintaining signs to educate the visitors to Baker Lake about low-impact camping practices. This may cause visitors to be more careful and thoughtful about their actions relative to the environment during their visit. This could benefit the area by reducing noise, litter, damage to vegetation, soil erosion, water pollution, and disturbance to wildlife that can be associated with recreational use.

Providing annual maintenance and replacement would ensure that the facilities are in good condition and meet health and safety standards during the term of any new license issued.

5.10.2.4 Trails and Trailheads

While visiting the area, people enjoy a variety of activities, including walking and hiking. The visitor surveys indicate that the existing users disperse in the basin to use various developed facilities and trails. Some visitors venture beyond Baker Lake and hike on trails leading into the adjacent wilderness areas and the NCNP. There are approximately 64 miles of trails within the Baker River watershed, of which approximately 17 miles are located in the lower elevations of the watershed near the Project. Low trail maintenance budgets have resulted in a backlog of maintenance needs, including heavy trail maintenance or trail relocation to meet USFS standards.

The MBSNF LRMP, Washington Statewide Comprehensive Outdoor Recreation Plan (SCORP) and Whatcom County Plan all recognize the projected growth in the most popular outdoor activities of walking and hiking and place a priority on providing additional trails to accommodate this use. Currently, the developed campgrounds at Baker Lake do not have trails that provide connections to other areas of recreational activity; visitors must currently drive, bike, or walk on roads. The Town of Concrete, near Lake Shannon and Puget's fish handling facility, has no trail connections to the Project or nearby natural resource features. Puget completed an assessment for trails as part of the relicensing process to identify desired connections and potential locations for trails.

A category of information known as "water trails" refers to information that is provided to boaters to locate features from the lake surface, such as public access points, campsites, portage areas, points of natural or cultural interest, wildlife viewing areas, and land-based trail connections. Currently, no such information is available to the public at the Project.

New Trails

The Draft Action would include development of a comprehensive trail development plan (PME 2.4.1). The plan would be developed considering the potential routes of trails known as East Lake Shannon Trail and West Baker Lake Trail. The plan would be developed based on the results of the Trail Routing Study completed during the relicensing process. The plan would identify the type use for the trail (e.g., hiking, biking) and a schedule to fund, develop, and maintain the following trails:

- connection of the southern end of the Baker Lake trail with Bayview, Kulshan, and Horseshoe Cove campgrounds;

- loop trails at least 2 miles in length at Panorama Point and Shannon Creek campgrounds;
- connection from Kulshan Campground to Depression Lake, West Pass dike, and Glover Mountain; and
- loop trail in or near the Town of Concrete.

In addition, water trail signage would be installed and water trail information would be provided at selected boat launches. Refer to appendix B for the full text of this measure.

Effects Analysis

Creating new trails would respond to the need for additional trails at the Project. It is consistent with the priorities and recommendations identified by the MBSNF LRMP, SCORP and County plans.

Although there are currently hiking trails in the vicinity of Baker Lake, these existing trails are routes that lead to destinations in the Mt. Baker Wilderness, NCNP, and the Noisy-Diobsud Wilderness rather than recreational destinations in and around Baker Lake. Although this measure does not specify the length of trails that would be constructed, in general, visitors to the Project would have improved access to other locations and facilities at Baker Lake that are designed specifically for walking and/or biking, and this measure would greatly increase the number and length of trails available for the public to use at the Project. At Lake Shannon, where currently no such trails exist, PME 2.4.1 would create a new opportunity for visitors at this area of the Project.

Providing water trail information would create an opportunity that does not currently exist for visitors. This measure would allow users to visit areas of interest and help them to locate areas that are appropriate for dispersed overnight use. This measure would likely improve the visitors' satisfaction during their time spent at the Project.

Existing Trails and Trailheads

Visitors to Baker Lake engage in multiple activities during their visits. A percentage of the current and future use of the trails in the upper basin can be attributed to these users. The trails affected are located on public land administered by the USFS and the NPS. These agencies have the responsibility to operate and maintain the trails under their jurisdiction.

Under this measure, Puget would provide a percentage of the total annual funding necessary to operate and maintain nearby trails and trailheads (PME 2.4.2). Refer to appendix B for the full text of this measure.

Effects Analysis

Maintaining existing trails and trailheads would address effects of recreational use associated with the Project. This measure appears to adequately cover the portion of the surrounding land base that Project visitors may use both currently and in the future. It is not possible to quantify the effects of this measure because of the percentage of funding, the length of some of the trails, and the fact that some of the trailheads were not identified in the measure. However, any funding provided under this measure would supplement the managing agency's funding for maintaining these trails and trailheads. This would be an increased level of funding over what is currently available for maintaining these improvements. This would improve trail and trailhead conditions for all visitors using the trails including those visitors who use these trails when they come to the Project.

5.10.2.5 Access Management

The Project reservoirs provide recreational opportunities for the public and the FERC requires that licensees provide adequate public access for this purpose. Public access to the reservoirs is currently by way of roads across public land under the jurisdiction of the USFS, and Skagit and Whatcom counties, as well as land owned by Puget. The public also crosses privately owned land, where a public right-of-way may or may not exist, to access the reservoirs. Although the issue of access is most often associated with public access for recreation, it is also an essential part of Project operations, cultural site management, and terrestrial and aquatic resource management. Whereas public access for recreation may require year-round motorized access, managing access for the Project operations and natural resource management may require restricting the location, type, and timing of permitted access.

Under PME 6.4, Puget would serve as a lead agency to develop a comprehensive program for managing access to the Project. Other entities would include landowners, the USFS, and WDNR. The program would address various needs related to access by providing funding and management for safe and adequate access for recreation, Project operations, and resource protection. Under this measure, funding would be provided to cover a portion of the annual maintenance costs of access roads. Puget would also assume management of the access associated with Project operations, resource protection, and recreational facilities and activities. This measure would also provide the mechanism to identify the appropriate level of access that should exist on the east side of Baker Lake. The management strategies employed under this measure would be developed to maintain and perpetuate the natural features of the adjacent wildernesses and other public lands with status that prohibit development of roads or motorized access. Refer to appendix B for the full text of this measure.

Effects Analysis

The multitude of entities that hold rights of access across roads leading to the Project reservoirs combined with other management objectives related to access create a need for a comprehensive approach to acquiring and managing access related to the Project. This measure would provide funding and management oversight by Puget. The funding provided by this measure would supplement the maintenance funding used by the agencies with jurisdiction for various roads related to the Project. The public would likely see fewer potholes and rough surfaces on roads at the Project, which would improve user satisfaction. Better roads could lead to increased use at the Project recreational facilities, particularly overnight RV users.

There may be existing access that could be deemed to be inappropriate and subsequently restricted or eliminated under this measure. Visitors who have traditionally used such routes would likely be displaced by this action. In addition to disappointing these existing users, some visitors may seek out and establish new routes in the area, which may cause additional resource damage.

Coordination with other agencies and landowners would allow an access management program to be developed such that the risk of indirect effects on their lands and resources are prevented or at least minimized. In particular, improvements to access routes near wilderness boundaries could increase the number of people that visit the wilderness. Excessive increased use in areas designated as wilderness could degrade the inherent qualities, such as solitude and natural state for which the wildernesses were established. The coordinated approach to access management should prevent such effects.

5.10.2.6 Recreational Safety

The Project reservoirs provide visitors with the opportunity to enjoy outdoor recreational activities, such as lake fishing, swimming, and boating. The land adjacent to the reservoirs serves as a host to overnight and day-use recreational activities such as camping, picnicking, hiking, observing wildlife, hunting, shoreline fishing, and scenic driving. While participating in these activities at the Project, visitors may be involved in accidents or face unplanned events that create a danger to their health and well being.

Water Recreation Safety

Water safety for visitors related to boating and swimming is an important consideration at the Project reservoirs. Property damage, injuries, and death occur on bodies of water throughout the country as a result of unsafe watercraft operation.

This measure would provide public education for safe boating and hazard awareness in the form of educational displays at boat launches and swimming areas (see PME 2.1.1). The measure would also include installing floating booms at developed swimming areas where boating would be prohibited. Refer to appendix B for the full text of this measure.

Effects Analysis

These measures would increase boater and swimmer awareness of possible hazards and could reduce the potential for accidents at the reservoirs.

Boating Hazard Management

Stumps, snags, logs, and rocks that lie just beneath the water surface are potential boating hazards. Because these objects are not readily visible, boaters may strike them unknowingly and cause damage to their boats or injure passengers. Fluctuating reservoir levels, tall stumps located below the high water mark, and gradual slope of the land beneath portions of the reservoirs cause certain areas of the reservoirs to require more caution to avoid collisions with submerged obstacles when operating a boat.

This measure would include development of a boating hazard management plan to provide public awareness and removal or trimming of selected stumps and snags (PME 2.1.2). Public awareness would be accomplished through informational displays installed and maintained at the public boat launches. Additionally, Puget would identify submerged obstacles with flags or buoys, so boaters can avoid these areas. Snags and stumps would be evaluated for trimming or removal in the drawdown zone near the public and user-created boat launches. This evaluation would consider the reservoir elevations that are compatible with reservoir management regimes from April 15 to October 31 and the environmental effect of any stump removal would be assessed. Refer to appendix B for the full text of this measure.

Effects Analysis

Reducing boating hazards and making boaters aware of where submerged hazards exist would serve to improve public safety at the Project reservoirs. These measures would likely reduce the potential for boating accidents. Visitors would feel a greater sense of confidence to use more of the lake surface and would likely be more satisfied with their boating experience.

Stump removal would disturb the ground below the high-water mark. Assessing the environmental effects prior to removing any stumps, as outlined in the measure, would minimize impacts on soil, water, cultural, or biological resources.

Law Enforcement

The presence of people and projected increased visitation near the Project create a need to provide for public assistance. The types of situations that currently or potentially exist include theft, vandalism, disturbances, assault, wildland fire, the need for search and rescue, and boating and vehicle accidents. The northern reaches of the Baker River basin that lie within Whatcom County are physically isolated from the county as a whole. This makes it difficult for the sheriff's department to maintain a continued presence in the area and to have an adequate response time to incidents without stationing an officer in the area.

The Project reservoirs and associated recreational facilities are one aspect of a larger landscape the public uses and visits. Counties and agencies managing the public land surrounding the Project have jurisdiction and funding to provide law enforcement. These public agencies believe additional financial support is needed from Puget to adequately provide public assistance attributed to the additional people that are in the area to use the Project reservoirs. Some visitor surveys indicated that the rude or noisy behavior of other users negatively affects their visit to the Project.

Puget currently pays over $300,000 per year to Whatcom County in property taxes and understands that a portion of the property taxes paid by land owners in the county is intended to support public services, including law enforcement. Puget provides additional support for law enforcement to Whatcom County by providing and maintaining housing for a local deputy at the Project. The USFS currently provides $60,000 per year to Whatcom County to patrol National Forest System lands in the county.

The Draft Action includes a measure to create a formal agreement between Puget and various public agencies that provide law enforcement in the Project vicinity, including the reservoir surfaces (PME 2.1.3). The agreement would identify a specified level of funding, not to exceed $20,000 per year to be provided by Puget and/or housing for a locally stationed law enforcement officer. The agreement would also identify the patrols that would be conducted that are directly related to the Project, and the USFS would receive $10,000 per year from Puget to support the agency's fire prevention program.

Effects Analysis

The Draft Action is not clear as to the exact level of support that Puget would provide, and it has the potential to increase the presence of law enforcement officers in the vicinity of the Project. Because Puget already provides housing for a local sheriff deputy, the minimum scope of this measure would provide the same level of service that currently exists. If Puget also provides funding for law enforcement, this would provide a level of service greater than currently exists. Considering the USFS provides $60,000 to Whatcom County annually, the maximum $20,000 of additional funding that could be provided with this measure could increase the level of law enforcement by as much as 33 percent. The may mean that visitors would have a greater sense of security, disturbances and rude behavior may be reduced, and a shorter response time to incidents would exist.

Taking into account the spectrum of law enforcement needs and the variety of public land managing agencies with law enforcement responsibilities, it would be reasonable and appropriate to take a cooperative approach to providing for law enforcement at the Project. This approach would allow the various affected entities to take advantage of economies of scale and leverage their available funding to provide an acceptable level of public assistance. This measure would respond to the need for public assistance created by the Project, recognizing that it creates only a portion of the entire need in the area and that there are other entities with the primary responsibility to provide this service.

5.10.2.7 Public Information, Interpretation, and Education

A broad spectrum of resources, services, and facilities, accompanied by rules and regulations related to their use and enjoyment, exist at the Project. Communication with the public regarding these topics is a key component of managing recreational use. There are a variety of resources near the Project, such as wildlife and plants, that can provide visitors with enjoyment and fulfill their interest in nature. There are facilities and services that offer a spectrum of recreational opportunities in the area, including camping, hiking, day use, and boat launching, provided, of course, that the public is made aware of what facilities and services are available by signage, information displays, brochures or other means of readily available information. Rules and regulations exist to protect people and environmental and cultural resources, and these must be well communicated to the visiting public to be effective.

Visitors and land management agency staff identified the need to improve visitor information, interpretation, and education at the Project. Although most of the visitors who were asked what was needed to improve their visit said "nothing," the fourth most popular affirmative response was “better information and signage.” Agency staff participating in the relicensing process identified this need as well. Agency plans also place a priority on interpretation in response to a projected growth in public participation and interest in interpretive programs. Currently, visitors can obtain information about services and facilities at the USFS office in Sedro-Woolley, and at information boards at campgrounds, day-use areas, and boat launches at the Project. Rules and regulations are often included on these display boards. Interpretive programs and opportunities are not currently available at the Project.

The Project reservoirs and associated recreational facilities are one aspect of a larger landscape that the public uses and visits. Agencies managing the public land surrounding the Project have the mission and funding to provide information to the public about the land and resources they manage. These public agencies believe that Puget should contribute to this effort because of the additional people that are in the area to use the Project reservoirs.

Visitor Information

The Draft Action would create a visitor information program in coordination with the USFS (PME 6.5.1). Under this measure, Puget would provide 50 percent (not to exceed $10,000, annually) of the cost to provide visitor information services in the basin, including developing a visitor information kiosk, providing and distributing printed visitor information, and providing year-round visitor information services at the Lower Baker Visitors’ Center. The information to be provided would include details about recreational facilities available in the area, rules and regulations, safety, trail maps, interpretive program schedules, and environmental awareness literature. The information would also describe actions and undertakings in the area that are a result of the cooperative efforts between Puget and the various entities participating in the relicensing process. The materials or media developed for this program would be made available to the public at the Lower Baker Visitors’ Center, the USFS office at Sedro-Woolley, and Kulshan Visitors’ Center kiosk. Refer to appendix B for the full text of this measure.

Effects Analysis

This measure would improve visitor satisfaction. New visitors to the area may find it easier to locate a campground, day-use area, or other location that meets their needs and expectations. Visitors could also be made aware of opportunities that they did not know existed, such as trail or boat launch locations. This information would open up new opportunities to visitors that they could take advantage of during their visit. Providing information about safety would reduce the risk of accidents.

Informing visitors about rules and regulations would reduce unintended harm to other visitors and terrestrial, aquatic, and cultural resources. This measure may cause visitors to be more careful and thoughtful about their actions relative to the environment and other visitors during their visit. This could benefit the area by reducing noise, litter, damage to vegetation, soil erosion, water pollution, and disturbance to wildlife that can be associated with recreational use.

As a coordinated effort with the USFS, this measure would provide seamless information to the public by providing area-wide information at multiple sites. The public would receive consistent and easily accessed information. The sites at which information would be provided are the obvious places where the public currently seeks information and would be the best way to reach as many visitors as possible.

Considering the recreational opportunities associated with the Project are only a segment of the variety of recreational opportunities available in the vicinity and that the USFS has both the mission and funding to provide visitor information, it would be reasonable and appropriate to take a cooperative approach to provide visitor information at the Project. This approach would allow Puget and the USFS to take advantage of economies of scale and leverage their available funding to provide visitor information. This measure would respond to the need for Puget-created visitor information, recognizing that this information would only be a portion of the entire need in the area and that the USFS also would have a role in providing this service.

Visitor Interpretive Services

The Draft Action would create a visitor interpretive services program in coordination with the USFS (PME 6.5.2). Under this measure, Puget would provide 50 percent (not to exceed $10,000, annually) of the cost to provide the interpretive services program in the basin. This funding would supplement the USFS funding for interpretive services. In addition, new interpretive displays would be installed and existing displays would be replaced. All displays would provide interpretation related to local terrestrial and aquatic resources, cultural history and prehistory of the area or the development of the Project. Puget would also provide interpretive services in the Upper Baker area between Memorial Day and Labor Day each year.

At the Lower Baker Visitors' Center, visitor interpretive services would be provided during the recreational season, and the interpretive displays would be replaced or improved, as appropriate. Refer to appendix B for the full text of this measure.

Effects Analysis

The Draft Action would improve visitor satisfaction by giving visitors a greater understanding and appreciation of the local resources and history. This information may also cause visitors to be more careful and thoughtful about their actions relative to the cultural and natural resources during their visit. This could benefit the area by reducing noise, litter, damage to vegetation and cultural sites, soil erosion, water pollution and disturbance to wildlife that can be associated with recreational use.

This measure would add an important recreational opportunity at the Project that does not currently exist. This measure would include both a passive approach and an interactive approach to serve visitors who seek information about the area. Visitors would either come upon the displays during the course of touring the area or purposefully visit displays that they are made aware of through visitor information provided about the area. Visitors who take part in an interpretive program could ask questions and get more specific information about their interests.

Considering that the Project is one of many interpretive opportunities in the area and that the USFS has both the mission and funding to provide interpretive opportunities for the public, it would be reasonable and appropriate to take a cooperative approach to providing this service at the Project. This approach would allow Puget and the USFS to take advantage of economies of scale and leverage their available funding to provide interpretation of local resources and history. This measure would respond to the need for interpretive opportunities created by the Project, recognizing that it creates only a portion of the entire need in the area and that the USFS also has a role in providing this service. This measure would also respond to the projected growth in the number of people participating and interested in interpretive programs in the future.

Cultural and Natural Resource and Conservation Education

The Project reservoirs and operations provide an opportunity for educational activities for the residents of northwest Washington, including people residing in Puget's electric area served by the Project. Currently, there are few opportunities for in-depth learning about the natural and cultural resources, including fish, wildlife, vegetation, recreation, and history of the Project area. There are even fewer opportunities for people to be involved in learning about and supporting conservation and management of these public lands.

Although environmental education may be provided in schools, the effectiveness of such a program is greatest where target audiences live, work, recreate, and attend school. Although environmental education is mandated in the state of Washington, funding for environmental education programs is generally a low priority, particularly for low income, minority, or otherwise under-served populations. Puget currently operates the Baker Lake Lodge for environmental education programs.

The Draft Action would provide $20,000, annually, to organizations, such as federal or state resource agencies, local Tribes, schools, and private, non-profit organizations that provide cultural and natural resource and conservation educational services. Puget would also provide educational programs related to the Project with an annual budget of $20,000 (PME 6.5.3).

Additionally, Puget would host up to 24 overnight educational programs, providing meals and overnight accommodations at the Baker Lake Lodge. Target audiences would include teachers, children, recreation visitors, local residents, conservation professionals, employees of the Project, and residents of the surrounding communities. The program contents would include a range of environmental and conservation subjects, energy production, use and conservation; and the natural and cultural heritage of the Baker River basin. Instruction methods for these programs would include field and classroom activities in the vicinity of the Project for the participants. Refer to appendix B for the full text of this measure.

Effects Analysis

The Draft Action reflects a community-based approach to educating children, visitors, residents, and key professionals about energy and the environment. This measure would provide educational opportunities both at the Project and at other locations as provided by other entities that conduct environmental education. The Draft Action would provide an opportunity for the local and state residents to learn about their environment, natural and cultural resources, and power production. Because Puget already provides environmental education at Baker Lake

Lodge, this measure would continue to fill a funding gap in public schools to provide environmental education. By expanding the program to include visitors to the area, this measure would respond to the need to provide better information at the Project.

The outdoor setting and hands-on approach provided by this measure would maximize the effectiveness of this training and educational opportunity. Teaching children about their environment would have benefits into the future as these children become visitors to their public lands and resources. Their education may cause them to be more careful and thoughtful about their actions relative to the environment and energy consumption. This could benefit the area surrounding the Project as well as the state of Washington through energy conservation and a reduction in noise, litter, damage to vegetation, soil erosion, water pollution, and disturbances to wildlife.

5.10.2.8 Ongoing Recreational Resource Needs

The term of any new license would likely be 30 to 50 years. The Draft Action has been developed using the most current information on user preferences, natural and cultural resource constraints, projected recreational needs, technology, and agency planning documents. However, during the term of any new license issued, site conditions, policies, and regulations would likely change in ways that cannot be foreseen and this could affect recreation at the Project.

The recreation-related portion of the Draft Action includes developing a fund to be administered by the Recreation Resources Group of the BRCC. The level of funding is not known at this time. The funding would be used to support a range of proposals to study and implement actions associated with recreational sites and recreational experiences that would address issues that arise during the term of any new license issued that are not addressed by the Draft Action relating to recreation (PME 2.6.1). Refer to appendix B for the full text of this measure.

Effects Analysis

Considering the changes that occur over time in society, science, and technology, it is reasonable to expect that these changes may create a need to re-evaluate measures in the Draft Action for recreation or to implement new actions. The Draft Action recognizes the uncertainties that exist in the future and would provide a mechanism to accommodate changed conditions. Corrective action could be taken during the term of the license to avoid unsafe conditions, damage to cultural and natural resources and undesirable recreational use. Visitor satisfaction would likely be sustained because the measure provides a way for recreational use and development to be managed in a way that would be consistent with the user preferences and future trends.

5.10.2.9 Secondary Effects of Proposed Measures

Lower Baker Power Plant Modifications

The Draft Action includes modifications at the Lower Baker powerhouse (section 3.2.1) requiring earth moving and construction activity. Public access is not allowed beyond the gate near the Visitors' Center, so there would be no direct effect on recreational use. However, the construction activities may cause some disruption to visitors in the form of noise and construction traffic on the roads used to access areas with recreational use. Visitors may choose not to fish and picnic in the vicinity of the reservoir near the dam to avoid noise. Traffic could be disrupted if road closures are necessary for safety, and this may reduce public access during construction. These effects would only occur during the construction period of 2 years. It may be possible to minimize these effects by scheduling road closures and other disruptive activities during the middle of the week or in winter months.

Terrestrial Resources

The Draft Action includes measures to enhance habitat for various terrestrial and aquatic species, including elk, amphibians, osprey, loons, cavity dwellers, and bald eagles. If these actions are successful and populations of these species become more abundant, visitors to the Project would likely have greater opportunities to view wildlife and amphibians. This would likely cause visitors to have a better recreational experience at the Project.

PME 1.2.2 would improve foraging habitat for grizzly bears on lands owned by Puget. No grizzly bears currently inhabit the Project vicinity; this measure would only be implemented after grizzly bear occupancy of the area has been established. Grizzly bear forage enhancement would occur on sites located a minimum of 0.3 mile from motorized or non-motorized high-intensity use trails or roads.

This measure could have both beneficial and harmful effects on recreation. Some visitors may enjoy knowing that grizzly bears have been reestablished in the area. However, there could be an increased potential for interactions between bears and humans. Some visitors could be deterred from coming to the area if they perceive they might be in danger from grizzly bears.

PME 1.1.2 would use a testing program to evaluate the potential for establishing vegetation in the reservoir fluctuation zone. Since shorelines are locations where visitors bank fish, swim and picnic, some displacement of visitors could occur. This effect could be minimized or eliminated by carefully selecting the locations to implement this measure.

Under PME 1.4.1, special status plants would be inventoried and management plans would be developed for areas with new Project activity or disturbance. Since site surveys have not been conducted, it is not possible to determine if special status species are present at locations of proposed recreational development. However, if special status species are found at these locations, the scope or placement of proposed recreational developments could be affected. The effects could include relocation of facilities or reduction in overnight capacity and the availability of lakefront campsites. New developments under the Draft Action for hiking, biking, wildlife viewing, visitor education, and interpretive opportunities could be reduced or modified, if special status plant species are found during surveys and if it is determined that the proposed new recreational development or its associated visitor use is incompatible with management of special status plant species.

Aquatic Measures

The Draft Action includes measures related to fish passage, propagation, and enhancement. If the Draft Action successfully increases fish populations in the reservoirs, visitors would likely have greater fishing success. This could draw more people to the Project and increase occupancy at the developed facilities and dispersed-use areas around the reservoir. Increased use at developed and dispersed-use areas may increase the needs related to facility operation, maintenance, and replacement. Increased visitation may also cause more use on roads and trails, creating increased maintenance needs for these improvements. The actions and successes of the Draft Action related to fishery improvement would be appropriate and interesting topics for visitor interpretation and education. Considering that the existing visitors tend to return to the area in succeeding years, fishery improvements brought about by these measures would provide a source of information to base interpretive and education programs and materials that can be updated.

Cultural Resource Measures

Measures to protect cultural and historical properties are included in the Draft Action. PME 4.1.1 sets forth a process to evaluate and protect these resources without site-specific references. Currently, there is no coordination between management of the recreational facilities and activities at the Project with historic or cultural resource management. The Draft Action would establish a new process for historic and cultural resources management that may affect development of recreational facilities under the Draft Action. If cultural or historical properties are present at proposed locations for development and if the review required by the Draft Action reveals a conflict with recreational use, the scope or placement of proposed recreational developments could be affected. The effects could include a reduction in overnight capacity and the availability of lakefront campsites. New developments under the Draft Action for hiking, biking, wildlife viewing, visitor education, and interpretive opportunities could be reduced or eliminated if cultural or historic resources are found during surveys and if it is determined that the proposed new recreational development or its associated visitor-use conflicts with their management. Cultural and historic resources would be an appropriate and interesting topic for visitor interpretation and education.

5.10.3 Cumulative Effects

Many past events have contributed to the existing condition relative to recreation in the Baker River watershed. Native Americans and homesteaders established the first area trails, which allowed foot and horse travel. In later years, mountain climbers also used these trails in their attempts to climb Mt. Baker and Mt. Shuksan. Additional routes were established with timber harvesting and the area then became accessible to vehicles. Even more roads were constructed with development of the Project and the main route to the Project, the Baker Lake Highway, was eventually paved which further improved the ease of access for the public and created recreational attractions in the form of large reservoirs.

The area draws visitors from nearby communities as well as the larger Washington cities that are located farther away from the Project. As the population growth in these communities has increased over time, recreational use at the Project has also increased. In the 1950s as part of the USFS's mission to provide quality recreational experiences for the public, recreational facilities were constructed to accommodate this use and provide comfort and conveniences for visitors.

Nearby, wilderness areas and national parks were established, protecting the area from further development, timber harvest, and road construction. The protections afforded these lands created places where people could enjoy solitude in a forested mountain setting, rely on their own physical and mental abilities, and visit a place where human-made features are not evident on the landscape. The trail systems were formalized and agencies with the authority to manage these areas were funded to improve and maintain the trails for public use. As public use of these lands continued to increase, the USFS and NPS instituted a permit system for wilderness visitors.

