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ACRONYMS, ABBREVIATIONS AND DEFINITIONS

µg/L	micrograms per liter
7-DADMax	7 day average daily maximum temperature
2006 DROE	2006 Draft Report of Examination
2009 Community Agreement	*2009 Agreement Regarding Lake Tapps Between Cascade Water Alliance and the Lake Tapps Community*
ADD	Average Day Demand
Applications	Water right applications S2-29920, R2-29935, and S2-29934 and change/transfer application CS2-160822CL
BOD5	5-day biochemical oxygen demand
Cascade	Cascade Water Alliance
CCTC	Climate Change Technical Committee
CELP	Center for Environmental Law and Policy
cfs	cubic feet per second
CIG	Climate Impacts Group (University of Washington)
CPSWSF	Central Puget Sound Water Suppliers' Forum
DEIS	Draft Environmental Impact Statement
DO	dissolved oxygen
DOH	Washington State Department of Health
Early Spring Avoidance Plan	Described in Condition 6, a reduction in diversions from the White River by up to the amount of the water supply withdrawal on days between February 15 and March 31 when the Puyallup River is below its MIF.
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
GCM	General Circulation Model
gpm	gallons per minute
Hydro Project	White River Hydroelectric Project
IFIM	Instream Flow Incremental Methodology
IPCC	Intergovernmental Panel on Climate Change
LiDAR	Light Detection and Ranging
Lower White River	The reach of the White River below the tailrace canal (RM 3.6)

LWD	large woody debris
Members	The municipal corporations and special-purpose municipal corporations in King County that are members of Cascade Water Alliance
mgd	million gallons per day
mg/L	milligrams per liter
MIF	minimum instream flow
MIT	Muckleshoot Indian Tribe
MMD	Mud Mountain Dam
n.d.	no date
NGVD	National Geodetic Vertical Datum
NOAA Fisheries	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
OCPI	overriding considerations of public interest
PCHB	Pollution Control Hearings Board
Project	Lake Tapps Reservoir Water Rights and Supply Project
PSRC	Puget Sound Regional Council
PTI	Puyallup Tribe of Indians
Puget	Puget Sound Energy (and its predecessors)
Puget Claim	Water right claim number 160822
Qa	Maximum Annual Quantity
Q(A)c	Upper Coarse-Grained Unit
Q(A)f	Upper Fine-Grained Unit
Q(B)c	Lower Coarse-Grained Unit
Q(B)f	Lower Fine-Grained Unit
Q(C)u	Unconsolidated/Undifferentiated Deposits
Qi	Maximum Instantaneous Quantity
Qva	Vashon Advance Outwash
Qvt	Vashon Glacial Till
RCW	Revised Code of Washington
Recommended Flow Regime	The flow regime that results from the minimum flows, diversion caps, ramping rates, and limitations on tailrace discharges established in the WRMA.
Reservation Reach	The reach of the White River between the diversion dam at RM 24.3 and the tailrace canal at RM 3.6
RM	River Mile

ROE	Report of Examination
SEPA	State Environmental Policy Act
TM	Technical Memorandum
TMDL	Total Maximum Daily Load
TSP	Cascade's *2004 Transmission and Supply Plan*
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WRMA	White River Management Agreement
WSDOT	Washington State Department of Transportation
WY	Water Year

1. INTRODUCTION

This Investigator's Report summarizes the Washington State Department of Ecology's ("Ecology") investigation and decisions corresponding to permit application number S2-29920, originally filed on June 20, 2000. Application S2-29920 is one of four related applications submitted for the same project, known as the "Lake Tapps Reservoir Water Rights and Supply Project" ("Project"). The four applications are comprised of three municipal water rights applications for new appropriations (S2-29920, R2-29935, and S2-29934) filed in 2000 and a change/transfer application (CS2-160822CL) filed in 2005 for existing pre-code water right claim number 160822 ("Puget Claim"). These four applications are referred to collectively as the "Applications."

Under application S2-29920, Cascade has also proposed to create a Regional Reserved Water Program that would establish a reserved quantity of water for the cities of Auburn, Bonney Lake, Buckley, and Sumner to use in connection with future applications for new water rights or changes to existing water rights. For clarity, Ecology has issued two separate Reports of Examination corresponding to application S2-29920: one corresponds to the Lake Tapps Reservoir Water Rights and Supply Project [permit S2-29920(A)] and the other corresponds to the Regional Reserved Water Program [permit S2-29920(B)]. Both of the permits are evaluated in this Investigator's Report.

Following submission of an application for a new appropriation, Ecology is required to investigate and determine what water, if any, is available for appropriation, to what beneficial use or uses the water can be applied, whether the appropriation would impair existing rights, and whether the appropriation is in the public interest. To approve the water right application Ecology must issue written findings of fact and determine that each of the following four requirements of RCW 90.03.290 has been satisfied:

1) Water is available for appropriation;

2) The proposed appropriation would be put to a beneficial use;

3) The proposed appropriation would not impair existing water rights; and,

4) The proposed appropriation would not be detrimental to the public interest.

This report first describes the proposed Project and the Applications. Second, it presents Ecology's investigations that form the basis of the decisions on the Applications. Third, it separately evaluates each of the requirements of the four part test. Finally, it presents the written findings of fact and decision.

The Applications are interrelated such that portions of Ecology's analysis and investigations of each of the Applications are identical. Therefore, while Ecology will issue one or more Reports of Examination ("ROE") for each of the Applications, the central analysis applicable to the Applications will be discussed in this Investigator's Report. Each of the ROEs will refer to this document and will address any unique aspects of each individual application.

1.1 The Applicant

Puget Sound Energy ("Puget") originally filed the Applications. On December 18, 2009 Puget conveyed its interest in the Applications through an asset purchase agreement to Cascade Water Alliance ("Cascade"). Through the Asset Purchase Agreement, Cascade also acquired Lake Tapps Reservoir, the Puget Claim, and associated hydroelectric project ("Hydro Project") facilities. Cascade is the current

Applicant for the Project. By letter dated December 15, 2009, Ecology accepted the assignment of the Applications from Puget to Cascade (Ecology 2009b).

Cascade is a non-profit corporation composed of municipal corporations and special-purpose municipal corporations in King County that are party to an Interlocal Agreement entered into under the authority of the Interlocal Cooperation Act (Chapter 39.34 RCW). The members of Cascade ("Members") work together to plan, develop, and operate a water supply system that will meet their current and future drinking water needs.

The Members are as follows:

- City of Bellevue
- City of Issaquah
- City of Kirkland
- City of Redmond
- City of Tukwila
- Covington Water District
- Skyway Water and Sewer District
- Sammamish Plateau Water and Sewer District

1.2 Lake Tapps Reservoir Water Rights and Supply Project

With this Project, Cascade's objective is to provide – in a coordinated, cost-effective, and environmentally responsible manner – a safe, reliable, high quality municipal water supply that will meet the current and projected demands of its Members and the Central Puget Sound region from a source that is sufficiently large, certain and non-speculative, and is available both for immediate, short-term use and for long-term use over a 50- to 100-year planning period.

To achieve this objective, Cascade proposes using Lake Tapps Reservoir to serve as a regional water supply for current and future populations' needs. In short, the Project consists of three basic elements (described in further detail in Section 3.3.1):

1. **New municipal appropriations** to divert water from the White River into Lake Tapps Reservoir, store water in the reservoir, and withdraw water from Lake Tapps for municipal water supply purposes. The new municipal water supply would provide 48.5 million gallons per day ("mgd") or 75 cubic feet per second ("cfs") Average Day Demand ("ADD") for the Members.

2. **Recommended Flow Regime for the Reservation Reach of the White River**, which includes minimum flow rates, diversion limits, limitations on tailrace discharge, and ramping rates. The Recommended Flow Regime was established in the White River Management Agreement ("WRMA") negotiated between Cascade and the Puyallup Tribe of Indians and Muckleshoot Indian Tribe (Cascade 2008b).

3. **Maintenance of Recreational Lake Levels** in accordance with the 2009 Agreement Regarding Lake Tapps between Cascade Water Alliance and the Lake Tapps Community ("2009 Community Agreement"; Cascade 2009).

1.3 The Applications

The Applications under consideration seek approval for various components of the Project.[1]

The three municipal water rights applications are necessary for the new consumptive appropriations for municipal supply. Each of the three applications addresses a component of the Project. The three applications are:

- Application S2-29920 requests authorization to 1) divert water for municipal supply purposes from the White River into Lake Tapps Reservoir for the Project and 2) establish a separate Regional Reserved Water Program for future use by the cities of Auburn, Bonney Lake, Buckley, and Sumner (together, the "Four Cities"). For clarity, Ecology has issued two separate ROEs corresponding to S2-29920: S2-22920(A) for the diversion from the White River into Lake Tapps Reservoir, and S2-22920(B) for the Regional Reserved Water Program.

- Application R2-29935 requests authorization to store the quantity of water diverted under Application S2-29920 in Lake Tapps Reservoir.

- Application S2-29934 requests authorization to withdraw the annual quantity of water diverted under Application S2-29920 and stored in Lake Tapps Reservoir under Application R2-29935 for municipal supply.

Puget submitted the application for a change in purpose of use of the Puget Claim to confirm that it continues to have the right under the Puget Claim to divert and use water for multiple beneficial purposes, including, but not limited to, recreation, reservoir maintenance, fish passage, flow augmentation, and water quality. The application to change the Puget Claim is a significant component of the Project because it confirms that Cascade may continue to use the Puget Claim as it has historically been used.

Table 1 lists the new water rights applications and the change of purpose of use application. In addition, Table 1 explains the minor changes from Cascade's original proposal.

[1] In addition to the Applications filed for the Project, Cascade also plans to donate a portion of the Puget Claim to permanent trust in the State Trust Water Rights Program after the applications under consideration are approved. Accordingly, Cascade has not submitted an application for the permanent donation. In the meantime, Ecology has approved Cascade's temporary donation of a portion of Puget's Claim into the State Trust Water Rights Program. The donation is intended to provide an additional legal mechanism to attain the Recommended Flow Regime described in further detail in Section 3.3.1.

Table 1 – Water Rights Applications and Change of Purpose of Use Application

Application No. (Filing Date)	Type	Description of Original Application	Description of Current Proposal
S2-29920[2] (Jun 20, 2000)	Permit for: Diversion from the White River	Quantity: Qa = Maximum Annual Quantity Qa = 72,400 acre-feet/year [equivalent to a 100 cubic feet per second ("cfs") continuous rate] Qi = Maximum Instantaneous Quantity Qi = 2,000 cfs Purpose: Public water supply for consumptive municipal, industrial, and commercial purposes.	***Lake Tapps Reservoir Water Rights and Supply Project [S2-29920(A)]:*** Quantity: Qa = 54,300 acre-feet/year (equivalent to a 75 cfs continuous rate) Qi = 1,000 cfs from February 15 until the Refill date or July 1, whichever is earlier; 400 cfs from the Refill date until September 15 or the subsequent date the Fall Drawdown commences, whichever is later; and 150 cfs from the date the Fall Drawdown commences to February 15 per WRMA Purpose: Unchanged from Original Application. ***Regional Reserved Water Program [S2-29920(B)]:*** Quantity: Qa = 5,060 acre-feet/year (equivalent to a 7 cfs continuous rate) Qi = 10 cfs Quantities are additive with Lake Tapps Reservoir Water Rights and Supply Project [S2-29920(A)]. Purpose: Unchanged from Original Application.
R2-29935[2] (Sep 15, 2000)	Permit for: Storage in Lake Tapps Reservoir	Quantity: Storage of up to 46,700 acre-feet of water in Lake Tapps Reservoir Purpose: Public water supply for consumptive municipal, industrial, and commercial purposes.	Quantity: Unchanged from Original Application. Purpose: Unchanged from Original Application.
S2-29934[2] (Sep 15, 2000)	Permit for: Withdrawal from Lake Tapps Reservoir	Quantity: Qa = 72,400 acre-feet/year (equivalent to a 100 cfs continuous rate) Qi = 150 cfs Purpose: Public water supply for consumptive municipal, industrial, and commercial purposes.	Quantity: Qa = 54,300 acre-feet/year (equivalent to a 75 cfs continuous rate) Qi = 135 cfs Purpose: Unchanged from Original Application
CS2-160822CL (Nov 22, 2005)	Change of: Puget Claim	Quantity: Qa = 1,440,000 acre-feet/year (equivalent to a 2,000 cfs continuous rate) Qi = 2,000 cfs Purpose: Hydropower and other beneficial uses including recreational reservoir levels; winter reservoir levels to maintain reservoir; protect and enhance fish and wildlife; maintenance of water quality for recreational purposes in the reservoir and to meet other regulatory requirements.	Quantity:[3] Qa = 931,281 acre-feet/year (perfected) (equivalent to a 1,286 cfs continuous rate) Qi = 1,988 cfs (perfected) Qi to be diverted from the White River under the changed Claim for non-hydropower purposes would be identical to Qi for S2-29920(A) per WRMA. Purpose: Unchanged from Original Application of Change.

[2] The original S2-29934 and R2-29935 applications submitted by Puget erroneously referred to the S2-29920 application as S2-29921.

[3] An application for a temporary donation of a portion of CS2-160822CL into the State Trust Water Rights Program was accepted by Ecology on October 26, 2009.

2. LEGAL REQUIREMENTS

2.1 Public Notice (RCW 90.03.280)

Puget published Public Notice for this project in the Tacoma News Tribune on October 5 and 12, 2000.

2.2 State Environmental Policy Act (SEPA)

Cascade assumed lead agency status for the environmental review of the Project under SEPA. On June 30, 2008, Cascade published *a Determination of Significance and Request for Comments on Scope of Environmental Impact Statement and Environmental Checklist* (Cascade 2008a). Cascade published the *Draft Environmental Impact Statement, Lake Tapps Water Rights and Supply Project* (Cascade 2010a) on January 29, 2010. The comment period for the Draft Environmental Impact Statement ("DEIS") was extended from January 29, 2010 until May 21, 2010, providing an overlapping comment period with the Draft ROEs. The Final Environmental Impact Statement ("FEIS") was published on June 16, 2010 (Cascade 2010c). The FEIS reviews potential impacts to earth, surface water quantity and quality, groundwater, plants and wildlife, fisheries, recreation and aesthetics, and shoreline use and land use, as well as the impacts of climate change on the Project. The Regional Reserved Water Program is evaluated in Chapter 13 of the FEIS. The FEIS provides the analysis and review of many of the issues addressed in this Investigator's Report, including the environmental considerations of the investigation in Section 4.

The FEIS concludes that the Project would have no significant adverse impacts. The FEIS proposes numerous mitigation measures for the Project, including conducting water quality studies; planning to replace current stream flow and diversion gaging equipment; conducting a study of tailrace discharges; making improvements to minimize leakage from the former Hydro Project powerhouse; conducting a fish screen study and installing fish screens; and providing approximately $20 million in fishery mitigation and enhancement funding.

2.3 Consultation with the Department of Fish and Wildlife

In accordance with RCW 77.57.020, Ecology provided notice to the Washington Department of Fish and Wildlife ("WDFW") of the water right applications associated with the Project. WDFW participated in review and evaluation of the Project at various phases. On February 17, 2010, WDFW was provided prior notification of the publication of the Draft ROEs.

2.4 Determinations

Chapter 90.03 RCW and chapter 90.44 RCW authorize the appropriation of public water for beneficial use and describe the process for obtaining water rights. Laws governing the water right permitting process are contained in RCW 90.03.250 through 90.03.340 and in RCW 90.44.050. In accordance with RCW 90.03.290, favorable determinations must be made on the following four criteria in order for an application for a new water right to be approved:

- Water must be available.
- The water use must be beneficial.
- There must be no impairment of existing rights.
- The water use must not be detrimental to the public interest.

Under WAC 173-510-040, the White River is closed to further consumptive appropriations. Stream "closures" are determinations by Ecology under RCW 90.54.020 that water is not available for further appropriations. *See Postema v. PCHB*, 142 Wn.2d 68, 95, 11 P.2d 726 (2000). However, a stream closure under the authority of RCW 90.54.020(3)(a) may in certain circumstances be overridden under an exception that authorizes a new appropriation from a closed stream "in those situations where it is clear that overriding considerations of the public interest will be served."

3. BACKGROUND

3.1 Project Location

Lake Tapps Reservoir is located in northern Pierce County, Washington, approximately 20 miles southeast of Puget Sound, 30 miles southeast of Seattle, and 18 miles east of Tacoma in Section 2, Township 19 North, Range 6 East (Figure 1). It is located in the Puyallup/White River watershed, Water Resource Inventory Area ("WRIA") 10. Lake Tapps Reservoir is approximately 4.5 miles long and 2.5 miles wide and has a surface area of 2,740 acres.

The City of Bonney Lake borders Lake Tapps Reservoir on the south, and much of the surrounding public land is owned by Pierce County. Other nearby population centers are the cities of Auburn, Buckley, Pacific, and Sumner. The common Pierce County/King County limit runs along the White River east of Lake Tapps Reservoir. The Muckleshoot Indian Reservation is located along the White River southeast of Auburn.

3.2 Project History

3.2.1 History of Hydro Project

Lake Tapps is a man-made reservoir that was constructed for the Hydro Project. The Pacific Coast Power Company (which eventually incorporated as Puget Sound Traction, Light and Power in 1912) built Lake Tapps Reservoir in 1911 by combining four lakes – Lake Tapps, Kirtley Lake, Crawford Lake, and Church Lake – into a single water body. The Pacific Coast Power Company constructed dikes to raise the water level over the area of the four lakes.

The Hydro Project generated power by diverting water from the White River, storing it in Lake Tapps, then releasing it back to the White River farther downstream. The Pacific Coast Power Company built a diversion dam near Buckley to divert a portion of the water from the White River at River Mile ("RM") 24.3 into an 8-mile-long diversion flow line and into the reservoir for storage. The diversion flow line consists of flumes, canals, fish screens, five settling basins, and sections of pipeline. At the fish screen, 20 cfs is continuously returned from the diversion canal to the White River to transport fish back to the river. Puget stored the diverted water in Lake Tapps Reservoir. At the western end of the reservoir, Puget used the elevation drop between the reservoir and the valley floor to help generate electricity. Water flowed through a 12-foot-diameter concrete intake tunnel (submerged flume) and control house to a forebay. Water collected in the forebay was sent through steel penstocks to a powerhouse located on the valley floor near Dieringer. The powerhouse was equipped with turbine generator units. Transmission lines carried the electricity to the system network that supplied Tacoma and Seattle. Released water then flowed through a 0.5-mile-long tailrace canal and back into the White River. The distance from the diversion dam to the end of the tailrace canal is approximately 14 miles.

In November 2003, Puget determined that it could no longer continue to economically operate the Hydro Project. As early as the 1990s, the Hydro Project was becoming less viable for Puget due to increased competition that resulted from deregulation of electric utilities pursuant to the Energy Policy Act of 1992. The ultimate decision to terminate the Hydro Project was primarily based on anticipated costs of compliance with conditions the Federal Energy Regulatory Commission ("FERC") was going to impose through its license for the Hydro Project that would require enhancement of salmon runs on the White River. On January 15, 2004, Puget ceased generating electricity at the Hydro Project.

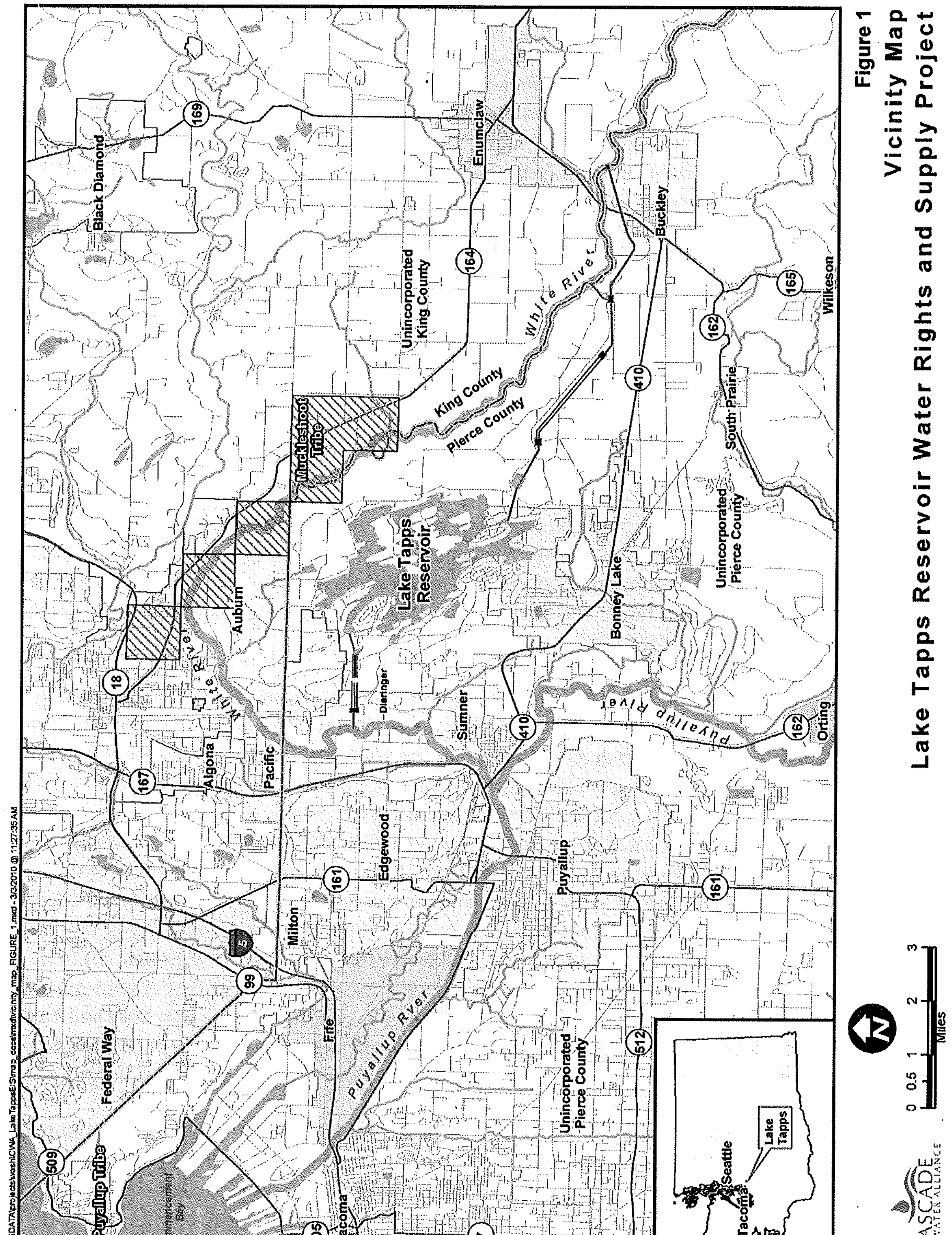

Figure 1 – Project Location Map (Cascade 2010c)

Since that time, Puget has continued to pay applicable annual water power licensing fees under chapter 90.16 RCW; divert water into Lake Tapps Reservoir; and manage water levels of Lake Tapps Reservoir to maintain water quality, control growth of nuisance aquatic vegetation, and provide recreational opportunities.

3.2.2 Puget Claim

The Puget Claim, the water right for the Hydro Project, dates back to 1895 and pre-dates the adoption of the surface water code in 1917. In June 1974, Puget filed a statement of claim to document the Puget Claim consistent with the Water Rights Registration Act, chapter 90.14 RCW. Historically, authorization under the Puget Claim has been used to fulfill a variety of purposes, including maintaining water quality and recreation in Lake Tapps, and providing flows for the fish bypass structure and for fish or wildlife habitat enhancement. Accordingly, Puget continued to divert water pursuant to the Puget Claim even after it ceased generating electricity at the Hydro Project in 2004.

For the period from 1988 through 2002, Puget diverted water from the White River pursuant to the Puget Claim at an average flow rate of 926 cfs and a maximum flow rate of up to 2,000 cfs. A summary of the historical average of flow rates is shown in Table 5-3 of the FEIS. Table 5-2 of the FEIS summarizes the flow rates of water diverted into Lake Tapps since 2004, after Puget ceased the Hydro Project.

3.2.3 History of Recreational Use of Lake Tapps

The history of the development of the Lake Tapps community and its relationship to Lake Tapps Reservoir dates back to the 1950s. Prior to 1954, the Lake Tapps area remained mostly rural. In 1954, Puget sold the land surrounding the reservoir to the Lake Tapps Development Company, and the character of the area began a transition to residential use. Puget granted title to the land surrounding Lake Tapps Reservoir above a contour line located at elevation 545 feet above sea level, but reserved the right to maintain utility lines and use roads for access to the reservoir over the conveyed lands. Puget did not convey title to the bed of Lake Tapps Reservoir or to any land up to the 545-foot contour line, and reserved the right to raise the water level within the reservoir and to dredge the reservoir bottom. Puget also granted the Lake Tapps Development Company the right to use Lake Tapps Reservoir for recreation and to allow other limited actions and activities as long as those activities and actions did not impact Puget's full use of the water of the reservoir for its operation.

Currently, private residences and public and private parks surround most of the reservoir. Lake Tapps Reservoir has become known for its recreational resources – boating, water skiing, fishing, and swimming are popular activities. Many waterfront homes and some public and private parks have boat launch facilities and docks.

3.2.4 Reservoir Operations

Historically, Puget managed water surface elevations of Lake Tapps Reservoir to meet essential goals of power production, maintain recreational lake levels, conduct maintenance, and control aquatic plant growth. Since Puget ceased generating electricity in 2004, Puget continued to divert water from the White River and manage lake water levels to maintain water quality, control growth of nuisance aquatic vegetation, and maintain recreational levels. Puget varied the amount of water in the reservoir by season, resulting in a yearly pattern of "pool" elevations:

- **Refill.** The late winter or early spring refill of the reservoir to the Normal Full Pool elevation.

- **Normal Full Pool.** A water surface elevation of between 541.0 and 542.5 feet with respect to the National Geodetic Vertical Datum of 1929 ("NGVD 29")[4].

- **Fall Drawdown.** The reduction of water level in the fall to help control aquatic vegetation growth and to allow dike maintenance.

3.2.5 History of Flow Requirements for the White and Puyallup Rivers

For purposes of analyzing stream flows and potential impacts, the White and Puyallup Rivers can be divided into several reaches. The "Reservation Reach" refers to the 21-mile length of the White River that carries water that is not diverted into Lake Tapps Reservoir between the diversion dam at RM 24.3 and the tailrace canal at RM 3.6 near Dieringer. This is known as the Reservation Reach of the White River, because it passes through the Muckleshoot Indian Reservation. Downstream of the confluence of the tailrace canal and the White River, the White River continues for 3.6 miles before joining the Puyallup River. The reach of the White River below the tailrace canal is referred as the "Lower White River." From the confluence with the White River, the Puyallup River continues for 10.4 miles before entering Commencement Bay in Tacoma. The Puyallup River below the confluence with the White River at RM 10.4 is referred to as the "Lower Puyallup River."

Minimum instream flows ("MIFs") in the White and Puyallup River watershed have been established by Ecology pursuant to its authority to establish rules governing the MIFs. In 1980, Ecology adopted through rulemaking an Instream Resources Protection Program for the White and Puyallup River watershed (chapter 173-510 WAC), with WAC 173-510-030(4) describing the MIFs for the Puyallup River. At the same time, Ecology closed the White River to further consumptive water right appropriations pursuant to WAC 173-510-040(3) but did not establish MIFs for the White River, as was done for the Puyallup River. Moreover, because the water rights for the Hydro Project predated the instream flow rule, the Hydro Project was not required to comply with the flows established in the rule for the Lower Puyallup River.

Historically, there were four other sources of stream flow requirements for the White River. First, in 1910, Pierce County Superior Court and King County Superior Court issued decrees vesting rights to 2,000 cfs that required the Pacific Coast Power Company to maintain instream flows of at least 30 cfs below the diversion dam.

Second, in 1986 a settlement agreement between Puget and the Muckleshoot Indian Tribe established a MIF of 130 cfs and a 3,650 second-foot-day water budget for fish transport for the Reservation Reach. The settlement also included a supplemental flow budget of 3,650 second foot-days or about 7,240 acre-feet annually.

Third, several agencies recommended minimum flows that would be imposed through the FERC relicensing process for the Hydro Project pursuant to Section 10(j) of the Federal Power Act.

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[4] The water surface elevation in Lake Tapps is recorded at U.S. Geological Survey (USGS) gage 12101000 – Lake Tapps near Sumner. This gage reports both stage (the direct reading of the stage gage) and water surface elevation with respect to the NGVD 29. Prior to a 2009 survey by Cascade, an incorrect relationship was used to translate observed stages to NGVD 29 elevations. In an independent survey, USGS confirmed that NGVD 29 is 0.5 feet lower than the measured stage. The USGS has corrected its published records.

Fourth, a 2005 letter from the National Oceanic and Atmospheric Administration National Marine Fisheries Service ("NOAA Fisheries") addressed to the U.S. Army Corp of Engineers ("USACE") proposed instream flows for Puget's operation of the Hydro Project. The proposed flows were developed for the U.S. Geological Survey ("USGS") White River above Boise Creek at Buckley gage. These flows were later incorporated into an Interim Operating Agreement between USACE and Puget.

3.3 Lake Tapps Reservoir Water Rights and Supply Project

This section describes the Lake Tapps Reservoir Water Rights and Supply Project ("Project"). The separate Regional Reserved Water Program is described in Section 3.4.

3.3.1 Project Components

The Project has four main components, as described below.

1. New Municipal Appropriations

First, under the Project, Cascade will divert water from the White River into Lake Tapps Reservoir, store water in the reservoir, and withdraw water for municipal water supply purposes. So long as the reservoir levels are maintained as described below, Cascade would withdraw water from Lake Tapps Reservoir for municipal supply purposes throughout the year according to the expected demand. Cascade anticipates that monthly demand would range from approximately 90 to 117 cfs during the summer months and from approximately 55 to 70 cfs during the winter, spring, and fall based on Cascade's historical and anticipated annual demand pattern. The yearly average flow rate of water withdrawn for municipal supply purposes would not exceed 75 cfs (the maximum rate allowed under the water right).

2. Recommended Flow Regime (WRMA)

Second, Cascade would simultaneously operate the Project in a manner to provide enhanced flows in the White River consistent with the WRMA. The WRMA establishes an agreed flow regime for the White River, which limits diversion from the White River into Lake Tapps Reservoir. Specifically, Cascade would abide by minimum flow rates for the Reservation Reach of the White River, as measured at the Buckley gage, as well as diversion limits, ramping rates and limitations on tailrace discharges from the Reservoir. This agreed-upon flow regime (referred to as the "Recommended Flow Regime") is based on the natural seasonal pattern in flow conditions to help improve fisheries resources and habitat in the White River and in the Lower Puyallup River. By letter to Ecology, Cascade requested that the Recommended Flow Regime be incorporated into the Draft ROE (Cascade 2008c).

So long as the minimum flows shown in Table 2 were met, Cascade could divert flows at rates up to 1,000 cfs from the White River from mid-February through the spring and into early summer, 400 cfs from summer into the fall, and 150 cfs from late fall through the winter until mid-February.

Table 2 – Minimum Flows for the White River (as measured at the Buckley gage) from WRMA

Time Period	Minimum Flow in the White River in cfs	Time Period	Minimum Flow in the White River in cfs
January 1-14	650	July 1-23	800
January 15-31	525	July 24-31	650
February 1-14	550	August 1-6	650
February 15-29	500	August 7-31	500
March 1-14	550	September 1-14	500
March 15-31	725	September 15-30	500
April 1-14	775	October 1-14	500
April 15-30	825	October 15-31	500
May 1-14	875	November 1-14	500
May 15-31	875	November 15-30	550
June 1-14	800	December 1-14	550
June 15-30	800	December 15-31	600

3. Reservoir Levels

Third, Cascade proposes that reservoir operations follow a seasonal pattern similar to that of historical conditions, but with the significant change of extending the normal length of the recreation season both earlier in the spring and later in the fall. This goal is documented in two agreements: the 2004 Community Agreement between Puget and groups representing the Lake Tapps community; and the 2009 Community Agreement between Cascade and the Lake Tapps Community.