In the future, the main trend that would affect recreation at the Project is the projected population increase in Washington. With an increase in population there would likely be increased urbanization of land near the Project. As people live closer to the Project, they have shorter distances to drive to recreate and this may translate into more people visiting the areas as well as more frequent visits from nearby residents. Increased visitation may cause local land management agencies to limit or redirect visitors if recreation use adjacent to the Project grows and degrades natural resources or visitor experiences beyond acceptable limits. Also, there would be an increasing proportion of the public that would be participating in outdoor recreation activities. Specifically, the activities that are projected to have the greatest proportional increase over the next 20 years include: (1) nature activities, (2) walking, (3) visiting a beach, (4) picnicking, (5) canoeing/kayaking, (6) bicycle riding, (7) non-pool swimming, (8) sightseeing, and (9) hiking.

Continued presence of the Project reservoirs would provide locations where demand for recreational activities with projected growth may be accommodated. Regionally, there are few large lakes and reservoirs where visitors may visit a beach, swim, canoe, and kayak. Considering the growing trend of these recreational activities and the scarcity of large bodies of flat water in the state of Washington, the Project is an important component of the landscape that would contribute to meeting the needs for public recreation. The new trails that would be constructed under the Draft Action would also contribute to meeting the projected need for sites where people can bicycle and hike.

If agencies restrict visitation on lands adjacent to the Project, the Project lands and waters may become hosts to displaced visitors. The Draft Action may provide recreational alternatives for visitors who may not be able to use the adjacent wilderness and National Forest System lands if future use restrictions are imposed.

5.10.4 Unavoidable Adverse Effects

The only unavoidable adverse effects of the Draft Action would be associated with the reconstruction at the Lower Baker powerhouse. There would be a short-term disruption to visitors during the 2-year construction period.

5.11 Aesthetic Resources

Note: The report from Study R-R5, which analyzes aesthetic resources, is due for completion in late October 2003.

5.11.1 Affected Environment

The Project is set in a rugged forested basin of the northern Cascade Range, incised by the Baker River and its tributaries. The river basin transitions at its mouth to the broader Skagit River valley. The aesthetic character of the area is mixed, reflecting both the striking natural setting and the effects of modifications from timber harvest, hydropower development, and the more urban characteristics of the Town of Concrete. The forested hillsides that dominate views in much of the Project area are a setting of outstanding natural beauty.

5.11.1.1 Visual Character of Project Area

The two primary viewsheds of concern for this Project are Baker Lake and Lake Shannon. Both are experienced from the Baker Lake Highway, the primary basin travel corridor and viewpoint for Project area visitors.

Baker Lake and its surroundings are within a USFS-designated scenic viewshed corridor and are managed to retain its high visual quality in the middle and foreground. The Northwest Forest Plan (USFS, 1990) projects that the 19,851-acre Baker Lake viewshed would retain a “slightly altered” visual condition throughout the projected 10-year planning period. Under this category, visitors may notice changes, but their primary impression should be of the natural appearance of the area. The Northwest Forest Plan defines management goals for the visual condition of the area to be “retention” and “partial retention.” The Sulphur and Anderson Creek viewsheds, tributary areas to Baker Lake, were inventoried as “heavily altered” from the effects of timber harvest and road construction. This condition was projected to remain the same or evolve to “moderately altered” during the planning period, likely in response to anticipated timber harvest activities. Because harvesting on federal lands was halted in the early 1990s under new planning direction (USFS and BLM, 1994, as amended), conditions have *[need description from Study R-R5 of changes over the last 10 years]*. Project lands in the Baker Lake area have a designated Visual Quality Objective of Partial Retention (USFS, 2002a) in which human activity may be evident, but it should remain subordinate to the natural landscape. An exception is an area north of Baker Lake, designated as Modification, where a greater degree of human activity can dominate the landscape.

The Lake Shannon viewshed is bracketed by the densely forested hills that extend from 3,000 to 4,500 feet around the lake. Views are dominated by these hillsides and the expanse of Lake Shannon. Coniferous vegetation, primarily Douglas fir, dominates the forests and is interspersed with mixed deciduous and other coniferous species. The Lake Shannon landscape has been more extensively modified by timber management activities than has the Baker Lake viewshed. Most of the land is commercially managed for timber production and cleared areas in various stages of regrowth are extensive. Roads constructed for timber harvest access have introduced linear forms to the landscape. Scattered rural residences and small farms are found in the southern part of the watershed. Views from higher elevations in this part of the basin include developed land uses in Concrete and the Skagit River valley. Because Lake Shannon is outside the USFS jurisdiction, inventories have not been performed to establish viewshed ratings and Visual Quality Objectives.

5.11.1.2 Project Features and Visibility

Puget conducted a visual resource study and identified a series of key viewpoints. These viewpoints are intended to provide a representative sampling of visual conditions within the Project area (figure 5-28, appendix A). They were selected to include both developed features and the natural setting observed by area visitors. *Summarize the viewpoints here from information to be provided in Study R-R5.*

Information to be obtained from the Study R-R5 when it is available.

The USFS expects an assessment of consistency with its Visual Management System: (a) "Landscape Visibility" designates key viewpoints and assesses context of Project from them; (b) "Landscape Character" assesses the variables that make a landscape identifiable and give it meaning (physical, biological, cultural heritage and current use patterns); and (c) "Scenic Attractiveness."

Baker Lake Viewshed

Use descriptions of viewpoints from Study R-R5. Describe appearance of constructed facilities and the extent to which they are evident from key viewpoints. Assess sensitivity of each. Describe seasonal variations in views of Baker Lake. Relate to seasonal nature of recreational use and primary viewing season. Note also that Baker Lake is drafted seasonally as part of a flood management provision of the existing license and through an agreement with the ACOE. The reservoir is drawn down up to 22.2 feet between November and March, corresponding to the period when the fewest visitors are present.

Lake Shannon Viewshed

Densely forested hills surround Lake Shannon, rising up to 4,500 feet. Evidence of human modifications is more common in the Lake Shannon area, where much of the land surrounding the lake is managed for commercial timber production. *Describe seasonal variations in views of Lake Shannon (effects of changes in water surface level); relate to seasonal nature of recreational use of Lake Shannon. Use descriptions of viewpoints from Study R-R5.*

5.11.2 Environmental Effects

To be provided upon completion of Study R-R5.

5.11.3 Unavoidable Adverse Effects

To be provided upon completion of Study R-R5.

5.12 Land Management and Use

5.12.1 Affected Environment

The Project vicinity is a rural setting in the Cascade foothills where forestry and recreation are the predominant uses. Some rural residences and small farms can be found in the lower elevations of the basin, outside the Town of Concrete. The Upper and Lower Baker dams are respectively about 8 miles and 1 mile north of Concrete. From this small community, two primary roads lead into the Baker River basin, the Burpee Hill Road, which leads from Concrete to the Baker Lake Highway, and a gravel secondary road leading to the east side of Lake Shannon. This rough route traverses large tracts of private property which periodically are not open to the public. For this reason, it is primarily used by local residents. The Baker Lake Highway, extending from State Route (SR) 20 to Baker Lake, is the primary route into the basin (figure 1-1).

The Baker River Project occupies lands within two counties, Whatcom and Skagit. All nearby communities are south of the Project, in Skagit County. The nearest is Concrete, a community of 790 (U.S. Census Bureau, 2003). Larger communities are closer to the Interstate 5 corridor, notably Mt. Vernon, Burlington, and Sedro-Woolley. The population of Skagit County in 2001 was approximately 105,247, a 2.2 percent increase from the previous year. This growth rate is slightly less than was experienced between 1990 and 2000 (U.S. Census Bureau, 2000). A similar pattern occurred in Whatcom County, with the 2001 population increasing by 2.4 percent to 170,849 from the previous year, a slight decrease from the previous 5 years.

Federal agencies (USFS and NPS) manage more than 86 percent of the watershed; the remainder is in state and private ownership. Recreational and natural resource management are the primary uses of public land, while commercial timber production is the predominant use of private land.

5.12.1.1 Land Ownership and Management Jurisdictions

The Upper Baker Development lies in Whatcom County and is largely surrounded by National Forest System lands within the MBSNF. To the south, the Lower Baker Development lies primarily within Skagit County and occupies a mix of state and private lands (table 5-36 and figure 5-29, appendix A).

Table 5-36. Approximate land and water area within the Baker River Project boundary.[a]

Project Area Component	Acres
Upper Baker	
Baker Lake reservoir area	
Puget ownership	325.2
National Forest System lands	4,539.7
Other private ownership	112.0
Subtotal reservoir area	4,976.9
Land area (all Whatcom County)[b]	
Puget ownership	271.3
National Forest System lands	585.3
Other private ownership	99.8
Subtotal land area	956.4
Upper Baker total reservoir and land	5,933.3
Lower Baker	
Lake Shannon reservoir area	
Puget ownership (Skagit County)	2,251.8
Subtotal reservoir area	2,251.8
Land area[c]	
Puget ownership (Skagit County)	221.4
National Forest System lands (Whatcom County)	43.5
Other ownership (Skagit County)	15
Subtotal land area	279.9
Lower Baker total reservoir and land	2,531.7
Baker River Project	
Reservoir area	7,228.7
Land area	1,236.3
Project total	8,465.0

[a] These numbers are based on 2003 Puget GIS data.
[b] Includes the area between elevation 727.77 feet msl (NAVD 88), the normal full-pool level for Baker Lake, and elevation 732.77 feet msl (NAVD 88), which defines the Project boundary for most of the Upper Baker Development, along with other areas within the Project boundary.
[c] Includes the area between elevation 442.35 feet msl (NAVD 88), the normal full-pool level for Lake Shannon, and elevation 443.75 feet msl (NAVD 88), which defines the Project boundary for most of the Lower Baker Development, along with other areas within the Project boundary.

Federal—Federal ownership is extensive at the Upper Baker Development, including 4,540 acres inundated by Baker Lake and 585 upland acres. Only 44 acres in the Lower Baker Development area (in Whatcom County) are federally controlled. Lands adjacent to Baker Lake are almost exclusively federally managed in accordance with the direction of the MBSNF LRMP (USFS, 1990) and the Northwest Forest Plan (USFS, 1994). These lands are designated as LSR to protect and enhance habitat for species associated with this habitat, most notably the spotted owl. Management objectives within this designation permit limited silvicultural treatments.

The Baker River above Baker Lake was identified as suitable and eligible for inclusion in the Wild and Scenic River System in the 1990 MBSNF Forest Plan. This Forest Plan recommended the first 2.1 miles of the river above Baker Lake as a "Scenic" segment and the upper 11.2 miles as a "Wild" segment. Baker River was found to possess outstandingly remarkable scenery, fisheries, and wildlife values. Noisy Creek, from its headwaters to Baker Lake (6.1 miles), was recommended for "Wild" designation based on wildlife and ecological values. The Forest Plan requires protection of the outstandingly remarkable values of these rivers in order not to preclude a future designation. Although Congress has not adopted these recommendations, the USFS manages the corridors as if the designations were in place.

Most lands on the east side of Baker Lake are designated by the Northwest Forest Plan as suitable for Semi-primitive Motorized recreation, reflecting motorized boat use on the lake. Such uses may not be consistent with the Northwest Forest Plan objectives. Lands to the west of the lake are designated as Roaded Natural areas.

State—Although there are no state-owned lands within the Project boundary, the WDNR administers approximately 5,000 acres in large patches to the east and west of Lake Shannon. The parcels range in size from about 40 to 640 acres. WDNR's forest lands are managed in trust for the benefit of institutions of the State of Washington, including schools and universities. Its lands in the Project vicinity are part of the North Puget Planning Unit, covered by a HCP (WDNR, 1997) to maintain and conserve habitat for the northern spotted owl and other listed and unlisted species. In addition to habitat protection, WDNR fulfills its state trust obligations by harvesting timber for commercial products. While the methods applied to a site are guided by the state Forest Practice Rules, generally the WDNR uses clearcut methods, or may select other methods if more appropriate to the specific habitat management objectives.

Counties—The Lake Shannon area is primarily within Skagit County, which has jurisdiction over private land uses outside the Project boundary. Skagit County assigns use designations to non-federal lands (Skagit County, 1997). Lands surrounding Lake Shannon and Lower Baker River are designated for forestry and mineral resource uses. Four zoning classifications apply to this part of the Project area. At the southern tip of Lake Shannon, lands are designated Secondary Forest. The goal of Secondary Forest zoning is to provide a transitional area between industrial forest uses and non-forestry land uses, allowing smaller scale resource production and more intense residential development (one dwelling per 20 acres). Concrete's incorporated area extends to Lake Shannon and these lands are managed under that community's planning process. The remainder of the Lake Shannon area is zoned Industrial Forest, designated to sustain production of forest products. Recreation development on

Industrial Forest land meets Skagit County objectives when supported by all affected land owners and when it does not conflict with commercial resource management. Two areas on the east side of Lake Shannon are designated in the Mineral Resources overlay, which allows mineral extraction and conservation of land for these purposes. These designations are consistent with one of the goals of the State's Growth Management Act (GMA), which is to maintain and enhance natural resource-based industries, including productive forest lands and to discourage incompatible uses (RCW 36.70A.020[8]).

The upper reach of Lake Shannon, Baker Lake, and the Baker River north of the lake are within Whatcom County. There are no land use designations in this portion of Whatcom County since the land is entirely within USFS jurisdiction. An exception to this is a private inholding at the southwest tip of Baker Lake, part of which is owned by Puget and designated by Whatcom County as Rural Forestry. The purpose of the Rural Forestry designation is to encourage non-industrial forest land owners to manage their lands for long-term productivity and sustained use of forest resources (Chapter 20.42, Whatcom County Code) and to manage these lands for wildlife, aesthetics and non-commodity uses. Specifically permitted uses include hydropower generation, recreation, and fish and wildlife propagation.

Town of Concrete—Puget's Project facilities extend within this community, although as a federal power withdrawal, they are outside the community's land management jurisdiction. Facilities include a fish handling complex, an adjacent visitor center with restrooms, interpretive displays, Project offices, abandoned concrete silos, and some maintenance facilities. These are within the community's Industrial zone, designated for retail and manufacturing services. Eight additional Project buildings and a storage yard are within a Residential zone of Concrete (Puget, 2002a). Puget provides a house in this area for a Whatcom County sheriff's deputy.

Private—Private lands owned by entities other than Puget can be found adjacent to the Project boundary on the southwest side of Baker Lake and around Lake Shannon. Ownership is primarily industrial forest products firms such as IP Forestry, Crown Pacific and Glacier Northwest. Some of these organizations allow public use of their roads at certain times of the year for recreational access. Dispersed camping also occurs on some private land.

Puget—Project features in Upper Baker Development area primarily occupy federal land. Puget-owned facilities include a 75-acre area on which Upper Baker dam, powerhouse, and an operations compound are located. Below the dam, at the confluence of the Baker River and Sulphur Creek, Puget maintains a gravel access road to the Spawning Beach 4 and fish rearing facilities. These two facilities are on USFS property, operated by Puget under a special-use permit.

Puget's ownership is much more extensive in the lower basin, including approximately 2,252 acres inundated by Lake Shannon. Lower Baker Project facilities are all within the incorporated boundary of Concrete. They occupy a narrow corridor extending south from the Lower Baker dam into the town. The dam, powerhouse, and surge tank occupy approximately 70 acres within the river corridor. The powerhouse is approximately 1,500 feet downstream of the dam, linked by a 1,410-foot-long buried penstock. Puget's offices and maintenance yards, approximately 0.75 mile downstream of Lower Baker dam, occupy 6 acres.

5.12.1.2 Land Uses and Access

Access to the Baker River basin is via SR 20, seasonally one of the main east-west routes across the Cascade Mountains that interconnects with Interstate 5. Baker Lake Highway is the principal roadway extending north from SR 20 into the Project area. Maintained by Skagit County, this paved road follows a route roughly parallel to the lakes, although about 0.5 to 1.0 mile to the west. Where the highway enters the National Forest, it leaves county jurisdiction and becomes Forest Road (FR) 11. Approximately 1.25 miles from its terminus, the highway brings travelers very close to Baker Lake. At this point, the pavement ends and the gravel travelway extends another seven miles, terminating about 1 mile beyond Baker Lake. Spur roads from this corridor lead to various Baker Lake access points.

Access to Lake Shannon, on the other hand, is very limited. No public roads extend from the Baker Lake Highway to the west shore of Lake Shannon. On the eastern side, the gravel Baker River Road extends from Concrete to the vicinity of Lower Baker dam. The unpaved road proceeds north beyond the Project facilities, where a spur switchbacks down steep terrain through private property to the Lake Shannon boat ramp. Glacier Northwest owns the access road and the property surrounding Puget's recreation site. Limited access northward on the slopes above Lake Shannon is available on a poorly maintained track, although through-access by the public along this road is not possible because most of the road is under private control and a damaged bridge over Thunder Creek (approximately two-thirds of the way up the lake) has not been replaced.

Historical use of the Baker River basin can be traced to the fur trading era of the early 1800s followed by intensive exploration by miners in the 1870s (Puget, 2002c). The extraction of gypsum, clay, and lime rock from sources in the Baker River drainage (materials used in the production of cement) became a long-standing and successful commercial enterprise. The first cement plant in the Pacific Northwest was developed in Concrete in 1906, and a second was operational by 1920; together they employed 400 workers. Cement was produced in the area until 1967 (Concrete, 2003). Raw materials were hauled from the basin via rail and then by overhead trolley after construction of the Lower Baker dam blocked the line. This rail line accelerated large-scale timber harvesting in the basin by the early 1920s. Development of the Lower Baker Project in 1924 to 1925 helped satisfy the growing demand for electrical energy from the local and regional economy. Other historical land uses in the basin include an early effort to sustain valued fisheries in the region when the state of Washington developed a sockeye hatchery at the historical location of Baker Lake in about 1906. Later assumed by the U.S. Fish Commission (now FWS), this facility was operational until 1937. Subsequent land uses in the Baker River basin predominantly have been timber production, hydropower generation, and recreation.

Commercial and industrial land uses in the Baker River basin currently include hydropower, timber production, and retail/services. Puget has operated hydropower facilities on the Baker River since 1925. In 1990, the Covanta Hydro Operations West's Koma Kulshan Project began operation on Rocky and Sulphur creeks, discharging into Sandy Creek, a tributary of Baker Lake. These are the only industrial uses currently occurring in the upper basin. In the lower basin, Puget's hydropower facilities and several quarry sites are the remaining industrial uses. The Town of Concrete is the center of commercial activity for the surrounding area, providing retail and service outlets. Within this community, Puget's Project facilities occupy approximately 6 acres and include offices, maintenance and storage facilities, a garage, and abandoned cement silos remaining from previous industrial activities. A 0.2-acre visitor center features a fish handling facility, informational exhibits, restrooms, and public parking.

Commercial timber production remains a major land use practice in the lower basin, where private and state-owned timberland dominates the lower to mid-elevations. Public and private forestlands at these lower elevations are managed primarily for production of softwood lumber in harvest rotations of 45 to 60 years. Federal lands in the basin administered by the USFS are managed to protect old-growth forest and the plants and animals that depend on this habitat. Commercial harvesting on federal lands in the upper watershed peaked in the 1960s. As the acreage of mature forest on public land declined, the effect on species dependant upon this habitat was acknowledged in the Northwest Forest Plan (USFS, 1990). This plan established a system of LSRs to provide habitat capable of supporting viable populations of species associated with late and old successional forests. The Baker LSR is about 82,100 acres and almost completely surrounds the Upper Baker Development. These lands are part of a network established throughout the range of the northern spotted owl to protect its nesting habitat. Recreational use of the basin continues to grow, and lands within the LSR may experience pressure related to this growth in human use. This presents management challenges for the USFS as it seeks to balance recreational uses with the provisions of the LSRs in popular areas such as the Baker River watershed. Because of these shifts in management objectives, no timber products are currently being removed from USFS lands (USFS, 2002a) except small amounts of firewood, cedar products, and hazard tree removal from campgrounds and road corridors.

Overlapping the LSR designations on the east side of Baker Lake is a segment of the approximately 27,800 acre Mt. Baker Noisy-Diobsud Inventoried Roadless Area (figure 5-30). This area was identified in 1979 by the USFS and included in the Roadless Area Conservation Rule published in the Federal Register on January 12, 2001. Until amendments to the Roadless Area Rule are released in late 2003, management direction for these lands will be consistent with the 1990 MBS National Forest Plan and the 1994 Forest Plan, which designates them as LSRs. When the USFS no longer is enjoined from implementing the Roadless Area Rule, within most of the Roadless Area proposed adjacent to Baker Lake, road construction and reconstruction would be prohibited. Within a more limited area, road construction would be permitted, if consistent with the LSR designation.

Opportunities for both developed and dispersed recreation are a highly valued land use in the Baker River basin. The Project reservoirs provide motorized and non-motorized boating and fishing opportunities in a natural setting that attracts many recreationists. National Forest System lands surrounding Baker Lake are designated either Roaded Natural or Semi-primitive Motorized (USFS, 2002a). Roaded Natural areas are accessible by the primary road system, in this case, the Baker Lake Highway. Much of the eastern shore of Baker Lake is designated Semi-primitive Motorized because of the influence of motor boats on the lake.

The regional population continues to grow and is expected to place increased recreational pressure on the natural attributes of the area. Currently, nine developed recreational sites in the basin provide approximately 300 campsites. Day use and overnight facilities, described in section 5.10, *Recreational Resources*, are operated by both Puget and the USFS. In addition, approximately 213 dispersed campsites were identified by Puget within 0.25 mile of the Project boundary and along the Baker Lake Highway, primarily in the upper part of the basin (Huckell Weinman, 2003a). Recreational use of the Lake Shannon area is significantly less than that of Baker Lake because lands surrounding Lake Shannon are privately owned, access is restricted, and the terrain is rugged. Although recreational activities peak in the summer, hunters are present in the fall, and in winter, miles of road and thousands of acres of National Forest System lands are open for snowmobiling and cross-country skiing.

Of particular attraction to some recreational users are the federally designated wilderness areas and a wild and scenic corridor. Two areas within the watershed, comprising 46 percent of the land, are designated as wilderness: the Mt. Baker Wilderness to the northwest of the Project and the Noisy-Diobsud Wilderness to the east (USFS, 2002a). West of Baker Lake is the Mt. Baker National Recreation Area, although it is primarily accessed through the basin to the west. The Skagit River Wild and Scenic corridor is due south of Lake Shannon, roughly paralleling SR 20. This designation, established in 1978, classifies the Skagit as a "Recreational" river. The USFS is interested in activities within the Baker River watershed as to their effect on the Skagit River and its "outstandingly remarkable" values (letter from J. Phipps, Forest Supervisor, MBSNF, USFS, Mountlake Terrace, WA, to L. Pernela, Manager of Licensing, Energy Production and Storage, Puget, Bellevue, WA, dated July 22, 2002).

The Project contributes to flood management along the middle and lower reaches of the Skagit River. Under a 1975 agreement with ACOE, Puget limits the maximum water surface of Baker Lake to provide 74,000 acre-feet of flood storage from mid-November to March 1. Flood control operation begins when natural flow in the Skagit River is forecasted to exceed 90,000 cfs. Flood control operations reduce the magnitude and frequency of flood events but do not prevent floods. The Federal Emergency Management Agency has defined a flood management boundary that includes all of Lake Shannon and the lower reach of the Baker River to its confluence with the Skagit. Project lands within the Town of Concrete are designated as Flood Zone A (appendix A, figure 5-30). The ACOE estimates that the Baker River Project prevented $90 million worth of flood damage since 1977 (presentation given by K. Brettmann, Hydraulic Engineer, Hydrology and Hydraulics Section, Seattle District, ACOE, Seattle, WA, to Economics and Operations Working Group, presented on October 28, 2002). Although Baker Lake flood control storage increases the volume and reliability of the combined flood control storage in the Baker River basin, flood control in the Skagit River Valley is limited by the comparatively large flood runoff from the basin's uncontrolled watersheds and the discharge capacity limitations of the main levees in the Lower Skagit River reach (ACOE, 2000b). In addition to the benefit derived by downstream land owners, the Northwest Forest Plan (USFS and BLM, 199a,b) cites the benefits of Project flood storage for the Skagit River Wild and Scenic corridor. The values of this corridor are preserved without the need for structural modifications within wild and scenic reaches.

The Project also supports fish production and rearing facilities on and adjacent to both Baker Lake and Lake Shannon. In the vicinity of Channel Creek in upper Baker Lake, three artificial spawning beaches have been constructed; two remain operational but are used only as auxiliary facilities. At the head of Lake Shannon on Sulphur Creek, Spawning Beach 4 has been operated since 1989. Adjacent to it is a large multi-species fish production facility.

5.12.2 Environmental Effects

5.12.2.1 Effect of Project Operations

Continued operation of the Baker River Project would influence land uses throughout the basin much as it has under the current license. Under the Draft Action, operational changes would not alter areas of inundation, change the flood management protocol, or construct significant new facilities in previously undisturbed areas. This section describes the effects of continued Project operation on three issues identified in the scoping process: (1) effects on farmland; (2) proximity of WDNR lands to the Project; and (3) effects on the Skagit River Wild and Scenic corridor. Section 5.12.2.2 describes the effects of various proposed measures on basin land uses, while the consistency of the proposed measures with federal, state, and local comprehensive plans is addressed in section 9.0.

Effects of Continued Project Operation on Farmland in Baker River Basin

Preservation of farmland from encroaching urbanization is an important issue to many in Skagit County. As development increases, conflicts arise between established agricultural uses and non-agricultural uses and industries. Skagit County planning ordinances (Chapter 5, Agricultural Resource Policies) specifically seek to preserve this local economic base (Skagit County, 2000).

Ongoing operation of the Project does not affect farmland in the Baker River basin. The Draft Action contains several terrestrial habitat management measures that would involve acquisition of lands or easements to protect specific types of habitat, some of which typically are provided by farms. The very limited amount of farmland in the Baker River basin is within areas zoned by Skagit County as Industrial Forestland.

Effects Analysis

Implementation of two terrestrial resource measures potentially could include farmlands in the basin. Neither would convert lands to developed uses. Under PME 1.1.1, Puget would acquire land or establish conservation easements for specific forest or wetland habitat types. If existing farmland supports wet meadow habitat, which is relatively uncommon in the steep basin, it potentially could be considered for this program. This habitat would be managed to meet the requirements of one of the seven analysis species identified by the WTRWG. Refer to appendix B for the full text of this measure.

Under PME 1.2.1, 575 acres of elk foraging habitat would be designated for protection. The Lower Baker River basin could provide some portion of this habitat, although specific locations of foraging habitat parcels will not be defined until ongoing forage investigations are complete. Some lands currently being farmed may be suitable for inclusion in the program.

Location of Project Lands in Relation to WDNR Lands and the Need for Leases or Rights-of-Way

Lands within the Project boundary, other Puget-owned lands, and WDNR-managed lands are depicted on figure 5-29, as are other ownership categories.

Effects Analysis

Until terrestrial enhancement lands are identified and potential recreation trail corridors are more firmly established, the potential to occupy WDNR lands cannot be determined.

Project Effects on the Values for Which the Skagit River Wild and Scenic Reach was Designated

The Baker River flows into a reach of the Skagit River designated for protection as a recreational segment of this federal Wild and Scenic River in 1978. A waterway designated under this category is considered to have recreational values that would attract regional visitation. The USFS manages this reach in partnership with non-federal parties, reflecting a diversity of ownership along the corridor. It is managed to protect fish and wildlife populations, primarily bald eagle and anadromous fish.