According to the 2004 Community Agreement, Puget agreed to maintain a Normal Full Pool water elevation (541.0 feet to 542.5 feet NGVD 1929) during the Annual Recreational Period (defined in that agreement as the period from April 15 through October 31) subject to specified operational variations. Such operational variations may be required due to forecasts of available precipitation, the terms and conditions of the water right, any necessary milfoil control, FERC requirements, or the terms and conditions of applicable law.

In the 2009 Community Agreement, Cascade committed to meeting specified reservoir surface elevations. Prior to the use of Lake Tapps Reservoir for municipal water supply, Cascade agreed to maintain Normal Full Pool from April 15 to September 30. After commencement of the use of Lake Tapps Reservoir for municipal water supply, that obligation is altered so that from September 16 through September 30, Normal Full Pool would be maintained 90% of the time, measured by the number of days (i.e., no more than 15 days in a rolling 10-year period of time). From October 1 through October 31, Cascade will make "reasonable efforts" to maintain Normal Full Pool.

Cascade accepted assignment of the 2004 Community Agreement; however, the 2009 Community Agreement will replace the 2004 Community Agreement following acceptance by both the Lake Tapps Community Council and Cascade of the ROEs to be issued by Ecology for the Applications.

Cascade's obligations under the 2009 Community Agreement are to be implemented with the following priority of interests for use of White River flows: (1) provision of minimum flows in the White River; (2) provision of recreational reservoir surface elevations; and (3) provision of municipal water supply. According to this prioritization system, recreation is not the highest priority. Thus, there is no guarantee that the elevation would be maintained at Normal Full Pool for the entire Annual Recreation Period.

4. Additional Mitigation Measures

The FEIS identified several additional mitigation measures including measures to protect the Puyallup River MIF in spring ("the Early Spring Avoidance Plan"); studies of water quality and fisheries issues in the tailrace; improvements to stream flow gaging; improvements to minimize leakage from the powerhouse; shortage management; provision of $19.8 million in fishery mitigation and enhancement funding; and other mitigation measures.

Under the Early Spring Avoidance Plan, Cascade would reduce diversions from the White River when the Puyallup River was projected to be below the MIF. This plan would operate each year from February 15 to March 31. Cascade would reduce diversions by up to the amount of water actually being withdrawn from Lake Tapps for municipal water supply.

3.3.2 Project Infrastructure

The Project would use many of the existing structures from Puget's former Hydro Project. As shown in Figure 2, Cascade would divert water from the White River at the location of the existing diversion dam. The diverted water would travel down the existing flow line where it would be stored in Lake Tapps Reservoir. Cascade would withdraw water from the forebay of the hydropower facility or from another location to be determined, and would treat it to meet drinking water standards before conveying it to a regional water distribution system.

Cascade would construct the following new facilities as part of the project: raw water intake pipe, water treatment plant, and a transmission pipeline with booster pumps as needed. No changes are proposed to the diversion dam, diversion canal, or Lake Tapps Reservoir as a direct result of the Project. As part of the Project, Cascade would make improvements to minimize leakage from the former Hydro Project powerhouse. Replacement of the diversion dam is planned as a component of another project by USACE.

A Water Treatment Plant Feasibility Study was conducted as part of the Lake Tapps Reservoir Water Right Feasibility Report (HDR 2002). The feasibility study concluded that there was a suitable site for construction of a treatment plant and that the site had no known environmental or permitting issues that would preclude its construction. The feasibility study included the preliminary selection of a treatment process that would meet Washington State Department of Health ("DOH") standards. The selected treatment process includes an inlet control structure, screens, flocculation tanks, membrane filtration, granular activated carbon beds, wash water recovery, and solids recovery. The final treatment configuration is subject to review and approval by DOH.

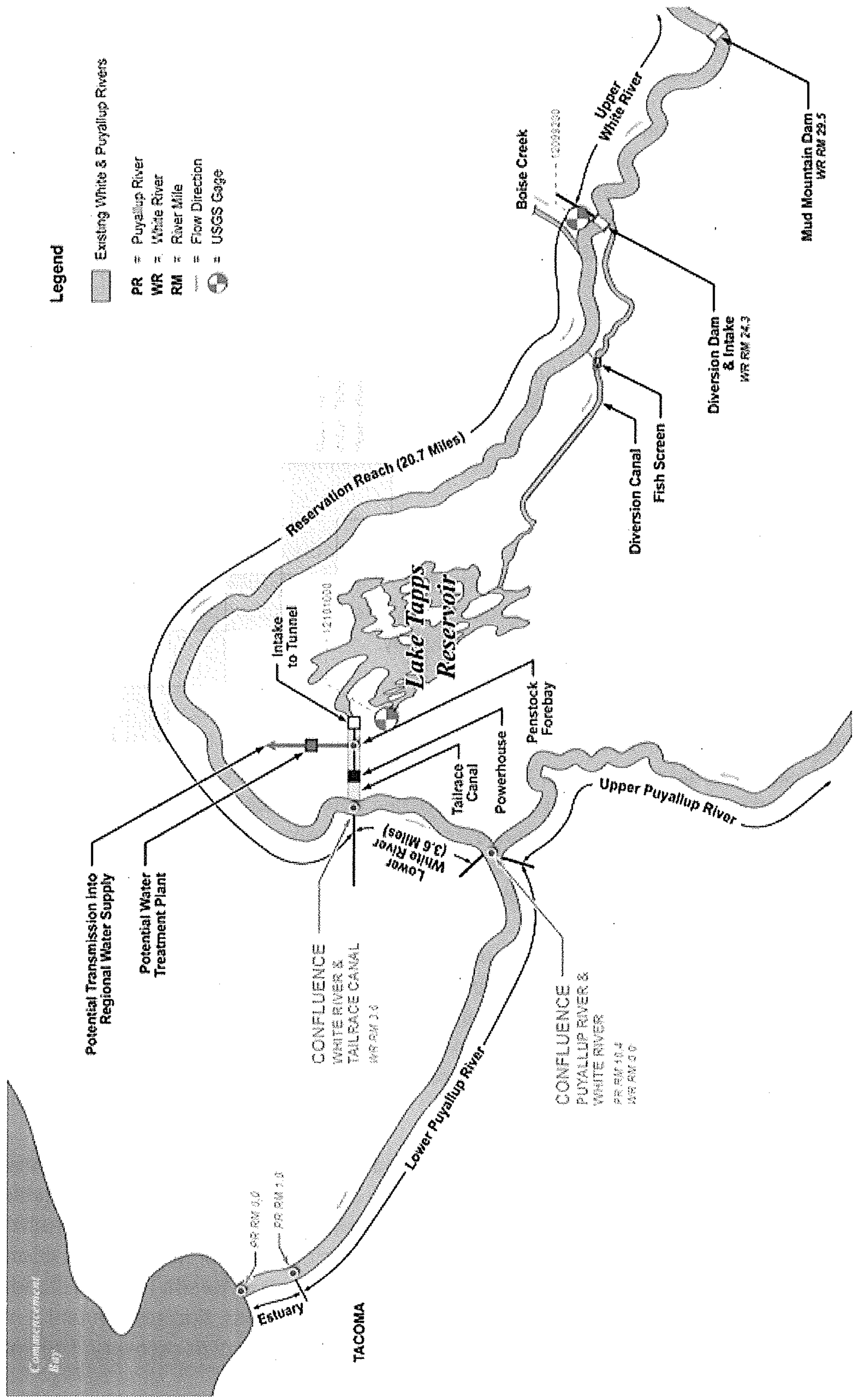

Figure 2 – Stream Reaches of the White and Puyallup Rivers (Cascade 2010c)

3.3.3 Place of Use

Water rights would be granted under applications S2-29920, R2-29935, and S2-29934 to provide a regional municipal water supply within a specified place of use. The place of use establishes the geographical area in which water utilities may use or supply water from Lake Tapps.

The place of use for this water right is the combined service areas described in the most recent Water System Plans approved by DOH for Cascade, the City of Seattle, and the City of Tacoma. The proposed place of use is shown on Figure 3. The place of use boundary (green dashed line) shown on Figure 3 is based on the most recent approved Water System Plans for those three purveyors. Figure 3 also includes the service areas for Members and the individual utilities that purchase water from the City of Seattle or City of Tacoma, as identified in the approved Water System Plans for those individual utilities. In some cases, the Water System Plans for the individual utilities are more recent that the approved Water System Plans for Cascade, City of Seattle and City of Tacoma. The place of use boundary would change over time as the Water System Plans are updated.

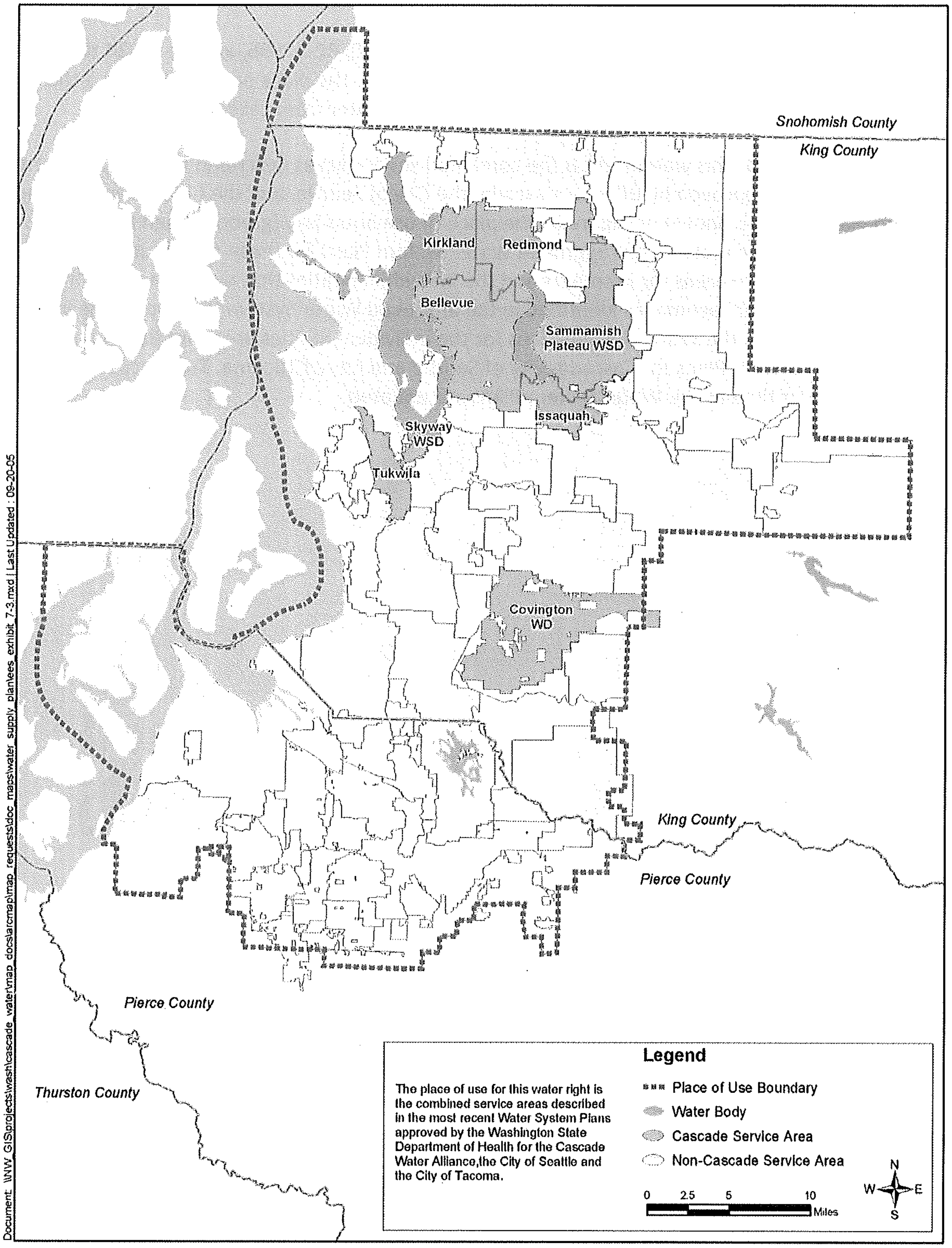

Figure 3 – Place of Use

3.4 Regional Reserved Water Program

The Cities of Auburn, Bonney Lake, Buckley, and Sumner (referred to collectively as the "Four Cities" and separately as a "City") have been engaged in long-running discussions with Cascade focusing on their own future water demands and Cascade's water rights applications for the Project. The Four Cities have expressed a desire to seek new water rights and/or changes to existing water rights to meet future municipal water needs for their citizens. On February 5, 2010, the Four Cities and Cascade entered into the "2010 Lake Tapps Area Water Resources Agreement" (Cascade 2010b) that provides for the Regional Reserved Water Program for the Lake Tapps region.

The Regional Reserved Water Program would provide a mechanism for a portion of the original quantity requested[5] under water right application No. S2-29920 to be used by the Four Cities to mitigate White River impacts in connection with applications to be submitted in the future by the Four Cities for new water rights or changes to existing water rights. Specifically, the following quantities are designated for "Regional Reserved Water": Qa = 5,060 acre feet (equivalent to a continuous 7 cfs withdrawal) and Qi = 10 cfs.

The Regional Reserved Water would be available to the Four Cities, individually or collectively, to use separate and independent of Cascade's Lake Tapps Reservoir Water Rights and Supply Project. The Four Cities would be able to use the Regional Reserved Water Program by dedicating the Regional Reserved Water to remain in stream (through cancellation of that portion of the permit, permanent donation to trust, or other appropriate mechanism) as a component of mitigation for the impacts associated with a separate water right application.

The Regional Reserved Water requires one or more additional water right applications or water right change applications to be submitted by a City and processed by Ecology. Without future applications, the Regional Reserved Water would stay in the White River and would not be authorized for diversion from the White River by Cascade. A City desiring to access and beneficially use the Regional Reserved Water would be entirely responsible for filing application(s) and completing the requisite necessary application review and environmental analysis to support application processing. Cascade would not be involved or have any obligations with respect to these application(s) and environmental analysis.

Presumably, an application by a City for a new water right or for a change to an existing water right located in proximity to the White River would have the potential to adversely impact flows in the White River (Figure 4). Each applicant would be responsible for demonstrating the mitigation value of the Regional Reserved Water for a specific water right application and for providing any additional mitigation of any kind that is required. Regional Reserved Water would only be available in a way that would not adversely affect the "Recommended Flow Regime" in the White River or the MIF in the Puyallup River. If used as mitigation, Regional Reserved Water could only be used to mitigate impacts to the mainstem White River downstream of the diversion dam and the mainstem Puyallup River downstream of the confluence with the White River. Any other impacts would have to be otherwise addressed or mitigated by the City submitting the application.

If Ecology approves a future application from a City, then a specific quantity of the Regional Reserved Water would be identified in the ROE for that specific water right. Any such ROE issued to a City would contain a development schedule for the beneficial use of its water and the specified quantity

[5] Cascade reduced the quantity of water requested under application S2-29920 for the Lake Tapps Water Rights and Supply Project by 25% (*i.e.*, from 100 cfs average flow to 75 cfs). The Reserved Water Program would change the total to 82 cfs, amounting to an 18% reduction from the original quantity.

of the Regional Reserved Water. Any portion of the Regional Reserved Water not authorized for use by an Ecology water right decision by December 31, 2030 would be cancelled.

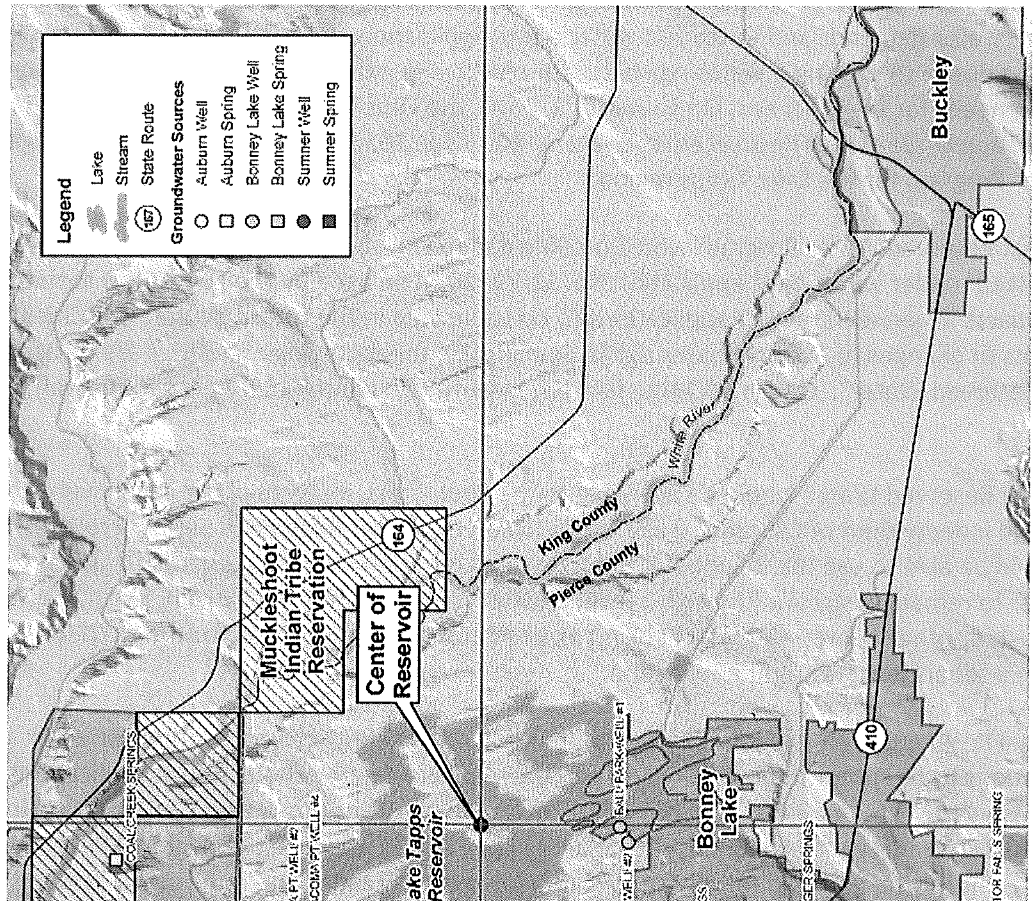

Figure 4 – Map of Four Cities Municipal Boundaries and Water Sources (Cascade 2010c).

3.5 Procedural History of the Applications

Prior to Puget's discontinuation of the Hydro Project in 2004, the Lake Tapps Task Force (a coalition made up of property owners, representatives from state and local governments, and Puget) concluded that using Lake Tapps as a water supply reservoir would be the most effective way to assure preservation of the lake. Its work recognized Puget's concerns about the economic viability of maintaining the Hydro Project for power production.

In 2000, Puget filed the three applications for new water appropriations (S2-29920, R2-29935, and S2-29934) relating to the diversion, storage, and withdrawal of the water for municipal and industrial supply.

In June 2003, Ecology issued ROEs approving Puget's applications for the three water rights. The Muckleshoot Indian Tribe, the Puyallup Tribe of Indians, the City of Auburn, the City of Buckley, and others appealed Ecology's decisions to the Pollution Control Hearings Board ("PCHB") in consolidated case number 03-105. In August 2004, following Puget's announcement that it was ceasing operation of the Hydro Project, the PCHB remanded the 2003 ROEs back to Ecology for modification of the ROEs to reflect the cessation of hydropower generation at the Hydro Project. *Puyallup Tribe of Indians, et al., v. Ecology, et al.*, PHCB No. 03-105, Order Remanding Case (Aug. 12, 2004).

On November 22, 2005, Puget submitted an application for a change of purpose of use of the Puget Claim to add additional purposes of use to conform the claim document to the historical uses of water over the past century and to continue to allow diversions for continuing recreation, reservoir maintenance, and water quality in the lake.

In September 2006, Ecology developed a Draft Report of Examination for Lake Tapps Reservoir Water Supply Project Application S2-29934 (Ecology 2006a), including the four water right applications, and posted it on the Ecology website for an informal review period.

In 2008-2010, Cascade entered into settlement agreements with major stakeholders in the Lake Tapps region and with protestants/appellants of prior ROEs. First, Cascade, the Puyallup Tribe of Indians and the Muckleshoot Indian Tribe entered into the WRMA that provides for enhanced minimum flows and several other measures (Cascade 2008b). Second, Cascade and the Lake Tapps Community entered into the 2009 Community Agreement to support recreational and community interests in Lake Tapps (Cascade 2009). Third, Cascade and the cities of Auburn, Bonney Lake, Buckley, and Sumner entered into the 2010 Lake Tapps Area Water Resources Agreement that addresses regional water supply (Cascade 2010b). Together, these agreements impose multiple obligations on Cascade regarding operation of the Project. Cascade modified its proposal to include the obligations of these agreements, and Ecology included these agreements in its analysis and evaluation of the Applications.

On May 7, 2010, Ecology published Draft ROEs pertaining to the Applications and posted them to the Ecology website for an informal comment period ending June 30, 2010. Six comment letters were received during the comment period. These comments are described in Section 4.9.

3.6 Cost Reimbursement

This application has been processed by Aspect Consulting, LLC and other consultants under two cost-reimbursement contracts. Initial processing of the application and issuance of the 2003 ROEs occurred through Ecology Cost-Reimbursement Project No. 9E52, under agreement between Ecology and Puget. Subsequent processing of the applications was performed by Aspect Consulting, LLC under Expert Agreement with the Washington State Office of the Attorney General.

4. INVESTIGATION

Evaluation of this application included, but was not limited to, research, review, and consultations relating to the four water right applications and associated files; the protestants' concerns; comments received on the Draft ROEs; issues raised on appeal of the 2003 ROE; pertinent state water codes; existing water rights in the vicinity; meetings with Puget's and Cascade's technical teams, including legal counsel, hydrologists, fishery biologists, and water quality scientists; comments from other resource agencies, including WDFW and DOH; technical memoranda ("TMs") submitted in response to the Preliminary Permit associated with this application (HDR 2002); supplemental technical analyses provided by Puget and Cascade; the FEIS (Cascade 2010c), DEIS (Cascade 2010a) and prior SEPA documents; site visits on October 3, 2001, December 5, 2001, and June 25, 2007; FERC and NOAA Fisheries documents related to the Hydro Project; and discussions and meetings with Ecology's water quality/watershed assessment staff.

This investigation first, in Sections 4.1 through 4.7, analyzes the Lake Tapps Reservoir Water Supply Project, and then, in Section 4.8, evaluates the potential additional effects of the Regional Reserved Water Program.

4.1 Demand and Supply

The intent of the Applications is to secure water rights to supply the municipal water needs of Cascade Members and the Central Puget Sound region. In 2009, Cascade prepared an analysis to forecast total water demand for the years 2010–2060 for the combined utilities of Cascade. The analysis is reported in a TM prepared by CDM and HDR Engineering, Inc. titled *Cascade Water Alliance Water Demand Forecast*, dated December 18, 2009 (CDM and HDR 2009). The FEIS summarizes the report in Chapter 3. The demand forecast used an econometric water demand approach with uncertainty analysis. Under this approach, sector water demands were statistically correlated with factors that influence those demands. This analysis updates the Cascade Composite Forecast that was included in Cascade's *2004 Transmission and Supply Plan* ("TSP") dated March 24, 2005 (Cascade 2005).

The demand forecast was developed as follows:

- Data on water use, rates charged to water customers, weather (including precipitation and maximum temperature), demographic information (including number of single- and multi-family households served, employment, median household income, employment mix), and water conservation activities (both passive and active) were obtained from the eight Members from 1990 through 2008, where data were available.

- Forecasts of households and employment through 2040 were obtained from Puget Sound Regional Council. These forecasts were extended to 2060.

- Statistical analysis was used to determine the relationship between water use per household and factors such as weather conditions, water rates, and household income. For commercial and industrial water uses, similar analysis was done on the basis of water use per employee.

- The demographic forecasts were combined with the statistical analysis of factors affecting water use, to produce a forecast of water use in future years from 2010 to 2060.

- Expectations regarding continued implementation of Cascade's and its Member's water conservation program over the planning period were built into the demand forecast.

- A range of values was estimated based on expected ranges of key variables.

Based on this procedure, the analysis provided several ranges of demand forecasts, including forecasts that take into consideration climate change and regional demand contingency (the estimate of the potential impact of additional requests for service from local water systems due to declines in supply from climate change, contamination, regulatory action, or other causes). The comprehensive water demand forecast for Cascade indicates that the range (90% confidence) without climate change or regional demand contingency is between 60 and 72 mgd (93 to 111 cfs) ADD by 2060. This range increases to 62 to 76 mgd (96 to 117 cfs) ADD by 2060 if climate change materializes as depicted in the three possible climate change models used in the study. This range is shown in more detail in Table 3. When climate change and regional demand contingency are both included, the most likely range in water demands is 69 to 88 mgd (107 to 136 cfs) ADD by 2060.

Table 3 – Demand Forecast with climate change, but without regional contingency

Year	Average Day Demand in mgd	
	Mean Expected Value	90% Confidence Rating
2010	41	40 – 42
2020	44	43 – 46
2030	49	47 – 52
2040	54	51 – 57
2050	60	56 – 65
2060	69	62 – 76

Some of this predicted demand will be satisfied by Cascade's existing sources. First, Cascade's Members have their independent sources of supply, which total approximately 18 mgd (28 cfs) ADD.

Second, Cascade purchases water from Seattle under the 50-year Declining Block Water Supply Agreement that became effective January 1, 2004 and extends through December 31, 2053. The Seattle agreement entitles Cascade to a specified amount (block) of water supply and transmission each year for a 50-year period ending December 31, 2053. At the outset, from 2009 through 2017, Cascade may purchase 33.3 mgd (51.5 cfs) ADD. From 2018 through 2023, Cascade may purchase 35.3 mgd (54.6 cfs) ADD. From then, the quantity decreases until 2045 through 2053, when Cascade can purchase only 5.3 mgd (8.2 cfs) ADD. At the end of the contract term in 2053, Cascade may continue to purchase from Seattle up to 5.3 mgd (8.2 cfs) ADD of water for Members that cannot be served economically by any other means.

Third, Cascade has entered into a wholesale water purchase agreement with Tacoma Public Utilities to supplement water purchased from Seattle. The Tacoma agreement entitles Cascade to a permanent supply of 4 mgd (6.1 cfs) ADD each year, and an additional guaranteed reserved supply of 6 mgd (9.3 cfs)

ADD through 2026, declining to 1 mgd (1.5 cfs) ADD in 2030, and discontinuing thereafter. The Tacoma Agreement includes minimum purchase requirements from 2009 through 2025, and entitles Cascade to additional temporary water, based on availability. Cascade has not taken delivery of water from Tacoma, and would need to complete construction of a pipeline in order to do so.

Water purchased under the Seattle and Tacoma agreements (with the exception of the 5.3 mgd (8.2 cfs) ADD available from Seattle after 2053 and the 4.0 mgd (6.1 cfs) ADD permanent water from Tacoma) is designed to serve as a "bridge" supply pending Cascade's development of a permanent, long-term supply in the future. The water suppliers providing the contracted supply need assurances that when the time comes to terminate the contract, the communities served by Cascade will not be dependent on the contracted water. In order to secure extensions in the term of the current agreements or increases in the amounts of water available, Cascade must provide assurances that it is able to develop independent sources of supply.

Cascade's three sources, including Members' independent supplies, the "tail" in the Seattle Agreement, and the Tacoma Agreement, total approximately 27 mgd (42 cfs) ADD.

Based on the predicted demand ranges, this results in a potentially significant forecast supply "deficit" for Cascade Members under the three scenarios:

- Without climate change or regional demand contingency, a deficit of between 33 and 45 mgd ADD by 2060.
- With climate change but without regional demand contingency, a deficit of between 35 to 49 ADD mgd by 2060
- With climate change and regional demand contingency, a deficit of between 42 to 61 mgd ADD by 2060.

Cascade's request for 54,300 acre-feet per year (75 cfs or 48.4 mgd ADD) is within the predicted ranges for demand forecasts that consider climate change, or climate change and regional demand contingency. Cascade has reduced its requested amount from 100 cfs (64.5 mgd) in the original water right applications on the basis of this demand analysis.

4.1.1 Why Lake Tapps?

Cascade and its Members have explored many options to satisfy the identified need for sources of water supply. These options and Cascade's analysis are more fully described in Section 3.4 of the FEIS.

Most recently, Cascade identified and evaluated 28 potential sources of supply. These 28 potential sources include many of those addressed in prior assessments such as the *Coordinated Water System Plans and Regional Water Supply Outlook* (CPSWSF and R.W. Beck 2001). They also include sources from which Cascade already obtained water by contract, such as Seattle Agreement and Tacoma Agreement. Cascade eliminated 8 potential sources that were determined unavailable. Cascade categorized the remaining 20 sources as either potential permanent sources or interim sources that could be used only temporarily. Cascade evaluated these 20 permanent and interim sources based on six criteria: financial consideration; reliability; operational considerations; environmental considerations; implementation challenges; and regional/intergovernmental considerations. A decision model was used to develop a consistent basis for comparing all 20 projects using these criteria.

Based on these criteria, Cascade concluded that only the Lake Tapps Reservoir supply is capable of meeting the complete set of Project objectives. Six potential interim sources may be useful as "bridge" supplies, but would not meet the objective of long-term supply to meet growth over a 50- to 100-year time frame.

Of the 14 potential sources in the "permanent" category, only 2 potential long-term sources of supply could be large enough to meet Cascade's needs in the 50- to 100-year time frame appropriate for large infrastructure investments. These are Lake Tapps Reservoir and Lake Washington. All other sources would need to be combined in a package of several sources to meet these long-term needs. Given the size of the available sources, there are only one or two combinations that would not include a large source such as Lake Tapps Reservoir or Lake Washington. Cascade determined that an assemblage of a large number of sources would provide insufficient operational certainty due to the unwieldy operational and management requirements of several sources. Based on this analysis, the smaller permanent sources were eliminated for further analysis in the FEIS because they would not meet the objective of long-term permanent certain supply to meet growth over a 50- to 100-year time frame.

Of the two potential sources in the permanent category that are sufficiently large, Lake Washington was eliminated from further consideration because of the high degree of uncertainty presented by environmental considerations, implementation challenges, and regional/intergovernmental considerations, including water right permitting.

Lake Tapps Reservoir is the only source of supply that offers sufficient certainty for development to meet growth over a 50- to 100-year time frame. It is the only source that provides assurances needed to secure a significant increase in contracted supply from Seattle Public Utilities and/or Tacoma Public Utilities in the near term. The Lake Tapps Reservoir supply, regardless of when it is developed, has both the certainty and quantity needed to provide assurances to immediately support further contracting.

An additional objective of Cascade's approach is to provide improved reliability to regional municipal water supplies for the Central Puget Sound region. Neither the interim sources listed above nor the smaller permanent sources on the list can satisfy this objective.

4.2 Surface Water Hydrology

The Project would divert water from the White River, store it in Lake Tapps, and withdraw water from Lake Tapps for water supply. It would alter flows in the river by changing the magnitude and timing of both the diversions from the White River and the releases from Lake Tapps through the tailrace. The Project would affect the hydrology of the White River below the diversion dam, Lake Tapps, and the Puyallup River below the confluence with the White River. These effects are evaluated in this section, starting with a brief review of existing conditions, followed by a description of the methodology for analysis, and concluding with a summary of the results of the analysis.

4.2.1 Existing Conditions

White River. The White River originates from the Emmons and Fryingpan glaciers of Mount Rainier and is approximately 75 miles long, with a drainage area of 494 square miles. It is a major tributary of the Puyallup River, joining the Puyallup River 10.4 miles above Commencement Bay. The White River is a gravel-bedded stream with a large bed load originating from sediment deposited by the glaciers of Mount Rainier. Sediments transported by the White River range from the powdery glacial till that gives the river its light gray color to large cobbles and boulders moved only by extremely high flows and volcanic events.

There are two major instream structures that have a significant influence on flows in the White River: (1) Mud Mountain Dam at RM 29.5, and (2) the diversion dam at RM 24.3.

Mud Mountain Dam ("MMD") is a flood control reservoir operated by USACE with a flood-storage capacity of 106,000 acre-feet of water. During periods of extremely high flow, water is temporarily stored behind the dam and later released at a lower rate after peak flow has subsided. Most of the time, the reservoir upstream of the dam is essentially empty and upstream river flows are allowed to pass through unimpeded.

The diversion dam on the White River is designed to allow for diversion of the full 2,000 cfs of the hydropower water right claim to a diversion canal leading to Lake Tapps, while maintaining minimum flows in the river and limiting accumulation of bed load sediments and floating wood in the diversion canal. The diversion dam is currently in poor condition and is scheduled for replacement by USACE, with construction slated to begin in 2012.

The river channel in the Reservation Reach is composed of sand, gravel, and cobbles, with a significant accumulation of large woody debris and high channel complexity. The river meanders and there are significant side channels and a well-developed floodplain and riparian zone. The upper section of the Reservation Reach has a steep gradient and a boulder/cobble bed. The middle section consists of a braided, broader channel. The gradient in the lower section of the reach is not as steep and the channel is broader and braided, and has a gravel/cobble substrate. Levees were constructed on portions of the lower section of the Reservation Reach to protect adjacent lands from flooding.

Three streamflow gages are installed on the White River in the project vicinity:

- White River near Buckley – USGS 12098500, located upstream of the diversion dam. This is the key gage used in the hydrologic analyses, as it represents the primary inflow to the system. USGS stopped reporting flow measurements for this gage in September 2003. The mean annual flow from 1929-33 and 1939-2003 was 1,435 cfs.

- White River above Boise Creek at Buckley – USGS 12099200, located just downstream of the diversion dam. This gage was installed in July 2003 to replace an older gage located farther downstream. The mean annual flow from 2004 to 2009 (the post-hydropower period) was 1,282 cfs. By comparison, the average flow at the older gage from 1978 to 2002 was 547 cfs. The difference is an indicator of the quantity of water no longer diverted to generate hydropower.

- White River near Auburn – USGS 12100496, located a few miles above the tailrace canal. The mean annual flow from 18 years between 1988 and 2008 was 868 cfs.

Diversion Canal. The diversion canal has a hydraulic capacity of about 2,000 cfs from the diversion dam to Printz Basin. Recent construction of a backflow prevention structure near the end of the diversion canal has limited the maximum flow rate from the diversion canal into Lake Tapps Reservoir to about 1,000 cfs.

Two flow measuring gages are installed in the diversion canal: USGS 12099000 – White River Canal at Buckley, and an Accusonic gage installed and operated by Puget. The USGS gage ceased reporting flow in September 2004.

Lake Tapps. Lake Tapps is a 2,740-acre reservoir comprised of 13 dikes and has an active storage capacity of at least 46,700 acre-feet. The main outlet of Lake Tapps is the intake of Puget's former Hydro Project. The reservoir outlet is located on the northwest shore of Lake Tapps and consists of a half-mile long concrete tunnel leading to the forebay. From there water is conveyed downhill through four penstocks to the Dieringer powerhouse, where it previously passed through turbines to generate power.

The turbines have been removed, but water still passes through the valves and gates formerly used to control power generation. These controls are difficult to close completely, and about 36 cfs leaks through them continuously. After hydropower generation ceased, one of the penstocks was modified to allow finer control of releases from the reservoir, but leakage continued. In the winter of 2010, Cascade initiated efforts to control leakage from the penstocks. These efforts were successful in substantially reducing the rate of leakage. Discharge from the powerhouse enters the tailrace canal, a 34-foot wide, half-mile long, unlined open channel leading to the White River at RM 3.6. Flow in the tailrace canal is measured at USGS gage 12101100 – Lake Tapps Diversion at Dieringer.

Puyallup River. The Puyallup River originates in glaciers on the west side of Mount Rainier and discharges to Commencement Bay in Tacoma. It has two major tributaries, the Carbon River and White River, which drain into it at RM 17.8 and 10.4, respectively. The portion of the Puyallup River between the confluence with the Lower White River and its mouth is referred to as the Lower Puyallup River. Prior to urbanization, the Lower Puyallup River meandered across a broad floodplain from the mouth of the river at sea level to the confluence with the Lower White River at about 50 feet elevation. Urbanization and channelization have confined the Lower Puyallup River to a relatively straight channel with levees on both banks.

The combined drainage basin of the Puyallup-White watershed is 970 square miles, producing a mean annual flow of 3,320 cfs (measured from 1914 to 2008 at USGS gage 12101500 - Puyallup River at Puyallup). A Minimum Instream Flow ("MIF") for the Puyallup River at Puyallup gage was established in WAC 173-510. The MIF varies seasonally from 1,000 cfs in late September through early November up to 2,000 cfs in May through early July.

4.2.2 Evaluation Methodology

Ecology's approach to evaluating effects of the Project on surface water hydrology involved developing a systems model capable of simulating Lake Tapps and the affected reaches of the White and Puyallup Rivers under different sets of operating rules for the reservoir. The operating rules define how water is diverted from the White River, how lake levels vary throughout the year in the reservoir, and how water is released from the tailrace back to the White River. The systems model is based on the past hydrologic records from gages in the basin. A model run simulates what would have happened if the new set of operating rules had been in effect in the past (or alternatively, what would happen if the future is exactly like the past).

The analysis is based on comparison of model runs using two different sets of operating rules: one representing the Project, and the other defining a Baseline. The Baseline is intended to represent the conditions that would prevail in the absence of the Project and is a reference point from which to measure the effects of the Project.

The following sections describe the model development, the assumptions used to develop operating rules for the Baseline, and the Project assumptions.

Lake Tapps Systems Model

The Lake Tapps Systems Model (the "Model") is a computer model developed in the STELLA 7.0.1 software package to evaluate the effects of the Project on flows in the White and Puyallup Rivers, and reservoir elevations in Lake Tapps. The Model was originally developed by HDR Engineering, Inc. (2002) and R2 Resource Consultants (Ramey and Yoder 2004) acting on behalf of Puget. Following the PCHB decision in 2004, the applicant provided the model to Ecology, and further model development has been lead by Aspect Consulting, LLC on behalf of Ecology. The details of model development, validation, and use since 2004 are documented in the *Water Quantity and Quality Analysis for the Lake Tapps Water Right Applications* (Aspect Consulting 2010).

The Model is a daily-time step, non-dimensional model that simulates flow or reservoir storage at select points between the diversion dam and the Puyallup River at the Puyallup gage. The model routes water from one location to another according to rules (logical statements) developed to represent the allowable project operations including diversions, the reservoir target elevations, and minimum flows.

The primary inputs to the model are observed time series of flow based on USGS gage records at the upstream boundary and other tributary locations. The model uses the following input time series:

- White River near Buckley;
- Boise Creek at Buckley;
- Puyallup River above the White/Puyallup confluence; and
- Local inflow at Auburn.

Model inputs for the White River near Buckley and Boise Creek at Buckley are historical flow data from the USGS gages at those locations. A correction (averaging 18 cfs) is applied to the White River near Buckley time series to improve continuity between the near Buckley, at Buckley, Boise Creek, and Canal Diversion records (Aspect 2010). The Puyallup River above the White/Puyallup confluence time series is calculated by subtracting USGS gage data for the White River near Auburn and tailrace from the gage data at the Puyallup River at Puyallup. The local inflow at Auburn series was calculated by subtracting the flow at the White River at Buckley from the White River near Auburn gage to represent local gains and losses in this reach of the White River.

Altogether, 7 gages are used to develop the inflow series for the Model. These gages have a common period of record of Water Year 1988 to 2002. The location of the gages are depicted on Figure 5. The period of record is limited on the early end by the White River near Auburn record, which started in October 1987, and on the late end by the White River near Buckley record, which ended in September 2003.

The 15-year period between Water Year 1988 and 2002 was drier than average, particularly in summer and early fall. August is a critical month for water resources as snowmelt typically has ended and river flows are low at the same time that water is increasingly important for recreation, water supply, and aquatic habitat uses. A comparison of average August flows in the White River is shown in Figure 6.

Based on August average flows, the model period of record has two dry years (1995 and 1996) and four drought years (1989, 1992, 1994, and 2001). On average, a 15-year period would have 2.25 dry years, and 1.5 drought years – or about 4 out of 15 years drier than normal. The period examined in the model has 6 drier than average years, and twice the expected number of drought years.

By using the historical record, the model assumes that future hydrologic conditions will be similar to those of the past. This scientific approach is the standard approach for evaluating hydrologic effects of proposed projects and was used throughout this ROE. By employing this approach, the model is conservative because it is based on a drier than normal period of the historical record. The model results likely overstate the frequency with which impacts would be expected to occur and are, therefore, an appropriate basis for regulatory decision-making.

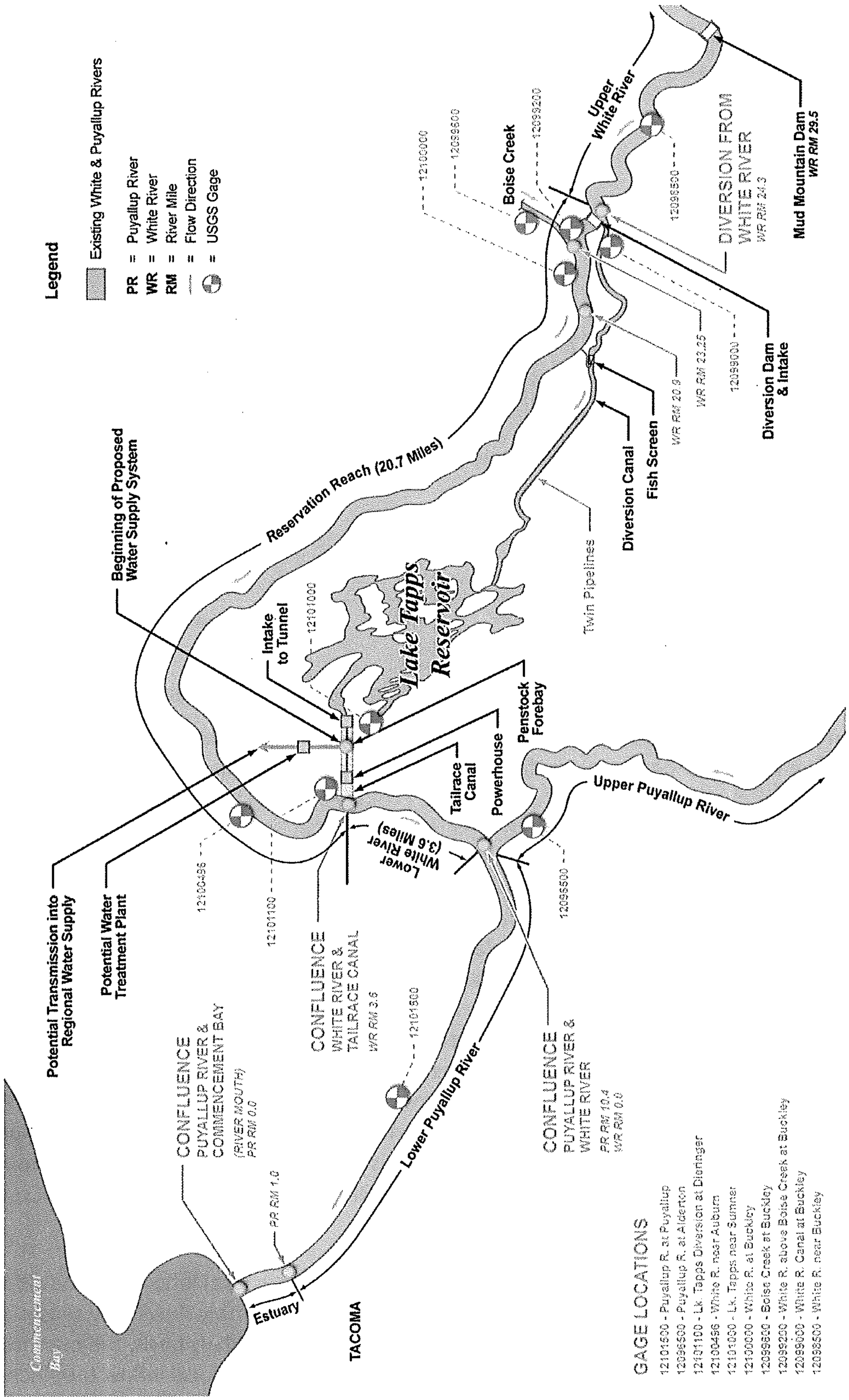

Figure 5 – Stream Reaches and Gages of the White and Puyallup Rivers. (Cascade 2010c)

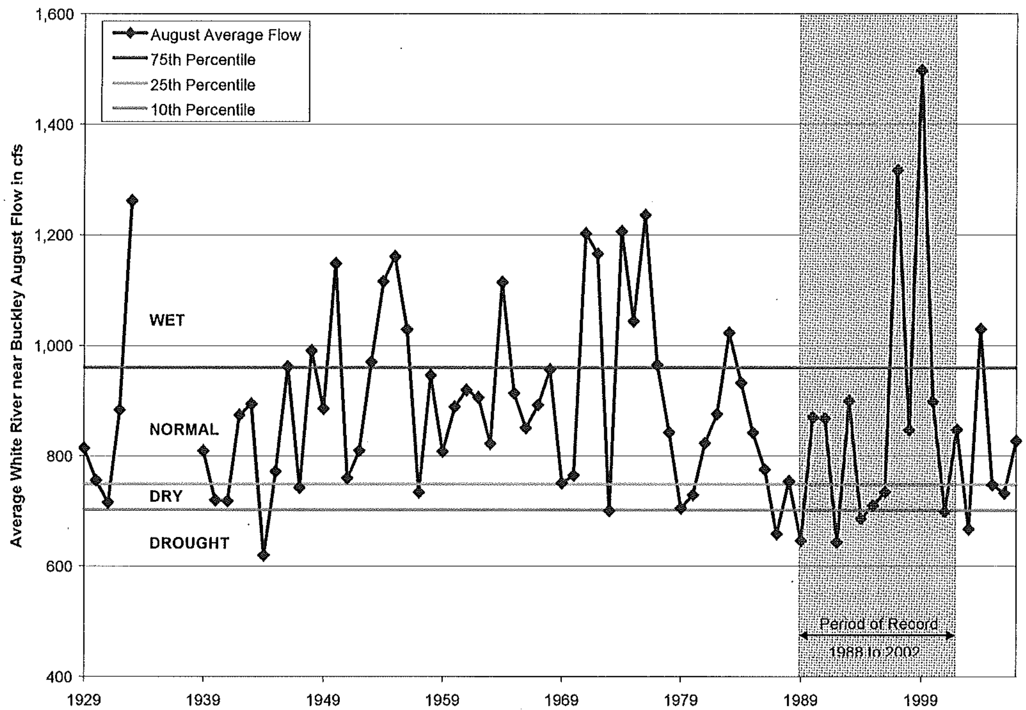

Figure 6 – Average Flow for August in the White River near Buckley

If future river flows are not similar to those of the past, perhaps because of climate change or a long-term climatic cycle, the model predictions would not be applicable and conclusions drawn from them could either overstate or understate impacts. Ecology's investigation includes an evaluation of the potential impacts of climate change on the Project, discussed in Section 4.7.

The Model also simulates the minor (or "local") inflows and outflows to Lake Tapps that are not measured by gages. These local flows are important for correctly simulating the quantity of diversions necessary to maintain the lake level, particularly in late summer. The following are local inflows and outflows from Lake Tapps: precipitation on the lake surface, evaporation, stormwater inflows, dike seepage, seepage to groundwater through the lake bottom, and discharge to Bowman Creek. These processes enter the model as individual time series. Daily data are used where available. Where daily data are not available, long-term averages are used. Precipitation and evaporation are based on historical data from nearby weather stations. Stormwater inflows are estimated using the Western Washington Hydrology Model 3 and basin characteristics from a Washington State Department of Transportation study (2005). Seepage to groundwater is based on Pacific Groundwater Group's mean estimate of seepage (PGG 1999 as reported in TM 27, HDR 2002). Discharge to Bowman Creek was assumed to be 1 cfs.

Without water diverted into Lake Tapps via the diversion canal, local inflows and outflows result in an average inflow to Lake Tapps of approximately 1 cfs. Average monthly flows vary seasonally, between a 29 cfs loss in July and August up to a 27 cfs gain in November. On a daily basis, the maximum loss from the lake is 38 cfs on hot, dry days in July and August and the maximum local inflow (not including diverted water) is 408 cfs during a large storm in November 1995.

Outputs from the model are time series of flow or reservoir storage and elevation for the following locations:

- White River below the diversion dam;
- White River near Auburn;
- Canal diversion;
- Lake Tapps storage and water surface elevation;
- Lake Tapps tailrace;
- White River below the tailrace; and
- Puyallup River at Puyallup.

Model Validation. Model validation was performed to confirm that the Model was accurately simulating the water balance in Lake Tapps. The Model was validated by attempting to reproduce the historical record for Lake Tapps stage, by running the model with historical diversions from the White River and historical tailrace releases. If the Model accurately simulates the minor inflows and outflows, then the validation runs should reproduce the historical storage volume in the lake, or its surrogate, water surface elevation. If the model does not reproduce the historical storage volume, it could indicate issues with simulation of the minor inflows and outflows, or it could be caused by gage error in the historical data from the canal or tailrace gages. Model validation focused on the critical summer period, and validation runs were performed for each of the 15 years in the period of record.

Validation results indicate that the Model is acceptable for use (and likely conservatively overestimates losses from the lake in summer). The Model closely matched historical storage in some years (particularly 1988 when diversions and releases were low), under-predicted storage in some, and over-predicted storage in others. A close match is clearly desirable, and under-prediction is acceptable as it indicates that the Model may be overestimating losses from the lake. Over-prediction is more of a concern because it could indicate that the Model is under-estimating lake losses. However, examination of two of the years with over-prediction (Water Years 1993 and 1994, both dry years) indicates that to match historical lake levels the model would require an additional loss from the lake of over 100 cfs that starts in July and ends abruptly in early September. This is not hydrologically realistic, and is an indicator that gage error is the likely source of the over-prediction of lake storage. There was also no pattern to the years of over-prediction, adding additional support that gage error is likely responsible. The Model matched or under-predicted reservoir elevations in 10 of 15 years.

<u>Baseline Assumptions for Systems Model</u>

The Baseline selected for evaluating the Project is the continued operation of Lake Tapps for water quality and recreational uses consistent with Puget's historical use of the Puget Claim and operations since ceasing power generation in 2004. Ecology views this scenario as the most likely to occur if the Project is not implemented. The operating rules for the Baseline were developed from the likely conditions for the change to the Puget Claim, and additional assumptions about how Lake Tapps might be operated without hydropower and without a water supply withdrawal. The resulting operating rules used in the Model for the Baseline were:

Diversion:

- Diversions from the White River are allowed for water quality, reservoir maintenance, and recreational uses.

- Diversions are capped at 650 cfs during the refill period and 375 cfs for the remainder of the year.[6]
- Diversion of up to 20 cfs is allowed to operate the fish screen, regardless of the flow in the White River.
- All other diversions from the White River must comply with the minimum flows established under an Interim Operating Agreement with USACE. These flows vary throughout the year from 350 to 500 cfs.
- Water is diverted for recreational use to meet or maintain the target reservoir elevation.
- Water is not normally diverted to maintain lake water quality. Under the conditions of the change to the Puget Claim, a water quality study would be performed to determine if diversions are necessary to maintain lake water quality. In lieu of the results of that study, it is assumed that diversions for water quality (i.e., flushing flows) are not necessary.
- The White River diversion dam will be replaced with a more efficient structure.

Lake Tapps Water Levels:

- The lake is operated to maintain Normal Full Pool at 542.5 feet NGVD 29 from April 15 to October 31.
- Fall drawdown occurs from November 1 to December 15.
- Winter low pool of 529.5 ft NGVD 29 is maintained from December 16 to the end of February.
- Refill starts on March 1 and continues until the lake reaches Normal Full Pool, or June 15, whichever is earlier.

Tailrace Releases:

- Tailrace releases occur primarily in fall to draw the lake down to prevent aquatic plant growth in Lake Tapps, and for maintenance, but may also occur anytime throughout the year to maintain lake levels in the target range.
- Leakage through the tailrace continues to occur at a rate of 36 cfs.

Project Assumptions for Systems Model

The Project Model runs are intended to represent the full effects of the new municipal water rights, and other elements of the Project as described in Section 3.3.1. The primary differences between the Baseline and the Project are the addition of the water supply withdrawal from Lake Tapps, higher minimum flows in the Reservation Reach of the White River, different diversion caps, and faster drawdown in fall and earlier refill in spring. The Project Model runs are based on withdrawal of the full 75 cfs quantity of the municipal water right application, which may not actually occur for several decades. The operating rules used in the Model runs for the Project are listed below where they differ from the Baseline:

Diversion:

- Diversions from the White River are allowed for water quality, reservoir maintenance, water supply, and recreational uses.
- Diversions are capped at 1,000 cfs during refill, 400 cfs in the remainder of the recreational period, and 150 cfs for the remainder of the year.

[6] These diversion limits assumed in the Baseline are lower than authorized in the Puget Claim. Under the Puget Claim, water may be diverted at up to 2,000 cfs, although as a practical matter recent installation (2006) of a backflow prevention structure near Printz Basin limits actual diversion capacity to approximately 1,000 cfs.

- Diversions from the White River, other than 20 cfs for operation of the fish screen, must comply with the Recommended Flow Regime, which varies throughout the year from 500 to 875 cfs as shown in Table 2.
- Between February 15 and March 31, diversions from the White River would be reduced by up to the amount of the water supply withdrawal on days when the Puyallup River is below its MIF. *See* Condition 6. This reduction is referred to as the "Early Spring Avoidance Plan."
- The White River diversion dam will be replaced with a more efficient structure.

Lake Tapps Water Levels:
- The lake is operated to maintain Normal Full Pool at 542.5 feet NGVD 29 from April 15 to October 31.
- Fall Drawdown occurs from November 1 to 30.
- Winter low pool of 529.5 ft NGVD 29 is maintained from December 1 to February 14.
- Refill starts on February 15 and continues until the lake reaches Normal Full Pool, or July 1, whichever is earlier.

Water Supply Withdrawal:
- Average monthly water supply withdrawals vary from 53 cfs in December and January to 117 cfs in August, averaging 75 cfs over the year.
- Stage 1 shortage management is in effect in dry years (1995 and 1996), and reduces water supply withdrawals by an average of 12% from April through October.
- Stage 2 shortage management is in effect in drought years (1989, 1992, 1994, and 2001) and reduces water supply withdrawals by an average of 17% from April through November.

Tailrace Releases
- Leakage is eliminated by improvements to the outlet works.

Priority of Water Use
- The Project would have the following priority for use of water:
    1. Operate the diversion canal fish screen.
    2. Support minimum flows in the White River Reservation Reach.
    3. Maintain lake levels from April 15 to September 30.
    4. Water supply withdrawals.
    5. Maintain lake levels from October 1 to April 14.
- Between April 15 and September 15, Cascade would reduce water supply withdrawals so that the lake elevation did not fall below 541.0 feet NGVD 29.
- From September 16 to 30, Cascade would reduce water supply withdrawals if the lake was below 541.0 feet NGVD 29 more than 10% of the time (i.e., the 10-year running total of days below Normal Full Pool shall not exceed 15).

4.2.3 Potential Effects of Project

The Project would divert water from the White River, store it in Lake Tapps, and withdraw water from Lake Tapps for water supply. These actions would alter flows in the White River by changing the magnitude and timing of both diversions from the White River and releases from Lake Tapps through the tailrace. As a result, the Project would affect the hydrology of the following stream reaches and water bodies in the White and Puyallup River systems:

- White River Reservation Reach

- Lake Tapps
- Lower White River
- Lower Puyallup River

Of these, the White River Reservation Reach would be affected only by changes in operation of the diversion dam. The remaining reaches and water bodies would be affected by changes at both the diversion and tailrace. This section quantitatively evaluates those changes by comparing model results for the Project and the Baseline.

Flows in the White and Puyallup Rivers

A comparison of annual average flows provides a clear indication of which reaches would be affected by the Project, and the overall magnitude of that impact. Annual average flows at various points in the watershed calculated for the Baseline and Project scenarios are shown in Table 4. The Project would reduce the flow in the White River below the tailrace and the Puyallup River below the confluence by the amount of the water supply withdrawal[7]. However, the Reservation Reach is affected differently than the reaches downstream of the tailrace.

Table 4 – Model Predicted Average Flows for WY 1988 to 2002

	Annual Average Flow in cfs (WY 1988-2002)				
Scenario	White River Reservation Reach	Canal Diversion	Tailrace Release	Lower White River	Lower Puyallup River
Baseline	1,366	97	75	1,594	3,229
Project	1,330	132	40	1,523	3,158
Difference	-35	+35	-35	-71	-71
Percent change	-2.6%	+36%	-47%	-4.5%	-2.2%

Note: Numbers may not add exactly due to rounding.

Roughly half of the water supply withdrawal would be obtained by increasing diversions from the White River, and the other half would come from reducing tailrace releases. The average flow in the Reservation Reach would be reduced by 35 cfs (or 2.6%). Downstream of the tailrace, the average flow in both the lower White River and the Lower Puyallup River would be reduced by 71 cfs, a 4.5% and 2.2% reduction, respectively.

Monthly average flows for the affected reaches were calculated to look at the seasonal timing of the changes in flow. The change in monthly average flows is shown in Figure 7. Positive values represent an increase in flows with the Project. The Project would increase average flows in March, April, and November, and would decrease flows in the remaining months.

[7] Total change shown in Table 4 is less than the full 75 cfs amount of the water right applications because of reduced water supply withdrawals during shortage management.

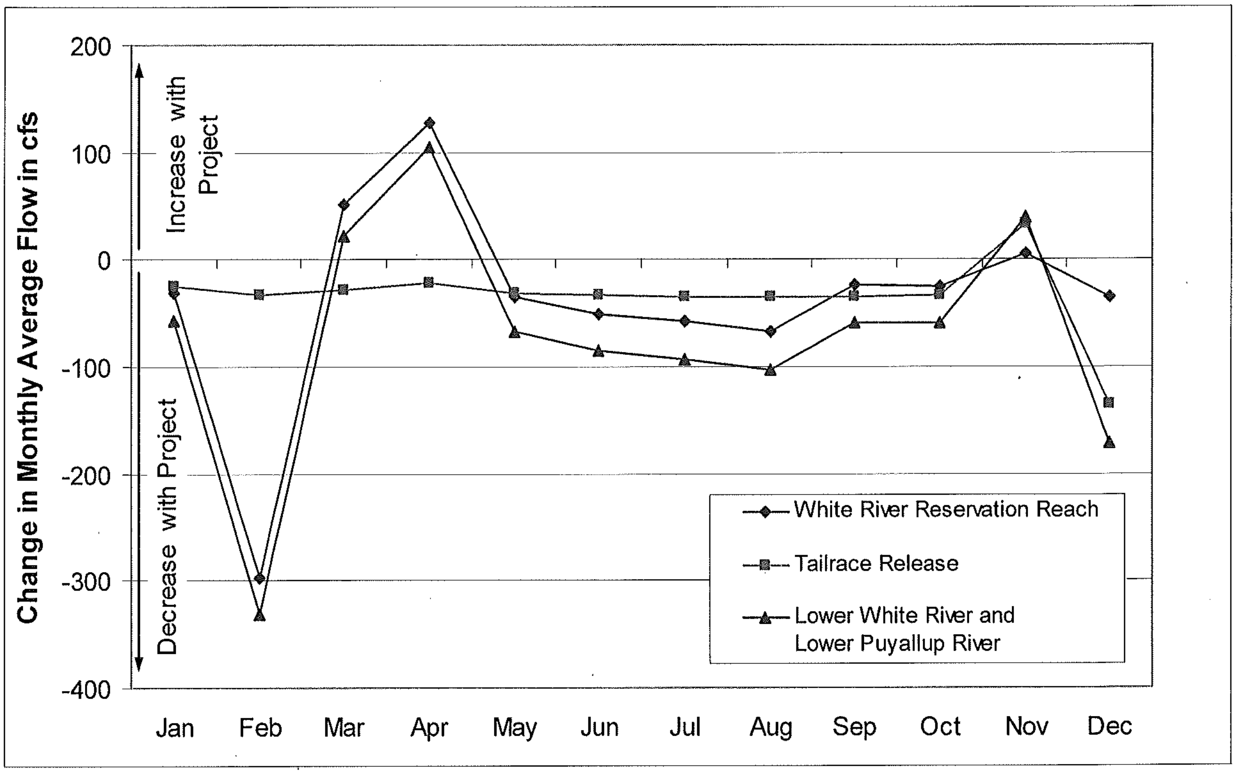

Figure 7– Change in Monthly Average Flows

The largest change in monthly average flows in the White River would occur in February, when the Project would cause a roughly 300 cfs decrease in river flows. This happens because the Project would allow Refill starting on February 15. Refill starts on March 1 under the Baseline assumptions, so for the last weeks of February water is being diverted to refill the reservoir under the Project and not under the Baseline. Refill is also allowed at a higher rate (1,000 cfs) under the Project, than in the Baseline (650 cfs). The earlier start and higher refill rate of the Project would be beneficial to flows in March and April because of the earlier completion of Refill.

Through the recreation season, the Project would divert more water from the White River to meet water supply needs. The amount of additional diversions would grow through summer as the water supply withdrawal increases. The increase in diversions (and corresponding decrease in Reservation Reach flow) peaks at 68 cfs in August. Combined with the decrease in tailrace releases, the lower White and Puyallup Rivers would experience an average decrease of just over 100 cfs in August. The impact on flows would be lower in September and October as water demand subsides.

The Project would cause a slight increase in river flows in November, particularly downstream of the tailrace. This occurs because the period for Fall Drawdown is shorter under the Project (November 1 to December 1) than in the Baseline (November 1 to December 15), causing the Project to release water through the tailrace at a higher flow rate. Other than November, the tailrace release under the Project would be consistently lower than the Baseline, primarily because the Project includes measures to reduce leakage from the powerhouse valves.

The Project would also affect flows on a day-to-day basis in a manner not captured by the evaluations of annual or monthly average change in flows. For example, when the Early Spring Avoidance Plan is triggered, the Project could increase flows in the Reservation Reach and Lower White and Puyallup Rivers. Or diversions under the Project may increase in the summer immediately following a step-down in the minimum flow.

A summary of the predicted daily changes in flow for the Reservation Reach and Lower White River is shown in Table 5. The Project would increase flows in the Reservation Reach 12% of the time, leave flows unchanged 21% of the time, and cause a decrease in flows 68% of the time. The increases in flows typically occur because of the higher minimum flows of the Project. These increases typically would occur when the flow in the White River upstream of the diversion dam is higher than the minimum flows of the Baseline scenario, but close to or lower than the minimum flows of the Project. There would be no change in the Reservation Reach when upstream flows are at their lowest (i.e., lower than both sets of minimum flows) or during Fall Drawdown. The remainder of the time, the Project would decrease flows in the White River by diverting water for the water supply.

Table 5 – Summary of Change in Flows in White River

White River Reach	Frequency of Change in Flows		
	Increase	No Change	Decrease
Reservation Reach	12%	21%	68%
Lower White River	17%	1%	82%

In the Lower White River, flows are either increased or decreased, but seldom remain unchanged. This occurs because of Project repairs to reduce leakage through the powerhouse valves. The increases in flows in the Lower White River are caused by the changes at the diversion discussed in the previous paragraph, and by difference in the timing of Refill and Fall Drawdown.