Effects Analysis

The primary influence of the Baker River Project on the Skagit River is its flow release regime. The Draft Action would sustain a regime that provides the same flood control requirements as under current operations and as under those operations in existence in 1978 and relatively constant releases of water for recreation and habitat benefits. As shown on figures 5-13 through 5-15, flows in the Skagit River under the Draft Action would be similar to current operations. Modeled flow projections indicate that median daily flows in the Skagit River would increase slightly during March through November and would decrease slightly from December through February, differences that are small in comparison to the magnitude of flows in the Skagit.

5.12.2.2 Secondary Effects of Proposed Measures

Lower Baker Power Plant Modifications

Puget would construct a new powerhouse below Lake Shannon to provide the desired ramping and minimum flow release control currently not possible with the existing facilities. This facility would be constructed at the same site as the original Lower Baker powerhouse that was destroyed by a landslide in 1965. It is immediately adjacent to the currently operating powerhouse. Construction of the powerhouse and a new bridge along the bank of the Baker River would require review under the state's Shoreline Master Program (SMP), administered at a local level by Skagit County or possibly by Concrete as the site is within its incorporated area.

Aquatic Measures

Downstream Fish Passage Facilities—Implementation of this measure generally would not conflict with current land uses (PME 3.2.3). In large part, the measure would involve modification or replacement of existing features, including the barge-mounted collection facilities and the associated downstream trucking facilities. New land uses would not be introduced with the exception of the proposed acclimation ponds. The ponds would be located in Concrete near the confluence of the Baker and Skagit rivers; however, a specific site has not been identified. If the selected site is within Puget's holdings, additional fisheries facilities would be consistent with current land uses. Additionally, continuing to facilitate the passage of anadromous fish to the Skagit River would help sustain the fishery value that is one of the primary factors for which it is designated for protection as a federal Wild and Scenic River.

Terrestrial Measures

Land Acquisition to Protect Forest and Wetland Habitat—The Draft Action would seek to acquire 216 acres of deciduous forest, forested wetland, shrub wetland and wet meadows within the Baker-Skagit drainage (PME 1.1.1). As described in appendix B, these lands would either be acquired or protected under conservation easements for the benefit of terrestrial species. Because specific parcels have not been identified, the land use effects cannot be assessed.

Provide Foraging Habitat for Elk—As described in appendix B, this measure would protect 575 acres of land for elk forage, at least 50 percent of which would be within the Baker River basin (PME 1.2.1). The investigation to identify the types of lands that would be suitable is currently in progress; therefore, no assessment of land use compatibility can be made at this time.

Provide Spring Forage for Grizzly Bears—This measure would provide 244 acres as grizzly forage habitat within the Baker BMU (PME 1.2.2). Currently, grizzlies do not inhabit the Project vicinity; the PME would be implemented only after occupancy of the Baker River basin by grizzly bears has been established. Forage habitat would be located a minimum of 0.3 mile from motorized or non-motorized high-intensity use roads or trails. Potential land use conflicts could occur with recreational users and could result in seasonal closure of some roads or trails. This land use would be consistent with the Grizzly Bear Recovery Plan (FWS, 1993) and recovery plan direction for the North Cascades Grizzly Bear Ecosystem (Servheen, 1997).

Recreational Measures

Manage Dispersed Camping—Under this measure, Puget would fund actions by the USFS to restore, manage, or decommission certain dispersed campsites in the Baker Lake vicinity (PME 2.2.2). Although specific sites have not been selected for treatment, this measure could have long-term land management benefits as some sites in environmentally and culturally sensitive areas would be closed. Conversely, a management challenge would be to effectively close sites without displacing users to adjacent areas, particularly in LSR lands.

Create New Trails—The Draft Action would fund the development of a number of new multi-use trails (PME 2.4.1). Potential locations include the West Baker Lake trail from the Bayview Campground to Kulshan Campground with a connection to Horseshoe Cove; short loop trails at the Panorama Point Campground and at Shannon Creek Campground; trail connecting Kulshan Campground, Depression Lake, West Pass Dike and Glover Mountain; and a short loop trail on Project lands in Concrete. Additionally, an East Lake Shannon Trail is under consideration, but as a secondary development priority to Puget. These segments were examined by Puget (Huckell Weinman, 2003a) to identify implementation constraints. This section describes potential land use constraints to the extent they are known. Potential trail routes have been mapped, although at the time of this analysis, field verification has yet to confirm their physical and aesthetic feasibility. Similarly, the potential corridors have not been discussed with land owners.

The highest priority trail segments are in the Baker Lake vicinity, where existing use is concentrated. The creation and improvement of trails in this vicinity is expected to increase recreational use. West Baker Lake trail segments extending outside the existing Project boundary would traverse USFS lands designated as LSRs. LSRs are managed to maintain functional late successional and old growth ecosystems, an objective that may not be consistent with increased human activity, which has the potential to reduce nesting productivity of protected species (USFS, 2002a). The Northwest Forest Plan determined that new development should not be permitted in LSRs unless the use objectives could not be met elsewhere, and then would only be permissible if the development had a neutral impact or could be effectively mitigated. Many of the proposed West Baker Trail segments are in designated LSRs. In its evaluation of potential trail segments, the USFS will need to determine if development in the LSR will be evaluated on a site specific level or a basin-wide level. This determination will establish if and where trails can be constructed in the vicinity of Baker Lake.

The proposed trail route at East Lake Shannon is conceptual at this stage. This corridor is of secondary development priority to Puget, as use in this area is less and development constraints may be significant. Additionally, it has yet to be determined whether the potential trail would use an existing road corridor or pioneer a new route. The primary constraints associated with the East Lake Shannon segments are private land ownership and geologic hazards. Conceptual plans site the trail across lands managed by Puget, the WDNR and various private owners. As specific discussions with these owners have not been initiated (personal communication, A. Hatfield, Puget, Bellevue, WA, with C. Efird, Louis Berger, Sacramento, CA, on July 30, 2003), compatibility can be assessed only in a general way. The trail would be entirely within Skagit County and the county Comprehensive Plan designates the area for forestry and mineral resource land uses (Skagit County, 2000). The goals for both categories seek to maintain these commercial endeavors and to prevent conflicts between industrial and non-industrial uses. The Comprehensive Plan allows recreation development in Industrial Forest zones if land owner approval is obtained and if the new use would not conflict with extraction resource activities.

The segment of trail proposed in the Town of Concrete would be within the jurisdiction of that community's Comprehensive Plan (Concrete, 2001). About half of the route would be within the existing Project boundary. The area from Lake Shannon along the Baker River to SR 20 is designated Forestry/Open Space, Public and Industrial under the Comprehensive Plan. The intent of the Open Space designation is to encourage appropriate natural resource management. The Public designation provides land for government services and facilities, and the Industrial designation concentrates industrial and commercial services that have greater impacts than other urban uses. Because trail segments would cross these various designations, an evaluation of consistency would be needed by Concrete before final segments are selected.

Bayview Campground—This 28-site family campground was nearly completed at the time USFS funding was withdrawn (PME 2.5.1). Campground infrastructure is in place, including roads, restrooms and campsites, although all would require substantial rehabilitation to meet current standards. Some use is made of this site as an overflow group camp area when the nearby Horseshoe Bay Campground is at capacity. Completion of this facility therefore would not represent a change from current land uses.

Provide Access and Development at Lake Shannon or Another Suitable Lakefront Site—This measure, defined in appendix B, identifies the need for enhanced lake-based recreation use at Lake Shannon, or if obstacles to improved development cannot be overcome here, at another suitable Skagit County lake (PME 2.5.3). Lake Shannon is the largest lake in the county and provides substantial flat-water boating opportunities, accessible to the public at a single site with limited services that Puget operates. Slopes on either side of the lake are quite steep and are characterized by a relatively high number of geologic hazards (Huckell Weinman, 2003b). Land ownership is a mix of state trust lands managed by WDNR, corporate resource lands (timber and minerals), limited Puget lands and a number of small private parcels. Implementing the site improvements proposed in the Draft Action would require overcoming obstacles that include steep slopes, poor access, and private land constraints. Should Puget successfully negotiate permanent public access on the private road to the existing Lake Shannon boat launch site, improvements here would be an expansion of an existing use. Skagit County would need to evaluate the consistency of the use with its land management objectives that favor extractive industries. No other potential Skagit County sites have yet been identified as suitable lakefront alternatives to Lake Shannon.

Fund Wildlife Observation Facility—As described in appendix B, this measure would establish new facilities for wildlife observation and interpretation (PME 2.5.6). The Little Park Creek wetland complex, adjacent to FR 11, has been identified as a potential location. A complete evaluation of suitable sites has yet to be completed; therefore, no assessment of land use compatibility is made at this time.

Access Management

Implement an Access Management Program—Access to Baker Lake and Lake Shannon is an important public benefit of the Project, but one that needs to be managed in order to protect the ecological and cultural values of the area (PME 6.4). Puget's Draft Action would include a program to manage access on Project lands and the need for access to adjacent recreation areas. Currently no specific measures have been proposed. The general intent of the measure is to balance the needs of various resources; therefore, consistency with established land uses would be sustained or improved. The USFS issued a scoping report for road management on USFS lands in the Baker River watershed (USFS, 2003d*)*. Under this plan, the USFS would permanently or seasonally close many spur roads off FR 11 near the northwest end of Baker Lake for the protection of wildlife (elk, mountain goat, grizzly bear, or bald eagles) or to convert road segments to recreation trails. Puget's measure is expected to be consistent with these objectives.

5.12.2.3 Consistency with State and Local Requirements

Skagit Wild and Scenic River Management Plan

The Skagit River is part of a national system of rivers protected under the Wild and Scenic Rivers Act (PL 90-542).[23] The Skagit Wild and Scenic River System was designated in 1978, and is managed by the USFS under a plan prepared in 1983. No portion of the Project's works, all of which existed prior to the Skagit River's designation, lie within the designated river area. The corridor does, however, benefit from the flood control that the Baker River Project provides. The Draft Action would maintain flood management as an operational objective and maintain similar as existed in 1978 and, therefore, would be consistent with this plan.

Skagit River Basin Planning (RCW 90.82)

In April 1998, the Washington legislature passed a measure to promote watershed-based planning in the state. Plans are to be developed by WRIA boundaries. The Skagit River Basin is divided into two inventory areas: the Lower Skagit (WRIA 3) and the Upper Skagit (WRIA 4). The Baker River is within WRIA 4 and flows from the Baker River also influence some Skagit River reaches of WRIA 3. The priority goals identified for WRIA 4 include establishing scientifically justifiable instream flows, meeting instream flow needs, meeting out of stream priority water rights, meeting future out of stream water rights, and developing strategies of increasing water supplies. The watershed assessment for WRIA 4 has not been completed, and the priority goals have not yet been addressed in planning or regulation. The Draft Action would not alter flow volumes that reach the Skagit River, although minimum flows between the existing Lower Baker powerhouse and the mouth of the Baker River would be increased from approximately 80 cfs to 300 cfs.

Skagit County Comprehensive Plan

Skagit County's Comprehensive Plan was adopted June 1, 1997, to establish a framework for the more detailed growth planning and implementation actions in designated unincorporated urban growth areas and in the County's rural areas.

The Baker River Project occupies four planning districts. The Comprehensive Plan designates the area around Lake Shannon and along the Baker River for forestry and mineral resource land uses. The southern tip of Lake Shannon is designated as an Incorporated Area (see

[23] The USFS studied the Baker River upstream of the project as "eligible" for inclusion under the Act due to remarkable scenic, fisheries and wildlife values and few potential resource conflicts; to date the Baker River has not been listed.

Town of Concrete Comprehensive Plan) and Secondary Forest. Secondary forestlands provide a transition between industrial forest uses and non-forestry uses, allowing smaller scale resource production. Most of the Lake Shannon area is designated as Industrial Forestland. Industrial forestry resource policies include goals to improve government relations with the forestry industry, promote innovative resource planning, improve economic stability of the forest products industry, establish and implement forest conservation strategies, and define permitted land uses. The Mineral Resources Overlay area establishes goals that seek to maintain and enhance long-term commercially significant mineral resource lands and scientific resource sites, and prevent conflicts between industrial and non-industrial land uses.

Land uses within the Forestry designations may not preclude industrial forestry practices and should not create inholdings of conflicting uses. The County's Comprehensive Plan encourages recreational opportunities that do not conflict with commercial natural resource management and that are supported by all affected land owners. For those elements of the Draft Action that would occur on properties outside of the FERC Project boundary, additional County comprehensive planning and development regulation consistency would be required. For example, the proposed East Lake Shannon trail may require County and land-owner approval. Additionally, road improvements or trail development could present potential conflicts in the Mineral Resource Overlay, and could require resolution between Puget, the private land owners, and the County to minimize potential conflicts with any mining operations.

The State's GMA directed counties to adopt shoreline management goals as part of their comprehensive plans. The recreation objective of Skagit County's Comprehensive Plan (Objective 8) encourages public access to shorelines and specifically encourages the expansion of access in areas already used for such purposes where shorelines can support expanded activities.

Whatcom County Comprehensive Plan

Whatcom County's Comprehensive Plan was adopted in May 1997 to guide growth in unincorporated areas of the County for 20 years (1997–2017), in coordination with local cities and in compliance with the Washington GMA. Because the federal government owns the majority of land around Baker Lake, the Comprehensive Plan does not include land use designations for this area, with the exception of a private inholding at the southwest tip of Baker Lake, designated are Rural Forestry. The Draft Action does not include any measures that would be inconsistent with this designation, as it permits hydropower generation, recreation and fish and wildlife propagation.

Whatcom County Shoreline Management Master Program

Title 23 of the Whatcom County Code establishes the County's Shoreline Management Program (adopted 1976, amended 1998). Although the lands within the Project boundary are outside of the jurisdiction of Whatcom County, the shoreline of Baker Lake is designated as one of Statewide Significance (including associated uplands and wetlands). The general priorities identified in the Program are the same as those itemized for the Skagit County SMP. Federal projects located on federal lands are not subject to state or county shoreline authority. Therefore, Project activities on USFS land in Whatcom County are expected to be exempt from the provisions of this program. However, any Project activities that occur within the County's shoreline areas would be subject to a consistency analysis under the CZMA and, through delegation of authority, the County's SMP.

Town of Concrete Comprehensive Plan

The Town of Concrete adopted its Comprehensive Plan in May 1998 for a 20-year planning period (1998–2018) and includes land use designations for long-term planning and zoning. The area from Lake Shannon along the Baker River to SR 20 is designated as Forestry/Open Space, Public, and Industrial. The intent of the Open Space designation is to encourage appropriate natural resource management in areas of Concrete that are best suited for low-density housing, open space, wildlife habitat, steep slope protection, water resource management, and activities/uses consistent with such management practices. The Public designation is intended to provide land for government services and facilities, and the Industrial designation to concentrate industrial and commercial services that have higher effects than other urban uses, such as manufacturing, commercial lumber yards and other related uses. Although conformance with the Town's comprehensive plan is not required for actions within the FERC Project boundary, measures proposed under the Draft Action, including a new powerhouse, upgraded fish passage facilities, and recreation trails, appear to be consistent with the various Comprehensive Plan designations.

Town of Concrete Shoreline Management Program

Concrete adopted the Skagit County Shoreline Management program (see section 9.1.7) to implement state direction for management of shorelines within the boundaries of the town. Consistency of the Draft Action with this plan would be determined for construction of the new powerhouse and the associated access bridge; modifications to the fish collection facilities at the barrier dam; and potentially a recreation trail adjacent to the Baker River. It is unclear at this time whether measures included in the Draft Action would be evaluated by Concrete or if its authority would be delegated to Skagit County.

5.12.2.4 Unavoidable Adverse Effects

No unavoidable adverse land use effects have been identified.

5.13 Effects of No-action Alternative

Under the No-action Alternative, Puget would continue to operate the Baker River Project generally as it has operated the Project in the recent past (refer to section 3.1.2, *Current Project Operation*). With no change to operating mode, the Project would continue to provide electrical generation and dependable capacity at current levels. No new environmental measures would be implemented, and the Project would continue to affect the Baker and Middle and Lower Skagit rivers as it has over the recent past. Land uses in the Project area would be similar to existing uses. Management of some Project lands could change, depending on utility goals during the term of any new license issued. Development along the SR 20 corridor would be expected to gradually become more dense as the population of Skagit County increases, placing greater pressure on the Baker River recreational facilities and on Project lands to preserve wildlife habitat. Flood management would follow current practices, so levels of downstream flood protection would remain unchanged.

6.0 DEVELOPMENTAL ANALYSIS

In this section, we look at the Baker River Project's use of the Baker River for hydropower purposes to see what effect various environmental measures would have on the Project's costs and power benefits. To estimate the net benefits of an alternative, we compare Project costs to the value of the power output. For any alternative, a positive net annual power benefit indicates that the value of the power exceeds the Project's costs.

6.1 Power and Economic Benefits of the Project

We base our economic studies on a 30-year period of analysis[24] and current (2006) price levels.[25] Consistent with the Commission's approach to economic analysis, the value of the power is determined by estimating the cost of obtaining the same amount of energy and capacity using other resources. Table 6-1 summarizes the assumptions we use in our analysis. Puget is a regulated utility, and the analysis reflects the authorized return on capital as accepted by the Washington Utilities and Transportation Commission (WUTC).

Under current conditions (No-action Alternative), and in the absence of any new environmental measures, we estimate annual Project costs as shown in table 6-2 under both no-inflation and with-inflation scenarios. The no-inflation scenario serves the Commission's economic analysis requirements consistent with the Mead Decision of 1995.[26]

We base the energy values for on-peak and off-peak generation on Puget's modeling to support its least cost plan (Puget, 2003b). We base the capacity value on the cost of replacing lost dependable capacity with a simple cycle combustion turbine and include only capital costs and fixed operations and maintenance costs in determining this value.

Under current conditions (No-action Alternative), the Project provides average annual generation of 701,089 MWh[27] and a dependable capacity of 148.30 MW as shown in table 6-3 (without inflation) and table 6-4 (with inflation). The annual power benefits under current conditions are $35,448,300 (without inflation) and $44,839,100 (with inflation).

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[24] The term of any new license issued will be determined by the Commission in the license order.

[25] For purposes of economic analysis, we assume that implementation of any new license terms would begin in 2006, the year of current license expiration, and we use 2006 as the base year of the analysis.

[26] Mead Corporation, Publishing Paper Division, 72 FERC ¶ 61,027 (July 13, 1995).

[27] This modeled value of average annual generation differs from the Project's historical generation of 708,000 MWh (as reported in section 2.2, *Need for Power*).

Table 6-1. Economic analysis parameters. (Source: Puget)

Base Year	2006
Period of Analysis (years)	30

Taxes and Insurance (%)	
Federal income tax rate	35
Levy rate	66
Assessment rate	1.48
Insurance	0.07

Energy Value ($/MWh) ($2006)	**Peak**	**Off-Peak**
January	39.09	30.82
February	40.15	31.37
March	37.98	32.22
April	35.58	26.00
May	26.99	20.25
June	18.94	17.63
July	41.41	37.27
August	52.83	42.34
September	49.05	41.62
October	43.45	39.21
November	43.98	38.90
December	45.37	39.40

Inflation	**No Inflation (%)**	**With Inflation (%)**
Energy values	0.00	2.50
O&M costs	0.00	2.50
Capital costs	0.00	2.50
Capacity Value ($/MW-year)[a]	63,500	80,900

Debt Structure	**Mix (%)**	**Raw Rate (%)** (No Inflation)	**Adjusted Rate (%)** (No Inflation)	**Raw Rate (%)** (With Inflation)	**Adjusted Rate (%)** (With Inflation)
Long-term debt	52.07	4.91	2.55	7.53	3.92
Short-term debt	5.50	1.95	0.11	4.50	0.25
Preferred	2.43	5.15	0.13	7.78	0.19
Common	40.00	8.29	3.32	11.00	4.40
Weighted average cost of capital[b]		--	6.10	--	8.76

[a] Source: Application for New License, exhibit D, table D-6.

[b] The weighted average cost of capital serves as the discount rate.

Table 6-2. Current annual costs.

	No Inflation			With Inflation		
	Capital Cost	Annual Expense	Total Annual Cost	Capital Cost	Annual Expense	Total Annual Cost
Net investment[a]	0	--	0	0	--	0
Future major capital cost[b]	15,971,200	--	1,105,700	15,971,200	--	1,398,600
Existing plant operations and maintenance[c]	--	3,079,000	3,079,000	--	3,894,700	3,894,700
Commission fees[d]	--	604,000	604,000	--	764,000	764,000
Relicensing costs[e]	20,320,000	--	1,406,800	20,320,000	--	1,779,500
Total	36,291,200	3,683,000	6,195,500	36,291,200	4,658,700	7,836,800
Total adjusted	--	--	7,290,800	--	--	9,098,800

[a] Net investment is the depreciated Project investment allocated to power purposes.

[b] Future major capital costs include major plant rehabilitation to maintain present-day capability scheduled between 2006 and 2035 and are expressed as a present value.

[c] Existing plant operations and maintenance includes operations and maintenance related to environmental measures associated with the current license. All new PMEs are incremental and presented in tables 6-5 and 6-6.

[d] Commission fees are based on statements of annual charges received from the Commission for federal lands and administrative charges based on authorized capacity.

[e] Relicensing costs include the administrative, legal/study, and other expenses to date and an estimate of the additional amount to be spent between now and license issuance.

[f] Adjustments include the effects of depreciation, income tax, property tax, and insurance.

Based on Interim HYDROPS Model Output (mid-July 2003)

Table 6-3. Project output and annual benefits summary ($2006, no inflation).

	No action (Current Operations)	Draft Action[a]	Draft Action minus No action
On-peak Generation			
Energy (MWh)	519,000	531,306	12,306
Value[b]	$20,226,000	$20,759,900	$533,900
Off-peak Generation			
Energy (MWh)	182,090	170,052	–12,038
Value[b]	$5,800,000	$5,573,200	–$226,800
Total Generation			
Energy (MWh)	701,089	701,358	269
Value	$26,026,000	$26,333,100	$307,100
Dependable Capacity			
Capacity (MW)	148.30	142.46	–5.84
Value	$9,422,300	$9,123,900	–$298,400
Total Power Benefits			
Value	$35,448,300	$35,457,000	$8,700
Unit value of benefits ($/MWh)	50.56	50.55	–0.01

[a] Draft Action is assumed to include 3 years without the new turbine generator at Lower Baker and 27 years with the new unit, based on a 2009 on-line date for the new unit.

[b] Our value of generation is based on modeling conducted to support Puget's *Least Cost Plan*. We have used values from 2004 and escalated the values to 2006. Reference table 6-1.

Based on Interim HYDROPS Model Output (mid-July 2003)

Table 6-4. Project output and annual benefits summary (with inflation).

	No action (Current Operations)	Draft Action[a]	Draft Action minus No-action
On-peak Generation			
Energy (MWh)	519,000	531,306	12,306
Value ($2006) [b]	$25,584,200	$26,259,500	$675,300
Off-peak Generation			
Energy (MWh)	182,090	170,052	–12,038
Value ($2006) [b]	$7,336,500	$7,049,700	–$286,800
Total Generation			
Energy (MWh)	701,089	701,358	269
Value ($2006)	$32,920,700	$33,309,200	$388,500

	No action (Current Operations)	Draft Action[a]	Draft Action minus No-action
Dependable Capacity			
Capacity (MW)	148.30	142.46	–5.84
Value ($2006)	$11,918,400	$11,541,000	–$377,400
Total Power Benefits			
Value ($2006)	$44,839,100	$44,850,200	$11,100
Unit value of benefits ($/MWh)	63.96	63.95	–0.01

[a] Draft Action is assumed to include 3 years without the new turbine generator at Lower Baker and 27 years with the new unit, based on a 2009 on-line date for the new unit.
[b] Our value of generation is based on modeling conducted to support Puget's *Least Cost Plan*. We have used values from 2004 and escalated the values to 2006, and then continue to escalate through 2035.

6.2 Cost of Environmental Measures

In this section, we estimate the annual costs of the various environmental measures contained in the Draft Action. First we address the impact of the operational changes on power benefits in terms of energy and capacity replacement costs. Then we estimate the cost of other PME measures.

6.2.1 Cost Impacts of Operational Changes

Currently, Puget generally operates the Baker River Project in coordination with its other power supply resources to meet the power needs of its customers. On a weekly basis, the demand for electricity is generally higher Monday through Saturday than on Sunday, and, on a daily basis, the demand for power peaks during the morning (6 a.m. to 10 a.m.) and early evening (5 p.m. to 9 p.m.). Typically, the Project generates power on weekdays and often on Saturday between 6 a.m. and 10 p.m. that corresponds to heavy load (on-peak) hours. Depending on lake levels, inflows, weather forecasts, and system demand, the Project may not generate weeknights and on weekends, particularly Sunday. During periods of high inflow, however, the Project may generate continuously for several days or weeks.

Puget provides a continuous minimum release of 80 cfs at the Lower Baker Development for the operation of the adult fish trap-and-haul facility located 0.3 mile downstream of the powerhouse. Additionally, in a voluntary program to reduce the potential for fish stranding, Puget seeks to limit the average downramp rate in the Baker River downstream of the Lower Baker powerhouse to 2,000 cfs per hour whenever the Skagit River flow falls below 18,000 cfs, as measured at the Skagit River near Concrete gage.

Operational changes, if implemented, would affect both energy generation and dependable capacity. We base our estimates of energy impacts on data provided by the HYDROPS model, a hydropower operations computer optimization model. We determine dependable capacity impacts by estimating Project capacity during a critical hydrologic period.

The Pacific Northwest Region adopted September 1936 through April 1937 as the critical period (ACOE, 1999). The most recent period similar to the critical period reflecting current Skagit River operations by Seattle City Light is January 2001 through April 2001, and we use this period for determining dependable capacity.[28]

The Draft Action operation includes a modified reservoir management regime (PME 6.3). It also includes a new downstream release regime consisting of minimum flows and ramp rates (PME 3.3.1). To implement this release regime, specifically the ramping limits, and to generate power with the minimum flow releases (300-cfs year-round of which 245 cfs may flow through the unit and 55 cfs will accrue from leakage), Puget would install a new 12.5-MW turbine generator at the Lower Baker Development. We display the impact of these operational measures on power benefits in table 6-3 (without inflation) and table 6-4 (with inflation).

Under Draft Action operations, the Project provides average annual generation of 701,358 MWh and a dependable capacity of 142.46 MW. The effect of the Draft Action operations, in conjunction with the new turbine generator, would be an increase in on-peak energy, but a reduction in dependable capacity relative to No-action.

The on-peak energy generation under the Draft Action is increased due to the greater hydraulic capability of the new turbine generator in tandem with the existing Lower Baker Unit 3. The dependable capacity decreases under the Draft Action because of two factors. First the minimum instream flow increases from 80 cfs under current operations to 300 cfs under the Draft Action. Furthermore, the Draft Action ramp rate measure requires a greater quantity of water to downramp at the Lower Baker Development. Both of these factors result in less water available for generation during the high demand hours of the critical period.

In combination, the increased on-peak generation and the reduced dependable capacity of the Draft Action result in a negligible effect on annual power benefits compared with No-action.