The magnitude of the change in daily flow ranges from large increases (532 to 568 cfs) on a few days to large decreases (980 to 1,294 cfs) on others. The largest increases occur in March, when Refill has been completed under the Project, but continues under the Baseline. The largest impacts occur during large rainstorms in February. During these events, Refill has started with the Project so diversions of up to 1,000 cfs are allowed from the White River. The additional stormwater inflow from the large rainstorm is also stored to refill the reservoir, whereas under the Baseline operating rules it was released to the Lower White River. These large changes are rare and more typically the change (in either direction) is much smaller. A histogram analysis developed by Aspect Consulting, LLC (2010) indicates that over 80% of the changes in flow resulting from the Project would be between a 100-cfs decrease and a 50-cfs increase.

Puyallup River MIF

Model runs for each scenario were evaluated to tally the number of days that flow would be below the MIF in the Puyallup River at Puyallup, and the volume of MIF shortfall. A summary of these results for each Baseline and Project scenario is presented in Table 6.

Table 6 – Model-Predicted Number and Volume of Puyallup River MIF Excursions

Total Number of Excursions in Days in 15 years			Volume of MIF Shortfall in acre feet		
Baseline	Project	Difference	Baseline	Project	Difference
498	558	60	192,260	188,497	-3,763

The total number of MIF excursions over the model period of record would increase by 60 with the Project, or 4 additional days of MIF excursion per year on average. The MIF excursions would be caused by increased diversions from the White River on days when the White River was above its minimum flow, but flows in the upper Puyallup River were low. They would also be caused by the reduction in tailrace discharges from fixing leakage through the powerhouse valves.

The total volume of MIF shortfall would decrease by about 2% (or 3,763 acre feet in the 15-year period simulated), primarily because of the Early Spring Avoidance Plan and faster refill under the Project. In simple terms, the refill strategy under the Project can be described as quickly filling when flows are high and reducing diversions when flows are below the Puyallup MIF. This significantly reduces both the number and magnitude of MIF excursions in March and April.

Statistical Low Flows (7Q10 and 7Q20)

The 7Q10 is the 7-day average low flow that occurs with a frequency of once in 10 years. Similarly, the 7Q20 is 7-day average low flow that occurs with a frequency of once in 20 years. These flows are important in water quality management of rivers because many National Pollutant Discharge Elimination System (NPDES) permits and Total Maximum Daily Load (TMDL) processes use them for calculating allowable pollutant loads and mixing zone sizes.

The impact of the Project on 7Q10 and 7Q20 low flows was calculated from the 15 years of model results. These results are statistically weak because only 15 years of data, during an abnormally dry period, were used to predict low flows with recurrence intervals of 10 and 20 years. Given these limitations, the estimates of 7Q10 and 7Q20 should be viewed as an indicator of the potential impact rather than a quantitative prediction of the impact. The results are shown in Table 7.

Table 7 – 7Q10 and 7Q20 Flows in cfs

Project Scenario	Lower White River		Puyallup River at Puyallup	
	7Q10	7Q20	7Q10	7Q20
Puyallup River TMDL	199	162	757	681
Baseline	377	359	742	695
Project	346	327	714	669
Difference	-31	-32	-28	-26

The 7Q10 and 7Q20 low flows for the Lower White River would be about 32 cfs lower under the Project. This is caused by the reduction in leakage from the powerhouse valves. These results are significantly higher than the historical values included in the Puyallup River TMDL because of the cessation of hydropower generation and the adoption of higher minimum flows at the diversion dam. Therefore, the Project would not impact the waste load allocation for the White River.

In the Puyallup River, the Project would cause slightly less of a reduction in 7Q10 and 7Q20 relative to the Baseline. The 7Q10 and 7Q20 flows with the Project would also be lower than those used in the Puyallup River TMDL. Such a reduction theoretically would reduce the allowable discharges from NPDES permit holders, but given its small magnitude is unlikely to have an actual effect. As the reduction is caused by repairing leakage from the powerhouse valves, it should not be considered a detrimental effect of the Project.

Lake Levels

The average lake elevation is important for evaluating potential impacts to groundwater. The average lake level would increase slightly with the Project as a result of the earlier refill. The average lake elevation under the Baseline scenario is 538.1 feet NGVD 29 and would increase to 538.5 feet with the Project. This small change in average lake elevation indicates that there is unlikely to be a noticeable difference in seepage from the lake to groundwater, and if the change does occur, it would likely be positive (more aquifer recharge).

Model results were also used to evaluate the potential impact to recreation on Lake Tapps. Those results are presented in Section 4.6.

Water Supply Withdrawal

The Model results identified a challenge in meeting both recreational and water supply needs during dry and drought summers. During most of the recreation season, withdrawals for water supply would be a lower priority than maintaining lake levels. The exception is October, when water supply takes priority.

When water supply is not a higher priority, there is the potential that not enough water would be available from the White River, or from storage in Lake Tapps, to allow for water supply withdrawals. The modeling results indicate that there would be no shortage for water supply in most years (10 of 15), as shown in Table 8. The shortages that would occur are generally short (ranging from 1 to 9 days).

The priority structure was built into the Model with the simplifying assumption that Cascade would completely cease withdrawals on any day when the lake level fell below a trigger point set near the lower end of Normal Full Pool. Realistically, Cascade would not suddenly stop withdrawing water from Lake Tapps. Instead, Cascade would likely be able to forecast the potential for shortage ahead of time and implement more stringent shortage management measures, or use alternate supplies. As such, the days of shortage described above may not be the best metric. Instead, it may be more appropriate to average those few days of shortage over a longer period to look at what reduction in demand would be necessary to conserve the same volume of water.

The three columns on the right of Table 8 compare the average July through September water supply withdrawal achieved in the Model versus the target. The difference indicates the additional reduction in demand that would be necessary to avoid the water supply shortages. These reductions range from 0.8 to 7.3 cfs or an additional 1 to 11% lowering of demand.

Finally, given that the Model simulates an unusually dry period, and that a simplistic trigger was used to indicate when to reduce water supply to protect recreational levels, the actual reliability of the Project probably would be higher than indicated by the Model results.

Table 8 – Water Supply Reliability

Water Year	Days of Water Supply Shortage	Jul -Sept Average Water Supply Withdrawal in cfs		
		Modeled Withdrawal	Target Withdrawal	Difference
1988	0	104.0	104.0	0
1989	1	78.7	79.5	-0.8
1990	0	104.0	104.0	0
1991	3	101.0	104.0	-3.0
1992	9	72.2	79.5	-7.3
1993	5	98.9	104.0	-5.1
1994	5	75.5	79.5	-4.1
1995	0	86.4	86.4	0
1996	0	86.4	86.4	0
1997	0	104.0	104.0	0
1998	0	104.0	104.0	0
1999	0	104.0	104.0	0
2000	0	104.0	104.0	0
2001	0	79.5	79.5	0
2002	0	104.0	104.0	0
Average	1.5 per year	93.8	95.1	-1.4
Total Days of Water Supply Shortfall	23			
Daily Reliability	99.58%			

Notes:
1) Orange rows indicate dry years, when Stage 1 shortage management was applied, and yellow rows indicate drought years and Stage 2 shortage management.
2) Target water supply withdrawal incorporates Stage 1 and Stage 2 reductions in demand.

Sensitivity Analysis

Additional water quantity model runs were also performed to examine the sensitivity of the Model to uncertainties in the implementation of the Project and in hydrologic processes (Aspect 2010). The sensitivity analysis focused on scenarios where less water would be available. Eight sensitivity runs were performed to examine four factors associated with implementation of the Project (pattern of water supply withdrawals, ability to control valve leakage, necessity of flushing flows, and operation of the diversion dam with a buffer on the minimum flow). Eleven runs were performed to examine four factors associated with hydrologic uncertainties (inaccuracy in White River near Buckley flows, inaccuracy in seepage estimates from Lake Tapps, inaccuracy in local inflows and outflows to\from Lake Tapps, and Lake Tapps stage-storage relationship).

Overall, the sensitivity runs indicate that the Project would remain viable over a reasonable range of hydrologic conditions and the full range of Project implementation conditions evaluated. The sensitivity analysis included two extreme runs (an additional 50 cfs continuous loss of water from Lake Tapps, or flows always 10% lower in the White River) where the Project was less viable, causing impacts to summer recreation and a sharp decrease in water supply reliability. More generally, flows in the White River below the diversion dam were only slightly affected and recreation was not impacted through

September 30. Water supply reliability dipped and the impact on October recreation increased as less water was available in the lake. In general, the Model results are not too sensitive to 20 to 30 cfs less water being available in the lake. Above that level, the impacts begin affecting summer recreation.

4.3 Groundwater Hydrology

Ecology's investigation of groundwater hydrology primarily relies on the analysis in Chapter 7 of the FEIS. The study area includes upland areas around Lake Tapps Reservoir and portions of the White and Puyallup River valleys, where topography ranges from about elevation 600 feet on the plateau where Lake Tapps Reservoir is located to about elevation 50 feet in the Puyallup River valley west of the reservoir. The areas investigated include the regional groundwater recharge areas, aquifers, and discharge zones that could be affected by the Project.

4.3.1 Existing Conditions

As reported in Chapter 7 of the FEIS, groundwater quality in the area is generally high. Purveyors of groundwater within the study area report clean and safe drinking water from their wells and springs. Annual reports show post-treatment water quality of drinking water pumped from study area aquifers meets or surpasses all standards regulated by the U.S. Environmental Protection Agency (USEPA) and DOH.

As described in the FEIS, there are several major aquifers and confining units in the area studied, including: Unconsolidated/Undifferentiated Deposits [Q(C)u]; Lower Coarse-Grained Unit [Q(B)c]; Lower Fine-Grained Unit [Q(B)f]; Upper Coarse-Grained Unit [Q(A)c]; Upper Fine-Grained Unit [Q(A)f]; Vashon Advance Outwash (Qva); and Vashon Till (Qvt).

Seepage from Lake Tapps and precipitation recharge these aquifers. The alluvial aquifer also receives recharge from the losing reaches of the White River and Puyallup River. The FEIS quantified components of recharge in the Lake Tapps Reservoir Upland:

- Total mean annual groundwater recharge in the Lake Tapps Reservoir Uplands is estimated at approximately 42 mgd, or 65 cfs.

- Annual seepage from Lake Tapps Reservoir to groundwater sources is estimated to be between 2.4 and 14.5 mgd (3.7 to 22.4 cfs). Seepage from the reservoir contributes an estimated 6% to 35%, or an average of 19%, of the total groundwater recharge from the Lake Tapps Reservoir Uplands.

- Seasonal changes in reservoir water levels can cause slight fluctuations in seepage from the reservoir. Analysis of average water level data recorded between 1996 and 2000 shows a seasonal variation of seepage rates from the reservoir of approximately +/- 3%. This relatively small seasonal fluctuation in seepage rates is due to the low hydraulic conductivity of the underlying Vashon Till and the relatively minor difference in hydraulic head associated with changes in reservoir level compared with the large vertical gradient between the groundwater table and the aquifer.

As noted in the FEIS, groundwater generally flows radially outward from Lake Tapps Reservoir in the Qva and Q(A)c aquifers toward the White River and Puyallup River. Groundwater discharges to the White River and Puyallup River. The White River receives some groundwater originating from the Lake Tapps Reservoir Upland. The FEIS estimated that groundwater discharge was about 0.24 mgd (0.37 cfs) per mile from the east edge of the Lake Tapps Reservoir Upland, and about 0.15 mgd (0.23 cfs) from the west edge of the Lake Tapps Reservoir Upland. Whether groundwater discharges to or is recharged by the White River depends on whether the river is a operating as a "gaining stream" or a "losing stream." Data from three different monitoring locations summarized in the FEIS demonstrated that the groundwater discharge or recharge varies by location. At one location, groundwater generally discharges to the White River during the winter and is recharged by the river in the summer. At another, groundwater is recharged by the White River during both summer and winter conditions. At the third, groundwater discharges to the White River at this location throughout the year. The available data indicate a complex hydrologic connection between the White River and the shallow aquifer, including gaining and losing reaches; however, detailed information is not available.

Additionally, groundwater discharges to several springs in the study area including the following:

- **Coal Creek Springs** – This spring, located at the northern edge of the Lake Tapps Reservoir Uplands, is used for water supply by Auburn. Coal Creek Springs discharges at a rate of approximately 4,200 gallons per minute ("gpm").

- **West Hill Spring** – This spring is used by Auburn for water supply. Based on Auburn's water right, West Hill Spring discharges at a rate of about 1,000 gpm.

- **Salmon Springs** – Salmon Springs A, located at the southwest edge of the Lake Tapps Reservoir Uplands, discharges at a rate of approximately 1,200 gpm. Salmon Springs B discharges at a rate of approximately 3,600 gpm.

- **Sumner Springs, Crystal/County Springs, and Elhi Springs** – Sumner uses three spring fields: Sumner Springs, Crystal/County Springs, and Elhi Springs. These springs discharge along the valley wall downslope of the plateau where Lake Tapps Reservoir is located.

- **Grainger Springs and Victor Falls Springs** – Bonney Lake uses two springs – Grainger Springs and Victor Falls Springs – with a reported yield of 4,050 gpm.

Although smaller springs in the area discharge some of the groundwater collected from the Lake Tapps Reservoir Uplands, the springs listed above account for a majority of the spring discharge from the Lake Tapps Reservoir Uplands, with an estimated total of approximately 14,000 gpm. Flows from these springs are generally constant. The combined flow rate of these springs is approximately 47% of the estimated total groundwater recharge from the Lake Tapps Reservoir Uplands.

Several wells operated by municipalities, water companies, various private parties, and other domestic users are located in the vicinity of the Project. As described in the FEIS, major purveyors of groundwater in the study area include Auburn, Sumner, Bonney Lake, Puyallup, and the Tapps Island Water System:

- Auburn. A majority of Auburn's water supply is extracted from the aquifers underlying the Auburn-Kent Valley and Coal Creek Springs. Auburn's Wells 5, 5A, and 5B use the Q(B)c aquifer. The depth of Auburn's wells ranges from 330.5 feet to 738 feet below top of casing.

- Sumner. Sumner's primary water supply comes from three spring fields (Sumner Springs, Crystal Springs/County Springs, and Elhi Springs) located east of the White River. During peak demand periods, groundwater is extracted from three wells: South Well, Dieringer Well, and West Well.

- Bonney Lake. Groundwater pumped from springs at Victor Falls and Grainger Springs and from wells at the Tacoma Point and Ball Park sites supply Bonney Lake. Although not used in recent years, Bonney Lake also maintains water rights associated with the McDonald Wells. In addition to its groundwater supplies, Bonney Lake entered an agreement in 2005 to purchase up to 2 mgd peak flow from Tacoma Water, as needed.

- Tapps Island Water System. Drinking water used by the Tapps Island Water System is supplied by six wells on the plateau where Lake Tapps Reservoir is located. The depths of the six wells range from 86 feet to 140 feet below the top of casing. No springs have been developed as a water source by the Tapps Island Water System.

- City of Puyallup. Puyallup uses water from five wells and two springs. Only one of these sources, Salmon Springs, is located in the study area.

- Other Group A/B Public Water Systems. Groundwater in the study area is extracted by smaller public water purveyors through approximately 65 wells and a spring. Groundwater is extracted by these users from shallow and deeper aquifers in both the uplands and river valley portions of the study area. The shallowest well is 47 feet below the top of casing, while the deepest well is 460 feet below top of casing. Most of the wells withdraw water from the Qva or Q(A)c aquifer.

Additional groundwater appropriations in the area are constrained by the Instream Resources Protection Program, which requires a determination as to whether the proposed withdrawal will affect flows in streams for which closures and instream flows have been adopted, including streams within the study area. WAC 173-510-040.

4.3.2 Evaluation Methodology

The water surface elevation in Lake Tapps provides the driving head to cause water to seep from the reservoir into the aquifer. The Project has the potential to influence aquifer recharge by changing Lake Tapps water levels. The FEIS investigated the potential impacts of the Project on aquifer recharge, spring flow, and the supply of groundwater to public and domestic wells.

The evaluation of impacts to groundwater in the FEIS uses Model results for reservoir storage and water levels for the Project and the Baseline (See Section 4.2.3 of this ROE) to evaluate the changes that could occur from operation of the Project. The potential change in aquifer recharge was computed in the FEIS using the Model-predicted changes in lake water levels and Darcy's Law.[8] The FEIS compared historic lake levels (both during and after hydropower operations ceased) in dry and average years with the predicted lake levels in those years with the Project.

4.3.3 Potential Effects of Proposal

Model results predict that the lake water surface elevation with the Project generally would not decrease below elevation 530 feet, while the historic reservoir level during the operation of the Hydro Project regularly decreased below elevation 525 feet. Under the Project, Refill would occur in April and May and start several months earlier than during hydropower operations, and the reservoir level would

[8] Darcy's Law is $Q = k * A * i$ where: Q = seepage in cubic ft/day, k = vertical hydraulic conductivity in ft /day, A = reservoir surface area in square feet, and i = vertical hydraulic gradient in ft/ft. The area of the reservoir is about 2,500 acres or 1.1×10^8 ft^2. The hydraulic conductivity was assigned at 1.0×10^{-6} cm/sec or 0.003 ft/day, based on prior research by PGG (1999).

be at a higher elevation for a longer period in the summer. The average reservoir level predicted for the Project is about 0.77 feet higher than the historic reservoir level during this period of Hydro Power operations. Compared to lake levels after Puget ceased hydropower operations, the reservoir level would be slightly higher in March and slightly lower in October and November. Model predictions indicate that the average reservoir level with the Project would be 538.50 feet, which is slightly higher than the model predictions for lake levels without hydropower operations (538.08 feet).

These changes in Lake Tapps Reservoir levels have the potential to influence the rate of water seeping from the reservoir to the aquifer. First, the FEIS compared aquifer recharge predicted for the Project with aquifer recharge during the Hydro Project's operations. The Project's average reservoir level (if the Project were applied to historic conditions from 1988 to 2002) would be 538.50 feet. This would be higher than the actual historic reservoir stage of 537.81 feet during this period. This means that the hydraulic gradient and the aquifer recharge associated with the Project would be slightly higher than occurred previously during hydropower operations. A change in reservoir level of about 1 foot would cause less than 1% change in hydraulic gradient and aquifer recharge, and would be insignificant. Next, the FEIS compared aquifer recharge under the Project with recharge under the Baseline. The average water level from 1988 to 2002 was computed from Model results. The average reservoir level with the Project (538.50 feet) would be higher than the Baseline at 538.08 feet. The difference in reservoir level between these two alternatives is about 0.42 foot and would have an insignificant effect on hydraulic gradient and aquifer recharge.

Based on these differences, the FEIS explored the potential impacts on public water systems drawing from aquifers and springs as well as other domestic wells:

- Public water systems drawing from aquifers. The aquifers in the vicinity of the plateau where Lake Tapps Reservoir is located are used for municipal water supply by Auburn and Bonney Lake. Sumner and Puyallup use groundwater from the White River and Puyallup River valley alluvial aquifer for municipal supply. Other public water system wells are located in the project vicinity. As indicated by well logs and well construction diagrams, the groundwater levels in almost all the municipal water supply production wells are above the well screen and pump intake. Since the production wells operated properly in the past with water levels above the well screen and pump intake and the Project is predicted to result in a reservoir water surface elevation higher than the reservoir water surface elevation during historic operations, the FEIS concludes that the Project would not adversely affect the municipal water supply wells.

- Springs. Springs located on the edges of the plateau where Lake Tapps Reservoir is located provide a source of public water supply to various municipalities including Auburn, Sumner, and Bonney Lake. Spring water flows out of the upper Qva and Q(A)c aquifer to these springs. The elevation of Lake Tapps Reservoir is above the elevations of these springs, and a portion of the recharge to these aquifers comes from Lake Tapps Reservoir seepage. The operation of the Project would not adversely affect spring flow because the Lake Tapps Reservoir level would be higher compared with historic reservoir operations, and the change in aquifer recharge from operation of the reservoir compared with the Project would be insignificant.

- Domestic Wells. Most domestic wells in the vicinity of the reservoir are several hundred feet deep and are completed in the uppermost Qva aquifer. It is not anticipated that domestic wells would be affected by the Project because the reservoir level would not change significantly and would be slightly higher than during the historic reservoir operations.

4.4 Water Quality

The Project would have the potential to affect water quality primarily by changing flows in the White River. The water quality in Lake Tapps would not be anticipated to change with the Project (relative to the Baseline). As a result, the water quality investigation focused on the parameters in each reach that could be affected by changes in flow. These parameters are as follows:

- White River Reservation Reach: Temperature, pH, and Dissolved Oxygen
- Lake Tapps: Phosphorus and Nuisance Algae
- Lower White River: Temperature, pH, and Dissolved Oxygen
- Lower Puyallup River: Temperature, pH, and Dissolved Oxygen

This section of the Investigation first presents the applicable water quality standards, then presents the existing conditions, evaluation methodology, and results separately for each reach and parameter.

In general, the assessments of potential changes in water quality resulting from the Project are based on the systems Model results. The specific analytical approach varies by parameter. Where possible, quantitative approaches were used; in other cases only qualitative approaches were feasible given the available data and the anticipated level of impact from the Project. Details of the quantitative calculations are available in the *Water Quantity and Quality Analyses for the Lake Tapps Water Right Applications* report (Aspect 2010).

4.4.1 Water Quality Standards

Washington State water quality standards for surface waters consist of designated uses and criteria and other provisions (e.g., anti-degradation) to protect those uses. Chapter 173-201A WAC. These standards apply throughout the watershed except on tribal lands. State marine water quality standards apply in the Puyallup River below RM 1. On the Puyallup River, the Puyallup Tribe's water quality standards apply between RM 1 and 7.3. Currently, there are no USEPA-approved water quality standards on the White River within the Muckleshoot Indian Tribe's reservation, although state standards apply above and below the reservation.

The state water quality criteria for temperature, dissolved oxygen, and pH applicable in each of the river reaches affected by the Project are shown in

Table 9. State water quality standards are based on the designated uses (type of aquatic life, recreation, water supply, etc.) of a surface water body. Of these designations, the aquatic life use establishes the numerical criteria of greatest interest for evaluating the potential impacts of the Project.

The State standards shown in

Table 9 apply at all times of the year. In addition, the State standards identify stricter temperature criteria for water bodies that require special protection during salmonid spawning and incubation. Ecology (2006b) identifies those portions of the White River between the tailrace and diversion dam that are not in the Muckleshoot Indian Reservation as spawning and incubation areas. The applicable 7-DADMax temperature criterion is 13 °C from September 15 to July 1.

Table 9 – State Water Quality Criteria

Water Body	Aquatic Life Use	Temperature (7-DADMax[9])	Dissolved Oxygen (minimum)	pH
Puyallup River (mouth to RM 1)	Salmonid Migration and Rearing	17.5 °C	6.5 mg/L	6.5≥pH≤ 8.5
Puyallup River (RM 7.3 to White River)	Core Summer Habitat	16 °C	9.5 mg/L	6.5≥pH≤ 8.5
White River (mouth to just above tailrace[10])	Spawning/Rearing	17.5 °C	8 mg/L	6.5≥pH≤ 8.5
White River (just above tailrace[10] to MMD)	Core Summer Habitat	16 °C	9.5 mg/L	6.5≥pH≤ 8.5

The Puyallup Tribe of Indians has been delegated federal Clean Water Act authority to administer water quality standards in the Puyallup River within the Puyallup Tribe's reservation. The Puyallup Tribe has established Water Quality Standards for Surface Waters of the Puyallup Tribe, 63 FR 53911, which includes the reach of the Puyallup River in the reservation. At the time of publication of this ROE, the applicable standards were those approved by the USEPA on October 10, 1994 and are shown in Table 10. The Puyallup Tribe's water quality standards also include an anti-degradation policy.

Table 10 – Current Water Quality Criteria of the Puyallup Tribe of Indians

Parameter	Class A Standard
Dissolved Oxygen	≥ 8 mg/L
pH	6.5 ≥ pH ≤ 8.5
Temperature	≤ 18 °C

The Puyallup Tribe is currently in the process of revising its water quality standards. A summary of the Puyallup Tribe's proposed standards (PTI 2005), as would be applicable to the Project, are shown in Table 11. If approved by the USEPA, these standards would apply at all times of the year.

Table 11 – Proposed Water Quality Criteria of the Puyallup Tribe of Indians

Water Body	Aquatic Life Use	Temperature (7-DADMax[9])	Dissolved Oxygen		pH
			7-DADMean[9]	Minimum	
Puyallup River (RM 1.0 to RM 7.3)	Native Char Rearing	12 °C	11 mg/L	9 mg/L	6.5 ≥ pH ≤ 8.5

[9] 7-DADMax is the 7-day average of daily maximum temperatures. 7-DADMean is the 7-day average of daily mean dissolved oxygen concentrations.

[10] The point just above the tailrace is defined in WAC 173-201A-602 as latitude 47.2438 longitude -122.2422 (Sect. 1 T20N R4E).

4.4.2 Analysis of Each Reach by Parameter

White River Reservation Reach Temperature

Existing Conditions. In the past, water temperature in the White River has regularly exceeded current standards, particularly during summer months (Figure 8). These violations were due in part to conditions in the upper watershed[11], but also by the quantity of flow in the river. Higher flows provide more water to absorb heat from sunlight and warm air. Higher flows also increase velocity and reduce the travel time through sun-exposed reaches.

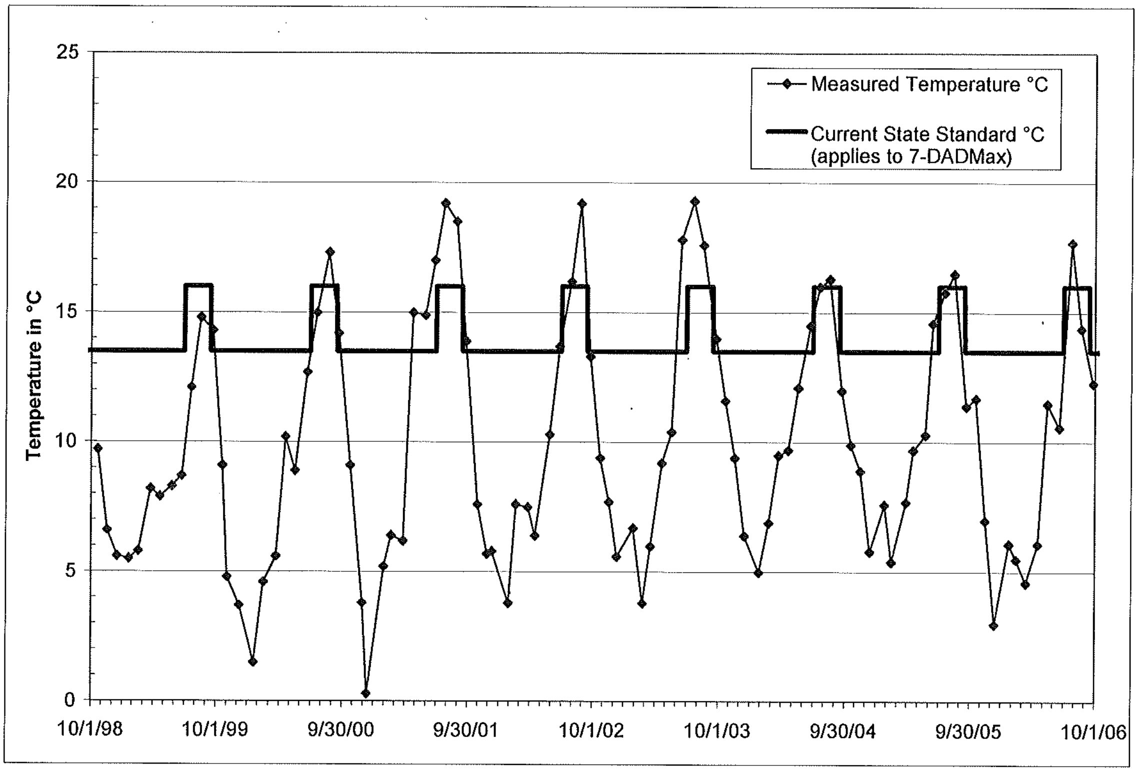

Figure 8– White River Temperature at RM 8.0 (Station 10C095) in Water Years 1999 to 2006

Diversions into Lake Tapps can affect Reservation Reach temperature by changing the flow in the reach. Data from 2001 (when Puget was diverting water for hydropower production) and 2004 (the first summer after Puget curtailed such diversions) show that diversions for hydropower can contribute to a change in temperature of several degrees in the Reservation Reach. In 2001, summer flows in the White River were in the range of 250 to 1,000 cfs, the result of dry conditions and hydropower diversions. In 2004, with diversions for power generation halted, flows in the river were higher, in the range of 500 to 4,500 cfs (Figure 9) and river temperatures were 2 to 3°C lower than in 2001.

Methodology. Temperature in the White River Reservation Reach was evaluated using regression equations developed by Keta Waters (2006) that relate water temperature to flow in the river. These regression equations were developed from water temperature monitoring data collected in the summers of 2001, 2002, and 2004. The regression equations are based on air temperatures from SeaTac airport, and flow at two points in the Reservation Reach: downstream of the diversion dam, and at the Auburn gage. The regression equations were used with daily flow results from the Model for both the Project and Baseline scenarios to predict water temperature on each day of each year from July 1 to

[11] In 2003, in cooperation with the U.S. Forest Service ("USFS"), Ecology prepared a TMDL study for temperature and sediment for the upper river, and the USFS is now implementing the recommendations from that study.

October 31. The 7-day average of daily maximum ("7-DADMax") temperatures was calculated for each day by averaging that day's daily maximum temperature with the daily maximum temperatures of the 3 days prior and the 3 days after that date. The change in 7-DADMax temperatures was calculated by comparing the predicted temperature on each day under the Baseline and with the Project.

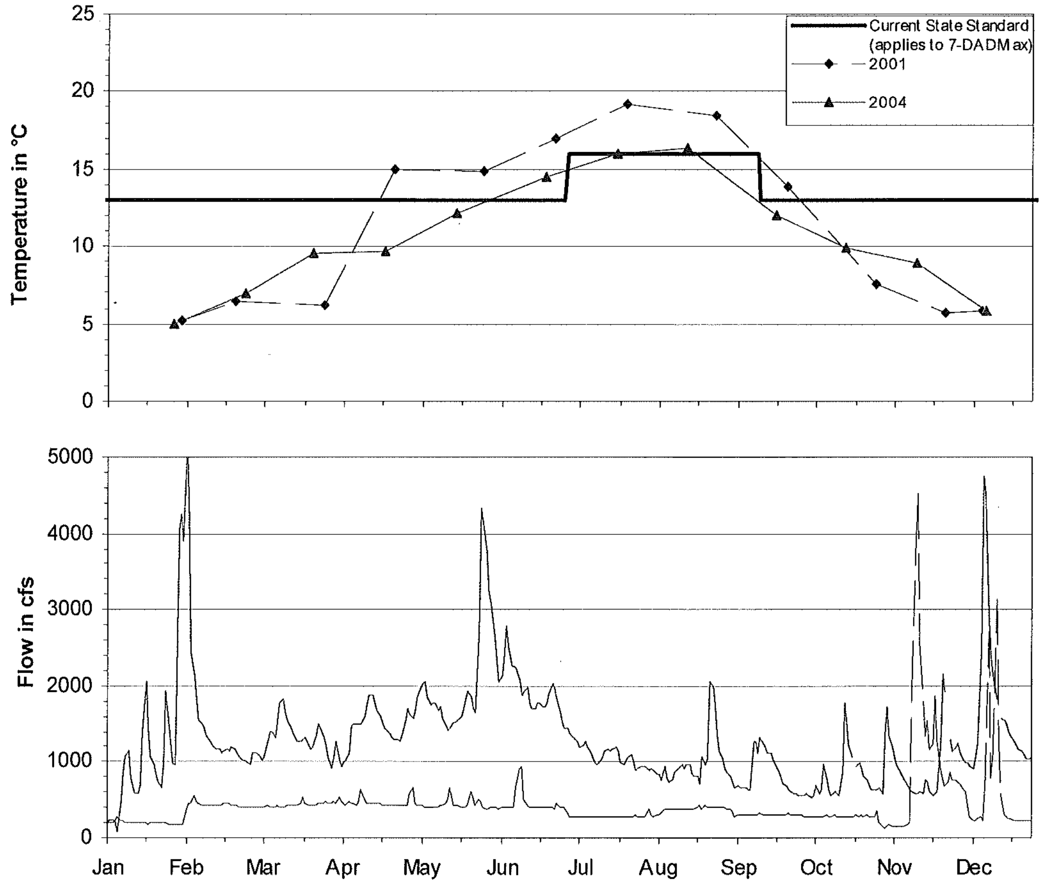

Figure 9– Temperature and Flow at White River RM 8.0 (Station 10C095) in 2001 and 2004

Results. The Project would increase average 7-DADMax temperatures in the White River, as shown in Table 12. However, the magnitude of the increase is generally small, ranging from 0.03 to 0.11 °C on average.