6.2.2 Cost of Other Environmental Measures

The Draft Action includes numerous environmental PME measures that do not affect Project operations and power benefits, but would affect Project costs. Table 6-5 summarizes the annual costs of the measures included in the Draft Action.[29]

6.3 Comparison of Alternatives

In this section, we summarize Project output, power benefits, and costs under the No-action Alternative (current conditions) and the Draft Action Alternative. The net effect of implementing the Draft Action is a $8,292,300 reduction in the net annual levelized value of the Project (about 29 percent of the net benefit) without inflation (table 6-6), or a $10,353,600 reduction (about 29 percent of the net benefit) with inflation included (table 6-7).

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[28] For a detailed explanation of the method for determining dependable capacity impacts, see the presentation given by M. Killgore, Louis Berger, Bellevue, WA, to the Technical Scenario Teamlet dated August 1, 2003, at www.pse.com/hydro/baker/meetings/technicalscenariohandouts.

[29] The annual cost is that levelized annual amount that is equivalent to the present value of the stream of planning, design, implementation, construction, operation, and maintenance costs over the 30-year period of analysis.

Table 6-5. Summary of Draft Action PME measures for the Baker River Project.

Measure	Annual Cost	
	No Inflation	With Inflation
Terrestrial Resources		
1.1.1 Provide young deciduous forest, forested wetland, shrub wetland and wet meadow	$51,100	$64,600
1.1.2 Evaluate the potential for establishing beneficial vegetation in the fluctuation zones	4,600	5,800
1.2.1 Provide foraging habitat for elk	69,300	87,600
1.2.2 Provide spring foraging habitat for grizzly bears	25,800	32,600
1.2.3 Provide summer habitat for mountain goats	3,700	4,700
1.2.4 Provide breeding habitat for amphibians	16,500	20,800
1.3.1 Provide nest structures for osprey at Lake Shannon	2,000	2,600
1.3.2 Provide floating nest platforms for common loons	4,800	6,000
1.3.3 Provide habitat for riparian cavity dwellers	3,900	5,000
1.3.4 Support the development of bald eagle nest management plans	500	600
1.4.1 Protect plants of special status	6,500	8,200
1.4.2 Develop and implement a noxious weed management plan	10,900	13,700
1.5.1 Provide a Terrestrial Enhancement and Research Fund	13,400	17,000
Subtotal	$213,000	$269,200
Recreational and Aesthetic Resources		
2.1.1 Implement a water recreation safety program	3,300	4,200
2.1.2 Develop and implement a boating hazard management plan	4,500	5,600
2.1.3 Develop law enforcement support	55,800	70,600
2.2.1 Fund dispersed campsite improvement, operation, and maintenance	15,700	19,900
2.2.2 Manage dispersed camping impacts	16,400	20,700
2.3.1 Develop and implement an aesthetics management plan for Lower Baker and Upper Baker	19,600	25,000
2.4.1 Create new trails	38,500	48,700
2.4.2 Maintain existing trails and trailheads	16,200	20,400
2.5.1 Enhance Bayview Campground	18,300	23,100
2.5.2 Fund USFS campground operation and maintenance	34,800	44,100
2.5.3 Provide access and development to Lake Shannon or another suitable lakefront site	93,900	118,800
2.5.4 Provide improvements to Kulshan Campground	54,800	69,300
2.5.5 Support redevelopment of Baker Lake Resort	29,400	37,100

Measure	Annual Cost: No Inflation	Annual Cost: With Inflation
2.5.6 Provide funding for wildlife observation facility	28,400	35,800
2.5.7 Provide and fund ADA compliance	8,500	10,700
2.6.1 Provide a Recreation Adaptive Management (RAM) Fund	50,000	63,200
Subtotal	$488,100	$617,200
Aquatic Resources		
3.1.1 Create Habitat Enhancement, Restoration, and Conservation Fund	38,500	48,600
3.1.2 Provide fish propagation and enhancement programs and facilities	564,600	714,100
3.2.1 Provide upstream passage continuity for migratory fish species (anadromous, adfluvial, fluvial, resident)	706,800	894,100
3.2.2 Address connectivity between Baker Lake and Lake Shannon	149,700	189,500
3.2.3 Provide downstream passage continuity for migratory fish species (anadromous, adfluvial, fluvial, resident)	3,385,700	4,307,900
3.3.1 Implement flow regime for the Baker River Project	1,388,900	1,756,800
3.4.1 Implement fluvial geomorphic management	11,100	14,100
3.4.2 Implement LWD management	19,000	24,000
3.4.3 Development and implement erosion control and implementation plan	4,700	5,900
3.5.1 Implement flow release water quality management	7,900	10,000
3.5.2 Implement reservoir water quality management	7,900	10,000
3.5.3 Implement storm water pollution prevention plan	--	--
Subtotal	$6,284,800	$7,972,000
Cultural Resources		
4.1.1 Implement the Historic Properties Management Plan	152,000	192,200
4.2.1 Provide a Cultural Resources Management (CRM) Fund	120,700	152,600
Subtotal	$272,700	$344,800
Flood Control Operations		
5.1 Maintain current levels of flood control at Upper Baker (16,000 acre-feet as replacement storage and an additional 58,000 acre-feet for a total of 74,000 acre-feet of flood control storage)	--	--
Subtotal	$0	$0
Shared Resources		
6.1 Utilize adaptive management principles	--	--
6.2 Create BRCC	25,000	31,600
6.3 Implement a reservoir level management and operations plan	--	--
6.4.1 Implement an access management program	12,700	16,000
6.5.1 Provide visitor information	34,200	43,300

Measure	Annual Cost No Inflation	Annual Cost With Inflation
6.5.2 Provide interpretive services	27,900	35,400
6.5.3 Provide cultural and natural resource and conservation education	70,500	89,200
Subtotal	170,300	215,500
PME Implementation		
Fund a PME implementation coordinator	100,000	126,500
Subtotal	100,000	126,500
Total PME Annual Cost	$7,528,900	$9,545,200

Based on Interim HYDROPS Model Output (mid-July 2003)

Table 6-6. Project costs and annual net power benefits summary (no inflation).

	No-action (Current Operations)	Draft Action	Draft Action minus Current Operations
Total generation (MWh)	701,089	701,358	269
Total power benefits ($2006)	35,448,300	35,457,000	8,700
Unit value of benefits ($/MWh)	50.56	50.55	–0.01
Annual Project costs ($2006)	7,290,600	15,591,600	8,301,000
Unit costs ($/MWh)	10.40	22.23	11.83
Net power benefits ($2006)	28,157,700	19,865,400	–8,292,300
Unit value of net power benefits ($/MWh)	40.16	28.32	–11.84

Based on Interim HYDROPS Model Output (mid-July 2003)

Table 6-7. Project costs and annual net power benefits summary (with inflation).

	No-action (Current Operations)	Draft Action	Draft Action minus Current Operations
Total generation (MWh)	701,089	701,358	269
Total power benefits ($2006)	44,839,100	44,850,200	11,100
Unit value of benefits ($/MWh)	63.96	63.95	–0.01
Annual Project costs ($2006)	9,098,600	19,463,300	10,364,700
Unit costs ($/MWh)	12.98	27.75	14.77
Net power benefits ($2006)	35,740,500	25,386,900	–10,535,600
Unit value of net power benefits ($/MWh)	50.98	36.20	–14.78

6.4 Other Economic Considerations

The economic analysis supporting the license application (see exhibit H, table H-1) includes the assumption that the Upper Baker Additional Flood Control Memorandum of Agreement (MOA) is successfully renegotiated and remains in force (ACOE, 2000c). Under the terms of the MOA, Puget is compensated for operating at a lower pool level at Upper Baker than would be the case in the absence of flood control. Table 6-8 summarizes the economic benefit of the MOA. If the provision for federal flood control is no longer required and the MOA is not renewed under the Draft Action, the benefits would decrease by the amount shown in the table.

Based on Interim HYDROPS Model Output (mid-July 2003)

Table 6-8. Project benefits from the ACOE-BPA agreement.

	No Inflation	With Inflation
On-peak generation (MWh)	7,000	7,000
Value ($2006)[a]	297,900	405,900
Off-peak generation (MWh)	--	--
Levelized annual value ($2006)	--	--
Total generation (MWh)	7,000	7,000
Generation value ($2006)	297,900	405,900
Dependable capacity (MW)[b]	3.50	3.50
Dependable capacity levelized annual value ($2006)	222,400	283,200
Total levelized annual value ($2006)	520,300	689,100
Unit value of benefits ($/MWh)	74.33	98.44

[a] Value is computed from November through February on-peak energy values.
[b] The critical period is 8 months. Because the agreement provides replacement capacity for 4 months at 7 MW, we assigned 3.5 MW.

6.5 Greenhouse Gases

By producing hydroelectricity, the Baker River Project displaces the need for other power plants, primarily fossil-fueled facilities, to operate, thereby avoiding some power plant emissions and creating an environmental benefit. If the electrical energy generated by the Project were replaced with generation using fossil fuels, greenhouse gas emissions could potentially increase by 300,000 tons of CO_2 emissions per year (0.403 tons per MWh for an efficient combined-cycle combustion turbine and 0.684 tons per MWh for a simple-cycle combustion turbine).

7.0 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Section 4(e) of the FPA provides that, in issuing licenses for non-federal hydropower projects, the Commission shall give equal consideration to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife (including related spawning grounds and habitat); the protection of recreational opportunities; and the preservation of other aspects of environmental quality. Furthermore, Section 10(a)(1) of the FPA provides that licensed projects "will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water power development, [for the adequate PME of fish and wildlife (including related spawning grounds and habitat)], and for other beneficial public uses, including irrigation, flood control, water supply, and recreation [and other purposes referred to in Section 4(e) of the FPA]."

7.1 Summary Environmental and Developmental Effects

In the preceding sections, we have evaluated the environmental and developmental effects of No action and the Draft Action Alternative. We summarize key differences in table 7-1.

7.2 Recommended Alternative

This section contains the basis for, and summary of, the Commission staff's recommendations to the Commission for relicensing the Baker River Project. This analysis considers the comparative environmental effects of the alternatives, their economic effects, and their consistency with relevant agency recommendations, comprehensive plans, and laws and policies.

In the final PDEA, we will explain how the Draft Action (Settlement Agreement) gives equal consideration to developmental and non-developmental resources and is best adapted to a comprehensive plan for the waterway.

The remainder of the section is reserved for later use by Commission staff to identify and explain the alternative recommended by staff to the Commission.

Based on Interim HYDROPS Model Output (mid-July 2003)

Table 7-1. Summary effects comparison of the alternatives.

Resource Area	No-action Alternative (current operation)	Draft Action
Power and Economics		
Annual generation (MWh)	701,089	701,358
On-peak generation (MWh)	519,000	531,306
Off-peak generation (MWh)	182,090	170,052
Dependable capacity (MW)	148.30	142.46
Annual power benefits ($1,000/year) (no inflation)	$35,448	$35,457
Annual Project costs ($1,000/year) (no inflation)	$7,291	$15,592
Annual power benefits ($1,000/year) (no inflation)	$28,158	$19,865
Geology and Soils		
Erosion	Continued erosion potential associated with project operations.	Earlier drawdown and later refill times would reduce the erosion potential for the Baker Lake shoreline, and the higher target minimum pool elevation would reduce the erosion potential at "high" erosion sites on terraces within the Lake Shannon drawdown zone. Implementation of an erosion control and implementation plan would reduce erosion potential associated with project operations and any ground-disturbing activity.

Resource Area	No-action Alternative (current operation)	Draft Action
Sediment transport	Continued interception of sediment supply from the Baker River upstream of the Lower Baker dam.	The frequency of flows around 4,600 cfs would increase, which could slightly increase the capacity to move sediments through the project to the Lower Baker River. Sediment deposition characteristics in the reservoirs would be unchanged. Habitat enhancement actions would enhance channel characteristics of the Lower Baker alluvial fan. A plan would determine if supplying sediments to the Middle Skagit River is needed to augment gravels in the Middle Skagit River and would provide a means of regularly reviewing the status of the Middle Skagit River channel characteristics.
Secondary effects	None	Modifying the Lower Baker power plant; constructing upstream and downstream fish passage facilities, amphibian breeding habitat, trails, roads, parking areas, campgrounds, and fishing platforms; and removing Baker Lake Resort facilities and hazard stumps and snags would result in localized increases in erosion during and immediately following ground disturbance. Effects would be controlled by implementation of the erosion control and implementation plan.
Water Quantity		
Project operations	Continued reduced peak flows in the Lower Baker River under flood control provisions. Continue to provide minimum flows of 80 cfs in the Lower Baker River and to fluctuate daily from peaking operations of as much as 4,200 cfs below the Lower Baker powerhouse.	Continued reduction of peak flows in the Lower Baker River and downstream, a small increase in 10 percent exceedance flows in the Lower Baker River, increased minimum flows (300 cfs) in the Lower Baker River, and similar daily flow fluctuations in both the Baker and Skagit rivers.

Resource Area	No-action Alternative (current operation)	Draft Action
Water Quality		
Project operations	Continue to drawdown Lake Shannon, contributing to increased turbidity levels in Lake Shannon.	Restricting the minimum drawdown level for Lake Shannon would reduce the potential of increasing turbidity in Lake Shannon, the Lower Baker River, and portions of the Skagit River. Increasing flows in the Lower Baker River may reduce TDG concentrations and increase compliance with State limits.
Stormwater pollution	Continue operations and maintenance activities with a potential to degrade water quality.	Implementation of an appropriate stormwater pollution prevention plan for Project facilities, operations, and maintenance would reduce the risk of water quality degradation.
Secondary effects	None	Modifying the Lower Baker power plant; constructing upstream and downstream fish passage facilities, amphibian breeding habitat; constructing trails, roads, parking areas, campgrounds, and fishing platforms; and removing Baker Lake Resort facilities and hazard stumps and snags would result in short-term localized increases in turbidity. Use of new and upgraded toilet facilities at dispersed sites could reduce concentrations of fecal coliforms and disease-causing organisms.
Aquatic Resources		
Project operations	Contribute to periodic redd dewatering, fish and aquatic organism stranding, and habitat alteration resulting from ramping. Reduced peak flows in the Skagit River would continue to benefit Chinook through increase in Chinook egg to migrant survival. *(Placeholder for effects on temperature)*	Reduced erosion potential for the Baker Lake shoreline and Lake Shannon drawdown zone and reduced TDG in Lower Baker River would benefit aquatic resources. Increased minimum flows in the Lower Baker River would increase aquatic habitat and likely increase aquatic invertebrate production. Chinook egg-to-migrant survival rates would be unchanged. Redd dewatering, fish and aquatic organism stranding, and habitat alteration resulting from Project ramping would persist.

Resource Area	No-action Alternative (current operation)	Draft Action
Upstream fish migration	Provide upstream fish migration passage with existing facilities.	Modernization of upstream fish migration passage facilities would likely reduce impacts on adult fish encountering or entering the facility and would not be expected to increase mortality rates significantly.
Downstream fish migration	Provide downstream fish migration passage with existing facilities.	Modernization of downstream fish migration passage facilities would likely increase juvenile collection efficiency and survival and reduce fish passage/mortality through the turbines/over the dams. Acclimation facilities may alleviate fish handling stress associated with collection, transport, and release.
Physical habitat	Continue to block transport of LWD and sediments to the Lower Baker River. No studies to address questions about the need for LWD in the Lower Baker River and gravel augmentation in the Skagit River would persist.	Studies would determine if transport of LWD to the Lower Baker River is warranted and if gravel augmentation in the Skagit River is needed. If warranted, either placement of gravels or LWD, or both would improve aquatic habitat.
Fish propagation and enhancement	Provide spawning beeches for artificial production of sockeye salmon.	Separate water supplies to Spawning Beach 4 segments would decrease potential for catastrophic failure. The decommissioning of Upper Baker spawning beach facilities and restoration of lower Channel Creek would improve natural fish spawning and rearing habitat in the Upper Baker River watershed over the long-term. Nutritional programs would improve habitat conditions for salmonids. Artificial production (supplementation) of coho, steelhead, and Chinook smolts may increase production of these species in the basin. Establishment of the HERC Fund would provide a formal guaranteed funding source for aquatic habitat conservation, restoration, and enhancement.

Resource Area	No-action Alternative (current operation)	Draft Action
Secondary effects	Informal and dispersed recreational activities may degrade aquatic and riparian habitat in localized areas along the Project reservoirs and tributary streams.	Modifications of the Lower Baker power plant may temporarily impact water quality and fish habitat, but are not expected to have a significant long-term effect. The ability to finely adjust Project ramping resulting from the power plant modifications would be a net benefit to aquatic resources in the Lower Baker and Skagit rivers. Formal designation and management of dispersed recreation sites and the closure of some sites should minimize potential adverse impacts on aquatic habitat. Expansion and improvement of recreation trails would increase human disturbance and angling pressure, and could have a minor effect on fish species.
Terrestrial Resources		
Project operations	Reservoir fluctuations would continue to present risk to known amphibian breeding sites and to limit access to in-reservoir forage by elk during the spring and fall.	Modified reservoir operations would protect known amphibian breeding sites and the majority of potentially suitable breeding habitat; earlier spring and fall drawdowns would allow elk access to reservoir fluctuation zones for foraging.
Plant communities and wildlife habitats	No acquisition or management of young deciduous forest or wetland habitats. No study of fluctuation zone vegetation.	A total of 88 acres of young deciduous forest and 128 acres of wetland habitats would be acquired and managed. A fluctuation zone vegetation study would be performed
Plants species of special concern and special status plant species	No formal plan for managing rare plants on state, private, or National Forest System lands.	A formal rare plant protection plan would be provided, including survey, site-specific mitigation and management, and monitoring.
Noxious weeds and invasive non-native plant species	Limited weed control activity in the vicinity of Project facilities.	A formal weed management plan including survey, site-specific management, and monitoring would reduce the potential for noxious weed invasions.

Resource Area	No-action Alternative (current operation)	Draft Action
Wildlife/Special status wildlife species	Continue informal osprey nest site management program; no other specific measure for wildlife would be implemented.	A formal osprey nest site management plan would be implemented; other wildlife enhancement would be provided: 575 acres of early seral elk foraging habitat, 3 acres of amphibian breeding habitat; loon floating nest platforms; enhancing a portion of 844 acres of mountain goat summer foraging habitat; and enhancing and managing snags and cavities for riparian cavity-dweller habitat around Lake Shannon
Ongoing terrestrial resource needs	No funding mechanism established for future resource needs.	The TERC Fund would be established to address future resource needs and respond to adaptive management decisions.
Secondary effects	No process for evaluating or mitigating secondary effects of Project operation.	Secondary effects of Project-related activities would be evaluated and addressed through constraint mapping as part of siting, implementation of rare plant, noxious weed, snag management plans.
Federally Listed Threatened and Endangered Species and Essential Fish Habitat		
Fish species	Chinook salmon redd dewatering, stranding, and habitat alterations caused by Project ramping would continue in the Lower Baker and Skagit rivers. Bull trout spawning habitat would continue to be impacted by reservoir fluctuations. Bull trout in Baker Lake and Lake Shannon would continue to be disconnected. Potential bull trout stranding and habitat alterations caused by Project Ramping would continue in the Lower Baker and Skagit rivers. Chinook, pink, and coho salmon EFH would continue to be impacted in the Lower Baker and Skagit Rivers. All of these impacts would continue to an unknown degree.	Chinook salmon redd dewatering, stranding, and habitat alterations caused by Project ramping would continue in the Lower Baker and Skagit rivers. Reservoir fluctuations would continue to affect bull trout spawning habitat. Bull trout in Baker Lake and Lake Shannon may be allowed to co-mingle, pending the outcome of the proposed connectivity evaluation. Potential bull trout stranding and habitat alterations caused by Project ramping would continue in the Lower Baker and Skagit rivers. Chinook, pink, and coho salmon EFH would continue to be impacted in the Lower Baker and Skagit Rivers. All of these impacts would continue to an unknown degree.

Resource Area	No-action Alternative (current operation)	Draft Action
Wildlife species	No enhancement measures for bald eagle or grizzly bear to be implemented.	Support would be provided to landowners for development and implementation of bald eagle nest site management plans. A total of 244 acres of grizzly bear core area spring foraging habitat would be provided in Baker BMU.
Cultural Resources		
Project operations	Contribute to the erosion of archaeological sites along the shoreline and within the draw down zone of Baker Lake and Lake Shannon.	Reduced erosion of archaeological sites along the shoreline of Baker Lake and within the draw down zone of Lake Shannon.
Ongoing cultural resources needs	Evolving cultural resources management issues are not addressed. No plan for future management of cultural resources	An HPMP and funding would address evolving issues for cultural resources management
Secondary effects	Continued informal use of dispersed camp sites contributes to the disturbance of archaeological sites and traditional cultural properties.	Managed use and closure of some dispersed camp sites would reduce disturbance to archaeological sites and traditional cultural properties. Modifications to the power plant and upstream and downstream fish passage facilities could affect properties eligible for listing in the National Register. Construction of recreational facilities and trails in archaeologically or culturally significant areas could affect archaeological sites or traditional cultural properties.
Recreational Resources		
Project operations	Continue to provide lake levels that allow functional and suitable use of all boat ramps and swimming beaches during peak recreation season, June–August but that affect use during the shoulder season in April–May and October–November.	Earlier drawdowns in the spring and fall would reduce the optimal locations for boat launches at four locations and the suitability of two swimming beaches during the shoulder season.

Resource Area	No-action Alternative (current operation)	Draft Action
	Contribute to unsafe boating conditions with rocks and stumps exposed in the shoulder season.	Earlier drawdowns in the spring and fall would expose rocks and stumps for longer periods in the shoulder season and increase the potential for boating accidents. Implementation of boating safely programs would address this problem.
	Continue information on dispersed camping opportunities during the peak recreation season in July and August.	Closure of some dispersed camping sites and earlier drawdowns in the spring and fall would reduce opportunities for dispersed camping, but better management of remaining sites would enhance the visitor experience.
Developed recreation	Continue to provide recreational opportunities at existing developed recreational facilities, which do not meet user needs and are in poor condition.	Redesign and improve recreational facilities to meet current standards and user needs. Overnight capacity would stay approximately the same: Bayview—138 PAOT increase, Kulshan—127 PAOT reduction, Baker Lake Resort—slight increase.
	No funds to address deferred maintenance at developed recreation facilities.	Provide funding for maintenance and replacement to address deferred maintenance concerns at recreational facilities and to improve the visitor experience and safety.
	No plans to address the problems of noise, vandalism and visitor behavior at developed recreation facilities.	Increased patrols and a host (at Lake Shannon) would reduce noise, vandalism and behavior problems at recreational facilities and enhance the visitor experience and safety.
	No plan to address public safety concerns with poor facility condition.	Reconstruction of facilities would eliminate public safety concerns and enhance the visitor use and experience.
	USFS recreational facilities are operated and maintained by the USFS.	Provide supplemental funding to the USFS for the operation and maintenance of recreation facilities.
	No developed recreation facilities would be provided at Lake Shannon.	Construct developed recreation facilities at Lake Shannon to improve boater access.
	No formal wildlife viewing opportunities would be provided for visitors.	Formal wildlife viewing opportunities would be created to enhance the visitor experience.
	Continue to allow commercial source for buying supplies, and renting cabins and boats at Baker Lake.	Visitors would not be able to purchase supplies and rent cabins or boats at Baker Lake.

Resource Area	No-action Alternative (current operation)	Draft Action
	Baker Lake Resort operates at an economic loss.	Baker Lake Resort would probably generate revenue.
	No plan to address opportunities and site accommodations for persons with disabilities at the Project.	Improve all developed recreation facilities at the Project to comply with the ADA guidelines.
Dispersed recreation	Continue informal dispersed campsites and/or their access, some of which are located in environmentally sensitive areas.	Close campsites located in environmentally sensitive areas.
	Maintain the current minimal level of patrols and management of dispersed camping, with trash, sanitation, and wildland fire problems.	Provide funding to the USFS to increase patrols and allow proper management of dispersed camping use. Better management would reduce trash and sanitation problems and the potential for wildland fire problems.
	No plan to provide visitor information about low impact dispersed camping and the trash, sanitation problems and activities that degrade natural resources.	Provide better signing and information to visitors about low impact camping techniques to reduce trash, sanitation problems and actions that may degrade natural resources.
Trails and trailheads	Maintain one interpretive trail near Baker Lake (Shadow of the Sentinels). Non-motorized trails are available on nearby USFS and NPS but not near the Project. Main routes of travel at the Project are the roads.	Develop new trails for non-motorized use at the Project reservoirs and near the Town of Concrete to expand recreational opportunities.
	No plan for water trail information.	Provide water trail information.
	No provision for maintenance on trails and trailheads on adjacent USFS and NPS land that originate near the Project.	Provide supplemental funding to the USFS to improve condition of the trails and trailheads adjacent to the Project and enhance the visitor experience and use.
Public access	No plan for the management and maintenance responsibilities of the access roads.	Identify road management and maintenance responsibilities.

Resource Area	No-action Alternative (current operation)	Draft Action
	With no developed recreational facilities at Lake Shannon, no legal public access to Lake Shannon would exist.	Provision of recreational access to Lake Shannon would provide a legal public access and increase use.
	No plan to improve the level of road maintenance.	Provide supplemental funding for maintenance to improve roads.
	Continue access road management with no consideration of other resource management needs or the needs of adjacent land management agencies.	Consider other resource management needs in the management of access roads, including restricting public access to environmentally sensitive areas.
Recreational safety	No plan to address boating and swimming safety at the Project.	Provide boating safety information, signage at swimming areas (floating booms), enhancement law enforcement, and remove stumps and rocks at the Project to reduce the incident of boating accidents to improve public safety.
Public information, interpretation, and education	No plan to provide information to visitors about low-impact uses, and visitors would continue to cause noise, litter, damage to vegetation, soil erosion, water pollution, and wildlife disturbance.	Provide signing and information to visitors about low-impact camping techniques and appropriate actions to take during their visit. By educating visitors, this should reduce trash, sanitation problems and actions that may degrade natural resources.
	Maintain visitor interpretation opportunities at the Lower Baker Visitors' Center.	In addition to the Lower Baker Visitors' Center, provide funding to the USFS for interpretation in the Baker Lake Basin and displays would create additional interpretive opportunities for visitors.
	Continue to provide educational programs at the Baker Lodge.	Educational programs at the Baker Lodge would be unchanged.
Ongoing recreational resource needs	Evolving recreational needs at the Project are not addressed.	As unforeseen recreation needs evolve, funding would be available to address the needs.

Resource Area	No-action Alternative (current operation)	Draft Action
Secondary effects	None.	Reconstruction at the Lower Baker powerhouse may temporarily restrict access and create noise for visitors; establishing vegetation along the shoreline and special status plant protection could displace some recreation use; an aesthetic management plan would improve the visitor's experience; enhancements to fisheries could increase angling and create more demand for recreational facilities, including roads and trails; monitoring water quality would protect the public users; and coordination between recreation management and cultural resource management would be provided.
Aesthetic Resources		
Land Use		
Project operations	No change in land use or flood management.	Inundated areas would be unchanged, as would flood management. The new powerhouse and access bridge would increase the extent of industrial development in the Lower Baker River.
Secondary effects	None	Public access to Project lands would be enhanced, including development of new trails on lands currently not available to the public. Additional recreation facilities would be provided to accommodate growth in regional demand. Management of some project lands would be modified, or new lands secured to protect habitat values for wetlands, elk and grizzly bear.
Consistency with state and local requirements	No change in the status of compliance with federal, state and local regulations.	Consistency with the MBSNF Plan would increase as measures would be implemented that alter the use of some lands to meet terrestrial, recreation, and aquatics objectives. The goals of the SCORP would be furthered by proposed facility and trail measures. Public access, as encouraged by the Skagit County Comprehensive Plan, would be enhanced.

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8.0 RECOMMENDATIONS OF FISH AND WILDLIFE AGENCIES

Under the provisions of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, and enhancement of fish and wildlife resources affected by the Project.

Section 10(j) of the FPA states that whenever the Commission believes that any fish and wildlife agency recommendation is inconsistent with the purposes and requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve any such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

This section of the final PDEA will be used to track whether preliminary Section 10(j) fish and wildlife agency recommendations (as well as preliminary Section 18 fishway prescriptions and preliminary Section 4(e) federal land management conditions) are addressed in the Draft Action (Settlement Agreement). The preliminary recommendations, prescriptions, and conditions will be displayed in table 8-1. The table will also show the source of the recommendations, the estimated levelized annual cost of the recommendations, and whether or not each recommendation is addressed within the Draft Action (Settlement Agreement).

Since preliminary recommendations, prescriptions, and conditions are not due to be filed until after publication of this draft PDEA, table 8-1 will be provided in the final PDEA.

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9.0 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a) (2) of the FPA requires that a project be evaluated to determine its consistency with federal or state comprehensive plans for improving, developing or conserving the waterway affected by the Project. There are 74 comprehensive plans that address various resources in Washington; 14 are applicable to the Baker River Project and are analyzed below. Other plans not on file with the Commission as comprehensive plans that are potentially relevant for resource management decisions are described in section 5.12.2.3.

9.1 Commission-Recognized Comprehensive Plans

9.1.1 MBSNF Land and Resource Management Plan (as amended)

The MBSNF LRMP was adopted in June 1990 and amended in April 1994 to incorporate guidance for managing National Forest System lands within the range of the northern spotted owl. This plan applies to all National Forest System lands around Baker Lake. The Mt. Baker Snoqualmie Forest Plan provides management prescriptions for land within the forest boundaries. Approximately 5,168.5 acres of Project lands are within the USFS boundary, of which approximately 4,540 are inundated by Baker Lake and the upper reaches of Lake Shannon. Puget coordinates with the USFS for land and resource management considerations to ensure some level of compatibility with the surrounding USFS resource objectives. The USFS Record of Decision on the management of forests within the range of the northern spotted owl (USFS and BLM, 1994B) designated the area around Baker Lake as an LSR, to be managed to protect and enhance habitat for late-successional and old-growth related species, including the northern spotted owl. Overlaying this designation along lakes, streams and wetlands are riparian reserves, a key component of the forest's Aquatic Conservation Strategy which seeks to restore and maintain populations of aquatic and riparian dependent species. Factored into these objectives is the challenge to balance the regional popularity of the area as a recreation destination and the effects associated with human uses.

Current operations would not alter the USFS's ability to manage its lands. Measures proposed as part of the Draft Action may improve the ability of the USFS to achieve some of its management goals, specifically related to recreation, access, aquatic and terrestrial resources. In its evaluation of the proposed measures, the USFS would assess consistency with the Forest Plan and the Record of Decision. The USFS position on consistency with the LSR, Aquatic Conservation Strategy, and other objectives will be summarized in this section when comments are received.

9.1.2 National Marine Fisheries Service/Pacific Fishery Management Council Fishery Management Plans

The PFMC is one of eight regional councils established under the MSA of 1976. The Pacific Council has developed fishery management plans for salmon, ground fish, halibut and other coastal pelagic species[30] in the U.S. Exclusive Economic Zone off the coasts of

[30] Pelagic species are those that use ocean habitat.

Washington, Oregon and California. Measures proposed under the Draft Action would be consistent with the objectives of these plans to sustain populations of anadromous salmonids.

9.1.3 State Comprehensive Outdoor Recreation Planning Document (SCORP) 2002 – 2005, An Assessment of Outdoor Recreation in Washington State

This plan, along with its implementing legislation (RCW 79A.25.020 (3)), presents the state's strategic plan for the acquisition, renovation and development of recreational resources and preservation of open space. It specifically recommends that hydropower operators "…enhance inventory with trails and paths for walking and bicycling, manage shoreline camping, improve access for on-water recreation, and improve opportunities for nonconsumptive interaction with nature, including fish and wildlife" (Chapter 5). Measures included in the Draft Action (see section 5.10.2) would be consistent with each of these objectives.

9.1.4 Washington State Hydropower Development/Resource Protection Plan

This is the state's first comprehensive hydropower plan and was adopted in December 1992 by the Washington State Energy Office. It applies only to new hydropower development at sites that do not have existing hydropower generation; therefore, the Baker River Project is exempt.

9.1.5 Washington Scenic Rivers Program/State Scenic Rivers Assessment

The Washington State Scenic Rivers Program was created by the Legislature in 1977 (RCW 79.72) for the purpose of balancing the use and development of rivers with an effort to protect a few of Washington's rivers. This list does not include either the Baker River or the Skagit River (Washington State Scenic Rivers Program, 1988); therefore, this plan is not applicable.

9.1.6 Washington Hydroelectric Project Assessment Guidelines

These guidelines were originally issued by the Washington Department of Game in 1987, which is how they are designated on the Commission's list of Comprehensive Plans. WDFW updated the guidelines in 1995 to explain its management goals and provide instructions for gathering information the WDFW considers necessary to assess potential impacts on fish and wildlife and their habitat. WDFW was an active participant in formulating many of the resource studies conducted for the Baker relicensing; therefore, its data collection guidance has been considered in the study process. Although several of these studies are ongoing, general consistency with the intent of the guidelines has been demonstrated.

9.1.7 Skagit County Shoreline Management Master Program

The Skagit County SMP (1976, reprinted 1983, amended 1995) was adopted to protect shorelines of the State from development that could adversely affect public interests. Revisions adopted in April 1995 amend the Program to address hydropower in each of its management categories. The shorelines of Lake Shannon and the Baker River, from its confluence with the Skagit River upstream to the Skagit-Whatcom County line, are designated as Shorelines of Statewide Significance. The shoreline area (a 200-foot management zone) around Lake Shannon is further designated as a Conservancy environment. The Baker River shorelines are designated Rural (from Lower Baker dam to the Town of Concrete) and Urban (within the Town of Concrete). The Skagit River, at its confluence with the Baker River, is designated as Rural Environment. The WDOE (or the Town of Concrete, as delegated by WDOE) may refer to the SMP when considering consistency with the CZMA.

The intent of the Conservancy Shoreline Area is to "ensure long term wise use, enhancement, and protection of natural resources and processes and valuable historic and cultural areas." Management goals in this shoreline area are to protect recreational benefits to the public and/or achieve sustained resource use without significant adverse impacts. Puget's management of lands within the Project boundary around Lake Shannon is consistent with this objective; no conflict is anticipated under the Draft Action.

The Rural Shoreline Area designation seeks to "protect agricultural land from urban density expansion, regulate intensive development along undeveloped shorelines, function as a buffer area between Urban and Conservancy Shoreline Areas and maintain open spaces and opportunities for recreational activities and a variety of uses compatible with agriculture and the shoreline environment." Under this designation, industrial uses are discouraged; however, 1995 Program amendments specifically identify hydropower as a permitted use. Under the Draft Action, a new powerhouse and access bridge would be constructed on the Lower Baker River at the site of the former powerhouse and adjacent to the currently operating powerhouse. A Shoreline Substantial Development Permit would be obtained from either WDOE or the Town of Concrete for these facilities. The permit would stipulate specific habitat protection measures to be implemented during construction. Because the facilities would not introduce a new use to this site, the development is expected to be considered consistent. Additionally, new trail segments may be developed near the shoreline in this reach. These would be consistent with the intent of the Rural Shoreline designation.

The Urban Shoreline Area designation ensures "optimum utilization of shorelines within urbanized or potentially urbanized areas, to identify areas suitable for intensive uses, both public and private, and to manage development and maintain urban shorelines for a variety of uses." Under the Draft Action, measures included within this designation may include modifications to the fish collection facilities, new recreation trails and possibly fish acclimation ponds. Modifications to the collection facilities would continue an existing land use. A site has not been selected for the acclimation pond(s), but is expected to be on Project lands near the Baker River, so likely, at least in part, would be within the Shoreline management zone. Because this new industrial and natural resource use would be partially shoreline-dependant, it is expected to be consistent with the Urban Shoreline designation. New trail segments also would be consistent with this designation as they would encourage pubic access.

9.1.8 Washington Natural Heritage Program

The Washington Natural Heritage Plan identifies natural areas for potential preservation under state law (WDNR, 2003). Areas are selected for protection based on the presence of priority ecosystems and species. The Plan also identifies methods of protection and responsible agencies. Periodically, it is updated to reflect current listings under the Washington Natural Heritage Program (WDNR, 1993, updated 1995). The program identifies special plants and some animals, terrestrial ecosystems, wetland and aquatic ecosystems, and unique geologic features throughout the state. This program identifies rare, threatened, and endangered species in the Project area. It is anticipated that the alternatives examined in this analysis would be consistent with this comprehensive plan; however, as specific development actions are considered throughout the period of the new license, consultation with the WDNR, WDFW, and FWS would be undertaken by Puget to ensure consistency with the biological components of this program. The program also contains lists and a map of all existing "natural areas" in Washington. No portion of the Baker River Project area is located within a designated natural area.

9.1.9 National Park Service General Management Plan: North Cascades National Park, Ross Lake National Recreation Area and Lake Chelan National Recreation Area

NPS (1988) adopted a general management plan for the NCNP Service Complex. Although upper reaches of the Baker River flow through these lands, the plan applies to management of lands within the park boundaries and therefore does not apply to the Baker River Project.

9.1.10 Northwest Power Planning Council: Northwest Conservation and Electric Power Plan

The Northwest Power Act of 1980 mandated that Idaho, Montana, Oregon and Washington prepare and adopt "a regional conservation and electric power plan." The states formed the NWPPC to implement the Act. In 1988, the Council adopted a Protected Areas Amendment that designated 44,000 stream miles for protection from future hydroelectric development. Existing hydroelectric projects, including the Baker River Project, are exempted from the protected area designations (NWPPC, 1998).

9.1.11 Washington Department of Ecology, State Wetlands Integration Policy

The Washington State Wetlands Integration Strategy was established to develop and implement a more coordinated system for protecting state wetland resources. Whatcom County is one of four local governments that received grant funding to design a wetlands program to demonstrate wetland management strategies that can be used around the state. Implementation of a Baker River Project alternative would not be directly affected by this policy.

9.1.12 Washington State Shorelands and Water Resources Program

The purpose of this program, pursuant to the Water Resources Act of 1971, is to provide guidelines to facilitate development of the water resources to the extent of their availability for further appropriation. The Baker River Project possesses perfected water rights for hydropower operation; therefore, Puget would not be subject to a review under this program.

9.1.13 Washington Department of Fish and Wildlife, Priority Habitat and Species Program

This program targets protection of fish and wildlife resources and their habitat. The plan's objectives are to identify species and habitat types that should receive management attention, to map the known locations of priority habitats and species, and identify the conditions required to maintain healthy populations of these species. WDFW maintains a database of this information which has been a useful resource during project investigations. While consistency with this program will be determined by WDFW in its review of the Baker River Project alternatives, species targeted by the program have been considered in the proposed measures; therefore, the Draft Action is expected to be found consistent with the plan objectives.

9.1.14 Washington Department of Natural Resources, Habitat Conservation Plan

In 1997 the WDNR issued a final HCP addressing the long-term management of 1.6 million acres of forested State of Washington trust lands within the range of the northern spotted owl. The HCP (WDNR, 1997) was developed in compliance with the ESA, and provided the basis for the FWS and NOAA Fisheries to issue Incidental Take Permits for legal forest management activities on the applicable state lands. Some parcels of WDNR-managed lands in the North Puget Planning Unit that are covered by the HCP are adjacent to or near Lake Shannon. The Draft Action identifies a potential recreation trail segment east of Lake Shannon, which may traverse lands managed by WDNR. Should this trail component be pursued, consultation with WDNR would be undertaken to select a route that would not compromise the habitat protection objectives identified in the HCP.

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10.0 FINDINGS OF (NO) SIGNIFICANT IMPACT

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APPENDIX A

MAPS

APPENDIX A—MAPS

Note: The Federal Energy Regulatory Commission Rule RM02-40-000, Order No. 630, as amended by RM02-4-001 and PL02-1-001, Order No. 630-A, requires applicants to separate certain information into the following categories:

- *Public*
- *Non-Internet Public*
- *Critical Energy Infrastructure Information (CEII)*
- *Privileged (other non-public)*

The maps contained in this appendix show environmental resource information in relationship to the location of Project facilities, Project boundaries, and reservoir extent. This location information is classified as "Non-Internet Public." These appendix A maps are included in Volume II, Part 2 of 2, *Applicant-Prepared Preliminary Draft Environmental Assessment, Non-Internet Information, Maps*. The maps will be maintained in the Commission's Public Reference Room and indexed on the Commission's FERRIS or eLibrary web locations, but there is no Internet access to the maps. The public may access these maps through the Commission's Public Reference Room.

The appendix A maps, located in Volume II, Part 2 of 2, are listed in table A-1 below.

Table A-1. Baker River Project maps.

Figure Number	Figure Title
1-1	Baker River Project location
5-1	Baker River watershed
5-19	Hydrography, fish facilities, and barriers
5-20	Vegetation cover types above full pool
5-21	Vegetation cover types below full pool
5-22	Wetland inventory for the Baker River Project area
5-23	Baker River watershed vegetation cover types
5-24	Baker River watershed vegetation seral stage
5-25	Project area ownership and developed recreation sites
5-26	Campgrounds, dispersed campsites, and trails
5-28	Scenic viewpoints and reservoir surface area contours
5-29	Land ownership
5-30	Land management designations

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APPENDIX B

Baker River Hydroelectric Project

Draft Protection, Mitigation, and Enhancement Measures for the Draft Action

The Draft Action evaluated in this PDEA comprises the protection, mitigation, and enhancement measures contained in this appendix. Puget provided this set of draft measures on June 2, 2003, for the purpose of fulfilling the requirements of the Commission's regulations that call for public review of a draft license application prior to application filing. The Draft Action will be updated in the final PDEA to reflect agreements reached under the continuing collaborative process toward settlement.

June 2, 2003

1.0 Terrestrial Resources Draft Measures

1.1 Management for General Habitat Types

1.1.1 Provide Young Deciduous Forest, Forested Wetland, Shrub Wetland and Wet Meadow

Summary of Measure
Provide 216 acres of specified forest and wetland habitat types on lands owned or controlled by Puget.

Description of Measure
Puget would acquire land or establish conservation easements to protect habitats of the types and amounts shown in Table 1, beginning no later than five years after acceptance of the new license. All of the habitat would be within the Baker-Skagit drainage. All of the habitat would be owned or controlled by Puget, and the locations of individual habitat patches would remain constant over the term of the new license.

All habitats provided under this PME action item would be of comparable quality to the corresponding habitat types that might become available in the Project area if the new license were not issued. Where the habitat provided under this PME action item meets or exceeds the requirements for one or more of the species-specific PME action items, the habitat provided under this action item would count toward satisfying the requirements of those species-specific action items.

Table 1. Forest and wetland habitat types to be provided by Puget.

Type of Habitat	Amount of Habitat (acres)
Young Deciduous Forest	88
Forested Wetland	81
Shrub Wetland	26
Wet Meadow	21
TOTAL	**216**

1.1.2 Evaluate the Potential for Establishing Beneficial Vegetation in the Fluctuation Zones

Summary of Measure
Identify and evaluate native plants for re-vegetating and/or altering the vegetation of portions of the reservoir fluctuation zones. If any plantings are proven successful, Puget

would implement a plan for establishing these plants within selected sections of the fluctuation zone for the term of the new license.

Description of Measure
In collaboration with the Baker River Coordinating Committee (BRCC; see Measure 6.2), Puget would identify and test native plants with the potential to persist within the reservoir fluctuation zones. Testing could include growing the plants under controlled conditions (e.g., greenhouse or nursery) as well as in the reservoirs to determine their abilities to tolerate periodic inundation. Field tests would run for a total period of five years, unless positive conclusive results can be obtained sooner.

1.2 Management for Species-Specific Habitats

1.2.1 Provide Foraging Habitat for Elk

Summary of Measure
Provide 575 acres of elk foraging habitat on lands owned or controlled by Puget.

Description of Measure
Puget would provide foraging habitat for elk (Cervus elaphus) in the amounts shown in Table 2, beginning no later than five years after acceptance of the new license. All of the foraging habitat would be within the identified range of the Nooksack Elk Herd, and at least 50 percent would be located within the Baker River Basin. Criteria for the patch size, proximity to roads and cover, and vegetative production of the foraging habitats would be established collaboratively by the Terrestrial Resources Working Group. At least 25 percent of the habitat would be provided in "permanent" forage patches, where "permanent" is defined as being available for at least 10 consecutive years in the same location. Up to 75 percent of the habitat may be provided in "temporary" forage patches, where "temporary" is defined as being available for at least one year but less than 10 consecutive years in the same location. Lands would be sampled annually to ensure they meet or exceed targets for the production (pounds per acre, dry weight) of known elk forage plants.

Table 2. Elk foraging habitat to be provided by Puget.

	Term of License		
	30-Year License	**40-Year License**	**50-Year License**
Average Annual Habitat Acres	575	575	575
Minimum Annual Habitat Acres	431	431	431
Total Habitat Acre-Years[1]	14,375	20,125	25,875

[1] Calculations of acre-years are based on the term of the new license minus five years to account for an initial period of land acquisition.

1.2.2 Provide Spring Foraging Habitat for Grizzly Bears

Summary of Measure

Provide 244 acres of grizzly bear core area spring foraging habitat on lands owned or controlled by Puget. Provide the habitat beginning no later than five years after grizzly bear spring occupancy is documented in the Baker BMU.

Description of Measure

Puget would provide 244 acres of core area spring foraging habitat for the grizzly bear (*Ursus arctos*) beginning no later than five years after the first determination of grizzly bear spring occupancy in the Baker BMU. Occupancy in the Baker BMU would be determined by the presence of an adult female grizzly bear (with or without cubs) during the spring or summer for two consecutive years. Once provided, the habitat would remain available through the term of the new license.

The spring foraging habitat would be provided within the Baker BMU. The location of the habitat within the Baker BMU may change during the term of the new license, but at least 50 percent would remain available in the same location(s) for at least 10 consecutive years, or until the end of the new license term, whichever occurs first.

Puget would work collaboratively with the other members of the Terrestrial Resources Working Group to set standards for spring forage production on the lands to be provided under this PME action item. The objective would be to provide spring forage of quality and quantity comparable to what could be expected to exist in deciduous forest, forested wetland, shrub wetland and wet meadow habitats in the Project area under the No-license Scenario. If necessary, the total area of lands would be increased above 244 acres to provide an amount of grizzly bear spring forage comparable to what might occur if the new license were not issued.

Core area spring foraging habitat provided under this PME action item would have no motorized or non-motorized high intensity use of roads or trails within 0.3 mile from April 1 through June 15. Roads and trails would be gated or otherwise blocked as necessary to ensure against human use during this period. Human access issues related to grizzly bear spring forage would also be incorporated into comprehensive access management plans for the Project.

1.2.3 Provide Summer Habitat for Mountain Goats

Summary of Measure

Support the USFS proposal to enhance mountain goat summer foraging habitat by funding a portion of the cost of habitat enhancement measures on US Forest Service (USFS) lands in the Baker River Basin.

Description of Measure

Puget would support efforts by the USFS to enhance mountain goat summer foraging habitat by funding a percentage of the cost of habitat enhancement on 844 acres of USFS lands in the Baker River Basin. The USFS would be responsible for environmental review, permitting and post-implementation monitoring of the habitat enhancement, and would assume responsibility for the effectiveness of the enhancement.

1.2.4 Provide Breeding Habitat for Amphibians

Summary of Measure

Create three acres of pond-breeding habitat for amphibians, either by creating new wetland habitat or modifying existing habitat.

Description of Measure

Puget would develop a program of creation and/or enhancement of three acres of ponded wetland habitat suitable for amphibian breeding. Wetland areas could be developed in the reservoir fluctuation zones; existing wetlands within the Project area or elsewhere in the basin could be enhanced (e.g., converting reed canarygrass wet meadows into ponded emergent and aquatic habitats); or new wetlands could be constructed. The program would also be designed to encourage emergent, semi-aquatic, and aquatic vegetation to develop within the ponded areas, and/or be planted.

1.3 Management for Habitat Elements

1.3.1 Provide Nest Structures for Osprey at Lake Shannon

Summary of Measure

Maintain 10 osprey nest structures on Lake Shannon.

Description of Measure

Puget would provide structures for safe nesting by up to 10 pairs of osprey at Lake Shannon. Puget currently maintains nine man-made nesting platforms on the reservoir. One additional platform would be erected, and all 10 would be periodically inspected and maintained to ensure their availability to nesting osprey. In order to promote the eventual conversion to nesting on natural platforms, Puget would also modify 10 existing trees/snags along the shoreline of Lake Shannon to make them suitable for osprey nesting. Puget would also monitor osprey nesting and productivity annually on both Lake Shannon and Baker Lake.

1.3.2 Provide Floating Nest Platforms for Common Loons

Summary of Measure

Construct and place three floating loon nest platforms in suitable locations within the Project area, and evaluate their effectiveness. The platforms would be protected from recreation disturbance by the placement of log booms/buoys and/or use restriction boundaries. If successful nesting occurs on one or more of the platforms, the number of platforms would be increased by three to a total of six. If no nesting activity (nest building) occurs for a period of 15 years following the installation of the initial three nest platforms, the value of platforms on other lakes in Skagit, Whatcom and Snohomish counties would be evaluated.

Description of Measure

Puget would construct and place three floating loon nest platforms in suitable locations within the Project area. The platform sites would be chosen based upon criteria developed by loon experts with successful nesting programs. Since loons utilize both reservoirs, efforts would be made to find a suitable platform location on each reservoir. Specifications for loon platforms would be adopted from other successful nest platform programs.

Protection of nest platforms from human disturbance could be difficult due to the high levels of recreational boat traffic on the reservoirs, particularly Baker Lake. Puget would construct and place a log boom or boundary buoys to protect each nest platform from human disturbance. Specifications of the log boom or buoys (length, number, buffer distance from nest) would be determined once the sites are identified. Puget would also work with the USFS to develop use restrictions to boats in the areas identified as loon nest sites.

All nest platforms and protection log booms and/or buoys are needed only seasonally. Puget would place the platforms by April 1 and remove them by July 31 each year, to coincide with loon nesting season. The structures would be stored the remainder of the year.

The nest structures would be monitored twice per month during the nesting season to determine whether or not they are being used by loons, and if any changes to the program are warranted due to human disturbance.

The potential for success of this measure is unknown. Puget would implement the program and monitor its success for 15 years. If, during the 15-year period, loons have either successfully bred or are making attempts to breed using the platforms, the number of platforms would be increased to six. If there are no attempts at nesting on the platforms during the 15-year period, the value of the platforms on other lakes in Skagit, Whatcom and Snohomish counties would be evaluated.

1.3.3 Provide Habitat for Riparian Cavity Dwellers

Summary of Measure

Develop a snag management plan for all lands associated with the Project. Provide temporary habitat for riparian cavity dwellers around Lake Shannon by erecting nest boxes to support tree swallows and wood ducks. Provide long-term habitat around Lake Shannon by managing riparian forest stands to provide natural cavities for the full compliment of native riparian cavity dwellers over the term of the new license.

Description of Measure
A comprehensive cavity nest/roost management program would be developed for Lake Shannon. The program would consider the needs of all native cavity nesters/roosters (as indicated by the analysis species) and include measures for meeting those needs. The needs of small species could be met by maintaining existing forest habitat, and by actively promoting the development of cavities (e.g., killing or infecting live trees) where natural rates of cavity development are not sufficient. The needs of large species could also be met through management of forest habitats in the long term, but short-term needs may require the placement of artificial structures (e.g., nest boxes) where there are no large trees.

Until such time as the riparian forest around Lake Shannon is able to meet the cavity nesting needs of the analysis species (wood duck and tree swallow), Puget would provide and maintain 10 wood duck nest boxes and 20 tree swallow nest boxes.

1.3.4 Support the Development of Bald Eagle Nest Management Plans

Summary of Measure
Assist local landowners at preparing plans for long-term management of bald eagle nesting, roosting and/or foraging habitat.

Description of Measure
Puget would develop and implement a plan for working with landowners to identify and protect habitats. Puget, the USFS and others have collected data on the presence and reproductive status of bald eagles in the Baker River Basin for most of the past 20 years. These data, along with the results of the T15 Basin Vegetation Mapping Study, the T2 Project Area Vegetation Mapping Study and WDFW Priority Habitats and Species maps, could be analyzed to identify potential areas for increased habitat protection.

1.4 Management of Botanical Resources

1.4.1 Protect Plants of Special Status

Summary of Measure
To protect plants with special status during the construction of new Project facilities and continued operation of the Project, Puget would conduct the following actions: 1) Survey all areas of potential new Project activity/disturbance if the areas have the potential to impact plants with special status, 2) develop site-specific management plans whenever special status plants are found to occur in areas where Project activity/disturbance is proposed, 3) develop a process for assessing and preventing conflicts between special status plants and Project related activities that emerge during the new license term, and 4) develop a monitoring and evaluation program for Threatened and Endangered Species (TES) plant locations within the area affected by the Project.

Description of Measure

Puget would survey all areas of potential new Project activity/disturbance if the areas have the potential to impact plants with special status. The Project area has the potential to support a number of species with special status at the state and/or federal level. Much of the existing Project area has been surveyed for these species (study T16), and a small number of occurrences have been documented. Areas of potential new Project activity (e.g., recreation developments, new generation facilities) have not yet been identified, and may require surveys prior to the new activities.

Prior to issuance of the license, Puget would complete a draft plan for site specific management of all known sites of Sensitive/Survey & Manage species. Within 6 months following acceptance of the license, and prior to any habitat disturbing activities, Puget would finalize the draft Sensitive/Survey & Manage species management plan. Both the draft and final plans must be approved by the USDA Forest Service. At a minimum, the plan would require Puget to:

1) Survey all areas of proposed new project activity or disturbance if these areas have potential to impact plants of special status, where "potential to impact" is determined by the USFS. Surveys would be conducted and documented as per the protocols outlined in the rare plant study plan.

2) Implement individual site-specific management plans for the following species at the following locations:

Species	Location
*Carex flava**	North end of Baker Lake, near mouth of Baker River
Hypogymnia duplicata	Site BE10-1, near Upper Baker dam
Schistostega pennata	Wetland 741, near mouth of Little Sandy Creek
Tetraphis geniculata	Wetland 741, near mouth of Little Sandy Creek
Schistostega pennata	Wetland 745, near mouth of Little Sandy Creek
Schistostega pennata	Site BN17-1 & 2, along Swift Creek
Schistostega pennata	Wetland 729, ~ ½ mile south of the mouth of Boulder Creek
Schistostega pennata	Wetland 27, along West Pass Dike

3) Implement individual site specific management plans for any new populations of TES or Survey & Manage plants encountered during 2003 field surveys.