Table 12 also indicates the frequency with which water temperature would be above the State Water Quality standard in Chapter 173-201A WAC. The White River from latitude 47.2438 longitude -122.2422 (just above the tailrace) to MMD is designated as having core summer salmonid habitat, which has a corresponding aquatic life temperature criterion of 16 °C. Ecology (2006b) establishes a lower temperature criterion of 13 °C from September 15 to July 1 for the White River between the tailrace and diversion dam (excluding the portions within the Muckleshoot Indian Reservation) to provide additional protection for salmonid spawning and incubation.

Under the Baseline, the 7-DADMax would exceed the 16 °C temperature criterion 29% of the time at RM 15.5 and 84% of the time at RM 4.9. With the Project, the percent of time temperatures exceed the criterion would increase by 1 to 3%. The 13 °C criterion would be exceeded 62 to 76% of the time under the Baseline scenario, and there would be little change with the Project.

Table 12 – 7-DADMax Temperatures

Scenario	Average 7-DADMax Temperature in °C		Percent of Time above Standard	
	RM 4.9	RM 15.5	RM 4.9	RM 15.5
July 1 to September 14 (Temperature Standard = 16 °C)				
Baseline	17.16	15.32	84%	29%
Project	17.27	15.40	85%	32%
Difference	0.11	0.08	1%	3%
September 15 to October 31 (Temperature Standard = 13 °C)				
Baseline	14.58	13.41	76%	62%
Project	14.62	13.44	77%	62%
Difference	0.04	0.03	1%	0%

In July and early August, there are periods when the Project would improve water temperatures because of the higher minimum flows. A histogram of the change in temperature is shown in Figure 10. About 2% of the time, the Project would improve water temperatures, and 7% of the time there would be no change. But most frequently, the Project would increase temperature – typically by 0.01 to 0.1 °C at RM 15.5 and 0.1 to 0.3 °C at RM 4.9.

From September 15 to October 31, the Project would either leave temperatures unchanged (35% frequency) or cause an increase in temperature, as shown in Figure 11. Most of the time the increase would be less than 0.3 °C, but on a few occasions (less than 1%) the temperature could increase by as much as 0.6 °C. The Project would only increase temperature during this period because the minimum flow (500 cfs) would be the same as the Baseline.

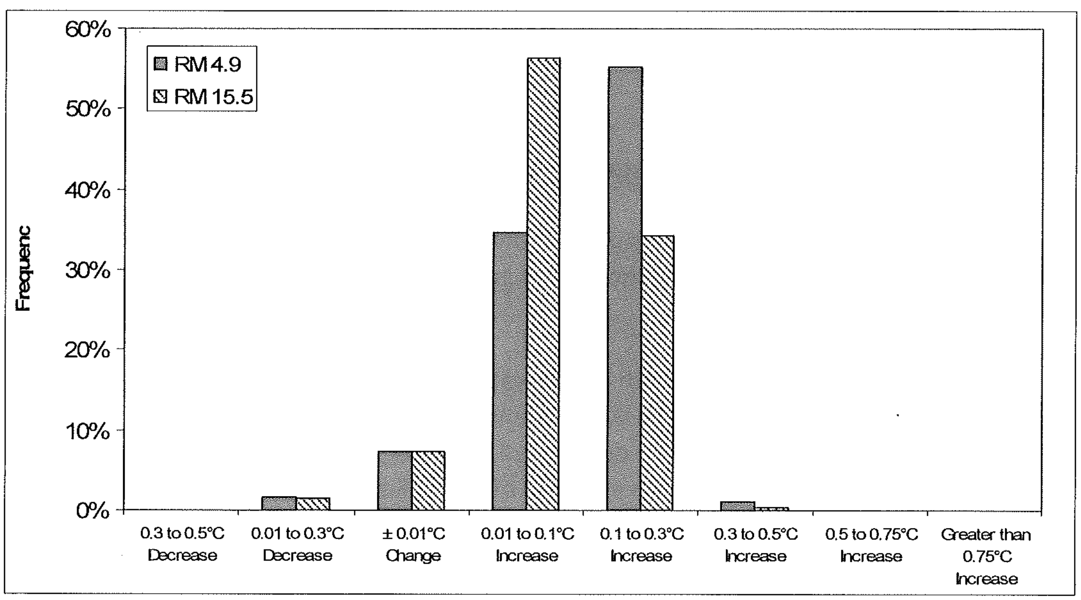

Figure 10 – Change in 7-DADMax Temperature - White River Reservation Reach, July 1 - September 14

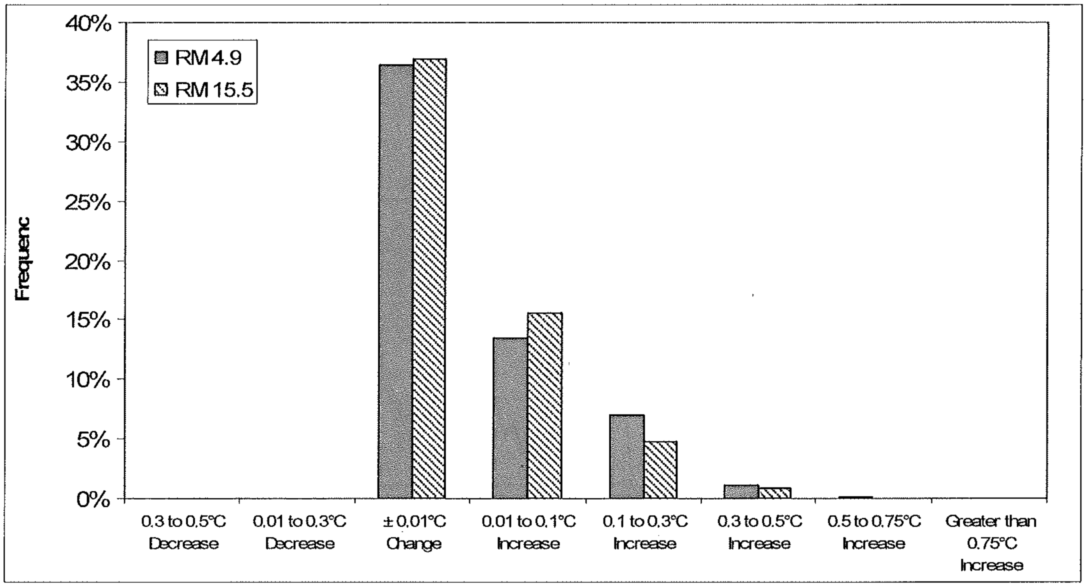

Figure 11 – Change in 7-DADMax Temperature - White River Reservation Reach, Sep 15 to Oct 31

These predicted temperatures for the Baseline and Project scenarios were used to evaluate if the Project could cause a violation of the State Water Quality Standards. For this evaluation, an exceedance of the temperature standard was considered to occur when the 7-DADMax temperature without the Project is within 0.3˚C of the temperature criterion (i.e., 15.7 or 12.7°C) and the Project would cause an increase of more than 0.3 ˚C. The results are shown in Table 13.

Table 13 – Exceedances of Temperature Standard in Reservation Reach

Total Number of Days of Exceedances of the White River Temperature Standard (WY 1988 - 2002) July 1 to September 14		Total Number of Days of Exceedances of the White River Temperature Standard (WY 1988 - 2002) September 15 to October 31	
RM 4.9	RM 15.5	RM 4.9	RM 15.5
13	3	2	0

Note: A day of exceedance is considered to occur when the 7-DADMax temperature for that day under the Baseline is >15.7˚ C from July 1 to September 14 or >12.7˚ C from September 15 to October 31 and the 7-DADMax temperature with the Project would be more than 0.3˚ C higher.

Based on the modeling results for flow and the regression equation for relating water temperature to flow, the Project would have the potential to cause a limited number of exceedances of the temperature standard. The exceedances generally occur farther downstream from the point of diversion. These exceedances would occur less than less 1% of the time.

White River Reservation Reach Dissolved Oxygen

Existing Conditions. Dissolved oxygen (DO) concentrations in the Reservation Reach are generally above the water quality standard of 9.5 milligrams per liter ("mg/L"), with occasional measurements slightly below the standard (Figure 12). Dissolved oxygen in the Reservation Reach has been monitored at RM 4.9 continuously in August to October 2002 (Ebbert 2003), and at RM 8.0 from 1998 to 2008 as a component of Ecology's Lakes and Rivers monitoring program (Ecology n.d.). DO at RM 4.9 ranged from 8.0 to 12.8 mg/L, and had a daily minimum DO concentrations below 9.5 mg/L on most days from mid-August to late September (see Figure 3.D in Ebbert 2003). DO was measured below water quality standards at RM 8.0 on two dates during the monitoring period: 9.2 mg/L on July 24, 2006 and 9.3 on July 24, 2001. These monthly measurements likely do not represent the daily minimum DO concentration.

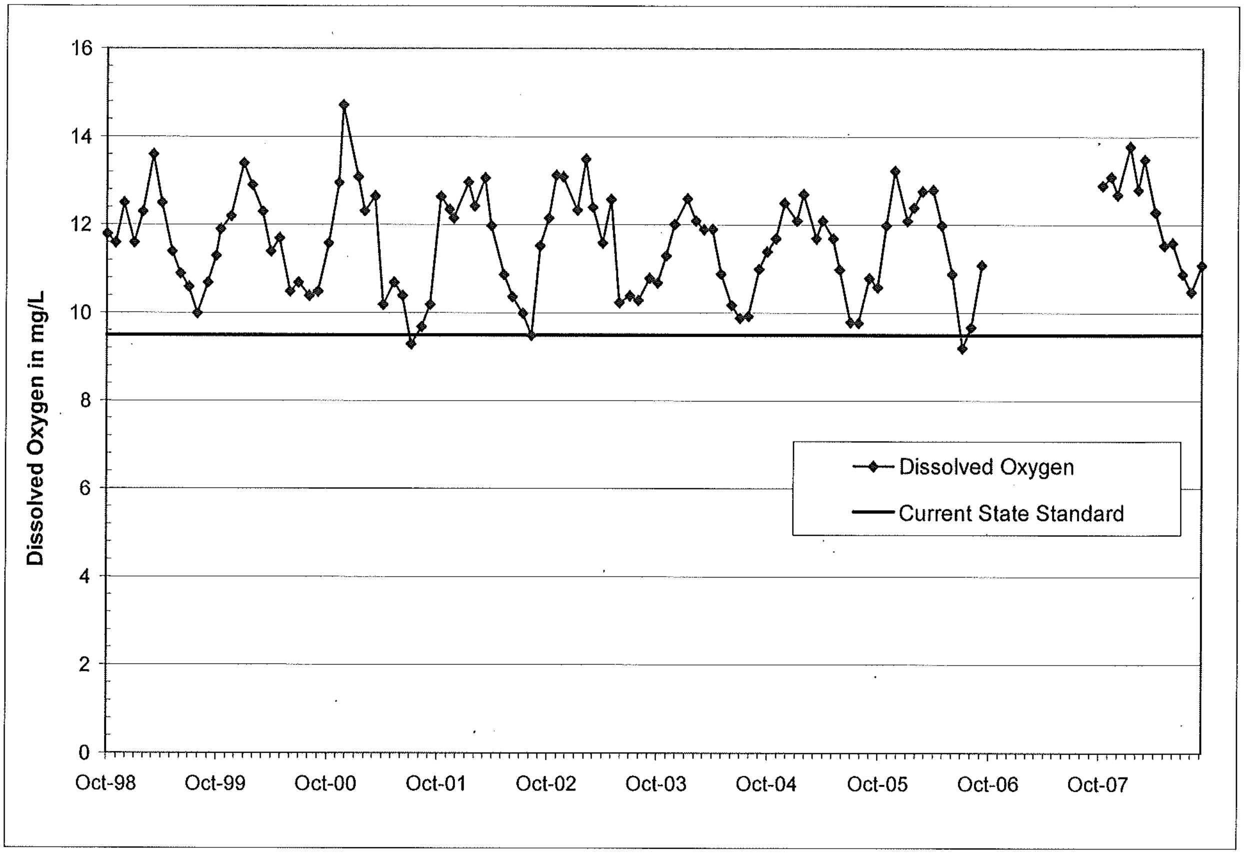

Figure 12 – White River Dissolved Oxygen at RM 8.0 (Station 10C095) in Water Years 1999 to 2006

Methodology. DO in the White River Reservation Reach was evaluated by using DO saturation. DO could not be evaluated directly because insufficient data have been collected under non-hydropower operating conditions to develop a correlation between flow and DO, as was done for flow and temperature by Keta Waters (2006). The ability of water to hold DO is dependent, in part, on the temperature of the water. A regression equation developed by the Committee on Sanitary Engineering Research (1960) relates DO saturation directly to water temperature. This equation was used to calculate the DO saturation for each day that water temperature results were available.

DO saturation values are the expected equilibrium concentration of DO for a given water temperature and salinity. Colder water can hold higher concentrations of DO compared to warm water, and fresh water holds higher amounts relative to marine waters. This approach does not calculate the actual DO concentration in the Reservation Reach, as upstream oxygen demands (such as wastewater treatment plant discharges) and other dissolved constituents in the water could reduce the concentration below saturation. If DO is below the saturation point because of upstream oxygen demands, then there would be no immediate change in DO concentrations if water temperature increases. However, DO concentrations that might otherwise recover by natural re-aeration at a lower temperature would have less opportunity to do so. Similarly, if the DO concentration is saturated or near saturation, temperature changes would not cause an immediate impact to DO, but DO would eventually drop to equilibrate to the new temperature.

Results. The Project would slightly reduce the capacity of the river to carry DO (Table 14) by raising average temperatures in the Reservation Reach. The average reduction in DO saturation at RM 15.5 would be 0.01 mg/L, increasing to a reduction of 0.1 mg/L downstream at RM 4.9. Generally, the DO saturation concentration would be above the state standard of 9.5 mg/L at both locations. However, the Project would cause a 0 to 1% increase in the frequency that the saturation level would be below the standard for DO concentration.

Table 14 – Dissolved Oxygen Saturation in White River Reservation Reach

Scenario	Average Daily Minimum DO Saturation in mg/L		Percent of Time below 9.5 mg/L	
	RM 4.9	RM 15.5	RM 4.9	RM 15.5
Baseline	9.81	10.14	31%	5%
Project	9.71	10.13	32%	5%

The range of predicted impacts on DO saturation is shown in Table 15. The Project could cause a decrease of up to 0.22 mg/L on some days, but more typically would leave DO unchanged, and on a few days, DO may be slightly higher.

Table 15 – Magnitude of Predicted Changes in DO Saturation in White River Reservation Reach

Change in Dissolved Oxygen Saturation in mg/L					
RM 4.9			RM 15.5		
Minimum	Average	Maximum	Minimum	Average	Maximum
-0.22	-0.02	0.04	-0.17	-0.01	0.03

<u>White River Reservation Reach pH</u>

Existing Conditions. The Reservation Reach of the White River has occasionally experienced pH levels above the state standard of 8.5. This reach is included in Ecology's Water Quality Assessment Report for 2008 as impaired for pH. Elevated pH occurred more frequently during hydropower generation, when there was less water in the Reservation Reach (Figure 13). Since June 2003, monthly grab samples for pH at RM 8 have been within the allowable range.

Elevated pH primarily occurs as a result of phosphorus-rich municipal wastewater discharges from the towns of Enumclaw and Buckley immediately below the diversion and, to a lesser extent, non-point sources. Higher concentrations of phosphorus cause increased growth of algae on the river bottom, and algae consume dissolved carbon dioxide in river water for growth. Reduced levels of dissolved carbon dioxide, an acid in water, cause the pH to rise.

As with temperature, pH in the Reservation Reach is also affected by flow. This occurs because higher flows reduce the concentration of phosphorus in the river through dilution. pH in the Reservation Reach has been lower since 2004 as a result of increased flows in the White River after Puget stopped diverting water for power generation.

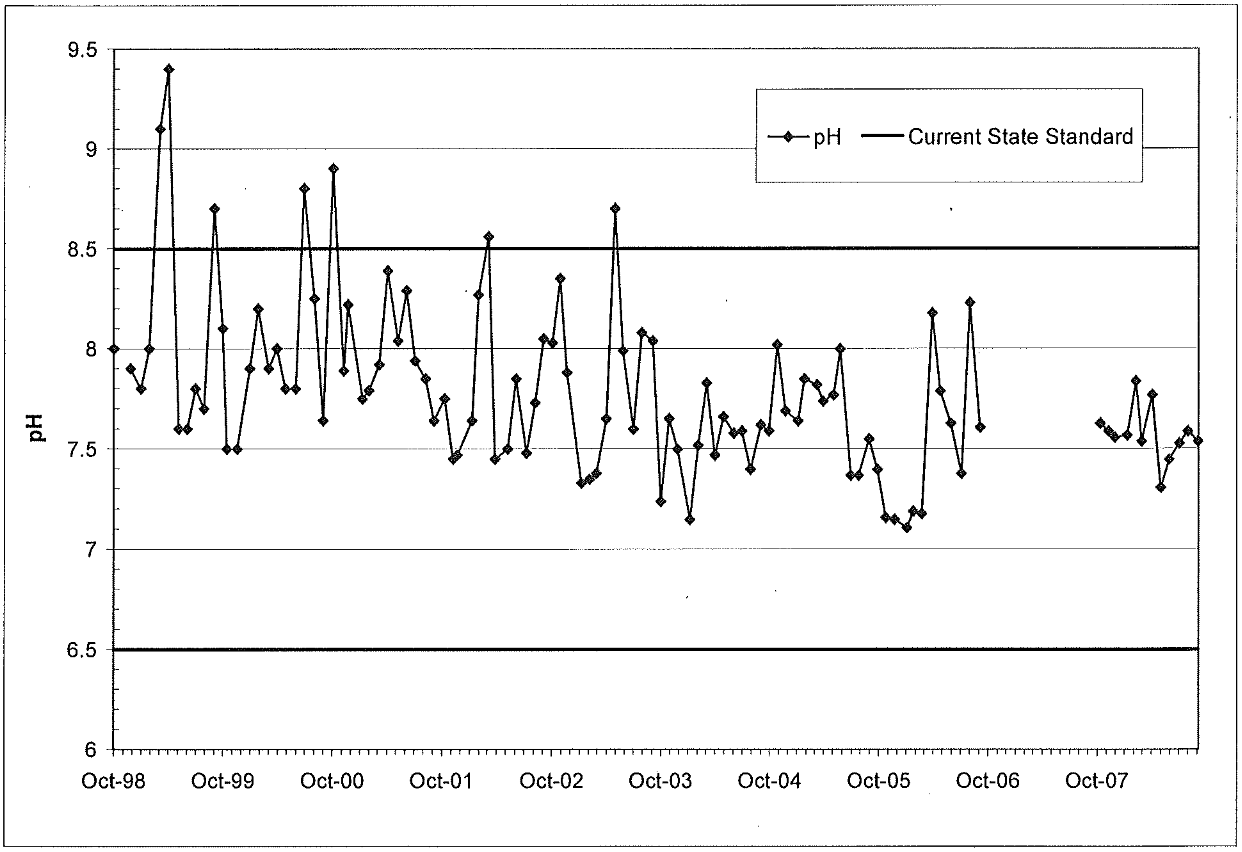

Figure 13 – White River pH at RM 8.0 (Station 10C095) in Water Years 1999 to 2006

Based on earlier pH exceedances, Ecology, USEPA, the Muckleshoot Indian Tribe, and the Puyallup Tribe of Indians are jointly preparing a TMDL study for phosphorus on the White River. A study of pH and nutrients in the Lower White River is currently planned (Ecology 2009a) to provide additional information for the TMDL process in light of the reduction in diversions for hydropower and recent improvements in nutrient-removal capabilities at the Buckley and Enumclaw wastewater treatment plants.

Methodology. pH in the White River Reservation Reach was evaluated qualitatively in the FEIS based on the Model-predicted change in flows, coupled with an understanding of the causes of the historical high pH measurements.

Results. The Project is not expected to adversely affect pH in the Reservation Reach because (1) the Project would not affect phosphorus levels in the River; (2) pH appears to have stabilized since June 2003 at levels within the water quality standards; (3) recent improvements in nutrient-removal capacity at upstream point sources should provide additional control; and (4) the change in flows would typically be small, with the higher minimum flows of the Recommended Flow Regime providing improved protection during the driest periods.

<u>Lake Tapps Reservoir Phosphorus and Nuisance Algae</u>

Existing Conditions. Like most lakes in North America, Lake Tapps stratifies in the summer, resulting in a warmer layer of water on top and a colder layer below. Stratification occurs because warm air and direct sunlight heat the water on the lake surface. As the water on the surface warms, it becomes buoyant, and it tends to float on top of, rather than mix with, the underlying cold water. In the fall, air temperatures drop and the water near the lake surface cools. Fall, winter, and spring winds are then able to keep lake water slowly mixed from top to bottom before the onset of stratification in the late spring.

In stratified lakes, the deeper cold water usually has lower levels of DO than the overlying warmer water. Lower DO occurs at depth because algae that live near the surface eventually die and sink to deeper water where they decompose, consuming oxygen and causing DO to drop. If a lake has an abundant source of light (from the sun – most lakes do) and nutrients in its surface layer, algae growth rates will be high. As a result, higher levels of nutrients and light lead to increased algae, which in turn lead to decreased DO in deep water.

The factor that primarily determines the quality of water in a lake is the quality of its source water – in this case, the White River. Since the White River carries a large sediment load at times, water in Lake Tapps historically has been cloudy, creating a low light condition that is not favorable for algae growth. Phosphorus levels in the lake have probably varied historically with changing phosphorus levels in the river.

The amount of water moving through a lake ("flushing flow") also influences water quality in the lake. If a relatively small amount of water is entering a lake relative to its size, water will remain in the lake for a long time. In the summer, lake water would have time to warm up, and sediment – and sediment-bound pollutants like phosphorus – would have time to settle to the bottom. In contrast, if a relatively large amount of water is moving through a lake, water will remain in the lake for a shorter time, and there would be less time for water to warm up and for sediment to settle out.

In 2004, when Puget stopped diverting water for power generation, it was noted that a change in flow through the lake could affect lake water quality. Some of the changes could make water quality better for recreational and aquatic life, including the following:

- A longer lake residence time could result in warmer water in the upper levels of the lake where most recreational activity occurs.
- A decrease in sediment delivered to the lake could result in clearer water, a more aesthetic condition for recreation.
- A decrease in phosphorus delivered to the lake by the river could result in a decrease of algae, clearer water, and higher levels of DO in the deeper lake waters.

However, some changes could counterbalance the positive effects and make water quality worse, including the following:

- A warmer surface layer could result in lower DO at the surface, as warmer water holds less DO than cold water.
- A decrease in suspended sediment in the lake could increase light at the lake, bringing increased algae and aquatic plant growth.
- Less dilution of any phosphorus that enters the lake from lakeside sources should cause increased algae levels, more turbid water, and lower levels of DO in the deeper lake waters.

Both Ecology and Pierce County sampled Lake Tapps in 2004 and 2005 to characterize water quality. The following conclusions can be drawn from the data:

- Temperatures were higher near the surface of the lake in 2004 relative to earlier years, reflecting increased residence time (Figure 14).

- The lake was clearer than in earlier years as evidenced by the increase in Secchi disc depth (the depth at which a circular disc lowered into the water column is no longer visible from the surface, an indicator of turbidity) from 2 feet in August 1999 to 10 feet in August 2005. This is the combined effect of a decrease in the sediment loading and an increase in residence time.

- Algal levels in the lake were low. Average chlorophyll-A was 3.0 micrograms per liter ("µg/L"), below USEPA's reference condition of 3.5 µg/L (Ecology 2006b).

- Algal levels in the lake were low because phosphorus levels were low. Total phosphorus concentrations near the surface averaged 5 µg/L, indicating oligotrophic (low nutrient) conditions, and well below the state's action level of 20 µg/L (Ecology 2006b).

- Water diverted from the White River had higher phosphorus concentrations than observed in Lake Tapps. Phosphorus concentrations were correlated with turbidity, but not with the diversion flow. A significant portion of the phosphorus load was removed by the settling basins in the diversion canal.

In summary, lake water quality was good in 2004 and 2005, and may have improved following the significant decrease in diversions with the cessation of hydropower generation.

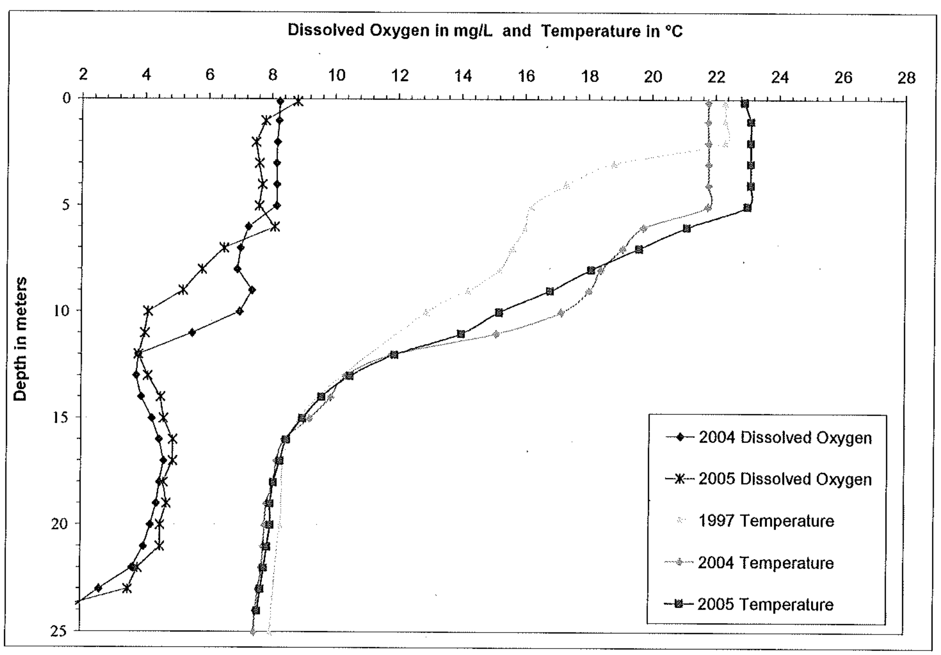

Figure 14 – Lake Tapps Temperature and Dissolved Oxygen Profiles in August (Ecology 2006b)

Methodology. The effect of the Project on water quality in Lake Tapps was evaluated quantitatively by calculating the change in flushing rate (Aspect 2010), and qualitatively in the FEIS by examining recent monitoring results under similar operations (low inflows, low releases) as would occur with the Project.

Results. The primary water quality concern in Lake Tapps is maintaining the relatively good water quality experienced in recent years. A key component in maintaining water quality would be ongoing management for aquatic plants (milfoil) and spill prevention from recreational vessels – neither of these factors would be affected by the Project. However, the Project would change the amount of inflow into the lake, which plays a role in limiting algal growth in the lake. As mentioned above, algal growth is affected by flushing rate, light penetration, and nutrient loading (particularly phosphorus). Of these factors, only the flushing rate and nutrient loading would be expected to change with the Project.

Generally, the phosphorus concentration in the White River is higher than the concentration in Lake Tapps, so by increasing diversions from the White River, the Project would increase the phosphorus load. Flushing rate would also increase. These changes affect the potential for algal growth in opposite ways. The increase in flushing rate would act to limit algal growth, while the increased phosphorus load could support increased growth.

The Project would increase flushing by 50%, but not to a level sufficient to control algal growth by itself. Under the Baseline, the lake would have a flushing rate of about 1.4 per year (or 0.4% per day), meaning that the average volume of Lake Tapps would turn over a little more than once in a year. The Project would increase lake flushing to around 2.1 per year (or 0.6% per day). Where the phosphorus concentrations in flushing water are similar to those in the lake, flushing controls algal growth by physically removing algae from the lake fast enough that population levels do not have time to increase to a nuisance level. This typically requires flushing rates of 10 to 15% per day (Cooke et al. 1993).

The phosphorus load with the Project, while higher than the Baseline, would still be lower than loading during the hydropower period and first 2 years of the post-hydropower period (2004 and 2005). During these periods, the lake had good water quality (Ecology 2006b) and there were no nuisance algal blooms or other nutrient-related water quality problems.

It is unlikely that the Project would have a detrimental effect on water quality in Lake Tapps as the increase in phosphorus loading is within the historical range.

<u>Lower White River Temperature</u>

Existing Conditions. Temperature in the Lower White River can exceed state standards in summer. Continuous monitoring conducted in 2001, 2004, and 2006 (Ecology 2008) indicated that the 7-DADMax temperature in the Lower White River generally exceeds the state standard of 17.5 °C through mid-August (Figure 15). In all 3 years, the 7-DADMax temperatures were typically near the standard until early September, then fell off to 13-15 °C. These data were collected both with (2001) and without (2004 and 2006) high diversions for hydropower generation. Temperatures in the Lower White River were similar in all 3 years. Additional flow in the Reservation Reach in 2004 probably had a beneficial effect on temperature in the lower river. Without the higher flows, water temperatures in both reaches likely would have been higher given the very warm summer air temperatures in 2004.

Methodology. Water temperature in the Lower White River is potentially affected by change in flow rates and water temperature in the Reservation Reach and in tailrace releases from Lake Tapps. These effects were evaluated using a mixing equation with Model-predicted flows for the Reservation Reach and tailrace releases, temperature predictions for the Reservation Reach using the Keta Waters (2006) regression, and limited temperature monitoring data for the Reservation Reach and Lake Tapps.

The temperature assumptions for the Reservation Reach and tailrace for most of the year are based on limited data. The Reservation Reach temperatures are from periodic spot measurements from various studies at RM 4.9 between 1998 and 2006 that provide 8 to 9 data points per month. Tailrace temperatures are based on continuous monitoring in the summers of 2004, 2005, 2007, and 2009 by the Puyallup Tribe of Indians and single measurements in each month in 2004 (Ecology 2006c). This data indicates that releases from Lake Tapps are generally slightly warmer than the river in fall and winter months, and cooler in summer. The methodology for predicting temperatures in the Lower White River presumes that the Project would not affect the temperature of tailrace releases from the lake.

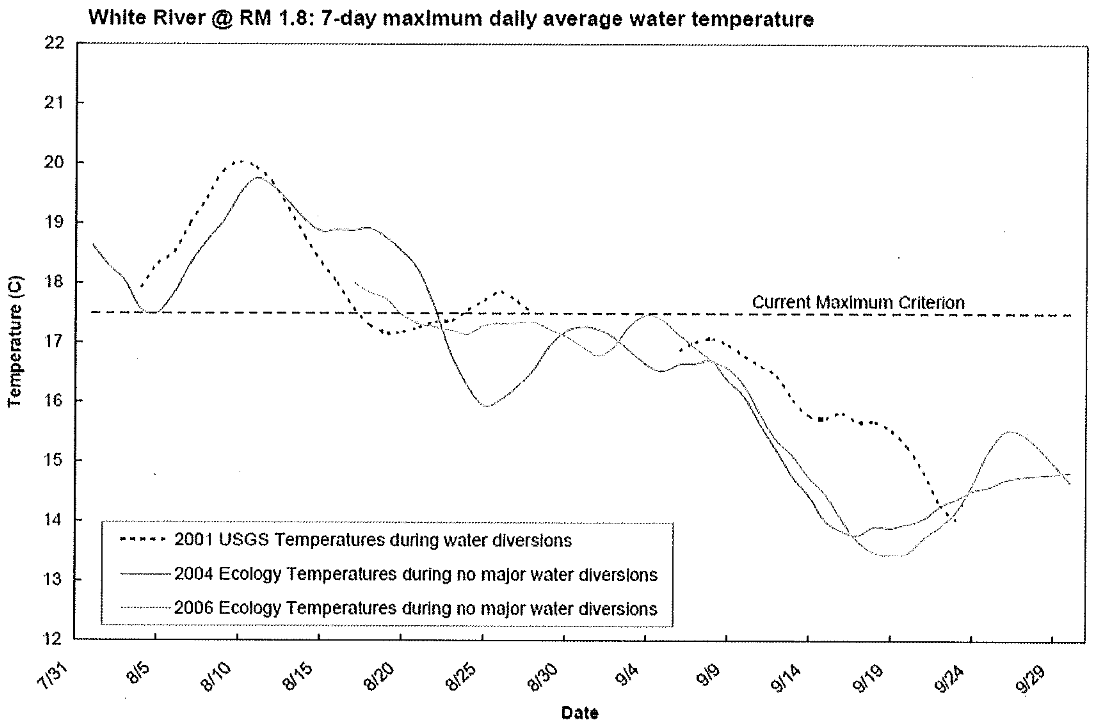

Figure 15 – 7-DADMax Temperatures in the White River at RM 1.8 (Ecology 2008)

Results. The results indicate that the Project would cause both increases and decreases in temperature in the Lower White River (Figure 16) depending on the time of year. Over the full 15-year period of record, the Project would lower temperatures 29% of the time, leave them unchanged 36% of the time, and raise them 35% of the time. It would lower temperatures by more than 1 °C on a few occasions, and raise temperatures by up to 1 °C on a few others.

The average change in Lower White River temperature is shown by month in Figure 17. On average, the Project would raise temperatures most notably in July and August, but also in April, September, and November, and lower temperatures the remainder of the year. The increases in temperatures are primarily caused by two factors: (1) higher temperatures in the Reservation Reach caused by increased diversions from the White River, and (2) a reduction in releases of cooler water from Lake Tapps during summer caused by stopping leakage. The largest decreases would occur in December, when drawdown would be completed under the Project, but still be occurring under the Baseline scenario. The tailrace discharge is warmer than the river in December, so reducing tailrace releases would reduce river temperature.

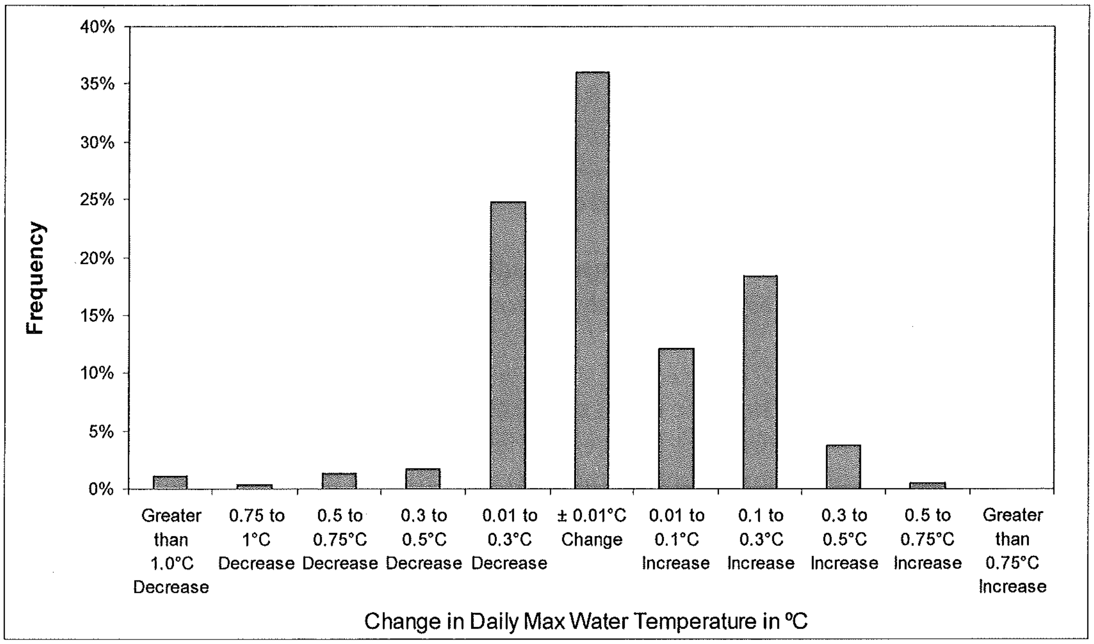

Figure 16 – Change in Daily Max Temperature in the Lower White River

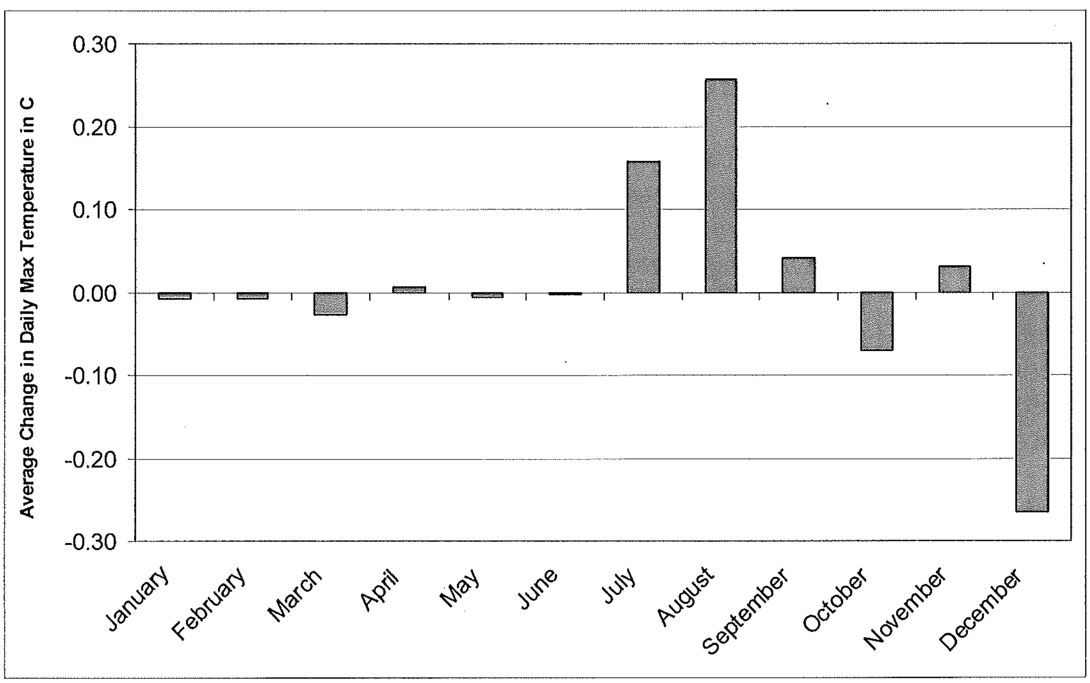

Figure 17 – Monthly Average Change in Lower White River Temperature

About 65% of the time, the Project would decrease or not affect temperatures. Increases in temperature would typically be less than 0.3 °C, but would primarily occur in summer months, when temperature is important. Decreases in temperature would occur in winter, when temperature is less important, but also in October.

Lower White River DO

Monitoring results indicate that DO in the Lower White River is typically between 9 and 11.5 mg/L, and can experience daily fluctuations of up to 2 mg/L. The USGS, the Puyallup Tribe of Indians, and Ecology monitored DO in the White River at RM 1.8 in the summers of 2001 and 2002 (Ebbert 2002 and 2003), and Ecology monitored the same location in the summers of 2004 and 2006 (Ecology 2005 and 2008). During hydropower diversions and releases, DO dipped slightly below the state minimum DO standard of 8.0 mg/L on two occasions in 2001 and once in 2002.

DO in the Lower White River has improved since cessation of hydropower. Ecology concluded that the reduced tailrace releases since 2004 have "likely improved the lowest daily DO levels in the river by at least 1 mg/L" (Ecology 2008).

The Project would likely have little to no effect on DO concentrations in the Lower White River. DO concentrations in the Lower White River are affected by flow and DO concentrations in the Reservation Reach, and flow and DO concentrations in the tailrace. DO saturation in the Reservation Reach is predicted to decrease slightly with the Project, which may have a slight effect on actual DO concentrations. Any effect on the Reservation Reach would be partially counterbalanced by the potential improvement in DO caused by reducing tailrace releases with the Project. DO in Lake Tapps is generally lower than in the White River, so the reduction in tailrace releases caused by the Project would act to slightly improve DO concentrations in the Lower White River. The net effect of these two opposing influences is likely to be small to negligible.

Lower White River pH

Limited pH data are available for the White River below the tailrace. Continuous pH monitoring data was collected from July to October 2001 and indicates a pH range of 6.8 to 7.6.

pH in the Lower White River is affected by upstream conditions in the White River and tailrace releases from Lake Tapps. The Reservation Reach of the White River has had occasional high pH measurements exceeding state standards. pH has generally lowered over time, and has continued to lower since cessation of hydropower (Figure 13).

pH in the Reservation Reach (at RM 4.9) and tailrace was monitored in August and October 2001 by HDR Engineering, Inc. as a component of the preliminary permit analyses (HDR 2002). During that period, pH in the tailrace ranged from 6.66 to 7.89 and on average was 0.6 units lower than in the White River at RM 4.9.

The effect of the Project on pH in the Lower White River would be expected to be small to negligible because the pH in the tailrace and the Reservation Reach (since cessation of hydropower generation) meet water quality standards, and the change in flow in the Lower White River caused by the Project is small at 4.5% percent on average (Table 4).

Lower Puyallup River Temperature

The Puyallup River below the confluence generally meets water quality standards for temperature. As shown in Figure 18, summer water temperatures in 2001 (when Puget was generating hydropower) met standards and were similar to water temperature in 2004 (when Puget was not generating power). Additional data collected in September and October of 2006 at RM 2.9 indicated that temperatures continued to meet state standards, with a range in 7DAD-Max temperatures of 12.8 and 14.5 C (Ecology 2008).

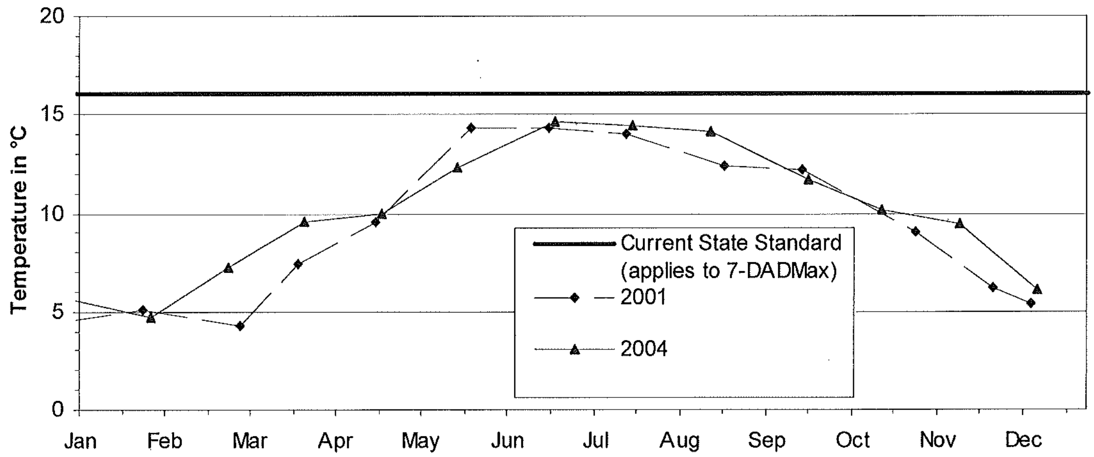

Figure 18 – Puyallup River Temperature at RM 8.3 (Station 10A070) in 2001 and 2004

The Project would have a small to negligible effect on temperature in the Lower Puyallup River because the temperatures in that reach currently meet standards, the reduction in flow caused by the Project would only be 2%, and the effect of the Project on temperature in the Lower White River would be buffered by additional inflow from the upstream Puyallup River.

Lower Puyallup River DO

The Puyallup River below the confluence generally meets water quality standards for DO. DO was measured below the state standard on several occasions in September 2000 in the Lower Puyallup River, prompting follow-up monitoring and a moratorium on TMDL allocations for 5-day biochemical oxygen demand ("BOD5") and ammonia. Low DO conditions were not observed in follow-up monitoring in 2001 or 2002, and the low concentrations in 2000 were suspected to have been caused by sediment buildup on the probe (Ebbert 2002). DO concentrations met standards both in 2001 (when Puget was generating hydropower) and in 2004 (when Puget was not generating power), as shown in Figure 19. Monitoring conducted in 2006 indicated that DO concentrations at RM 2.9 were close to, but always met standards (Ecology 2008).

The Project would have a small to negligible effect on DO in the Lower Puyallup River, as the Lower Puyallup River has generally met DO standards since cessation of hydropower generation, the reduction in flow caused by the Project would only be 2%, and the effect of the Project on DO in the Lower White River is expected to be minor.

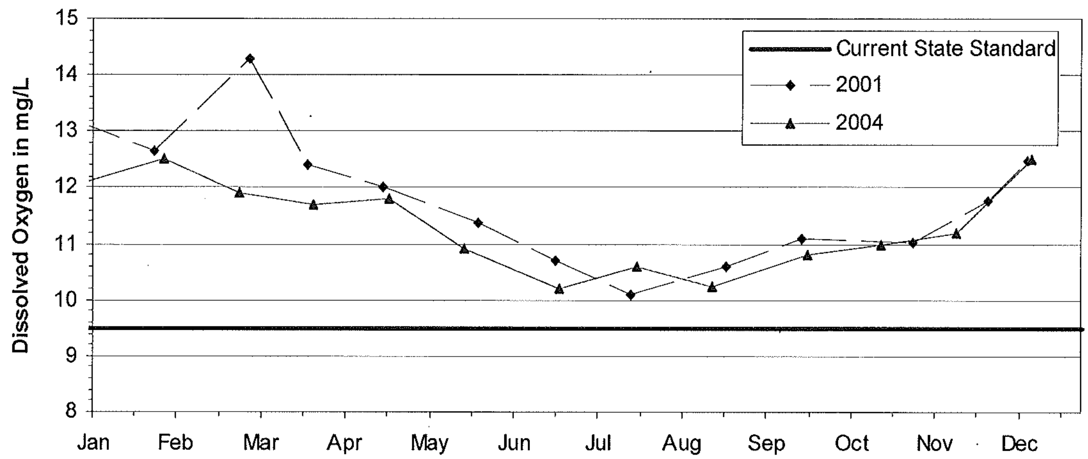

Figure 19 – Puyallup River Dissolved Oxygen at RM 8.3 (Station 10A070) in 2001 and 2004

Lower Puyallup River pH

pH in the Lower Puyallup River generally meets state and tribal standards. The most complete pH data available are monthly measurements from Ecology's Puyallup River at Meridian monitoring location (Station 10A070) at RM 8.3. Since January 2004, 55 monthly pH measurements at that station have ranged from 7.21 to 7.84.

The Project would have a small to negligible effect on pH in the Lower Puyallup River as the Lower Puyallup River generally meets pH standards, the reduction in flow caused by the Project would only be 2%, and the effect of the Project on DO in the Lower White River is expected to be minor.

4.5 Fisheries

The following investigation is based on the descriptions of the effects of the Project on the hydrology and water quality of the White River and Puyallup River systems and Lake Tapps Reservoir described in the previous sections of this ROE. Additionally, the section is based on detailed analysis in the FEIS, which examined the Project's potential impacts on fisheries. Specifically, the FEIS investigated the impacts on the water bodies downstream of the diversion dam that may receive more or less water (or water at a different time) as a result of the Project, including the Reservation Reach of the White River, Lake Tapps Reservoir, the Lower White River, the Lower Puyallup River, as well as the lands around them.

4.5.1 Existing Conditions

Chapter 9 of the FEIS describes in detail the existing conditions, including the man-made alterations of physical habitat (dams, levees, and fish ladders), the existing river conditions, and status of fish species within the area.

With respect to man-made alterations of physical habitat, there are two dams in the project vicinity that affect fisheries resources, as well as levees and fish passage structures:

- Diversion dam.
  The diversion dam's condition and design have detrimental effects to fish in multiple ways, from direct injury and mortality to hindering the function of the fish trap at the dam. The diversion dam is a barrier to upstream fish passage except during high water events, and USACE maintains a fish trap at the diversion dam to capture migrating salmon and transport them upstream of

MMD. Flows spill over and through the dam creating multiple attraction points potentially causing mortality or injury on the damaged wooded apron, or delay in migration. Additionally, some migrating salmon can swim upstream during high water events without encountering the fish trap, with no other way past MMD to upstream habitat. The diversion dam also has no features to ensure or aid transport of large woody debris ("LWD") into the Reservation Reach. The USACE has been working on replacing the diversion dam and making other fish passage improvements, with construction scheduled to begin in 2013

- Mud Mountain Dam.
  MMD is a flood control reservoir built by USACE in 1948 on RM 29.5 of the White River. MMD impounds about 4 miles of the White River, from RM 35 to RM 31 just above the confluence with the Clearwater River. MMD provides flood protection for land along the White River and along the Lower Puyallup River downstream of its confluence with the White River. The reservoir is empty most of the time; however, during periods of high precipitation, the reservoir is temporarily filled to reduce the river flow. MMD is an impassible barrier to upstream fish passage. In 1995, USACE made a series of fish passage improvements at MMD for downstream passage of fish.

- Levees.
  Existing levees also affect fisheries resources. Levees have been constructed in the area to provide flood protection and control channel migration and bank erosion. Levee construction and channel modifications for flood control have resulted in straighter rivers with decreased river lengths and widths and, in places, have isolated the river channels from the floodplains. Construction of flood control and bank erosion prevention structures and associated channel modifications has removed some of the natural sinuosity of the rivers and restricted the spawning and rearing habitats once present in riverine ponds and side channels.

- Fish Passage Structures.
  Finally, the existing built environment includes fish ladder, trap, and transport structures that impact fisheries. With respect to downstream migration, a "vee screen" allows water to flow through the legs of the vee into the diversion canal leading to Lake Tapps Reservoir while channeling fish to the bottom of the vee and into a bypass that returns the fish to the White River. With respect to upstream migration, USACE constructed a fish ladder and trap at the diversion dam in 1948 for upstream-migrating fish (the Buckley Fish Trap). When anadromous salmonids return upstream to the upper White River to spawn, they are captured in the fish trap at the top of the fish ladder in the diversion dam, and are then transported via a tanker truck and released in the upper White River upstream of MMD at RM 33.6. During the salmonid spawning run (late May to early October), USACE operates the trap 1 to 5 days per week or as necessary. The trap is checked for fish presence, then the trap is hoisted onto a tanker truck and the fish are released from the trap to the truck. In 2009, a record number of pink salmon returned to the White River, challenging the capacity of the trap and haul operation.

The FEIS also examines the conditions of Lake Tapps Reservoir and the various watercourses affected by the proposal:

- **Reservation Reach (RM 24.3 to RM 3.6).** The White River Reservation Reach acts as a fish migration corridor and also provides spawning and rearing habitat for seven species of salmonids including spring and fall Chinook, coho, chum, and pink salmon, and steelhead, cutthroat, and bull trout. The Reservation Reach below the diversion dam is a meandering river with many gravel bars and side channels in some areas. The upper section of the Reservation Reach (RM 24.3 to RM 20.9) is characterized by a moderate to steep gradient and streambed substrate consisting of gravel and cobbles with boulder-sized riprap or deposits of sand along the edges. The riparian corridor is well developed in the Upper Section, and overhanging vegetation provides adequate protection for fish from predation. The middle section (RM 20.9 to RM 9.1) is not as steep as the Upper Section and consists of a broad, complex, braided channel with many significant side channels and a substrate composed of gravel/cobbles with abundant spawning gravel. LWD is present and forms large logjams. The lower section (RM 9.1 to RM 3.6), through Auburn, is gravel/cobble-dominated, contains sparse LWD, is confined by levees, and is a low-gradient system with a decrease in spawning gravel and spawning activity compared with the Upper Section.

- **Lower White River (RM 3.6 to RM 0.0).** The Lower White River below the confluence with the tailrace at RM 3.6 to its confluence with the Lower Puyallup River is channelized and straightened with levees on both banks. The substrate in this section consists largely of embedded cobble and gravel substrates, with sand deposits where low-velocity conditions are present along the river edges. The river gradient in this straightened section is much lower than in the Upper Section. Overhanging vegetation is sparse, but vegetation grows along both levees on either side of the river in this area.

- **Lower Puyallup River.** The main stem Lower Puyallup River below the confluence with the White River is extensively channelized and mostly contained within a series of flood protection dikes, revetments, and levees along both banks. Most LWD has been removed as part of ongoing channel maintenance activities. These flood control measures have eliminated connections with side- and off-channel aquatic habitats and decreased riparian vegetation. The Lower Puyallup River has a low channel gradient, with deposits of sand covering much of the river bottom, and is tidally influenced near the estuary. Levees isolate the Lower Puyallup River from local sources of gravel. Channelization of the river causes high water velocity during peak flow events. These factors result in a river reach with a limited amount of stable spawning gravel. As a result, survival is believed to be low for any spawning that occurs. Channelization and levees have also reduced riverine processes that form pools, side channels, and other habitat features and refugia needed by salmonids, thereby decreasing the suitability of this area for all salmonids. Since the amounts of rearing, holding, and spawning habitats are limited, salmon primarily use the Lower Puyallup River as a transportation corridor.

- **Lake Tapps Reservoir.** Lake Tapps Reservoir stratifies in the summer with a warm layer on top and a cold layer on the bottom. The bottom cold layer has a higher DO content than the upper warm layer. Productivity (i.e., the ability to produce food in the water body) is low due to the turbidity caused by the glacial origins of diverted White River water. Aquatic plants are limited by this turbidity as well as by annual lake drawdown.

  Lake Tapps Reservoir is managed as a warm water fishery by WDFW, and has been historically stocked by this agency. The reservoir is heavily used for recreational purposes, including fishing, when the water surface elevation is at Normal Full Pool. A resident fisheries enhancement plan developed by WDFW and Puget in 1990 included a salmonid stocking program, warm water fish habitat improvements, and a monitoring and evaluation program to assess the success of the two enhancement programs. However, these enhancement programs have not been implemented. WDFW is stocking tiger muskellunge in Lake Tapps Reservoir. The stocked fishery in Lake Tapps Reservoir is considered part of the affected environment and is discussed in the

FEIS; however, the primary focus of the fisheries resources analysis is on the fish species native to the White River and Puyallup River.

The FEIS noted that the flow rate in the Reservation Reach has generally increased due to the decrease in White River diversions since 2004. The average annual flow rate at the upstream end of the Reservation Reach (measured at the Buckley gage) was 554 cfs during the hydropower period[12]. During the hydropower period, flow exceeded 1,000 cfs only about 15% of the time. Since hydropower power generation ceased in early 2004, the average annual flow at the same location was 1,313 cfs. Average monthly flow has also increased in every month of the year.

As described in more detail in the FEIS, the Puyallup/White River system supports several species of fish. The analysis in the FEIS focuses primarily on salmonid fish species in the White River and Puyallup River. The non-salmonid fish species that occur in the White River and Puyallup River are not listed as threatened or endangered under the Endangered Species Act ("ESA").

Non-salmonids. Non-salmonid species in the Puyallup River Basin include Pacific lamprey and river lamprey. Other native freshwater species that may be present in the Puyallup River Basin include dace, peamouth, three-spine stickleback, largescale sucker, and up to seven species of freshwater sculpin.

Salmonids. The mix of salmonid species and life stages present in the White River and Puyallup River varies spatially and temporally. The mix of salmonid species includes Chinook salmon, steelhead trout, bull trout, coho salmon, pink salmon, chum salmon, sockeye salmon, cutthroat trout, and mountain whitefish.

- As noted in the FEIS, three Chinook stocks are present in the Puyallup River Basin: White River spring Chinook, White River fall Chinook, and Puyallup River fall Chinook. The White River is the only river in the Puget Sound area to support a run of spring Chinook. The White River spring Chinook salmon hatchery stock is listed as a threatened species under the ESA. This stock is considered essential to recovery of the natural stocks in the Puyallup River Basin. White River spring and White River fall and Puyallup River fall run Chinook salmon in the Puyallup River Basin are also listed as threatened under the ESA. Puget Sound Chinook are listed as a State Candidate Species by WDFW.

- Additionally, rainbow trout and steelhead trout (*Oncorhynchus mykiss*), the anadromous form of rainbow trout, are present throughout the Puyallup River Basin. Offspring from both steelhead and rainbow trout can either become anadromous or remain in fresh water. Both winter and summer runs of steelhead trout use the Puyallup River system, but most steelhead in the Puyallup River Basin are winter-run. Three winter steelhead stocks – those in the main stem Puyallup River, White River, and Carbon River – have been identified in the Puyallup River system. These wild native stocks are treated separately due to geographical spawning isolation. It is suspected that summer steelhead in the White River are fish straying from the Green River or Skagit River systems. However, because both winter and summer steelhead are known to use the White River system, it is presumed that there are steelhead in the system throughout the year. Naturally spawned anadromous winter-run and summer-run steelhead populations in the Puyallup River Basin are listed as threatened species under the ESA.

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[12] For the purposes of this analysis, the hydropower period is defined as 1990 through 2003. The post-hydropower period is defined as February 2004 through September 2008.

- Bull trout (*Salvelinus confluentus*) are present in the Puyallup River Basin and have both non-migratory freshwater and anadromous forms in the White River. The Puyallup Tribe of Indians has studied bull trout movement and spawning within the White River (PTI 2007), documenting spawning at multiple locations in the upper White River watershed. Bull trout in the Puyallup River Basin are listed as a threatened species under the ESA. Puget Sound bull trout are listed as a state candidate species by WDFW.

- Two coho stocks (*Oncorhynchus kisutch*) are present in the Puyallup River Basin based on distinctly separate spawning distributions. The two stocks, as defined by WDFW, are the Puyallup River and White River stocks.

- Puyallup River pink salmon use the White River, Carbon River, and Puyallup River for spawning, incubation, and migration in odd-numbered years. Nearly all known historical pink salmon spawning in the Puyallup River system has occurred in a few clear water tributaries such as South Prairie Creek, Kapowsin Creek, Fennel Creek, and Boise Creek. Pink salmon spawning has been observed in the main stem Puyallup River, Lower Carbon River, and White River. During recent years pink salmon escapement has been high and increased spawning activity has been documented in the upper main stem and west fork of the White River. Biologists for the Puyallup Tribe of Indians have indicated that the Puyallup River has not seen this utilization explosion and noted that most of these returning fish have been spawning in the White River system.

- Chum salmon are present throughout the Puyallup Basin, with spawners observed as far upstream as RM 23.5 (Boise Creek) on the White River and near RM 29.5 (Fox Creek) on the Puyallup River. The Puyallup Tribe has been rearing chum salmon in the Diru Creek Hatchery facility since 1979, and the Tribe currently rears and releases between 1.5 and 2.7 million chum. The Diru Creek Hatchery is located on a tributary to Clarks Creek on the Puyallup River. The Puyallup Tribal Fisheries Department has been operating a juvenile fish trap on the Puyallup River (at RM 10.6) since 2001. At this trap, outmigrating juvenile chum are detected from early March, with peak outmigration occurring in the first week of May.

- Sockeye salmon are found in the White River system in relatively small numbers. Escapement above MMD ranged between 5 and 378 adult migrants (averaging only 43 individuals) between 1983 and 2007. The relatively small numbers are typical of populations of sockeye found in river systems that do not have lakes.

- A coastal cutthroat trout population is present in the Puyallup River system. However, little is known about its population status. Juvenile coastal cutthroat rearing habits are similar to those of coho and steelhead, residing in fresh water for at least a year. However, coastal cutthroat may spend their entire marine life cycle within estuarine habitats.

Fish Species in Lake Tapps Reservoir. Finally, there are several species of fish in Lake Tapps Reservoir. As catalogued in the FEIS, a total of 12 fish species were captured during a WDFW fisheries survey of Lake Tapps reservoir during fall 1997, including, in order of numerical dominance: largescale sucker (*Catostomus macrocheilus*), kokanee (*O.nerka*), yellow perch (*Perca flavescens*), redside shiner (*Richardsonius balteatus*), rock bass (*Ambloplites rupestris*), black crappie (*Pomoxis nigromaculatus*), common carp (*Cyprinus carpio*), mountain whitefish (*Prosopium williamsoni*), sculpin (Cottus sp.), smallmouth bass (*Micropterus dolomieu*), bluegill (*Lepomis macrochirus*), and cutthroat trout (*O.clarki*).

Based on biomass (total fish mass weight per unit volume), largescale suckers and common carp were the two dominant species.

Lake Tapps Reservoir is also well known in the area for its tiger muskellunge (*Esox masquinongy x E. lucius or E. lucius x E. masquinongy*) and largemouth bass fishery. Tiger muskellunge, a hybrid of the musky and the northern pike, have been stocked in Lake Tapps Reservoir following the suggestion made in the 1997 survey in an attempt to improve the density and growth of warm water fish species through predation of the largescale suckers and common carp.

The FEIS also examined fisheries monitoring data to identify the individual species' use of the watercourses. In sum, Chinook, coho, steelhead, and pink salmon use the section of the Reservation Reach from the diversion dam downstream to approximately RM 11. Chum salmon have been observed, but the majority of chum salmon usually spawn below RM 15. Spawning survey information from the Puyallup Tribe indicates that a greater number of Chinook salmon spawn in the upper half of the Reservation Reach than in the lower half. A 1-mile-long side channel at RM 14.5 supports Chinook, coho, and pink salmon as well as the highest concentration of chum salmon spawners in the White River. Aerial surveys by the Puyallup Tribe have documented Chinook and steelhead spawning in another side channel located on the left bank near RM 12. Preliminary observations by Puyallup Tribe fisheries biologists indicate that the Reservation Reach and associated side channels are used by different life stages of Chinook, coho, steelhead, chum, and pink salmon. The FEIS presents more detailed fisheries monitoring data by species.

4.5.2 Evaluation Methodology

The FEIS evaluated the Project's impacts on fish by using past analyses. First, the FEIS investigated Instream Flow Incremental Methodology ("IFIM") studies that identified minimum flows on the White and Puyallup rivers that were protective of the fisheries. The FEIS reviewed various IFIM studies conducted by Puget and USGS, as well as the conclusions that USGS, NOAA Fisheries, and Ecology reached based on those IFIM studies.

Additionally, wetted areas were calculated for each reach by Aspect Consulting, LLC (2010), using Model-simulated flows and relationships between flow and wetted area developed by Herrera Environmental Consultants for the Reservation Reach and by R2 Resource Consultants for the Lower Puyallup River and Lower White River. As described in the FEIS, Herrera Environmental Consultants (2006, 2007) developed relationships between flow and wetted area for four distinct segments of the Reservation Reach: the Upper, Middle, and Lower Sections, as well as an additional Focused Study Area located in the Middle Section. These relationships were developed from field surveys and hydraulic analysis using the HEC GeoRAS model. These relationships account for wetted area in the side channel and mainstem. These relationships were applied along with the daily average flow results from the Model to calculate the wetted area in that reach for each day. Statistical analysis was performed on the resulting time series of wetted area.