4) Prepare a set of guidelines describing the mitigation measures that would be taken if newly discovered populations are encountered during the life of the license. Assumption: transplanting and/or relocation of rare plants is not considered an acceptable means of mitigation for impacts since survival rates are generally very low *(CITE, 19--)*.

5) Implement an annual monitoring and evaluation program for TES plant locations within the area affected by the project (this area would be specified in the 4e terms and conditions). The plan would specify the measures that would be taken if monitoring indicates that a rare population is declining.

* For *Carex flava* specifically, the management plan would include:

a) Methods and timelines for controlling reed canarygrass immediately around the *Carex flava* and within a minimum 200' buffer of the populations. Assumption: methods that control the grass but may pose a risk to the sedge would not be considered.

b) Methods and timelines for seed banking, propagation, and revegetating appropriate habitat for *Carex flava* in coordination with U of W Center for Rare Plant Conservation. Assumption: source material would not be harvested if collection has potential to impact the viability of the individual or population.

1.4.2 Develop and Implement a Noxious Weed Management Plan

Summary of Measure

Puget would implement site-specific and species-specific plans for noxious weed control that have been collaboratively developed with other interested members of the Baker River Coordinating Committee (BRCC) (see *Measure 6.2*). Plans would address control or eradication, site revegetation and treatment effectiveness monitoring in and around the Project area. On a specified periodic basis, Puget would resurvey designated portions of the Project area and re-evaluate treatment methods.

Description of Measure

Puget would work with other members of the BRCC to develop site-specific and species-specific management programs for noxious weed prevention, control or eradication, site revegetation, and treatment effectiveness monitoring in and around the Project area. Once developed, Puget would fund and implement the plans in designated areas. Activities on federal lands would be conducted in close coordination with the USFS. All activities would be conducted in coordination with Skagit and Whatcom County weed boards. Puget's current vegetation management program at the Baker River Project would be modified to support these new management procedures.

The goals of the management program are: 1) prevent the introduction of new noxious weeds in the Project area, 2) control the spread of existing or newly discovered Class A, B, and C noxious weeds within the area affected by the Project, 3) eradicate existing or newly discovered Class A and "B designate" weeds within the area affected by the Project, according to methods approved by the USFS, and 4) evaluate other invasive species periodically to determine if control and/or eradication is warranted.

The program would be designed to eradicate specified invasive non-native plants and noxious weeds from the Project area on a 5-year cycle of treatment and monitoring, and prevent their return for the remainder of the new license term. During these periods, designated portions of the Project area would be resurveyed and treatment methods re-evaluated. Options for control of the spread of existing weeds would be evaluated and implemented during each 5-year cycle. Current county and federal weed control policies, as well as noxious weed lists, would be used as guidelines for control, and would be updated for each management cycle.

Prevention would be accomplished via implementation of the specific measures listed in the USFS Forest Plan Amendment #14: Best Management Practices for Prevention of Noxious Weeds (Appendix C in: Potash, L. 1999. Forest-Wide Environmental Assessment for Noxious Weed Management on the Mt. Baker-Snoqualmie National Forest. USDA Forest Service, Mountlake Terrace, WA). Any updates of best management practices on national forest lands would be provided to Puget and implemented upon receipt.

Active restoration measures would be implemented to decrease "weed-friendly" habitat. All revegetation on USFS lands would follow Region 6 policy regarding native plant movement guidelines. Use of desirable non-native species would follow the recommendations in the MBS Native Plant Notebook (Potash and Aubry 1997).

1.5 Terrestrial Funding

1.5.1 Provide a Terrestrial Enhancement and Research Fund (TERF)

Summary of Measure

Puget would create the Terrestrial Enhancement and Research Fund (TERF), an annual discretionary fund to be administered by the Terrestrial Subcommittee of the Baker River Coordinating Committee. The purpose of the fund is to provide a firm commitment and resource pool to address ongoing needs relative to terrestrial species and their habitats during the license period. The fund is discretionary in use and additive to firm operational costs and other financial commitments called out in the Agreement.

Description of Measure

This is a discretionary fund for terrestrial research and enhancement activities. Specifics on implementation of this fund parallel those detailed under the Habitat Enhancement, Restoration, and Conservation Fund (see *Measure 3.1.1*).

2.0 Recreational and Aesthetic Resources Draft Measures

2.1 Recreational Safety and Resource Protection

2.1.1 Implement Water Recreation Safety Program

__Summary of Measure__
Develop a water recreation safety program for Baker Lake and Lake Shannon that addresses applicable safety aspects of water-based recreation, primarily boating and swimming.

__Description of Measure__
- Maintain informational displays addressing potential water safety hazards and boating regulations at public boat launches and swimming/day-use areas.
- Provide floating booms around developed swimming areas, to include "no boating" signage visible from the water.
- Develop and install maps and descriptive information about recommended boating channels and selected hazards at all public boat launching sites on the reservoirs.

2.1.2 Develop and Implement Boating Hazard Management Plan

__Summary of Measure__
Develop and implement a boating hazard management plan, including informational displays addressing potential boater safety hazards, and obstruction/hazard marking and removal.

__Description of Measure__
- Maintain informational displays addressing potential boater safety hazards and boating regulations at public boat launches.
- Remove or trim select hazard stumps and snags in the vicinity of all developed and highly frequented user-made public boat launch ramps on Lake Shannon and Baker Lake to an elevation compatible with the reservoir management regimes during the peak recreation season from April 15 through October 31. The distance from boat launching sites would be determined by the Baker River Coordinating Committee (BRCC) on a case by case basis. Where stumps are proposed for removal, the environmental impact of these actions would be assessed. Attach buoys, flags and/or other markers to selected stumps and snags that may represent continued, significant navigation hazards to provide visual warnings to boaters and/or to delineate the safe navigation channel in the Lake Shannon narrows.

2.1.3 Develop Law Enforcement Support

__Summary of Measure__
Develop a comprehensive law enforcement agreement between Puget, the Whatcom County Sheriff's Office and the US Forest Service that includes law enforcement support at the Project and in the immediate vicinity. Annual contributions for law enforcement

support would be limited to $20,000 in 2003 dollars. An alternative would be for Puget to provide local housing for a deputy.

<u>Description of Measure</u>

- Implement a formal agreement between Puget, Skagit County, the Whatcom County Sheriff's Office, the US Forest Service, the National Park Service, and any other appropriate law enforcement agencies (WDFW?) that provides for a specified level of law enforcement coverage in the project vicinity, including the lake surfaces, which may include direct funding and/or Puget-funded housing for locally stationed enforcement.
- Agreed-upon Project-related patrol.
- Include $10,000 in 2003 dollars annually to support USFS fire prevention programs.

2.2 Baker Lake Dispersed Recreation

2.2.1 Fund Dispersed Campsite Improvement, Operation and Maintenance

<u>Summary of Measure</u>

Provide Puget funding to cover up to 50 percent of the capital, operation, and maintenance costs associated with the management of specified dispersed camping sites located along and in the immediate vicinity of Baker Lake and Depression Lake. This funding would be limited to $10,000 annually for operation and maintenance expenses and up $100,000 for initial capital improvements. These sites are to be identified from the complete list of sites inventoried through Study R12 (see *Appendix A*). *[Note: Issue of funding versus responsibility needs to be addressed.]*

<u>Description of Measure</u>

Provide funding to cover up to 50 percent of the costs for the following elements of a dispersed campsite management program:

- Periodic grounds maintenance, to include refuse removal, on a schedule to be negotiated with the USFS.
- Removal of user-made improvements determined to be out of compliance with USFS regulations.
- Improve selected dispersed campsites in the Project-affected area that experience concentrated use, by providing items that, on a site-specific basis, could include tent pads, fire pits, and vault or backcountry toilets. Larger dispersed camping areas could receive Romtec single vault toilets, while Wallowa toilets or similar designs would be appropriate for smaller sites.
- Maintain facilities installed at hardened and improved sites on a long-term basis, including periodic repair or replacement of facilities and periodic servicing of toilet facilities for waste removal.
- Construct and maintain signage at these sites that educates dispersed users about the need to practice safe, legal, environment-friendly dispersed use.
- Monitor dispersed use levels and patterns, and physical conditions at the dispersed campsites.

- Develop and implement a dispersed camping fee program, to provide revenues to help defray the costs of the dispersed campsite program.
- Coordinate with Aesthetics Management Plan.

2.2.2 Manage Dispersed Camping Impact

Summary of Measure

Provide Puget funding to cover 50 percent of the capital cost to manage resource impacts to bring up to an acceptable standard the dispersed camping activity in the Baker Lake vicinity. These costs would be limited to $35,000. Provide Puget funding to cover 50 percent of the ongoing operation and maintenance expenses associated with public education in protecting dispersed resources. These costs would be limited to $10,000 annually. These actions would apply to the same subset of the total number of sites as identified in *Measure 2.2.1* and should be included in a management plan with a cost-sharing schedule.

Description of Measure

Provide Puget funding to cover 50 percent of the cost of the following program elements:

- Identify, in conjunction with the USFS, existing dispersed campsites to be closed because they are located in environmentally and culturally sensitive areas, have received extensive surface disturbance, are located in areas that are too difficult or inefficient to manage, and/or are not needed to support demand for dispersed camping at Baker Lake.
- Close access to and decommission the sites selected for closure, including installation of gates or other barriers to block roads, installation of signage needed to post the closures, and restoration of disturbed areas at the closed sites.
- Educate the public regarding low-impact use and potential harm to resource values by distributing at appropriate sites printed fliers on low-impact camping practices. These sites may include Puget Lower Baker Visitors Center, the Kulshan Visitors Shelter, the USFS Sedro-Woolley Ranger Station and the Baker Lake Visitor Center.
- Re-vegetate/restore damaged areas near selected dispersed sites that are to remain open for use, in a manner consistent with site identification and restoration guidance from the Terrestrial Resources Working Group.

2.3 Aesthetics Management

2.3.1 Develop and Implement an Aesthetics Management Plan for Lower Baker and Upper Baker

Summary of Measure

Within two years of acceptance of the license, Puget, in consultation with the Baker River Coordinating Committee, would develop and implement an aesthetics management plan for all project-related facilities at the Baker River Project.

Description of Measure
General actions prescribed in the plan could include:

- Applying structural treatments to Project facilities, such as painting, resurfacing or redesigning.
- Providing screening treatments to Project facilities, such as planting landscape screens.
- Trimming or removing vegetation to open or enhance desired views from selected points.
- Putting constraints on Project operations, intended to reduce the exposure of the reservoir shoreline area.

Specific actions could include:

- Constructing and maintaining suitable landscaped areas around the Puget Lower Baker Office, adult fish trap and crew quarters.
- Providing 6 ft-chain link fencing along the north side of the Puget Upper Baker compound west of the dam, including privacy slats.
- Providing the landscaped planting of native low-growing vegetation on the lawn area north of the Upper Baker compound fencing.
- Providing separate cedar fencing in front of the operator's cottage at Upper Baker.

2.4 Trails and Trailheads

2.4.1 Create New Trails

Summary of Measure
Provide Puget funding to create new trails, in accordance with a Comprehensive Trail Development Plan, in locations to be identified by the R15 Trail Routing study reports. Trails would be constructed to USFS standards for their projected use designation. Multi-use designations could include bicycles if acceptable to the landowners. All trails or trail sections built on Puget or private land would be created to similar standards. These trails would be created within a time period to be determined by the scope of construction necessary to satisfy the desired opportunities, consistent with projections of future demand.

The maximum miles of trail will be no more that the total number of miles included on the R15 Recreational Trail Routing map, less than the proposed trail section extending from Park Creek Campground north up the Swift Creek drainage.

Description of Measure

- Create a Comprehensive Trail Development Plan to include potential routes of East Lake Shannon Trail and West Baker Lake Trail. Include scope and schedule for each. In the twelfth year, the plan will be reviewed. As a result of this or subsequent reviews, Puget will provide a maximum of X additional miles of trail, based on identified need.
- Create, within the first 5 years of the new license, a trail system linking the southern end of the Baker Lake Trail with Bayview Campground on the southwest side of

Baker Lake, including connections with the Puget Kulshan Campground and the USFS Horseshoe Cove Campground.
- Create, within the first five years of the new license, short loop trails to serve the USFS Panorama Point and Shannon Creek Campgrounds. These trails would be no less than 2 miles each.
- Create, within the first year of the new license, trail connections from Kulshan Campground to Depression Lake and West Pass Dike, and to Glover Mountain.
- Create, within the first three years of the new license, a short loop trail on Puget lands in or near the Town of Concrete, to serve local, community-based trail needs and connect with terrestrial and/or aquatic resource enhancement actions.
- Provide water trail signage at select boat launch ramps. Information could include public access points and campsites, portage areas, points of natural or cultural interest, wildlife viewing areas and land-based trail connections.

2.4.2 Maintain Existing Trails and Trailheads

Summary of Measure

Provide Puget funding to cover 20 percent of the net annual cost to maintain, repair, and operate the selected existing trails and their trailheads affected by Project-related users. The net cost would include the revenue offset generated through the sales of Northwest Forest Passes. These costs shall not exceed $15,000 annually.

Description of Measure

Puget would provide 20 percent of the net annual cost (not to exceed $15,000 annually) to maintain, repair and operate the following trails:
- Baker River and Baker Lake trails and trailhead. (13.6 Miles)
- Mt. Baker National Recreation Area (NRA) trails and trailhead facilities. (X Miles)
- Anderson Lakes, Anderson Butte, and Watson Lake Trails and trailhead. (3.5 Miles)
- Blue Lake and Dock Butte trails and trailhead. (2.2 Miles)
- Shuksan Lake trail and trailhead. (2 Miles)
- Shuksan Ridge trail and trailhead. (X Miles)
- Boulder Creak trail and trailhead. (2.1 Miles)
- Noisy Creek trail. (1 Miles)
- Elbow Lake and Ridley Creek trails and trailhead. (X Miles)
- Proposed trail on the west bank of Baker Lake. (X Miles) (See *Measure 2.4.1*)

2.5 Developed Recreation Facilities

2.5.1 Enhance Bayview Campground

Summary of Measure

Provide Puget funding to complete the construction of Bayview Campground (north and south) as a (nominal) 23-site (south) and 5-site (north) USFS family campground, at such time as the total developed overnight occupancy in the Baker Basin exceeds 60 percent during July and August for two consecutive years.

Description of Measure

Provide Puget funding sufficient to rehabilitate the existing facilities, including roads, paths, restrooms/vault toilets, campsites (including campsite features), campground vegetation, signs, etc., and construct additional campsites as needed to achieve the desired campground capacity. The completion of this campground could serve as additional capacity for existing or future users in a configuration that responds to existing and anticipated needs (as verified), such as group sites or education related group facilities (as determined).

2.5.2 Fund USFS Campground Operation and Maintenance

Summary of Measure

Provide Puget annual funding to 50 percent of the net USFS operation and maintenance costs, including revenue and concessionaire costs, for USFS developed campgrounds associated with the Baker Project. These cost would be limited to $50,000 in 2003 dollars. These sites may include Horseshoe Cove, Shannon Creek, Maple Grove and Panorama Point Campgrounds. These actions include the annual administration, maintenance, and replacement costs. Puget consult with the BRCC on timing and scope of similar programs for the Bayview Campground. The goal is to bring campgrounds up to standard and then maintain them going forward.

Description of Measure

The proposed action includes financing or providing 50 percent of the annual costs (not to exceed $50,000 annually) for:

- Site safety and security.
- Fee collection.
- Grounds maintenance.
- Facility cleaning and maintenance.
- Facility repair or component replacement as necessary to maintain existing condition.
- Resource restoration/mitigation.
- Vegetation management.

2.5.3 Provide Access and Development to Lake Shannon or Another Suitable Lakefront Site

Summary of Measure

Develop a Recreation Management Plan that includes facility development for overnight camping, day use, and boat launching activities in Skagit County. This development could occur at Lake Shannon or at another suitable site. These developments would enhance and support the activities that currently occur at Lake Shannon.

Description of Measure

Measures for development include:

- Secure long-term public access to an appropriate site.

- Eventually create perimeter trail within the parcel boundary (primitive is fine). This trail would be designated for hiking only and would be limited to a maximum length of 1 mile.
- Install and maintain Romtec restrooms/vault toilets.
- Provide and service several permanent wildlife-proof trash receptacles.
- Construct site improvements to provide 24 standard campsites including fire pits and picnic tables.
- Provide and enforce a maximum stay policy.
- Provide adequate grounds keeping to maintain the site's aesthetic appearance. This includes restoration of degraded areas with native plantings.
- Construct a day-use facility in conjunction with overnight area to include a picnic shelter, four picnic tables and four fire rings, with use separation between the camping and day-use areas.
- Provide a padlocked gate.
- Provide a safe public drinking water supply.
- Provide a group camp for up to 20 people.
- Provide an informational kiosk and improved signage.
- Provide campground user fee collection.
- Provide police patrol of the site on a regular basis.
- Provide a designated parking area with boat trailer parking spots.
- Provide a designated area for day-use activities, including picnic shelter, picnic tables with fire grates and trash receptacles.
- Provide vehicle barriers to prevent uncontrolled vehicle access to pedestrian-only areas of the site.
- Provide hosting.

2.5.4 Provide Improvements to Kulshan Campground

Summary of Measure
Develop a component of the Recreation Management Plan that includes redevelopment of the Puget Kulshan Campground.

Description of Measure
Specific actions that Puget would implement at the Kulshan Campground include:

- Reconfigure the road and campsite arrangement in the original campground area, to reduce the capacity by 20 percent to provide more space and screening between sites and reduce the regimented feel of the facility.
- Upgrade the existing water and sewer utility hookups in the campground.
- Provide electrical hookups to 30 percent of the sites in the campground.
- Replace the existing portable toilets with two double and one single Romtec SST Traditional vault toilets.
- Modify the existing restroom facility to include showers.
- Develop a pedestrian path connecting the campground with the West Pass Dike area and Depression Lake, pending successful resolution of safety/liability considerations regarding the overflow ditch.

- Install low-growing landscaping between the newer campsites and the access road to West Pass Dike.
- Pave the pinwheel spur roads, which access the newly developed sites on the west side of the road from the restrooms to West Pass Dike.
- Provide electrical and water hookups to the newly developed sites on the west side of the road from the restrooms to West Pass Dike.

2.5.5 Support Redevelopment of Baker Lake Resort

Summary of Measure
Develop and implement a plan for the Baker Lake Resort area. Develop the plan before the termination of the existing special use permit term in 2008.

Description of Measure
This plan could include:
- Decommission and remove structures, including all cabins, boathouse, store, generator building and associated fuel tanks.
- Install a propane generator in the well house to operate the water well.
- Remove existing electrical and water hookups.
- Remove existing boat dock.
- Construct six communal water sources throughout the campground.
- Rehabilitate generator building, boathouse and store sites and vegetate with appropriate native species.
- Rehabilitate degraded areas with appropriate native species.
- Construct campsites at existing cabin locations.
- Replace existing picnic tables and fire pits with those meeting USFS specifications for use in campgrounds.

2.5.6 Provide Funding for Wildlife Observation Facility

Summary of Measure
Construct new day-use facilities to support wildlife observation and interpretation by visitors to the Baker Basin. A potential location could be at Little Park Creek Wetland Loop Trail.

Description of Measure
Provide a maximum of $150,000 Puget funding to support construction of new facilities in a location suitable for wildlife observation and interpretation. Puget would operate and maintain these facilities throughout the term of the new license. Specific components of this action would include:
- Select an appropriate location, in consultation with the USFS and terrestrial and aquatic resource interests, for the development of a wildlife viewing facility.
- Construct a small-scale viewing facility and other appropriate facilities, to consist of an observation platform with appropriate screening and walkways.
- Provide for ADA access to facility and some ADA trail access.

- Install interpretive displays.
- Install trash receptacles.
- Provide parking for 12 vehicles.
- Provide long-term maintenance of the facility, including periodic repair and/or replacement as necessary.

2.5.7 Provide and Fund ADA Compliance

Summary of Measure
Within 2 years of issuance of a new license, Puget will develop and implement a transition plan to comply with current ADA direction at sites associated with the project. The plan will include funding an implementation of specific measures on a site-by-site basis.

Description of Measure
The proposed action includes funding and/or implementing the following specific measure:

- Construct an ADA-accessible fishing platform on Depression Lake, to provide recreational fishing access for people with disabilities.

2.6 Recreation Funding

2.6.1 Provide a Recreation Adaptive Management Fund (RAM)

Summary of Measure
The Baker River Project would provide an annual discretionary fund to be administered by the Recreation Resource Group of the Baker River Coordinating Committee (BRCC). The purpose of the fund is to provide a firm commitment and resource pool to address ongoing recreation resource needs and impacts during the license period. The fund is discretionary in use and additive to firm operational costs and other financial commitments called out in this Agreement.

Description of Measure
Puget would establish a fund to be used for the enhancement of recreational sites and experiences in the Project-affected area in accordance with applicable provisions of Washington State law and this Agreement. Specifics on implementation of this fund parallel those detailed under the Habitat Enhancement, Restoration, and Conservation Fund (see *Measure 3.1.1*).

3.0 Aquatic Resources Draft Measures

3.1 Aquatic Species Management Plan

3.1.1 Create Habitat Enhancement, Restoration, and Conservation Fund (HERC)

Summary of Measure

Puget would create the Habitat Enhancement, Restoration and Conservation Fund (HERC), an annual discretionary fund to be administered by the Aquatics Subcommittee of the Baker River Coordinating Committee (BRCC) (see *Measure 6.2*). The purpose of the fund is to provide a firm commitment and resource pool to address ongoing needs relative to aquatic species and their habitats during the license period. The fund is discretionary in use and additive to firm operational costs and other financial commitments called out in this Agreement.

Description of Measure

Create HERC Fund: Puget would establish a fund to be used for the enhancement, conservation, and/or restoration of habitat for aquatic species in accordance with applicable provisions of Washington State law and this Agreement.

Selection of Projects and Approval of Budgets: The BRCC would select projects and approve budgets for expenditure from the HERC Fund for any action, structure, facility, program or measure, including education programs (referred to herein generally as "projects") intended to further the purpose of enhancement, conservation, or restoration of habitat or species related to the Baker River Project.

Projects would be chosen based upon agreed guidelines. High priority would be given to habitat improvements in the basin, including the acquisition of interests in land such as conservation easements or other habitat conservation measures. Studies, implementation, monitoring, evaluation, and legal expenses associated with any project would be financed from the HERC Fund.

HERC Funding Amount: The HERC Fund would be in two parts, primary and matching funding.

- Primary HERC Fund: Puget would provide a monetary contribution to the HERC of $______ per year for the first 10 years of the new license and $_______ per year thereafter for the term of the license for enhancement, conservation and/or restoration activities associated with aquatic species or their habitat.
- Matching HERC Fund: Any party may also propose projects utilizing matching funds. Parties proposing such projects would be responsible for development of matching funds. Puget would provide a monetary contribution to the HERC of $______ per year for the first 10 years of the new license and $______ per year thereafter to be utilized on a 50 percent matching fund basis for enhancement, conservation and/or restoration activities associated with aquatic species or their habitat.

The HERC Fund is to be administered by the Aquatics Subcommittee of the BRCC. The BRCC would review and approve projects for which HERC funding is requested. The BRCC would select projects and approve project budgets from the HERC by joint written documentation of all members of the BRCC.

Funds may be utilized on a priority basis within the Baker Basin and subsequently within the Middle Skagit downstream of the Baker River. Whenever feasible, projects selected by the BRCC would take into consideration and be coordinated with other conservation plans or programs. Whenever feasible, the BRCC would cost-share with other programs, seek matching funds, and "piggy-back" programs onto other habitat efforts.

The HERC Fund can be used on an annual basis or accumulated for future use. If a beneficial project is identified and existing funds are insufficient, up to 50 percent of the next year's fund may be withdrawn from the fund to be used. Such pre-spending of succeeding year's funding would not occur more than three years in a row.

At Puget's discretion, the HERC Fund may be held in escrow or provided for by annual budget. The parties to this Agreement may audit Puget's records relating to the fund during normal business hours following reasonable notice.

Prohibited Uses of the HERC Fund: The BRCC would act in strict accordance with the following:

- No money from the HERC Fund would be used to enforce compliance with this Agreement.
- Members of the BRCC and their expenses would not be compensated through the HERC Fund.
- Administrative costs, staffing and consultants, reports and brochures, landowner assistance and public education costs collectively would not exceed $______ in 2006 dollars in any given year without the unanimous vote of the BRCC.

Reports and Accounting for Fund Use: At least annually, Puget would provide a financial reporting of HERC Fund activity to the BRCC.

Puget recommends the fund be utilized for some or all of the following topic areas at the determination of the BRCC:

Measure	PME Option
Resident Salmonid Program Native Species Initiative and recreational fishing opportunities	3.01c
Non-native or Invasive Aquatic Animal Species	3.01d
Water Quality Enhancement	3.04c
Riparian Enhancement	3.04d
Channel Modification	3.04e
Noxious Weed Control	3.04f

3.1.2 Provide Fish Propagation and Enhancement Programs and Facilities

Summary of Measure
Fish propagation and enhancement programs and facilities at the Baker River Project would include continued operation of the Sockeye Spawning Beach (Beach 4), restoration and decommissioning of Beaches 2 and 3, and several supplementation programs.

Description of Measure
Sockeye Spawning Beaches/Low Impact Enhancement Programs: Puget would continue to fund the operation of the Sockeye Spawning Beach (Beach 4).

- Facility Modifications: Beach 4 would be modified for improved functionality and productivity by doing the following:
  1. Isolate water supply and drains to each of the existing segments
  2. Install concrete walls between segments
  3. Improve alarm systems

- Operations: Within 6 months of completed modifications, Puget would provide a complete manual of operations for the spawning beach. The manual would include:
  1. Flow distribution schematic and plan
  2. Emergency response plan
  3. Call out procedures
  4. Security plan
  5. Management
  6. Reporting procedures
  7. Operations plan
  8. Equipment list and supplier
  9. Fish distribution plan
  10. Spill containment plan
  11. Hygiene plan for disease control

Operation of Beach 4 would be by annual contract secured with appropriate and qualified operators as approved by the Baker River Coordinating Committee (BRCC).

- Programs: Contractors operating the beach would be selected by Puget from candidates who have previously been qualified by the BRCC. Contracts would be issued for a 5-year period and must be secured at least 12 months before the expiration of the existing contract.

  Programs, loading densities, etc., for the spawning beach would be determined by the BRCC. Studies to optimize performance may be conducted within the context of beach operations and would be funded by the annual budget for the beaches or independently by Puget.

The BRCC would develop improvements to release strategies. Puget at the direction of the BRCC would develop and maintain several release sites as alternates to West Pass Dike. Puget would investigate time-of-day release strategies to improve survival.

The BRCC would develop an implementation plan to release Sockeye salmon fry into Lake Shannon and eliminate imports of non-native kokanee.

- Monitoring and Evaluation: Puget would perform an annual audit of the operation of the Spawning Beach facility based on June 1 to May 31 operating year and provide such audit to the BRCC for review by December 31 each year.