4.5.3 Potential Effects of Proposal

The Model-predicted change in wetted area by reach is shown in Table 16. Overall, the Project would cause a 1% decrease in wetted area. The change in wetted area by reach varies from 0.2 to 3.3%, depending on the channel and side channel characteristics of each reach. In general, the more channelized reaches like the Lower White River and Lower Puyallup River would experience smaller changes in wetted area. The Middle Reservation Reach and Focused Study Area would experience the largest changes, but those changes are still relatively small.

Table 16 – Percent Change in Wetted Area in Acres by Reach

Statistic	Scenario	White River Reservation Reach				Lower White	Lower Puyallup	Total
		Upper	Middle	Lower	Focused Study Area			
		RM 20.9 to 24.3	RM 9.1 to 20.9	RM 3.6 to 9.1	RM 12.9 to 14.4	RM 0.0 to 3.5	RM 5.9 to 10.4	
Average Wetted Area in Acres	Baseline	66.5	236.8	143.5	24.1	46.5	112.8	606.1
	Proposed Action	65.9	233.3	142.3	23.3	46.2	112.6	600.3
	Difference	-0.6	-3.5	-1.2	-0.8	-0.3	-0.2	-5.8
Percent Change		-0.9%	-1.4%	-0.8%	-3.3%	-0.6%	-0.2%	-1.0%

These results and additional analyses from the FEIS were combined to evaluate the effect of the Project on fisheries in each affected reach.

White River Reservation Reach

As noted in the FEIS, the most critical period for juvenile salmonid rearing in the Reservation Reach is during the low flow period between August and October. Thus, low flows during that period would have the greatest likelihood of affecting juvenile salmonids. The Project would protect minimum flows in the Reservation Reach through implementation of the Recommended Flow Regime.

The greatest diversions from the White River would occur in the late winter and early spring to refill Lake Tapps. The primary concern during this period would be to ensure that smolt outmigration was not affected. In the White River and Puyallup River, salmonid smolt outmigration occurs primarily from February through August when chum smolts begin outmigrating in February, winter steelhead smolts and bull trout in April, and Chinook smolts in May. The early part of this period encompasses the time of spring runoff when flows are typically high. Increases in river discharge stimulates the movement of salmon and steelhead smolts and adult bull trout, and higher typical flows during May and June would probably benefit juvenile salmonid and adult bull trout outmigration. From a functional perspective, the predicted reduction in flow during the spring and early summer would not affect smolt outmigration.

There would be little difference between the Project and the Baseline in the number of acres of wetted area. On average, there would be 5.3 acres less wetted area with the Project (Table 16), a 1.2% reduction. Duration curves for wetted area in each of the four segments of the Reservation Reach are shown in Figure 20. With the exception of the Middle Reservation Reach, the Project and Baseline curves are almost indistinguishable in Figure 20, indicating a small change in wetted area. Habitat in the Middle Reservation Reach is more susceptible to changes in flow because this reach flows through a broader valley segment that contains.more side channels than the other sections. Even so, the difference between the Project and Baseline would be small (as shown in Figure 20), and the Project would not impact the lowest flows.

The amount of refugia available to fish in the side channels would vary slightly for the Project flows compared with the flows under the Baseline, but the amount of area is not biologically significant since the flow patterns are very similar and the changes in the amount of refugia available are seasonally dynamic under a more natural hydrograph (i.e., stream flow over time). It is the natural yearly and seasonal variability in flows that shapes channel morphology, transports sediments, distributes LWD, and establishes connectivity with floodplain and side channel areas.

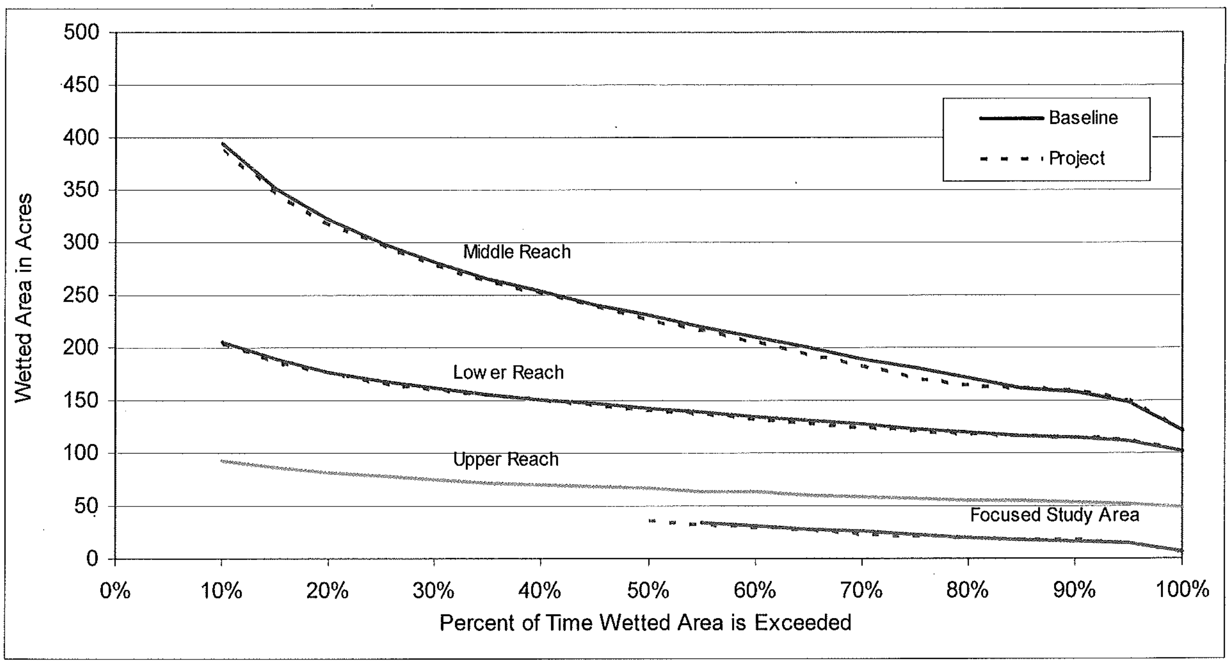

Figure 20 – Change in Wetted Area in the Reservation Reach

Lower White River

On average, the Project would reduce the wetted area in the Lower White River by 0.3 acre, or 0.6%. Side channel habitat is limited in the Lower White River, as it is channelized between levees from RM 8.5 to the confluence with the Puyallup River. The change in wetted area is not expected to impact fisheries resources in the Lower White River.

Lower Puyallup River

The maximum decrease in flow would occur during higher flow periods when the MIF in the river would be fully met and when ample rearing habitat was available for salmonids. This amount of flow reduction at these flow levels causes a very minor reduction in wetted width and useable habitat. On average, the Project would reduce the wetted area in the Lower Puyallup River by 0.2% (Table 16). The Puyallup River is channelized between levees along both banks from the confluence with the White River downstream to Commencement Bay. The FEIS cited a study indicating that spawning and rearing habitat is very limited or unfavorable in this section of the river and this lower section of the Puyallup River is mainly used as a transportation corridor for migrating salmonids.

Lake Tapps Reservoir

Annual drawdown of the reservoir water levels currently occurs in the fall and winter, and would continue if the Project were implemented. The Project would alter current reservoir procedures by filling the reservoir approximately one month earlier in an average water year. Because the change in flood timing would occur during the early spring before most warm water fish have started spawning, effects on warm water fish would not be expected to result from the Project.

For a dry year scenario, early season water levels would be lower than current conditions due to a delayed Refill. This scenario is not predicted to occur during most years, and prolonged ecological impacts would not be anticipated. Due to the minimal change in reservoir surface elevation and residence time, there would be no effect on the resident fish species occupying the reservoir.

There would be little difference in reservoir levels between the Project and the Baseline during an average water year. It is estimated that the average Lake Tapps Reservoir water surface elevation would be 0.4 foot higher under the Project than under the Baseline. The average residence time of water would be more than 2 months shorter under the Project than under the Baseline (176 days versus 253 days). These changes would not be expected to affect fish in the reservoir.

Summary

Overall, the effect of the Project on flows would have small to negligible impacts on the fisheries in the Reservation Reach, Lower White River, and Lower Puyallup River. Implementation of the Recommended Flow Regime would protect flows during the critical low flow period. The Recommended Flow Regime also includes a pattern of minimum flows that better mimics the natural flow regime of the White River than other previous regimes. The Recommended Flow Regime would be well above the IFIM values established by NOAA Fisheries and would be very favorable to salmonid outmigration, rearing, spawning, and migration in the Reservation Reach. The data indicate that the increase in flows in the Reservation Reach since hydropower operations ceased has been beneficial to the recovery of certain fish species in the White River system.

The small changes in wetted area are not expected to impact fisheries resources in the White River and Puyallup River. These minor impacts are mitigated by the implementation of fishery mitigation and enhancement activities as part of the Project under the settlement agreements with the Puyallup Tribe of Indians and the Muckleshoot Indian Tribe (listed in Section 3.3.1).

It is unlikely that minor changes in water surface elevations would affect fish in Lake Tapps Reservoir because the changes would be within the limits of existing seasonal variation.

4.6 Recreation

This section evaluates the Project's potential impacts to recreational opportunities along sections of the White River downstream of the diversion dam, on Lake Tapps Reservoir, and along the Lower Puyallup River.

4.6.1 Existing Conditions

Lake Tapps Reservoir offers many recreational opportunities such as boating, water skiing, fishing, and swimming. Lake Tapps Reservoir is heavily used by motorized and non-motorized watercraft, and facilities along its shoreline (such as parks, docks, water slides, and entertainment gathering areas) provide various forms of water-related outdoor recreation. Lake Tapps Reservoir is also used for fishing for warm water fish species that are not as common elsewhere in Washington's lakes.

Currently, private residences and public and private parks surround most of the reservoir. According the *Lake Tapps Boat Management Plan* (Pierce County 2005), by 1998 over 95% of the platted properties around the reservoir contained a residence. The reservoir's shape is extremely irregular and there are numerous islands, creating approximately 57.5 miles of shoreline. The reservoir bottom is riddled with tree stumps and snags. The east side of the reservoir contains a higher concentration of shallow areas and visible boating hazards. The eastern shoreline is less intensely developed due to the presence of dikes and public roads adjacent to the reservoir edge.

Many waterfront homes and some public and private parks have boat launch facilities and docks. An informal survey conducted in 2003 for preparation of the *Lake Tapps Boat Management Plan* identified 1,620 docks, 180 boat ramps, 2 planes, and a total of 2,604 boats including power boats, non-motorized boats, and personal watercraft (e.g., jet skis).

There are several points of access for the general public. Boat launch facilities located on the north end at the Lake Tapps North Park and on the south end at Allan Yorke Park are available for a fee. Pierce County and the City of Bonney Lake own the public parks, and the Tapps Island Homeowners' Association owns a public golf course. There are also two types of private parks; Puget owns and operates a private park for its employees, and the individual residential communities around the lake typically have private parks maintained by their homeowner's associations.

Along the White River, no designated public boat access points exist along the reach between Buckley and Puyallup. Table 10-1 in the FEIS lists public park facilities near Auburn, Pacific, and Sumner with direct water and/or shoreline access to the White River. Opportunities for recreational fishing are not available along the Reservation Reach of the White River due to the lack of access. Fishing for pink salmon is popular from Auburn downstream to the confluence with the Lower Puyallup River in odd-numbered years when these salmon return to spawn.

The Lower Puyallup River is contained by levees on both shorelines, creating a relatively straight channel as it flows toward Commencement Bay. The City of Puyallup is actively pursuing grants to implement phases of the Riverwalk Trail; however, existing recreational opportunities or points of public access are lacking. Sport fishing in the Puyallup River Basin includes target species such as Chinook, coho, pink, chum, and steelhead.

4.6.2 Evaluation Methodology

The potential impacts to the White River and Lower Puyallup River were estimated based on the average monthly flows for the Project and Baseline for the reaches of these rivers within the study area (see Section 4.2.3). Cascade used this information in the FEIS to assess whether or not recreational opportunities and aesthetics along the White River or Lower Puyallup River would be affected based on the change in flow.

The potential impacts on recreation and aesthetics at Lake Tapps Reservoir were evaluated based on Model results for lake water surface elevation, particularly during the recreation season. For the purpose of evaluating potential project impacts, Cascade conducted topographic and aerial Light Detection and Ranging ("LiDAR") surveys to reveal the elevation and topography of shorelines. The aerial survey data allowed visual inspection of the entire shoreline with detailed contour information at 1-foot intervals.

4.6.3 Potential Effects of Proposal

The FEIS concluded that no direct impacts to recreation or aesthetics on the White River or the Lower Puyallup River are anticipated from the Project. Water flow rates in the White River and Lower Puyallup River would remain within the limits of existing seasonal variations. Water would be diverted from the White River at a rate that maintained the Recommended Flow Regime. Under the Project, flow rates would neither exceed the maximum nor drop below the minimum levels identified for the Baseline.

The potential effects on lake recreation were evaluated by using Model results to tally the number of days that the lake would be drawn below Normal Full Pool during various periods of the April 15 to October 31 recreation season. The periods were selected to coincide with the Cascade's three-tiered commitment to maintain lake levels under the 2009 Community Agreement. The results of this analysis are presented in

Table 17.

Table 17 – Recreation Impacts in WY 1988 to 2002

Scenario	Metric	Apr 15 to Sep 15	Sep 16 to Sep 30	Oct 1 to Oct 31
Baseline	Total Days below Normal Full Pool	0	0	38
	Total % of Days below Normal Full Pool	0%	0%	8%
Project	Commitment to Maintain Normal Full Pool	At All Times	90% of Time	Reasonable Effort
	Total Days below Normal Full Pool	13 (All in April 2001)	12 (11 in 1989)	145
	Total % of Days below Normal Full Pool	0.6%	5%	31%

Under the Baseline, there would be sufficient water to maintain recreational levels from April 15 to September 30 in all years and through the end of October in most years. There would be some years (3 out of 15) when the lake would dip below recreational levels prior to the end of October, resulting in 38 days (or 8% of the time) in the 15-year model period of record when the lake would be below Normal Full Pool.

The addition of the water supply withdrawal would make it more difficult to maintain lake levels, particularly in late September and October. However, Model results show that Cascade would be able to keep its commitment to maintain recreational levels through September 15 almost all of the time, with the one exception being refill occurring 13 days late in 2001. The Project would also meet its commitment to maintain lake levels from September 15 to 30 at least 90% of the time; however, reduction of water supply withdrawals would be necessary to do so. Finally, the Project would provide recreational lake levels approximately 70% of the time in October, meeting its commitment to make a reasonable effort to maintain Normal Full Pool. The worst case year in the model period of record for maintaining recreation for both the Baseline and Project is 1989. Model-predicted and historical lake levels for 1989 are shown in Figure 21.

In 1989, involuntary drawdown of the reservoir would start in early September under both the Baseline and Project, though the rate of drawdown would be greater under the Project. With the Project, the lake level would meet Normal Full Pool from April 15 through September 15; however, it would drop below that level shortly thereafter. The remaining days in September would count toward the 10% of time that impacts to recreation are allowed under the 2009 Community Agreement. If subsequent years had similar drawdown, Cascade would need to reduce water supply withdrawals to meet recreation commitments. Under the Baseline scenario, the lake would be maintained within the Normal Full Pool range until October 1. In both scenarios, recreation would be impacted throughout October.

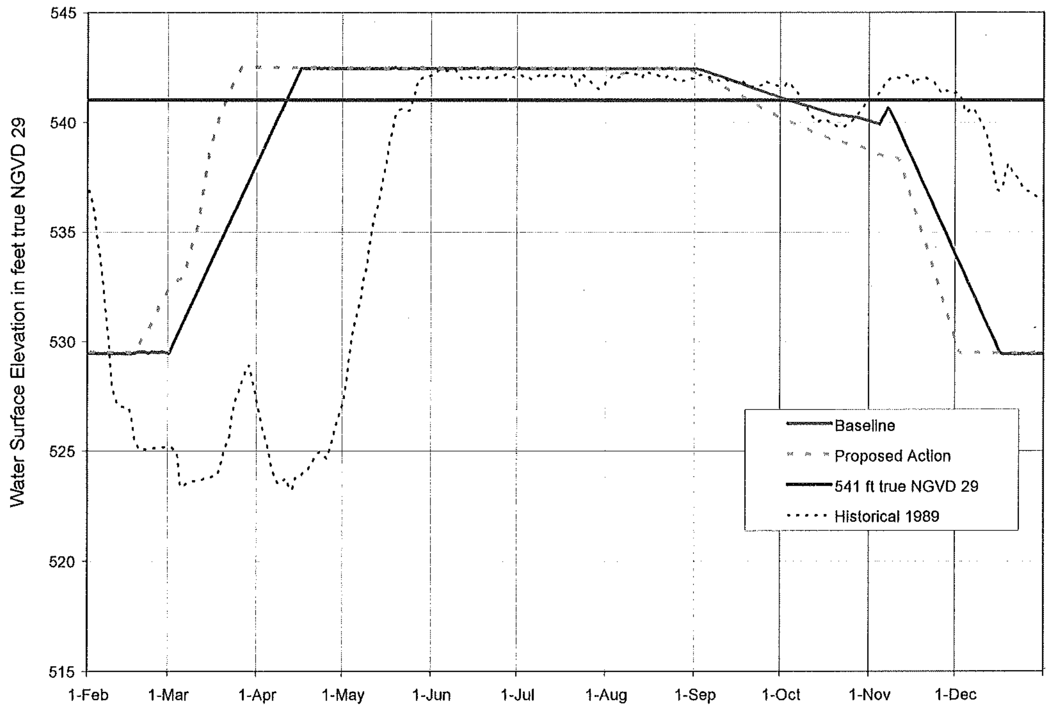

Figure 21 – Modeled Reservoir Elevations in 1989 (worst year in record)

A graphical representation of the days the lake would be below Normal Full Pool during the recreation season is shown in Figure 22. In Figure 22, days when the lake would be below Normal Full Pool (541.0 feet NGVD 29) by less than 0.5 foot are shaded light gray, by 0.5 to 1.0 foot are gray, and by more than 1 foot are black. Dry years are indicated in orange, and drought years are yellow. A diagonal hatch indicates days in 1987 and 2002 that are outside the model period of record. Figure 22 indicates that with the Project the lake would reliably be within the Normal Full Pool range from May to mid-September, the most desirable period for lake recreation. There would be one year (2001) when Refill would be delayed into late April, but in all cases the lake could fill by May 1. The majority of impact to late season recreation would occur in drought years like 1989, 1992, 1994, and 2001.

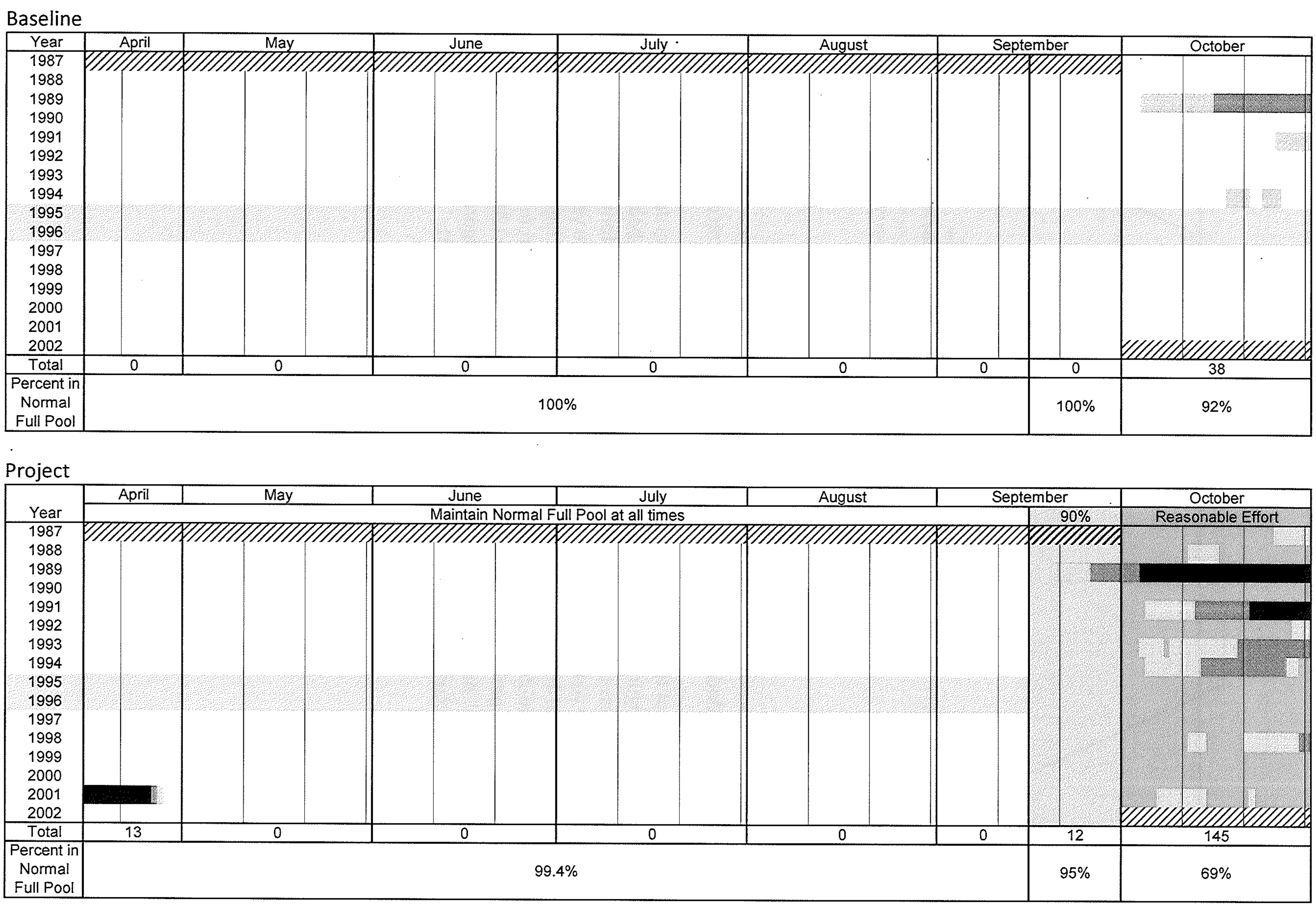

Figure 22 – Days of Recreational Impact under Baseline and Project

4.7 Climate Change

Climate change is the change in the state of the climate over time from both natural causes and human activities. The FEIS evaluated both the potential impact of the Project on climate change as well as the impact of climate change on the Project. As concluded in the FEIS, the Project would not result in additional greenhouse gas emissions above those of the No Action Alternative, and therefore the Project would not affect the global climate. This section (and Chapter 12 of the FEIS) focuses on how climate change could affect the Project.

Climate change has the potential to affect air temperatures and precipitation patterns in the Pacific Northwest in ways that could exacerbate current stresses on water resources (Vano et al 2009). According to the Intergovernmental Panel on Climate Change ("IPCC"), "warming in western mountains [of North America] is projected to cause decreased snowpack, more winter flooding and reduced summer flows, exacerbating competition for over-allocated water resources" (IPCC 2007).

It is relevant to consider the potential effects of climate change in evaluating the availability of water for a new major regional water supply such as the Project. The evaluation of the potential for climate change to impact water resources in the White River and Lake Tapps includes the following components:

- A summary of international consensus on climate change, focusing on conclusions relevant to the Pacific Northwest.
- A summary of local consensus on climate change in the Pacific Northwest and its potential effects on water supplies.
- An examination of the results and limitations of two previous studies estimating the potential impacts of climate change on the White River Basin.
- A description of why climate-impacted flow results from one of those studies could not be used with the Lake Tapps Systems Model to draw quantitative predictions of the effect of climate change on the Project.
- Qualitative predictions and recommendations for the Project based on the analyses mentioned above.

At the international level, the IPCC is the leading international group evaluating climate change. Established by the World Meteorological Organization and by the United Nations Environment Programme, the IPCC aims to "provide the world with a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences" (IPCC n.d.). The IPCC has developed a suite of emissions scenarios that are used in General Circulation Models ("GCMs") by climate scientists to simulate a range of potential future climate conditions.

The IPCC provides Assessment Reports at regular intervals and its Fourth Assessment Report, published in 2007, is the most recent. The IPCC's Fourth Assessment Report, a consensus document that was produced and reviewed by hundreds of scientists, consists of four documents: a Synthesis Report; and working group reports on (a) the physical science, (b) impacts, adaptation, and vulnerability, and (c) mitigation of climate change. The Synthesis Report (IPCC 2007b) included the following conclusions relevant to this Project:

- Warming of the climate system is unequivocal.

- Most of the global average warming over the past 50 years is very likely due to anthropogenic (i.e., those derived from human activities) greenhouse gas increases.

- With current climate change mitigation policies and related sustainable development practices, global greenhouse gas emissions will continue to grow over the next few decades.

- Anthropogenic warming and sea level rise will continue for centuries even if greenhouse gas emissions are reduced sufficiently for greenhouse gas concentrations to stabilize.

- Warming in western mountains of North America is projected to cause decreased snowpack, more winter flooding, and reduced summer flows, exacerbating competition for over-allocated water resources.

In the Puget Sound region, the University of Washington's Climate Impacts Group ("CIG") has been leading the effort to evaluate the potential effects of climate change locally using down-scaled results from global climate models. One component of that effort has been assisting the Climate Change Technical Committee ("CCTC") of the Regional Water Supply Planning Process, a regional planning process involving state agencies, public utilities, water purveyors (including Cascade), tribes, and non-profit organizations. The goal of the planning process is "to develop substantive technical information regarding current and emerging water resource management issues in and around King County" (Regional Water Supply Planning Process n.d.). The CCTC, in a document titled *Climate Change Building Blocks* (CCTC 2006), reached consensus on the following conclusions relevant to this study:

- The global average temperature has increased during the 20th century and is forecasted to increase in the 21st century.

- Warming in the Puget Sound region has increased at a faster rate than the global average and increases in temperature are forecasted to continue.

- Forecasted increases in temperatures associated with climate change will further reduce snowpack and glaciers in the Pacific Northwest mountains.

- Global precipitation is projected to increase, although there is less certainty in predicting changes in precipitation than in temperature.

- Climate change is projected to increase winter flows and decrease summer flows in snowmelt-influenced river systems of the Pacific Northwest.

- Climate change is projected to increase the frequency of drought events in the Pacific Northwest.

From this foundation of understanding, CIG has proceeded to quantify the impact of climate change on water resources using this general approach (Palmer 2007):

1. Use climate model (GCM) results for future climate conditions on a global scale.

2. Re-scale global climate data down to a river basin scale.

3. Downscale climate model data to simulate streamflows under altered climate conditions using hydrologic modeling.

4. Assess the effects of altered stream flows on water resource systems using systems simulation models.

Using this approach, CIG has completed two studies (Ball 2004, Palmer and Polebitski 2009) focused on quantifying the impact of climate change on the White River Basin, including a water supply from Lake Tapps. These studies are not directly applicable because the assumptions about how the water supply would operate are significantly different from the current proposal. However, both studies found that with climate change impacts, sufficient water may not be able available to meet all needs.

Palmer and Polebitski's (2009) results for predicted effect of climate change on monthly average flows in the White River are compared with the proposed minimum flows for the Project in Figure 23. These results are upstream of the diversion dam and thus are not subject to the limitations about differing assumptions in Project operations. The predicted results for climate-impacted flows indicate an increasing shift in the timing of peak streamflows. Currently, average streamflows peak in June as a result of snowmelt. As temperatures increase, less snow will accumulate and snowmelt will occur more rapidly, shifting the peak streamflows to January. The start of the shift away from a snowmelt peak is evident in the 2025 results, and by 2075 there would no longer be a snowmelt peak. Late summer streamflows are predicted to decrease as well, and by 2075 the average streamflow is predicted to be just above the minimum flows.

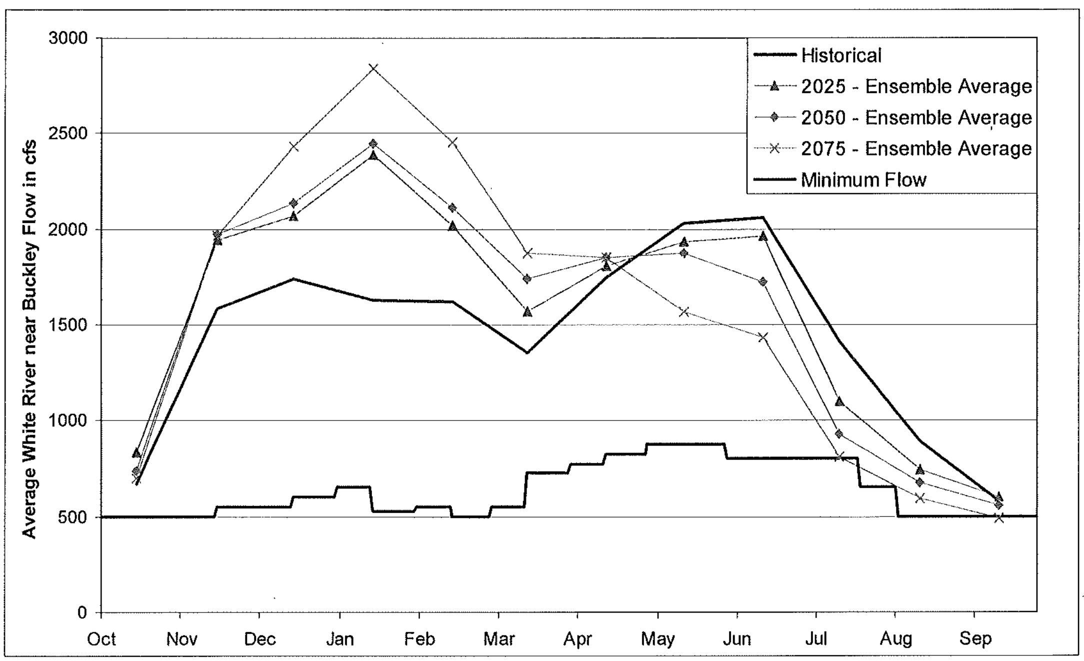

Figure 23 – Predicted Monthly Flows in the White River near Buckley in 2025, 2050, and 2075

On average, these Model results predict a roughly 8% increase in flow in the White River as shown in Table 18. However, most of that increase would come in late fall and winter. Summer flows are predicted to decline over time, decreasing by 17.8% by 2025 and up to 38% by 2075. Spring flows are predicted to increase slightly.

Table 18 – Potential Effects of Climate Change on Seasonal Flows in the White River near Buckley

Scenario	Spring (March to May)	Summer (June to August)	Fall (September to November)	Winter (December to February)	Annual
2025 Average	2.8%	-17.8%	19.7%	31.3%	8.0%
2050 Average	6.1%	-28.1%	16.3%	36.3%	7.0%
2075 Average	3.7%	-38.0%	11.7%	57.1%	8.8%

Aspect Consulting (2010) attempted to use the climate-impacted flows developed by Palmer and Polebitski in the Lake Tapps Systems Model. However, upon careful evaluation of the flow data, a hydrologically unrealistic drop in flow of several hundred cfs was identified on July 1 of most years. Further investigation with the study's authors indicated that the sudden decrease in streamflows was caused by a bias-correction routine. When used in the Lake Tapps Systems Model, these climate-impacted flows erroneously created a water shortage on July 1, resulting in water supply and recreational impacts that affect the remainder of the summer. The magnitude of the error introduced is such that the climate-impacted flows could not be used in the Model and thus Aspect Consulting was not able to make quantitative predictions about the impact of climate change on the Project.

Results from the sensitivity runs indicate that the Project is relatively sensitive to reductions in streamflow in the White River. A year-round reduction of 10% was sufficient to cause the Project to be unable to meet both its recreation and water supply goals. The potential reductions in late summer streamflows with climate change are predicted to be greater than 10%. However, the climate change results predict an overall increase in the average annual flow, particularly during winter. Because the Model is based on a particularly dry period of the historical record, these results may be overstated.