- Reporting: The contractor operating the beach would provide a final annual report of operations of the previous year to the BRCC by June 1 of each year. Such report would contain information regarding the operations, problems, facility status, future needs and results of the program.

<u>Restore and Decommission Beaches 2 and 3:</u> Puget would implement the following for Beaches 2 and 3:

Retention of Spawning Beaches 2 or 3 is preferred by parties while other PME measures are implemented. Puget would make necessary modifications (such as leak reduction) to one or both of these beaches to improve their performance as an interim measure. At such time as the BRCC determines these facilities are no longer necessary, decommissioning would proceed following the protocol below:
- Configure the channel to natural meander and optimize coho usage.
- Remove all structures and restore landscaping.
- Initiate returns to site with a temporary supplementation program (with the capacity to be determined).
- Develop pilot nutritional enhancement in Channel Creek to increase rearing capacity for coho.

<u>Supplementation Programs:</u> Puget would implement the following supplementation programs: *[Placeholder numbers, species and programs. Possible modifications and alternative language may be substituted.]*

Improve artificial incubation and rearing facilities at Sulphur Creek to support up to 20,000 lbs instantaneous rearing capacity.
- Coho: Release 20,000 coho smolts (at 10 to 15/lb.) per year for duration of license.
- Steelhead: Release 25,000 steelhead smolts (at 6 to 8/lb) per year for the duration of the license.
- Chinook: Rear and release 25,000 spring Chinook smolts (at 10 to 15/lb) at the Baker River trap per year for the duration of the license.
- Or as an alternative: Support Chinook rearing programs off site for the Skagit River basin yearly for the duration of the license.

- Rainbow Trout or other preferred species: Rear and release 10,000 catchable-sized rainbow trout to Depression Lake per year for the duration of the license.
- Increase sockeye production to the basin.

3.2 Fish Passage Management Implementation Plan

3.2.1 Provide Upstream Passage Continuity for Migratory Fish Species (Anadromous, Adfluvial, Fluvial, Resident)

Summary of Measure
Upstream passage at the Baker River Project would be provided using trap, sort and haul facilities located on the Baker River in Concrete and other programs and facilities as appropriate for the Upper Baker Development.

Description of Measure
Puget would provide and operate passage facilities for upstream migratory fish at the Lower Baker Development. The facility design, construction, testing and operations and maintenance would be approved by the BRCC and satisfy specific Section 18 authorities by US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). Upstream passage would be provided using trap, sort and haul facilities located on the Baker River in Concrete as agreed to by the Fish Passage Technical Working Group. The facilities may use the existing site and some or all existing facilities as agreed to by the parties.

- Construction: Puget would provide complete plans and specifications for construction of facilities for attraction, capture, and transport of upstream migrating fish at the Lower Baker Development no less than 120 days before initiation of construction and within 2 years of acceptance of the license.

- Participation for review: The USFWS and NMFS have Section 18 (FPA) prescriptive authority for fish passage facilities. However, a number of parties have interest in the configuration and performance of the facilities. Therefore, Puget would consult with the BRCC and at least the USFWS, NMFS, Washington Department of Fish and Wildlife, and the Swinomish, Upper Skagit and Sauk-Suiattle Tribes regarding the development and approval of the design. Approved designs would be submitted to the FERC for approval at least 60 days before initiation of construction.

- Materials: Prior to construction, Puget would provide a complete list of components to the BRCC.

- QA/QC: At least 60 days before initiation of construction, Puget would provide a quality assurance/quality control plan to the BRCC for their approval to confirm that approved plans would be constructed as designed.

- O and M Plans: At least 60 days before initiation of operation, Puget would provide complete plans and specifications for operation and maintenance of upstream passage facilities.

- Emergency Response Plan: Within 60 days of initiation of operation, Puget would provide, for review by the BRCC, a response plan addressing operational contingencies and emergencies.

- Monitoring, Evaluation and Reporting: Puget would conduct startup testing and evaluation and provide for monitoring the operations and condition of the trapping, sorting and hauling facilities.

  Each year Puget would provide a report to the FERC and the BRCC describing the operation of the facility for the previous 12 months. The report would include the numbers and species of fish captured in the trap and the associated disposition of those fish. The report would include a description of problems and associated remedies for such problems.

  Puget would provide a schedule for reporting the operation of the facilities. Puget would also provide a mechanism for auditing such compliance and reporting such compliance to the BRCC and the FERC.

- Modifications: Apart from routine operation and maintenance funding, Puget would provide funding on an annual basis for modification of the facilities to address changing needs and technologies. The use of this fund would be at the agreement of the BRCC. In the event that the funds are not expended in a given year because an identified need would exceed the quantity of funds available for such purpose, the funds may be accumulated until the next year but are not co-mingled with the HERC Fund.

3.2.2 Address Connectivity Between Baker Lake and Lake Shannon

Summary of Measure

To address connectivity between Baker Lake and Lake Shannon, Puget would study and implement effective connectivity for native aquatic species isolated by the project structures.

Description of Measure

- Within three years of acceptance of the license, Puget would conduct a study in consultation with the BRCC to determine ways to address connectivity between Baker Lake and Lake Shannon. The study may include: tagging, radiotagging or other study methodologies.

- Results from the study would be used to determine whether facilities or programs are needed to co-mingle isolated groups of fish to provide connectivity. In the event that, in the opinion of the BRCC, the study demonstrates that essential fish passage continuity could be provided through a trap and haul facility, Puget would plan and construct, in consultation with the BRCC, a prototype trap and haul facility for the Upper Baker Development. This facility would be a test facility constructed with sufficient economy in scope, but detail in operational design, to determine if capture and transport is feasible.

If, in the opinion of the BRCC, a facility would not appropriately achieve fish species connectivity, Puget would propose an alternative plan to achieve continuity, which may include seining or other capture and release techniques.

- Develop permanent facility as needed. In the event that the test facility above is demonstrated feasible, Puget would, in consultation with the BRCC, plan, construct, and operate permanent trap and haul facilities. Construction, operations, consultation protocols, and other considerations would follow the formats for the upstream passage facilities. The guiding principle would be a program or facility that is effective but modest in scope.

3.2.3 Provide Downstream Passage Continuity for Migratory Fish Species (Anadromous, Adfluvial, Fluvial, Resident)

Summary of Measure
Puget would provide and operate passage facilities for downstream migratory fish at the Upper Baker and Lower Baker Developments using sequential development of fish attraction barge technology, with trap and haul and acclimation ponds for release. Incentives related to avoided costs are available for early resolution of migratory facility development using principles of adaptive management.

Description of Measure
Puget proposes a five-stage development of downstream passage facilities based on fish attraction barge technology with an adaptive management decision incentive for early resolution of migratory facility development.

Adaptive Management Decision Incentive (AMDI): At any time following the acceptance of Stage 1, 2, or 3 of the downstream passage facility development sequence, 20 percent of the cost avoided in succeeding unconstructed modules would be added to the HERC fund for use in fish programs administered by the BRCC.

Attraction Barge: Puget would design, in consultation with the FPTWG or the BRCC (whichever is in existence at the time), a fish attraction barge with a flow capacity of 250 cfs (roughly twice the existing gaged operating flow) to be installed at Upper Baker. The barge would be designed in a modular format to permit adaptive management development of the passage technology, including expanded flow capability. The facility would be designed to accept three extension modules for increased flow capacity of 250 cfs each to be added sequentially in three subsequent testing phases as necessary to a total attraction flow of 1000 cfs or the minimum flow associated with a single unit of continuous operation at Upper Baker. Modules would be designed to permit installation within a single off-season period in preparation for the following season.

The attraction barge module concept would be developed in scale model to permit resolution of flow continuity, flow orientation and construction/installation issues.

Ancillary Facilities: Puget would design and install, in consultation with the FPTWG or the BRCC, a new exclusionary guidenet system to provide a continuous and durable fish barrier.

Trap, sort and haul modifications would be made to the Upper Baker Trap.

Acclimation facilities would be sited and constructed at Concrete near the confluence of the Baker River with the Skagit River.

Development and Testing: Concept development and testing would be conducted in the following sequence (see Figure 1):

Stage 1: After model design development and construction and installation of Module 1.

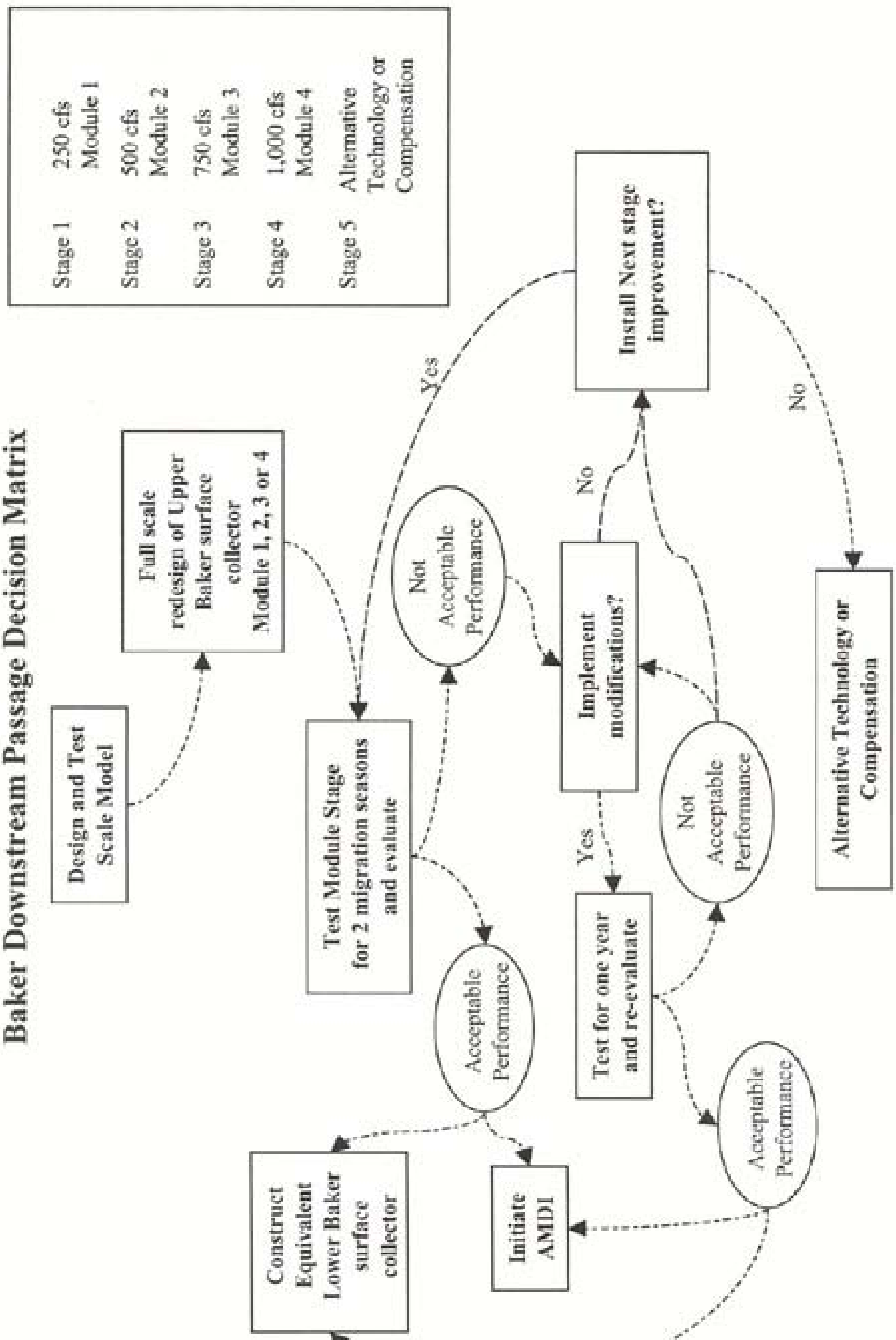
Year 1: Test Module 1 and evaluate.

The base module (250 cfs) would be constructed, operated and tested for two migration seasons. Fish behavior relative to the barge would be tested using acoustic tagging and/or other applicable techniques to track fish behavior as well as account for migration success. Following Year 2 testing and evaluation, the FPTWG or the BRCC would convene to determine if Module 1 is successful as installed, if modifications to Module 1 are necessary to improve its effectiveness, or if increased attraction flow is necessary.

Year 2: Test Module 1 and evaluate.

Year 3: Either a) Accept Module 1 and construct at Lower Baker or b) Modify Module 1 and test another year or c) Go to Stage 2.

Figure 1
Baker Downstream Passage Decision Matrix



The Adaptive Management Decision Initiative (AMDI) is shared cost savings dedicated to discretionary fisheries enhancement programs resulting from early resolution of final passage design.

Throughout this matrix decision process, the Fish Passage Technical Group of the Baker River Coordinating Committee will determine direction.

a) If Module 1 is, in the opinion of the BRCC, performing satisfactorily as installed, a second equivalent passage facility would be constructed at Lower Baker Dam and Adaptive Management Decision Incentive (AMDI) would be initiated.
b) If modifications are necessary, those modifications would be instituted and tested in Year 3. After Year 3 testing and evaluation are complete, the FPTWG or the BRCC would convene to determine if Module 1 is successful as modified or if further modifications to Module 1 are necessary.
c) Go to Stage 2 (see below).

Year 4: Accept Module 1 as modified in Year 3 and construct at Lower Baker or Modify Module 1 and test another year.
If Module 1 is, in the opinion of the BRCC, performing satisfactorily as modified, a second equivalent passage facility would be constructed at Lower Baker Dam and AMDI would be initiated.

Year 5: Accept Module 1 as modified in Year 4 or Modify Module 1 and test in Year 6.
If Module 1 is, in the opinion of the BRCC, performing satisfactorily as installed, a second equivalent passage facility would be constructed at Lower Baker Dam and AMDI would be initiated.

Stage 2: Add Module 2 to increase flow to 500 cfs by Year 4 and test for two years.

Year 5: Test Modules 1 and 2 for two years. If after testing and evaluation, Modules 1and 2 are, in the opinion of the BRCC, performing satisfactorily, a second equivalent passage facility would be constructed at Lower Baker Dam and AMDI would be initiated.

Stage 3: Add Module 3 to increase flow to 750 cfs by Year 7 and test for two years.
If sufficient progress in migration success has not been achieved following testing in Years 4 and 5 and, in the opinion of the BRCC, increased flow attraction is needed, a third module would be constructed and installed at Upper Baker by Year 7. No additional modifications would be installed at Lower Baker until final resolution of passage success at Upper Baker is achieved.

If Modules 1, 2 and 3 are, in the opinion of the BRCC, performing satisfactorily as installed and tested, a third module would be installed at Lower Baker and AMDI would be initiated.

Stage 4: Add Module 4 to increase flow to 1000 cfs by Year 10 and test for two years.
If sufficient progress in migration success has not been achieved following testing in Year 8 and, in the opinion of the BRCC, increased flow attraction is needed, a fourth and final module would be constructed and installed at Upper Baker by Year 10. No additional modifications would be installed at Lower Baker until final resolution of passage success at Upper Baker is achieved.

Stage 5: Alternative Technologies and/or compensation.
If sufficient progress in migration success has not been achieved following testing in Year 12 and, in the opinion of the BRCC, the concept cannot be sufficiently modified to achieve success, the BRCC would investigate alternative technologies. In the event that no alternative technology can be assured to provide greater success, compensation to the HERC Fund would be equivalent to 100 percent of the original avoided cost.

General Design Features:

- Construction: Puget would provide complete plans and specifications for construction of facilities for attraction, capture, and transport of upstream migrating fish at the Lower Baker Development no less than 120 days before initiation of construction and within two years of acceptance of the license.

- Participation for Review: The USFWS and NMFS have Section 18 (FPA) prescriptive authority for fish passage facilities. However, a number of parties have interest in the configuration and performance of the facilities. Therefore, Puget shall consult with the BRCC and at least the USFWS, NMFS, WDFW, and the Swinomish, Upper Skagit and Sauk-Suiattle Tribes regarding the development and approval of the design. Approved designs would be submitted to the FERC for approval at least 60 days before initiation of construction.

- Materials: Prior to construction, Puget would provide a complete list of components to the BRCC.

- QA/QC: At least 60 days before initiation of construction, Puget would provide a quality assurance/quality control plan to the BRCC for their approval to confirm that approved plans would be constructed as designed.

- O and M Plans: At least 60 days before initiation of operation, Puget would provide complete plans and specifications for operation and maintenance of downstream passage facilities.

  Within 60 days of initiation of operation, Puget would provide, for review by the BRCC, a response plan addressing operational contingencies and emergencies.

- Monitoring, Evaluation and Reporting: Puget would conduct startup testing and evaluation and have a provision for monitoring the operations and condition of the trapping, sorting and hauling facilities.

- Each year Puget would provide a report to the FERC and the BRCC describing the operation of the facility for the previous 12 months. The report would include the numbers and species of fish captured in the trap and the associated disposition of those fish. The report would include a description of problems and associated remedies for such problems.

Puget would provide a schedule for reporting the operation of the facilities. Puget would also provide a mechanism for auditing such compliance and reporting such compliance to the BRCC and the FERC.

3.3 Flow Management Implementation Plan for Fish and Other Aquatic Species

3.3.1 Implement Flow Regime for the Baker River Project

Summary of Measure
Puget would establish a flow regime that addresses minimum instream flow, ramping, amplitude and cycling under various hydrologic scenarios. The reporting from gaging sites and contingency protocols would also be established.

Description of Measure

Instream Flow:
Puget would release flows at the Baker River Project within the conditions outlined in the flow schedule in Table 3. For simplicity of compliance and compliance tracking, the flow schedule is based on three general hydrologic scenarios, a normal year, a high-water year, and a low-water year, defined as follows:

- A normal-water condition is defined as instantaneous inflows to the Baker Basin between the 15 percent and 85 percent annual exceedance, as calculated at the confluence of the Baker River and the Skagit River.
- A high-water condition is defined as instantaneous inflows to the Baker Basin exceeding the 15 percent annual exceedance for the month as calculated at the confluence of the Baker River and the Skagit River.
- A low-water condition is defined as instantaneous inflows to the Baker Basin less than the 85 percent exceedance for the month as calculated at the confluence of the Baker River and the Skagit River.

Table 3. Schedule for minimum flow releases for the Baker River Project as measured at the Baker River at Concrete Gage.

Month	Instream Flow
January	300 cfs
February	300 cfs
March	300 cfs
April	300 cfs
May	300 cfs
June	300 cfs
July	300 cfs
August	300 cfs
September	300 cfs
October	300 cfs
November	300 cfs
December	300 cfs

After the water condition is determined, the minimum instream flow would remain at the listed value except by express approval of the Baker River Coordinating Committee.

This overall schedule may be altered by agreement of the BRCC.

Ramping:
Puget would change the rate of flow from the Baker River Project within the conditions outlined below.

Because of variables outside Puget's control (e.g., bank storage or release, wind action, tributary input, micro fluctuations from upstream projects, etc.), instantaneous rates are considered targets for compliance. Day/night relationships have temporal biological meaning; however, because the flows travel downstream, time-of-day relationships are best addressed by constant rates.

Fluctuations in the stage of the Skagit River are routinely imposed by the Skagit River Project as well as in response to changes in unregulated flow contribution from tributaries. For purposes of compliance, ramping compliance would be assessed by meeting either of two standards: (1) no greater than 650 cfs reduction per hour caused by the Lower Baker Development on the Baker River measured at the Baker River Near Concrete Gage (USGS no. 12193500); or (2) 6 inches per hour total reduction as measured at the Skagit River Near Concrete Gage (USGS no.12194000). These ramping restrictions shall be in effect whenever the flow as measured at the Skagit River above the Baker River confluence is less than or equal to 18,000 cfs as estimated by taking the difference between USGS gage no. 12194000 and the appropriately lagged value at USGS gage no. 12193500.

Range of Ramping Measurements:
The rates for ramping represent a not-to-exceed rate of downward change on a per hour basis. Implementation is on a linear continuous basis. However, it is understood that various conditions may alter instantaneous rates of change at the point of measurement. These conditions include hydraulic conditions, the operation of the Skagit River Project, natural flow conditions, bank storage, supplemental flow or extractions, etc. Therefore, for the purpose of ramping compliance, rate of change per 15-minute increment would be used.

Amplitude and Cycling:
Changes of maximum and minimum stage in the Skagit River by virtue of operation of the Baker River Project would not exceed 2 feet on a daily basis. Amplitude would be measured to the nearest 0.1 foot and would be compared on a rolling 24-hour basis.

Recording for All Parameters: The gage for measuring flow releases would be the Baker River at Concrete gage (USGS # 12193500). The gages for ramping and amplitude compliance would be the Skagit River near Concrete gage(s) (USGS # 12194000) or other gage(s) as approved by the Baker River Coordinating Committee.

Monitoring and Reporting Protocols:

- Protocols: Puget would monitor the flow releases, ramping, and amplitude continuously. Access to data would be provided through the World Wide Web at the USGS website or other appropriate site. However, Puget would provide annual updates to the FERC and the BRCC related to compliance. The BRCC and the FERC would be the recipient of an annual flow report.
- Violations: In the event of a violation of the flow release, ramping, or amplitude schedule, Puget would report such violations as soon as discovered, but in no case later than 24 hours. Email notification, or other reporting mechanisms agreeable to the parties, would be made to the FERC and the BRCC. Puget would provide a follow-up report to the FERC and BRCC within two weeks of the incident. The report would contain:
    - A summary of the incident
    - The cause of the incident
    - The response to the incident
    - The actions taken to prevent a recurrence of similar incidents in the future

Contingencies and Emergencies Related to Flow Management Associated with the Baker River Project:

- Human Health and Safety: In the event that human health and safety are at risk, these instream flow values may be temporarily altered. However, FERC and the BRCC would be notified in accordance with the procedures outlined below.

- Unit Failures: In the event that the unit(s) at Lower Baker Development is at risk of failure or the unit is involuntarily forced off-line, these instream flow values may be temporarily altered. However, FERC and the BRCC would be notified in accordance with the procedures outlined below.

- Force Majeure: Instream flow values may be temporarily altered based on other certain unforeseen but significant acts of nature, etc. *[Force Majeure Language]*. However, FERC and the BRCC would be notified in accordance with the procedures outlined below.

- Notification: In the event of a temporary alteration of the instream flow values, Puget would report such actions as soon as they are known, but in no case later than 24 hours. Email notification, or other reporting mechanisms agreeable to the parties, would be made to the FERC and the BRCC. Puget would provide a follow-up report to the FERC and BRCC within two weeks of the incident. The report would contain:
    - A summary of the incident
    - The cause of the incident
    - The response to the incident
    - The actions taken to prevent a recurrence of similar incidents in the future

3.4 Physical Habitat Management

3.4.1 Implement Fluvial Geomorphic Management

Summary of Measure

Puget would restore the natural function of sediment transport in the Baker River Basin to the lower Baker and Skagit rivers downstream from the Baker Project, and undertake actions to enhance channel morphologic function of the lower Baker alluvial fan.

Description of Measure

Lower Baker River:

Within two years of acceptance of the license, Puget would provide a plan in consultation with the BRCC and FERC for immediate implementation of habitat enhancement actions intended to improve the geomorphic function of the lower Baker River alluvial fan. The fan landform is defined as the mainstem river channel and the associated depositional feature located within the Skagit River floodplain. *[Additional text to be developed in concert with Study A16.]*

Skagit River:

Within two years of acceptance of the license, Puget would provide a plan in consultation with the BRCC and FERC to address the potential for future augmentation of gravel to the Skagit River. The plan shall specify:

- Procedures for monitoring conditions in the Skagit River to determine when and if gravel augmentation becomes warranted;
- Procedures for determining the amount of gravel to be placed annually;
- Placement timing, locations, and methods;
- Material sources and grades;
- Permitting;
- Coordination of the gravel augmentation program with other basinwide habitat restoration activities; and
- Reporting schedule.

1) Determination of the need for placement.

Although construction of the Baker Project cut off the supply of bedload from the Baker River to the Skagit River, available evidence suggests that the middle Skagit River is currently aggrading. The causes of this aggradation are unknown, but could be the result of increased tributary sediment inputs, a reduction in the river's sediment transport capacity as a result of flood control, or a combination of those and other factors that are unrelated to Baker Project operations. Determining the reason for the existing Skagit River aggradation is beyond the scope of the Baker Project gravel augmentation plan.

To determine when and if gravel augmentation to the Skagit River may be desirable, Puget would develop a plan to monitor trends in the bed surface texture and tendency towards aggradation/degradation in the middle Skagit River downstream of the Project. The monitoring program is expected to consist of:

- Annual evaluation of stage discharge relationships at the Skagit River near Concrete and Skagit River near Mount Vernon gages maintained by the USGS;
- Establishment and re-survey at five-year intervals of up to three transects in the vicinity of the Baker River confluence and the Skagit River near Concrete gage; and
- Sampling of the bed surface texture at gravel bars within the active channel that are exposed by low flows concurrent with transect surveys.

If monitoring conducted in support of the Baker River gravel augmentation plan or other scientifically sound research and monitoring programs document a consistent trend towards coarsening of the bed surface or degradation in the middle Skagit River downstream of the confluence with the Baker River, a proposal for gravel augmentation intended to restore bedload inputs from the Baker River to the Skagit River would be developed and presented to the BRCC. To be considered a consistent trend, bed coarsening and/or degradation would have to occur at two or more survey transects and persist over at least a five-year period. Short-term changes at any individual transect that occur in response to individual flow events would not be considered evidence of a trend toward aggradation or bed coarsening. If and when degradation or bed coarsening is first observed, the frequency of monitoring may be increased to ensure timely identification of long-term trends.

2) Procedures for determining the amount of gravel to be placed annually.

If a consistent trend toward bed coarsening or aggradation is documented in the middle Skagit River, the BRCC may recommend implementation of the gravel augmentation plan. In no case would the amount of gravel placed exceed the amount of bedload intercepted by the Baker River (which currently is estimated to consist of approximately 12,500 tons of gravel and small cobble-sized sediment).

Because bedload contributions from the Baker River historically represented only a small fraction of the total sediment yield to the Skagit River, an empirical approach would be utilized whereby placement is initiated using smaller increments (e.g., 1,000 tons per year) in conjunction with continued monitoring and gradual increases in the annual amount of material placed if the trend towards bed coarsening and degradation continued. If a consistent trend towards aggradation is observed following implementation of the gravel augmentation program, annual gravel placement would be reduced or halted. The gravel augmentation program implemented under PME 3.4.1 would not include intensive modeling of sediment transport relationships within the middle Skagit River.

3) Material sources and grades.

The plan would identify existing local material sources within the Skagit River Basin.

- Material intended for placement would consist of gravel and cobble-sized sediments; the size distribution and grade of material would be identified during development of the plan.

- Alluvial or glacial material is required.
- Gravel sources would be approved by the BRCC.

4) Permitting.

Gravel augmentation would be coordinated with other restoration efforts underway in the Skagit River basin. Gravel augmentation would not be implemented if efforts elsewhere in the middle Skagit basin are focused on reducing the supply of coarse sediment. Gravel augmentation activities would comply with all federal, state and local permit requirements.

5) Reporting.

A report would be submitted to the BRCC following each five-year re-survey of selected monitoring sites, describing the results of the monitoring. The BRCC would determine whether or not implementation of gravel augmentation is warranted.

If a gravel implementation program is implemented, annual reports would be submitted to the BRCC describing the results of the placement program and ongoing monitoring. These reports would include recommendations for adaptive management, including alternative placement quantities, gravel introduction sites or methods, or other proposed changes to the program.

3.4.2 Implement Large Woody Debris Management

Summary of Measure

Puget would provide for the movement of LWD that enters the two reservoirs to ensure its continued use in terrestrial and aquatic ecosystems in the Baker River Basin and Skagit River downstream from the Baker River Project. The goal is to ensure the continued movement of LWD in the ecosystems of the Baker River Basin and Skagit River downstream from the Baker River Project.

Description of Measure

Within one year of acceptance of the license, Puget shall provide a plan to the BRCC and FERC for management of LWD within the Baker Project. This plan would address wood over 12 inches (30cm) in diameter and over 8 feet long.

The plan would include:

1) Annual Inventory – Inventory wood below the normal full pool (724 feet for Baker Lake and 438.6 feet for Lake Shannon) elevations for at least the following characteristics:
    a. Type (single piece, fixed or floating; rafted)
    b. Size class (based on length, diameter, rootwad)
    c. Decay condition
    d. Location (forebay, north, center, south zone)
    e. Amount of LWD removed

LWD inventories would be conducted annually for the first five years after the LWD management plan is implemented, and thereafter at five-year intervals and_following major flow events (e.g., more than a five-year return interval) in the Skagit River basin.

2) Timing and Priority of Removal – Based on the requested uses of the wood each year, pieces would be removed with the following priorities:
   a. Wood that is in the forebay area or floating in the south or center zones would be utilized first.
   b. Wood in existing rafts or embedded in sediments would not be removed unless for safety reasons.

3) Decision Making Process – The BRCC would be the primary group for deciding which mitigation or enhancement projects would be allocated the LWD that is removed from the Project reservoirs. Priorities for LWD allocation are:
   a. Ecosystem restoration projects identified in the FERC license as mitigation for the Baker River Hydropower Project.
   b. Ecosystem enhancement opportunities first within the Baker River Basin and then the Skagit River downstream of Baker River, as identified by the BRCC in the future. During the first five years after acceptance of the license, Puget and the BRCC would investigate opportunities to place large wood in the active channels, floodplains, or riparian areas. This investigation should consider the feasibility, risk and environmental effects of these projects. Additional opportunities would be evaluated every 10 years. *[Need to address permitting and liability / provision for alternatives]*
   c. The BRCC would consider requests from agencies and other groups for use of the wood. These agencies or groups would be responsible for analysis of feasibility, risk, and environmental assessments associated with the projects. These may be ecosystem uses or social uses such as firewood.

4) Costs – Puget would cover the costs of collection and transport of wood as follows:
   a. Annually move up to 27 pieces between 60 and 90 cm, and 8 pieces larger than 90 cm to staging areas near the Skagit River (based on a 20-year average from Study A20 – Large Woody Debris Budget).
   b. Move wood for identified mitigation projects in the Baker River Basin to the project site.
   c. Move wood for non-related projects to stockpile.
   d. If, in the opinion of the BRCC, LWD is insufficient in the Baker River or Skagit River downstream of the Project, LWD would be allocated to projects that involve anchoring LWD in the river. The locations and methods of anchoring LWD structures in the Skagit River and lower Baker River would be directed by the BRCC and must comply with all federal, state and local permitting requirements. Funding for anchored LWD placement would be allocated from the HERC fund by the BRCC.

5) Logistics – The plan would describe the logistics of moving wood in terms of how the wood would be moved, and where it would be stockpiled for use. Length of time in stockpiles should be less than five years in order to minimize decay of wood and unauthorized use.

6) Data Management – Puget would keep records of the annual inventories, amount of LWD removed from the reservoir by size class, annual LWD allocation and the quantities used for projects. These data would be used to verify the model estimates of inputs to the reservoirs.

3.4.3 Erosion Control and Implementation Plan

Summary of Measure
Develop and implement an Erosion Control and Implementation Plan to address project impacts on resources and facilities. This plan would cover erosion control for: construction, containment from project-related failures, and chronic reservoir erosion.

Description of Measure
Within one year of acceptance of the license, Puget would develop an Erosion Control and Implementation Plan. The plan would:
1) Identify and prioritize sites for treatment
2) Detail treatment methods, materials, costs and timing
3) Provide an implementation framework and schedule
4) Provide for monitoring treatment effectiveness
5) Provide for treatment maintenance

The plan would detail treatments by site and provide an annual cost estimate. The plan would also ensure cross-resource issues are addressed. *[Note: ARWG members expressed desire for specifics on what treatments would involve; consider specifying Best Management Practices (BMPs) to address common situations?]*

3.5 Water Quality

3.5.1 Implement Flow Release Water Quality Management

Summary of Measure
Puget would monitor and comply with applicable water quality parameters related to flow release at the Baker River Project.

Description of Measure
Puget would monitor specified parameters per the Water Quality Monitoring Plan Schedule *[to be provided]*.

Period of Monitoring: Monitoring would continue for a period of three years following acceptance of the license or for a period as determined in consultation between the Department of Ecology (DOE) and Puget.

Puget would provide summary reports of monitoring results annually to the FERC, DOE and BRCC. In the event of a violation of a water quality parameter, Puget would report such violations as soon as discovered, but in no case later than 24 hours to the FERC, DOE and BRCC. Phone and/or email notification, or other reporting mechanisms agreeable to the parties, would be made to the FERC, DOE and the BRCC.

Puget would provide a follow-up report to the DOE, FERC and BRCC within two weeks of the incident. The report would contain:

- A summary of the incident
- The cause of the incident
- The response to the incident
- The actions taken to prevent a recurrence of similar incidents in the future

In the event that a given water quality parameter is not in compliance with the water quality standards of the state, Puget would provide, within six months of the documentation that such compliance is not achieved, a plan to reach compliance, using best available technologies.

In the event that a given water quality parameter cannot be brought into compliance with the water quality standards of the state, Puget would provide sufficient documentation that the parameter cannot be met and the reasons for failing to reach compliance.

3.5.2 Implement Reservoir Water Quality Management

Summary of Measure

Puget would monitor and comply with applicable water quality parameters for reservoir waters at the Baker River Project. A*t Lake Shannon minimum pool elevation for water quality would be 380 feet msl (NGVD 29) or 383.75 ms. (NAVD 88).*

Description of Measure

Puget would monitor specified parameters for reservoir waters at the Baker River Project per the Water Quality Monitoring Plan Schedule *[to be provided]*.

Monitoring would continue for a period of three years following acceptance of the license or for a period as determined in consultation between the Department of Ecology (DOE) and Puget. Puget would provide summary reports of monitoring results annually to the FERC, DOE and BRCC. In the event of a violation of a water quality parameter, Puget would report such violations as soon as discovered, but in no case later than 24 hours to the FERC, DOE and BRCC. Phone and/or email notification, or other reporting mechanisms agreeable to the parties, would be made to the FERC, DOE and the BRCC.

Puget would provide a follow-up report to the DOE, FERC and BRCC within two weeks of the incident. The report would contain:

- A summary of the incident
- The cause of the incident

- The response to the incident
- The actions taken to prevent a recurrence of similar incidents in the future

In the event that a given water quality parameter is not in compliance with the water quality standards of the state, Puget would provide, within six months of the documentation that such compliance is not achieved, a plan to reach compliance, using best available technologies.

In the event that a given water quality parameter cannot be brought into compliance with the water quality standards of the state, Puget would provide sufficient documentation that the parameter cannot be met and the reasons for failing to reach compliance.

3.5.3 Implement Stormwater Pollution Prevention Planning

Summary of Measure

Puget would monitor and comply with applicable water quality standards for waters at the Baker River Project including stormwater pollution prevention, erosion control planning and spill prevention, containment and clean-up planning.

Description of Measure

Puget would develop and implement a Stormwater Pollution Prevention Plan (SWPPP) for all project-related facilities including access roads, transmission corridors, structures and staging areas, and for all activities related to project operation and maintenance.

The stormwater pollution prevention plan (SWPPP) shall meet or exceed the standards and specifications of the August 2001 Ecology Stormwater Management Manual for Western Washington, or the most current edition. The SWPPP shall include "best management practices" *[reference?]* for erosion control, facility maintenance, source control and spill prevention, containment and cleanup. The SWPPP shall be kept current and be made available to the Department of Ecology upon request.

Puget shall obtain coverage under an NPDES Construction Stormwater General Permit for land disturbing activities that exceed one (1) acre, prior to the construction-related activity.

4.0 Cultural and Historical Resources Draft Measures

4.1 Historic Properties Management Plan (HPMP)

4.1.1 Implement the Historic Properties Management Plan

Summary of Measure

Puget would implement the Historic Properties Management Plan (HPMP).

Description of Measure

FERC regulations for compliance with the National Historic Preservation Act (NHPA) require that Puget establish a program to manage cultural resources affected by the Baker River Project. Puget would implement the Historic Properties Management Plan (HPMP), following NHPA Section 106 guidelines, in conjunction with the activity of the Cultural/Historical Resources Working Group and in consultation with FERC, the Washington State Office of Archaeology and Historic Preservation (OAHP), the US Forest Service and affected Indian tribes. The HPMP would provide Puget personnel with guidance for protecting and managing cultural resources over the period of the new license.

The HPMP would include, but not be limited to, the following:

1) Individual management measures for each historic property, including specific protective and mitigation measures, guidelines for maintaining historic buildings and structures, and measures for avoiding effects on traditional cultural properties.

Puget has completed the archaeological inventory and evaluation in the Area of Potential Effect (APE) from Project operations, providing baseline data for effective management of cultural resources. Following guidelines established for the NHPA, resources have been evaluated for National Register eligibility, and effects to National Register-eligible sites have been assessed. This process is not complete for traditional cultural properties and for a few low elevation archaeological sites prior to filing the license application. Specifications for completion of these tasks would be included in the HPMP.

2) Clearly defined policies and programs that provide for all aspects of cultural resource management including project review and planning, tribal coordination, assessment of new actions, a listing of excluded actions, measures to be undertaken in cases of emergency or accidental discovery of cultural material or human remains, and procedures for curation of cultural material and samples.

Puget would assign a Cultural Resources Coordinator to oversee implementation of the Historic Properties Management Plan (HPMP), to participate in review of Project developments and consult with parties to the HPMP, and to oversee development and implementation of cultural resources training. In addition, the Cultural Resources Coordinator would work with Project personnel and other resource managers to address shared concerns.

Puget would incorporate cultural resource review in early stages of proposed developments at Project facilities and on Baker River Hydroelectric Project lands by instituting annual planning review and development plan screening to filter for actions that may affect archaeological sites, traditional cultural properties, and historic buildings and structures.

Review for cultural resource concerns would be built into early planning stages through the following two mechanisms:

- Annual review of proposed construction and development projects for potential land/soil disturbance, and changes to buildings and structures.
- Review of Project development plans, including area of impact, scope of work, proposed design, materials, work methods, equipment use, etc.

Ground-disturbing activity, whether in the course of general Project operations and maintenance (example: snag clearing) or new developments (examples: construction of new buildings, contouring of land), may damage archaeological sites or interfere with traditional cultural sites of significance to the Tribes. Likewise, modifications to buildings and structures and disturbance in previously undeveloped areas may affect other types of cultural resources, making it necessary to identify and resolve effects. A standard decision-making process would allow for lead time in assessing potential effects and for carrying out NHPA Section 106 review procedures, which involve identification of impacts and consultation with interested parties.

In addition, Puget would implement the Unanticipated Discovery Plan developed by the Cultural/Historical Resources Working Group as a protocol to be followed by Project personnel who unexpectedly come across human or cultural remains in the course of Project activities and developments.

3) Provisions for protection of known sites including annual monitoring and sponsorship of law enforcement training and presence.

A monitoring plan would establish areas and intervals for periodic monitoring in order to assess the condition of archaeological sites and historic buildings and structures and to determine if additional protective measures are needed. Consultation with the tribes would assist in monitoring potential impacts on traditional cultural properties. Monitoring may have a seasonal component or may address sensitive areas or dynamic areas where accelerated erosion may be of concern.

Puget would sponsor periodic one-day workshops for representatives of local law enforcement agencies, such as the Town of Concrete Police Department and the Whatcom and Skagit County Sheriff's Offices. Workshops would be conducted with the assistance of qualified professionals, such as representatives of other law enforcement agencies who have experience and expertise in dealing with cultural resource law enforcement issues, such as ARPA and state laws. The US Forest Service and affected tribal police would be invited to participate.

4) Provisions for training and education for Puget personnel about the cultural heritage of the project and for outreach to the public.

Puget would develop and implement annual training for Puget staff and contractors to enhance their understanding of the measures of the HPMP and particularly the Unanticipated Discovery Plan. Instruction would assist employee's capability to recognize cultural materials and to understand the Plan's measures. Training would also address the importance of keeping information on the nature and location of archaeological sites and of any traditional cultural properties confidential. A workshop would be presented annually, with periodic updates for new employees. Materials would be provided to support supervisors who may need to orient field crews and contractors working on Project lands.

Puget's Cultural Resources Coordinator would work with Puget education, community relations and resource personnel to ensure that Puget's public interpretation and education programs include components on history and prehistory, promote stewardship of cultural resources, and encourage cooperation with other educational and outreach programs in the Baker River area. The Cultural Resources Advisory Group would provide assistance with development and evaluation of cultural resources-related public interpretation and education.

5) Provisions for implementation of the management measures, policies, programs, and provisions including:

- Schedule with priorities for site mitigation and protection and other recommended measures and provisions;
- Reporting to FERC and other agencies;
- Composition of an Advisory Group;
- Creation of a Cultural Coordinator position within Puget;
- Dispute resolution and conflict management;
- Review and revision of the HPMP to accommodate changing conditions; and
- Funding.

4.2 Cultural Resources Funding

4.2.1 Provide a Cultural Resources Management Fund (CRMF)

Summary of Measure

Puget would create a Cultural Resources Management Fund (CRMF), an annual discretionary fund to be administered by the Cultural Resources Subcommittee of the Baker River Coordinating Committee. The purpose of the fund is to provide firm commitment and a resource pool to address ongoing needs relative to cultural resource management requirements during the license period. The fund is discretionary in use and additive to firm operational costs and other financial commitments called out in the Agreement.

Description of Measure

This is a discretionary fund for cultural resources research and enhancement activities. This fund would be separate from funding required for implementation and support of the Historic Properties Management Plan (HPMP). Funding for the HPMP would be detailed in the management plan. Specifics on implementation of this fund parallel those detailed under the Habitat Enhancement, Restoration, and Conservation Fund (see *Measure 3.1.1)*.

5.0 Economics and Operations Draft Measures

5.1 Maintain Current Levels of Flood Control at Upper Baker

Summary of Measure

Maintain current levels of flood control operations at Upper Baker. This provides for 16,000 acre-feet as replacement storage and provides for an additional storage amount up to 58,000 acre-feet for a total of 74,000 acre-feet.

Description of Measure

The current Corps of Engineers' flood control operation at Upper Baker was set by Congress in 1977 at a total of 74,000 acre-feet with 16,000 acre-feet as replacement storage and the remaining 58,000 additional acre-feet with compensation provided to the Licensee. Proposal here is to retain that language, pending results of an ongoing feasibility study.

Article 32 of the current Baker License states:

> "The Licensee shall so operate the Upper Baker River reservoir as to provide each year 16,000 acre-feet of space for flood regulation between November 1 and March 1 as replacement for the valley storage eliminated by the development. Utilization of this storage space shall be as directed by the District Engineer, Corps of Engineers.
>
> "In addition to the above-specified 16,000 acre-feet, the Licensee shall provide in the Upper Baker River reservoir space for flood control during the storage drawdown season (about September 1 to April 15) up to a maximum of 84,000 acre-feet as may be requested by the District Engineer, provided that suitable arrangement shall have been made to compensate the Licensee for the reservation of flood control space other than the 16,000 acre-feet specified herein."

6.0 Shared Resources Draft Measures

6.1 Utilize Adaptive Management Principles

Summary of Measure
The Baker River Project would utilize principles of Adaptive Management.

Description of Measure
Adaptive management has been defined as:

"A method for examining alternative strategies for meeting measurable goals and objectives, and then, if necessary, adjusting future management actions according to what is learned."

[To be determined]

6.2 Create Baker River Coordinating Committee (BRCC)

Summary of Measure
As part of the Adaptive Management Plan for the Baker River Project, the parties agree to create and participate in a committee called the Baker River Coordinating Committee (BRCC). The purpose of the BRCC is to perform several coordination and management functions related to the Baker River Project and associated resource interests. The BRCC would form several subcommittees related to topic areas including aquatics, terrestrial, recreation, cultural and others that may form from time to time.

Description of Measure

Responsibilities of the BRCC:
The Baker River Coordinating Committee (BRCC) would be used as the primary means of consultation and coordination between the parties in connection with the conduct of studies, the implementation of the measures set forth in this Agreement, and for dispute resolution. All study designs and modifications to study designs would be subject to agreement by the BRCC except as specifically called out in this Agreement.

The BRCC would be responsible for establishing and monitoring the annual management protocols for operation of the fish passage facilities, fish, wildlife and recreation programs, and other measures called out in this Agreement.

The BRCC would be responsible to develop management policy and scope for the Baker Basin and coordinate such activities with other regional interests through the subcommittees related to topic areas, including aquatics, terrestrial, recreation, cultural and others that may form from time to time.

Meetings of the BRCC:

- The BRCC would be composed of one (1) representative of each party to this Agreement, whom they would designate from time to time.
- The BRCC would act only by consensus. Each representative would have one vote. Each party would provide all other parties with written notice of its designated representative to the BRCC.
- Frequency of BRCC meetings: The BRCC would meet whenever requested by any two (2) members following a minimum of ten (10) days written notice.
- Documentation of BRCC actions: The parties may choose and Puget would fund a neutral third party to record and distribute minutes of BRCC meetings.

BRCC Monitoring and Evaluation of Study Conduct:
The BRCC would serve as the primary body to monitor and evaluate compliance with the conditions of this Agreement as they relate to resources. The BRCC would oversee the planning, conduct, evaluation and reporting of studies related to Project functions as they relate to resource management.

All studies and reports prepared in association with the work of the BRCC would be available to all members of the committee as soon as reasonably possible. Draft reports would be circulated through the BRCC representatives for comment, and comments either would be addressed in order or made an appendix to the final report. All studies would be conducted following accepted techniques and methodologies in use for similar studies in the region. All studies would be based on sound biological and statistical design and analysis.

Adaptive Management Used by the BRCC:
The BRCC would utilize Adaptive Management (see *Measure 6.1*) as the method to conduct on-going improvement to resource decisions. To this end, the BRCC would evaluate changing needs, recent information, and study results to determine if emerging issues would influence existing or proposed management, facilities, programs, or policies for the basin.

BRCC Administration of Resource Funds:
The BRCC is responsible for the approval and oversight of funding distribution related to the various resource funds agreed to in the Settlement Agreement, including but not necessarily limited to the Habitat Enhancement, Restoration, and Conservation Fund (HERC), the Terrestrial Enhancement and Research Fund (TERF), the Recreation Adaptive Management Fund (RAM) and the Cultural Resources Management Fund (CRMF).

6.3 Implement a Reservoir Level Management and Operations Plan

Summary of Measure
The reservoir management plan is based on a blended consideration of aquatic, recreational, cultural, and terrestrial resource needs, as well as human health and safety, property, and project economic and operational issues.

Description of Measure
Changes of maximum and minimum stage in Baker Lake and Lake Shannon reservoirs by virtue of operation of the Baker River Project shall be according to Table 4. Elevation would be measured to the nearest 0.1 feet and would be compared on a rolling 24-hour basis.

Table 4. Reservoir management regime.

Baker Lake			
Month	**Elevation (NGVD 29)**	Elevation **(NAVD 88)**	Rationale
January	707.8 or less	711.6	Flood control
February	707.8 or less	711.6	Flood control
March	710 or less	713.8	Wildlife
April	710 or less	713.8	Cultural protection/Recreation/Power
May 1-15	710 or less	713.8	Cultural protection/Recreation/Power
May 16-31	715 or less	718.8	Cultural protection/Recreation/Power
June	715 or greater	718.8	Cultural protection/Recreation/Power
July	715 or greater	718.8	Cultural protection/Recreation/Power
August 1–Labor Day	715 or greater	718.8	Cultural protection/Recreation/Power
September (after Labor Day–September 30	715 or less	718.8	Wildlife
October	715 or less	718.8	Wildlife
November 1–14	715 or less	718.8	Wildlife
November 15–30	707.8 or less	711.6	Flood control
December	707.8 or less	711.6	Flood control

Lake Shannon			
Month	**Elevation (NGVD 29)**	**Elevation (NAVD 88)**	**Rationale**
January	438.6 or less	442.35	Power/Instream flow management
February	425 or less	428.75	Wildlife
March	425 or less	428.75	Wildlife

April	425 or less	428.75	Wildlife
May	425 or less	428.75	Wildlife
June	401 or greater	404.75	Recreation
July	401 or greater	404.75	Recreation
August	401 or greater	404.75	Recreation
September	401 or greater	404.75	Recreation
October	438.6 or less	442.35	Power/Instream flow management
November	438.6 or less	442.35	Power/ Instream flow management
December	438.6 or less	442.35	Power/ Instream flow management

Range stage height measurements:

Implementation compliance would be through an instantaneous point exceedance basis. However, it is understood that certain conditions may alter instantaneous rates of change at the point of measurement, including hydraulic conditions, natural flow conditions, wind or flow extractions. Therefore, for the purpose of compliance, average per day increment would be used. Compliance for the two reservoirs would be measured at two gages: the Baker Lake Gage USGS #12191600 and the Lake Shannon Gage USGS #12193000, respectively.

Puget would monitor the stage height continuously. Access to reservoir stage height would be provided through the World Wide Web. However, Puget would provide annual updates to the FERC and the BRCC related to reservoir management compliance.

In the event of a violation of the reservoir rule curve schedule, Puget would report such violations as soon as discovered, but in no case later than 24 hours. Email notification, or other reporting mechanisms agreeable to the parties, would be made to the FERC and the BRCC. Puget would provide a follow-up report to the FERC and BRCC within two weeks of the incident. The report would contain:

- A summary of the incident
- The cause of the incident
- The response to the incident
- The actions taken to prevent a recurrence of similar incidents in the future

6.4 Implement an Access Management Program

Summary of Measure

Prepare and implement an access management program, in cooperation with private, state, and federal landowners.

Description of Measure

Puget would develop a comprehensive program for managing access related to the Project and project license conditions. Several areas of management needs are:

- Provide Puget funding to cover an agreed percentage of the annual cost to manage and maintain Project-related roads for operations, public access, and safety to appropriate standards.
- Management of access to recreation sites, such as developed and dispersed camp sites, trails, boat ramps, reservoir drawdown zones, etc., that are determined to be Project related.
- Management of access to protect and/or manage other resources, such as terrestrial, aquatic, and cultural/historical, in or outside of the Project area. Maintain and perpetuate the "natural" features of the North Cascades National Park that are affected by project related users, the Noisy-Diobsud Wilderness, the Stephen T. Mather Wilderness, the Mt. Baker Wilderness, the Mt. Baker National Recreation Area, and the contiguous Inventoried Roadless Area, designated without the development of roads.
- Security for Project facilities.
- Public and agency access to the east side of Baker Lake.

Puget would provide the lead for this effort, and would involve other landowners, including the USFS, WDNR, and other private landowners. Puget would assist the USFS with access management in accordance with the USFS Road Management EA on federal lands.

6.5 Provide Informational, Interpretive and Educational Services and Facilities

6.5.1 Provide Visitor Information

Summary of Measure
Develop and implement a joint-venture visitor information program that provides a public service to Project-area visitors.

Description of Measure
- Provide funding to cover 50 percent (not to exceed $10,000 in 2003 dollars annually) of the cost of a visitor information services program for recreational visitors to the basin. This may include an on-route information kiosk. This funding would be used to supplement existing visitor information services. The program would provide materials and/or distribute information about topics of interest to Project-area visitors, such as recreational facilities and activities, interpretative and educational facilities and programs, fishing season and regulations, and safety messages.
- Construct, maintain and supply a shelter for visitor informational materials at the Kulshan Campground.
- Operate visitor information services at the Lower Baker Visitors Center year-round, including distribution of information materials and responding to visitor inquiries.
- Provide materials or media for the Lower Baker Visitors Center, the USFS Sedro-Woolley Ranger Station, and Kulshan Visitors Shelter. Distribution material would include campground brochures, trail maps, environmental awareness literature, interpretive performance schedules, etc. The materials would describe the joint work

underway, the rationale behind these efforts, and the achievements culminating from the Settlement Agreement and new FERC License.

6.5.2 Provide Interpretive Services

Summary of Measure

Develop and implement a joint-venture interpretive services program that provides a public service to Project-area visitors.

Description of Measure

- Provide the USFS with funding to cover 50 percent (not to exceed $10,000 in 2003 dollars annually) of the cost of an interpretive services program for recreational visitors to the basin. This funding would be used to supplement existing USFS services.
- Provide funding for development and installation of interpretive displays and/or materials or media at specified locations in the Project area. Specific actions include replacement of existing interpretive displays at existing facilities, addition of interpretive displays at existing facilities, or installation of interpretive displays at new facilities developed through the Project recreation plan. The displays would provide information about topics of interest to Project-area visitors, such as local aquatic and terrestrial resources, the cultural history and prehistory of the area, or the development of the Baker Project.
- Provide interpretive services in the Upper Baker area between Memorial Day and Labor Day each year.
- Staff the Lower Baker Visitors Center providing interpretive services through Labor Day each year.
- Maintain the interpretive displays at the Lower Baker Visitors Center, including replacement or improvement as appropriate.

6.5.3 Provide Cultural and Natural Resource and Conservation Education

Summary of Measure

Provide funding to develop, operate, maintain and support cultural and natural resource and conservation education programs, services and activities for individuals and groups visiting, using or participating in the Baker Hydroelectric Project, the Project area, the Puget service area, and local watershed communities.

Description of Measure

- Contribute $20,000 direct funding support to organizations that provide cultural and natural resource and conservation education services that are geographically or topically related to the Baker River Project. Recipient organizations could include federal or state resource agencies, local Tribes, local school districts, colleges or universities, and private, non-profit organizations.
- Operate and maintain Puget educational programs related to the Project under an annual budget of $20,000.

- Operate the Baker Lake Lodge to annually host up to 24 overnight educational program events to be organized by other service providers. Meals and overnight accommodations for these events would be provided by Puget. Maximum capacity of the lodge is 26 people.
- Contribute funding, adjusted annually for inflation. If funding is not used, it is diverted to another educational program with a nexus to the program.

The orientation of the educational programs to be supported through this measure are summarized as follows:

- Target audiences would include: school children, teachers, recreational users, visitors to the Project area and surrounding public lands, local residents, conservation professionals, Puget employees and surrounding communities etc. The target population for Skagit County (2000 Census) alone is 102,979 plus.
- Content areas would include: natural and cultural heritage of the Baker River Basin; wildlife, terrestrial, cultural, historical, aquatic and other resources; watershed management; energy production, use and conservation; reducing recreational and other human-induced impacts to plants and animals.
- Program types would include: field and classroom activities, nature hikes, seminars, workshops, tours, trainings, outdoor education and recreation activities, curriculum development.

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