The future is uncertain and future predictions of climate change impact are, at best, imperfect and should be used only as indicators of what might happen, not an exact description of what will happen. Climate models are being used to make predictions decades into the future, then these large-scale results are being down-scaled to the watershed level, then run through a hydrologic model, then used in a systems model. Each of the steps has its limitations and uncertainties.

The weight of scientific evidence, including that developed internationally and locally through consensus processes, suggests that climate change has the potential to place a severe strain on water resources in western Washington. It would be wise for Cascade to incorporate adaptive management measures (such as additional shortage management, supplemental water sources, or use of MMD for summer flow augmentation) into the Project to allow for adaptation to the potential impacts of climate change. Otherwise, it is possible that the Project may not always be able to meet all its recreation and water supply goals. As the lowest priority water use during the critical summer months, water supply would be the first to be impacted.

4.8 Potential Additional Effect of the Regional Reserved Water Program

In connection with future water applications from the Four Cities, the Regional Reserved Water Program would allow for mitigation of impacts to flow in the White River of up to 10 cfs on an instantaneous basis and 5,060 acre feet on an annual basis. The Regional Reserved Water Program would have the potential to affect the flow, water quality, and habitat in the White River Reservation Reach, Lower White River, and the Lower Puyallup River. The evaluation of environmental impacts of the Regional Reserved Water Program is based on the assumption that all of the Regional Reserved Water would be put to use.

Ecology's approach to evaluating effects of the Regional Reserved Water Program on surface water hydrology is to modify the systems model developed for the Lake Tapps Reservoir Water Rights and Supply Project to include a new diversion from the White River equal to the full quantity of Regional Reserved Water (5,060 acre feet per year, 10 cfs instantaneous maximum). The Regional Reserved Water Program was simulated assuming the Project was also operating at the same time. Based on direction from Cascade, the Regional Reserved Water Program was assigned a lower priority then diversions into Lake Tapps. The point of diversion for the Regional Reserved Water was conservatively located immediately downstream of the diversion dam, the most upstream point in the Reservation Reach. It is unlikely that the future Four Cities' applications would require full use of the Regional Reserved Water at a point this far upstream (see Figure 4). The diversion was assumed to have a seasonal pattern with a peak diversion of 10 cfs in July and August and a minimum diversion of 5.7 cfs in winter. This seasonal pattern was based on regional demand pattern information provided by Cascade for their Project.

Operating rules were added to the Model to allow diversion of Regional Reserved Water only when both the minimum flow in the White River and the Puyallup River MIF were met. This modeling approach overestimates the availability of Regional Reserved Water as it does not account for the travel time from the point of diversion to the Puyallup River at Puyallup gage. This is a limitation of the systems modeling approach and daily time step. In order to not affect the Puyallup River MIF, a City would need to cease use of Regional Reserved Water far enough in advance so that there would be no adverse effect on measured flows at the gage, when flows are below the MIF.

The analysis was based on comparison of model runs using two different sets of operating rules: one representing just the Project, and the other representing that Project with addition of the Regional Reserved Water Program. The effects of the Regional Reserved Water Program on flow, water quality and habitat in the affected reaches of the White and Puyallup Rivers were evaluated using the analytical approaches developed for the Project and described above. Results are presented in the following sections.

4.8.1 Surface Water Hydrology

Full use of the Regional Reserved Water Program would reduce flows in the Reservation Reach, Lower White River and Lower Puyallup River by up to 5.5 cfs on average, and up to 10 cfs during peak months. The average reduction is less than 7 cfs because Regional Reserved Water would not always be available.

The change in average flows at various points in the White and Puyallup River system is shown in Table 19. As shown in the Table, full use of the Regional Reserved Water Program would not affect operation of Lake Tapps or Cascade's water supply. The reduction in flow would uniformly affect all downstream reaches.

Table 19 – Change in Flows with the Regional Reserved Water Program

Scenario	Average Flows in cfs (WY 1988-2002)					
	Reservation Reach	Canal Diversion	Tailrace Release	Lake Tapps Water Supply Withdrawal	Lower White	Lower Puyallup
Project	1330	132	40	71	1523	3159
Project + Regional Reserved Water Program	1325	132	40	71	1518	3153
Difference	-5.5	0	0	0	-5.5	-5.5

As mentioned above, there are portions of each year when Regional Reserved Water would not be available for use. This occurs because the use of Regional Reserved Water is subject to the minimum flow for the White River and the Puyallup River MIF, and Regional Reserved Water is a lower priority than diversions into Lake Tapps. Model results assessing the availability of Regional Reserved Water in each of the 15 years simulated are shown in Table 20.

Table 20 – Availability of Regional Reserved Water

Water Year	Average Available in cfs	Days Regional Reserved Water is Not Available	Percent of Time Available
1988	4.48	163	55.5%
1989	5.08	113	69.0%
1990	5.93	79	78.4%
1991	6.55	46	87.4%
1992	3.18	193	47.3%
1993	5.26	118	67.7%
1994	4.52	146	60.0%
1995	5.93	72	80.3%
1996	6.21	56	84.7%
1997	7.00	33	91.0%
1998	5.97	75	79.5%
1999	6.35	66	81.9%
2000	5.91	80	78.1%
2001	3.78	193	47.1%
2002	6.08	71	80.5%
Average	5.48	100	72.6%

Note: Orange shading indicates dry years (1995 and 1996) and yellow indicates drought years (1989, 1992, 1994, and 2001).

Overall, this analysis suggests that Regional Reserved Water would be available about 73 percent of the time, but availability would vary by year from 91 percent in the best year (1997) to 47 percent in the worst (1992 and 2001). Availability would be generally lowest in drought years, but would vary based on the specific hydrologic pattern of each year.

Seasonally, Regional Reserved Water would be most available during peak snowmelt in May and June, and least available in September and October. The pattern of monthly average availability is shown in Figure 24. There would also be a dip in availability in February and March, when larger quantities of water would be diverted into Lake Tapps to refill the Reservoir.

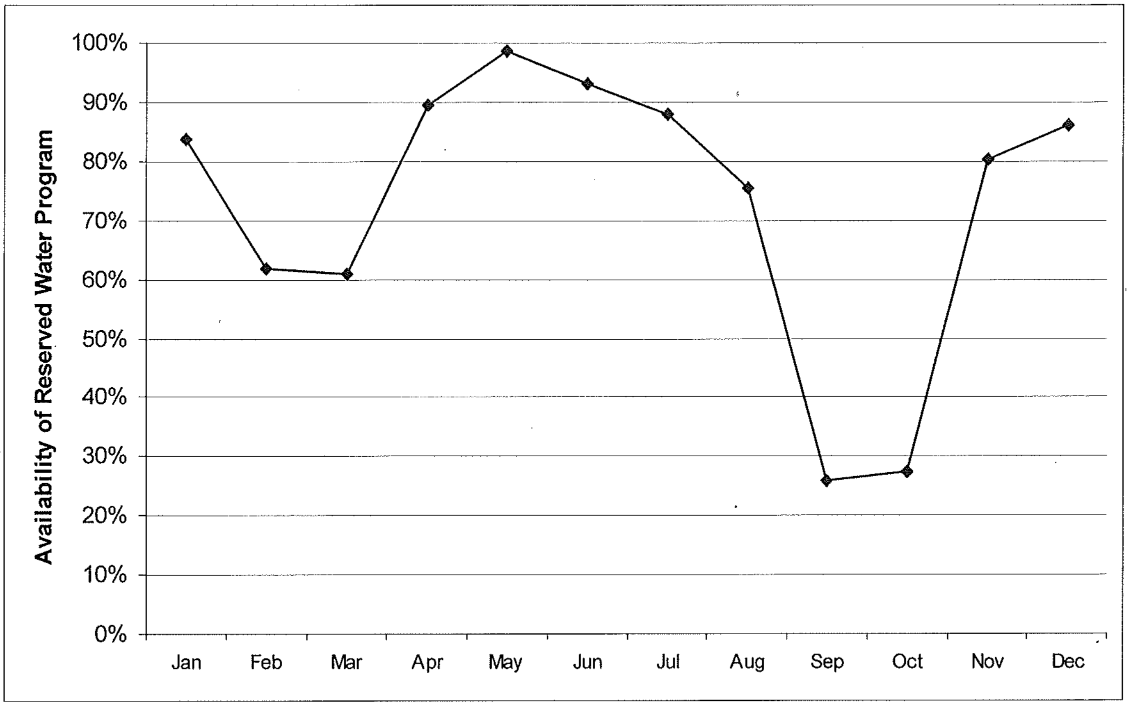

Figure 24 – Monthly Average Availability of Regional Reserved Water.

This analysis was based on simplifying assumptions about how the Regional Reserved Water may be used. Ultimately, the availability of Regional Reserved Water will vary on a case-by-case basis depending on the specifics of the related water right applications and mitigation strategy. The percent of time that Regional Reserved Water would be available would likely be less than indicated once travel time is incorporated in the approach to protect the Puyallup River MIF. However, the annual yield could be more or less than shown in Table 20 (but not to exceed 5,060 acre feet per year) depending on the specifics of the future applications, and in particular on the seasonal pattern for use of the Regional Reserved Water.

4.8.2 Water Quality

Use of the Regional Reserved Water Program would have the potential to impact water quality in the Reservation Reach, Lower White River, and Lower Puyallup River by reducing flows. The effects on temperature in the Reservation Reach were evaluated quantitatively for the Reservation Reach using the regression equations described in Section 4.4 that relate water temperature to flow in the river. The effects on water quality in lower reaches were evaluated qualitatively based on the results for temperature in the Reservation Reach.

The Regional Reserved Water Program would have a minimal effect on 7-DADMax temperatures as shown in Table 21. On average, the Model predicts that the 7-DADMax temperature would increase relative to the Project by 0.01 °C from July 1 to September 14, and there would be almost no change from September 15 to October 15. There would be almost no change in the percent of time in either period that water temperatures would be above the State Standard.

Table 21 – 7-DADMax Temperatures in the Reservation Reach with Regional Reserved Water

Scenario	Average 7-DADMax Temperature in °C		Percent of Time above Standard	
	RM 4.9	RM 15.5	RM 4.9	RM 15.5
July 1 to September 14 (Temperature Standard = 16 °C)				
Project	17.27	15.40	85%	32%
Project + Regional Reserved Water Program	17.28	15.41	85%	32%
Difference	0.01	0.01	0%	0%
September 15 to October 31 (Temperature Standard = 13 °C)				
Project	14.62	13.44	77%	62%
Project + Regional Reserved Water Program	14.62	13.45	77%	62%
Difference	0.00	0.00	0%	0%

Given the minimum changes in water temperature in Reservation Reach with the Regional Reserved Water Program, there would be no detrimental impact to DO concentrations. Of the many factors that affect DO concentration in water, temperature is the only factor that the Regional Reserved Water Program has the potential to change. Water temperature affects the ability of water to hold DO. Theoretically, by raising water temperatures the Regional Reserved Water Program would have the potential to reduce DO concentrations by decreasing DO saturation. However, the effect on DO saturation from a 0.01 °C increase in water temperature is negligible and would result in an even smaller effect on actual DO concentrations.

As the Regional Reserved Water Program would have a negligible effect on temperature or DO in the Reservation Reach, and would not cause any change in the operation of Lake Tapps, it is reasonable to conclude that there would be negligible effects to water quality in the Lower White River and Lower Puyallup River.

4.8.3 Aquatic Habitat

By diverting water from the White River, the Regional Reserved Water Program would cause a reduction in wetted area in the Reservation Reach, Lower White River, and Lower Puyallup River on days when minimum flows were met. The magnitude of the reduction in aquatic habitat was quantified using the relationships between flow and wetted area developed by Herrera for the Reservation Reach and by R2 Resource Consultants for the Lower Puyallup River and Lower White River as described in Section 4.5.2.

On average, full use of the Regional Reserved Water would reduce wetted area by about 1 acre, as shown in Table 22. This represents a 0.15 percent decrease in wetted area compared with the Project. Most of the reduction in wetted area would occur in the Reservation Reach. The reduction in the Lower White River and Lower Puyallup River would be negligible.

Table 22 – Percent Change in Wetted Area in Acres by Reach with Regional Reserved Water

Scenario	White River	Lower	Lower	Total

	Reservation Reach	White	Puyallup	
Project	442.3	46.24	112.59	601.1
Project + Regional Reserved Water Program	441.4	46.22	112.57	600.2
Difference	-0.9	-0.02	-0.02	-0.94
Percent Difference	0.2%	0.04%	0.02%	0.15%

The Regional Reserved Water Program would not have a significant impact on aquatic habitat because the change in wetted area is small and would occur at non-critical times of year. There would be no reduction in wetted area caused by use the Regional Reserved Water when flows were below either the minimum flow in the White River or the Puyallup River MIF. Further, even if minimum flows are met, Regional Reserved Water typically would be less available for use in the lowest flow months of September and October.

4.9 Consideration of Protests and Comments

Four formal protests were submitted to Ecology regarding the Applications. The protestants' concerns are briefly summarized below.

Auburn Protest

A protest was submitted by the City of Auburn on November 2, 2000, focusing on concerns regarding the accelerated timing of the review of senior applications under the Cost-Reimbursement Program, specifically regarding the Auburn's pending water rights applications for Wells 6 and 7. Auburn was concerned about not having sufficient time to complete studies to support its applications. These applications were formally withdrawn by Auburn on August 6, 2002.

Puyallup Tribe of Indians Protest

A protest was received from the Puyallup Tribe of Indians on November 8, 2000, requesting that Ecology not proceed with permitting until it has cooperated with the tribal water resource managers in addressing environmental and regulatory issues. The Puyallup Tribe expressed concern about the following:

- Harm to fisheries caused by committing water to consumptive uses;
- Likely increases in thermal and contaminant loading in the Puyallup River system;
- Impairment of existing water rights, including tribal rights;
- Need for programmatic and site-specific environmental impact statements;
- Need for appropriate instream flows relative to fisheries requirements; and
- Concern that the Applications are not clear about whether additional water would be diverted beyond Puget's existing water right claims.

The Puyallup Tribe submitted additional comments on February 15, 2002, and September 23, 2002, regarding TMs prepared by HDR Engineering, Inc. in response to the project's Preliminary Permit. Those comments primarily focused on the following additional areas:

- Tribal jurisdiction over water flows, levels, and water quality in portions of the Puyallup River;
- Project impacts to the Puyallup River TMDL and waste load allocation;
- Adequacy of the public water quality analysis relative to WAC requirements;
- Lack of demonstrated need for the water supply;
- Hydropower operations should not be the baseline for measuring project impacts;

- Mitigation water should be released at the diversion dam rather than the tailrace;
- Puyallup River MIF should be evaluated instantaneously not on a daily average;
- Flow model over-predicts water quantities and thus is not reliable;
- Water quality impacts violate tribal and state anti-degradation policies; and
- Reductions in flow caused by the Project would impact fish production and access to off-channel habitats.

Muckleshoot Indian Tribe Protest

Ecology received a protest from the Muckleshoot Indian Tribe ("MIT") on November 9, 2000. The MIT protest was based on the adverse effects on flow regimes, water quality, and aquatic and riparian ecosystems function of the White and Puyallup Rivers caused by the withdrawal of water for consumptive use. The MIT protest identified two primary concerns:

- Lack of a demonstrated need for a regional water supply from the White River; and
- Lack of environmental benefits.

The MIT submitted lengthy additional comments on August 14, 2002, regarding the TMs prepared by HDR Engineering, Inc. in response to the Project's Preliminary Permit. Those comments primarily focused on the following additional areas:

- Project is purely a speculative economic interest;
- The proposed distribution system lacks sufficient detail;
- Lake Tapps water is not the "Highest Quality Source" available to meet future demands;
- Proposed source exchange mitigation is unproven and speculative at best;
- TMs use an inappropriate Baseline from which to measure impacts of the Project;
- Flow model contains flaws that make it unreliable for assessing impacts, and affect the water quality analyses; and
- Out-of-basin transfer of municipal water supply by private entities raises substantial public policy issues.

In its comment letter, dated June 30, 2010, pertaining to the 2010 Draft ROEs, the MIT withdrew its previous protests and objections on condition that "the permits issued by the Department are consistent with Cascade's obligations under its agreement with the two Tribes."

Response to Tribal Protests and Comments

The technical and policy comments from the Puyallup Tribe of Indians and MIT ("Tribes") have been considered carefully during review of the Applications. Many of the Tribes' technical comments are addressed in the Investigations section of this ROE, particularly in the discussions of the water quantity, water quality, and fisheries analyses. Concerns over impairment of treaty water rights are addressed in the Impairment Discussion in Section 5.3.

In addition, several of the Tribes' major concerns have been addressed by subsequent changes to the Project, the addition of new analyses, and the WRMA between Cascade and the Tribes. The following points briefly describe Ecology's conclusions regarding several of the Tribes' major concerns:

Suitability of Lake Tapps as a Drinking Water Source. Ecology has sufficient information to conclude that it is feasible to treat Lake Tapps water to provide a high quality drinking water source. DOH would conduct additional reviews of the Water System Plan and other components of the proposed water supply before a water supply withdrawal from Lake Tapps would begin.

Lack of Demonstrated Demand for a New Regional Water Supply. The intent of the Project is to provide a significant source of public water supply for meeting the future needs of Cascade's Members and the Central Puget Sound region. Due to its scale and central location, this Project would provide a unique potential source to meet regional public water supply needs and thereby increase the reliability of meeting future demands. As discussed in this ROE, Cascade predicts that without a significant new source of water such as the Lake Tapps supply, Cascade's Members would have an average unmet demand of by 33 to 61 mgd by 2060.

Definition of Baseline from Which to Measure Impacts. The Baseline scenario used in this ROE is appropriate because it represents the most likely future operations of Lake Tapps independent of hydropower or a water supply project.

Water Quantity Model. No model perfectly represents the real world. The water quantity model is adequate for evaluating the proposed Project and was revised to incorporate many of the Tribes' comments. Limitations of the model and some of the specific changes that were made to address comments are discussed in Aspect Consulting's report (2010).

Water Quality Impacts. Additional water quality evaluations have been conducted and added to the ROE in Section 4.4 to determine the potential water quality impacts of the Project. The water quality impacts were considered in evaluating the Project relative to the public interest (see Section 5.1).

Adequacy of Proposed Mitigation. The mitigation proposal has changed significantly since the Tribes' comments. Most elements of the current mitigation proposal were negotiated with the Tribes as components of the WRMA.

CELP Protest

A protest was submitted from Center for Environmental Law and Policy ("CELP") on November 10, 2000, citing concerns focused on potential "take" under the ESA. The protest letter assumed that an additional 2,000 cfs would be withdrawn from the White River under the Applications. Puget clarified that the total combined diversion from the White River for its existing claim and the new water supply would be limited to a maximum of 2,000 cfs. Subsequently, Cascade has proposed diversion caps that would further reduce the maximum diversion.

Comments on 2006 DROE

On September 25, 2006, Ecology published a draft ROE for Application S2-29934 (Ecology 2006a) on its website for an informal 45 business-day public review period. Comments were received from 59 parties including: Puget; Cascade; the Muckleshoot Indian Tribe; the Puyallup Tribe of Indians; Pierce County; the cities of Auburn, Buckley and Kent; the Lake Tapps Community Council; and multiple water districts, other interested governments, and private citizens. A brief summary of the comments received is included below:

- Supply and demand analysis:
    - Project provides water for out-of-basin demands before addressing growing communities within the basin.
    - Demand is overestimated.
    - Alternative sources should be evaluated.
    - The Shoreline Water District, Fall City Water District, and Cedar River Water and Sewer District requested to be excluded from the proposed place of use.
- SEPA:
    - ROE relies on outdated SEPA documents.

- Baseline:
  - Multiple Baseline scenarios create confusion.
  - The Baseline scenarios should use the Interim Operating Agreement minimum flows.
  - Puget should be given credit for the difference between 130 cfs and the Interim Operating Agreement flows.
  - All references to conditions under hydropower operations should be removed from the ROE.
- Project Definition:
  - Land donation should not be considered part of mitigation.
  - Eliminate or revise two mitigation components.
  - Proposed minimum flows are not an improvement over existing conditions and the more protective Puyallup Flow Proposal should be used in their place.
  - Require the tailrace barrier dam and intake fish screens only if warranted.
  - Source exchange should be limited to Cascade Members, or kept within the basin.
  - Diversion caps should be eliminated.
  - Project should be revised to prevent loss of lake recreation from Memorial Day to Labor Day.
- Flow:
  - Project would reduce flows in the bypass reach (i.e., the Reservation Reach) by 100 cfs. This impact has not been analyzed.
- Water Quality:
  - ROE fails to analyze water quality conditions affecting fish.
  - Reservation Reach would be impacted by the Project, and temperature, pH, and habitat impacts need to be evaluated.
  - Lake Tapps does not have suitable water quality for a drinking water supply.
  - Monitoring results suggest flushing flows are not necessary to maintain water quality in Lake Tapps.
  - Water quality discussion should reference new water quality standards.
- Fisheries:
  - Existing conditions description and other components of fisheries analysis based on outdated information.
  - IFIM/Weighted Useable Area studies incorrectly used to justify lower flows.
  - Draft ROE does not evaluate loss of wetted area or access to off-channel habitat.
  - Reservation Reach, and Lower White and Puyallup Rivers are wrongly dismissed as unproductive fish habitat.
- Four Part Test:
  - Overriding considerations of public interest ("OCPI") applies to groundwater withdrawals, not surface water diversions.
  - Demand is speculative.
  - Impairment of senior water rights not evaluated.
  - Reconsider definition of beneficial use to eliminate references to time period.

Every comment was considered in preparing the ROEs. Ecology believes that every comment or concern has been addressed, or Ecology disagrees with the comment or concern.

<u>Comments on 2010 Draft ROEs</u>

On May 7, 2010, Ecology published the Draft ROEs for the Project on its website for an informal public review period that ended June 30, 2010. Comments were received from the following 6 parties:

Cascade, the Lake Tapps Community Council, King County, the Muckleshoot Indian Tribe, the Puyallup Tribe of Indians, and one private citizen. A brief summary of the comments received is included below:

- Place of Use
    - POU should refer to WAC definition of service area.
    - POU should either refer to the date of the most recent water supply plan, or clarify that POU is flexible as plans are updated. ROE should note that flexible POU is an issue currently before State Supreme Court.
- Conditions
    - Recreational Lake Levels
        - Clarify obligations if 2009 Agreement does not go into effect.
    - Water System Planning
        - Include a reference to compliance with relevant planning requirements under chapter 70.116 RCW.
    - Trust Water Donation
        - Objection to the requirement to apply for a donation to trust as 1) it appears Ecology has prejudged the application, 2) the terms of donation are too strict and are likely to result in impairment, 3) SEPA analysis is required, and 4) permanent donation may contravene the Cascade's obligations under other agreements.
        - Trust water donation will be structured to honor all three of Cascade's agreements
    - Emergency Operations
        - Emergency Conditions should be defined.
        - Emergency Conditions should exclude drought, climate change, or diversions for water quality or recreation.
    - Ecology Review and Approval Process
        - Include cross references to conditions that require each process.
    - Adaptive Management
        - One commenter supported the stakeholder proposed language.
        - Three commenters did not support the stakeholder proposed language.
        - Stakeholders should be tasked to form a committee with reasonable decision authority.
    - Regional Reserved Water Program
        - Clarify that use of program water shall not reduce flows in White River below the minimum flow.
        - Portion of Reserved Water not allocated by December 31, 2030 should be cancelled, not relinquished.
        - Objection to Regional Reserved Water Program as 1) the use of surface water to mitigate for yet to be defined groundwater impacts is an unsound practice, 2) the reserve would potentially diminish flows that would otherwise be dedicated to instream flow, and 3) Ecology is obligated to investigate a proposed application at the time the application is made, not before.
- Change to the Claim
    - Support for the change of use so that environmental benefits have clear and explicit authorization.
    - Recreation is not a "new" use.
- Investigator's Report
    - Background

        - Describe recent efforts to minimize tailrace leakage.
        - The 2005 NMFS letter did not supersede the Agency minimum flows.
    - Project Description
        - In multiple locations, the Investigators report improperly refers to the minimum flows as the only component of the Recommended Flow Regime.
        - The proposed April 15 to October 31 recreational season is not necessarily longer than historical conditions as sometimes the lake was kept full beyond October.
    - Baseline Condition
        - Selected baseline erroneously assumes continued diversion of water into Lake Tapps.
    - Flood Control
        - Examine the potential with USACE for using Lake Tapps to provide up to 2000 cfs of additional flood control.
        - The WRMA should have force majeure conditions added for flood control and maintenance of lake levels.
    - Lake Levels
        - There is uncertainty in estimating losses from the lake. Cascade should be required to further investigate lake loss.
        - Independent model results using different assumptions result in predicted impacts to lake levels in 29 to 48 percent of years.
        - Cascade should be required to provide annual lake level forecasts.
    - Fisheries
        - Describe degraded condition of diversion dam and shortcomings of fish trap.
        - Fish screen facility is critical. Yearly maintenance and testing should be required.
        - PTI has completed studies of Bull Trout use of the White River system.
        - Forecasting fish behavior is uncertain and forecasts tend to use worst case analyses. Some flexibility may be welcomed.
    - Water Quality
        - Limited grab sample data for pH is insufficient to conclude that no pH excursions have occurred since 2004.
        - Reference does not support statement that a planned study will reexamine the necessity of the pH TMDL.
    - Conservation of Riparian Lands
        - Only 500 acres of the 2,500 has been protected. Is the failure to protect the remaining 2,000 acres a significant impact and should mitigation be required?
    - Climate Change
        - Note with approval the inclusion of climate change in evaluation. Ecology and DOH should include climate change analysis as a component of future water right applications and water supply plans.
        - Climate change was not included in the modeling effort – the warming trend should be further investigated and a correction factor added to future forecasts.
        - Climate change evaluation supports the inclusion of the stakeholder adaptive management provision and the "go slow" approach to the trust donation.
    - In addition, several more minor typographical and technical corrections were suggested.

Every comment was considered in preparing the ROEs. Ecology believes that every comment or concern has been addressed, or Ecology disagrees with the comment or concern.

4.10 Recommendation of the Department of Fish and Wildlife

RCW 77.57.020 requires that Ecology give notice to the Department of Fish and Wildlife about applications to divert or store water. Ecology initially consulted with WDFW when the Applications were filed with Ecology. Ecology periodically consulted with WDFW throughout the evaluation of the Applications. WDFW issued three comment letters to Ecology. These letters were dated November 8, 2000, July 28, 2006, and July 16, 2010.

WDFW's November 8, 2000 letter cites concerns regarding the impacts of the Project on fish in the White and Puyallup Rivers and in Lake Tapps. The concerns cited are as follows:

- A change application should be filed to divert water into Lake Tapps for a use other than hydropower.
- The minimum flows are less than desired for fish, and it is unclear that they are instantaneous flows and are not based on daily or hourly averages.
- Down-ramping rates need to be included, and should be instantaneous, not based on hourly or daily averages.
- Stream gaging must be included to measure compliance with minimum flow and ramping requirements.
- To protect fish, the Project should include screening of water withdrawn from Lake Tapps.

WFDW's concerns have been considered carefully during Ecology's review of the Applications, and have been addressed by subsequent changes to the applicant's proposal and/or results of additional analyses. WDFW's July 28, 2006 letter indicates that the proposed revisions to the minimum flows and ramping rates are acceptable since they are equal to or greater than what WDFW had previously recommended. The letter re-iterates that the minimum flows and ramping rates are instantaneous rates and not based on hourly or daily averages.

In July 2010, WDFW reviewed the Draft ROEs. WDFW's July 16, 2010 letter affirms that the most recent Draft ROEs addressed WDFW's concerns regarding minimum flows, ramping rates, stream gaging, and fish screens on lake outlets.

5. CONCLUSIONS

To approve the Applications for new water rights, Ecology must find that each of the following four requirements of RCW 90.03.290 has been satisfied:

1. Water is available for appropriation;
2. The proposed use would be put to a beneficial use;
3. The proposed appropriation would not impair existing water rights; and
4. The proposed appropriation would not be detrimental to the public interest.

5.1 Availability of Water

In March 1980, Ecology promulgated rules in chapter 173-510 WAC that set forth the provisions for future allocation of water from the Puyallup River Basin. The stated purpose of the rules is to "retain perennial rivers, streams, and lakes in the Puyallup River basin within instream flows and levels necessary to provide protection for wildlife, fish, scenic-aesthetic, environmental values, recreation, navigation, and to preserve high water quality standards" (WAC 173-510-020).

The rules in chapter 173-510 WAC close the White River and all tributaries "to further consumptive appropriations" [WAC 173-510-040(3)] and also establish specific instream flows on the Lower Puyallup River, which is defined as "from the influence of the mean annual high tide at low base flow levels to the confluence with the White River" [WAC 173-510-030(1)]. The specific instream flows for the Lower Puyallup River are provided in WAC 173-510-030(2). These flows range from 1,000 cfs in the fall to 2,000 cfs in May through July.

The applicant has proposed to use water for municipal supply purposes in a manner that would not increase the volume of non-attainment of the minimum flows for the Lower Puyallup River. However, the applicant's proposed use of water would impact the White River from the diversion dam to the confluence with the Puyallup River, since the water proposed to be withdrawn for water supply would otherwise be flowing in that reach of the White River.

Under WAC 173-510-040, the White River is closed to further consumptive appropriations. Stream "closures" are determinations by Ecology under RCW 90.54.020 that water is not *available* for further appropriations. *See Postema v. PCHB*, 142 Wn.2d 68, 95, 11 P.2d 726 (2000).

However, a stream closure under the authority of RCW 90.54.020(3)(a) may in certain circumstances be overridden under an exception that authorizes a new appropriation from a closed stream "in those situations where it is clear that overriding considerations of the public interest will be served."

In making a statutory determination of overriding considerations of public interest under RCW 90.54.020(2)(a), the analysis applies three steps:

1. Determine whether and to what extent important public interests would be served by the proposed appropriation. The public interests served may include benefits to the community at large as well as benefits to the river or other environmental resources.
2. Determine whether and to what extent the proposed appropriation would harm any of the public interests (fish, wildlife, scenic, aesthetic, and other environmental and navigational values) protected by the closure and/or any other public interests.
3. Determine whether the public interests served (as determined in Step 1) clearly override any harm (as determined in Step 2).

The following sections of this report present this three-step OCPI analysis.

5.1.1 Step 1: Analysis of Public Interests Potentially Benefited by the Project

Public Water Supply Benefits. The Project would provide a significant source of public water supply for addressing future needs of customers and businesses served by the cities and water utilities that comprise Cascade. Providing reliable public water supplies that meet the needs of population and economic growth is an important state policy recognized in RCW 90.54.010 and .020. As discussed in Section 4.1, the supply and demand analysis predicts that without the Project, Members would have an average unmet demand of 37,000 to 50,400 acre-feet per year (33 to 45 mgd) by 2060. Considering the potential impacts of climate change or regional demand contingency, the unmet demand could be 47,000 to 68,300 acre-feet per year (42 and 61 mgd) by 2060. The new regional water supply established by the Project would provide a measure of resilience to the cities and water utilities that comprise the Applicant, as well as to entities that may contract with the Applicant should climate change impact water supplies throughout the Puget Sound region. In addition, the Regional Reserved Water Program would assist the Four Cities in providing public water supply to their citizens.

Maintaining Lake Tapps as a Recreational, Aesthetic, Groundwater Recharge, and Wildlife Habitat Benefit without Significant Public Expenditure. At present, the Project is the only viable proposal that has the financial and organizational resources to continue to maintain Lake Tapps and the recreational, aesthetic, groundwater recharge, and habitat benefits it provides.

The lake is heavily used during the summer for boating and swimming, and the County Park is among the most popular swimming areas in Pierce County. The Project includes commitments to provide recreational water levels from April 15 to September 30 (*see* Condition 5), which would be a longer recreational season than was historically provided under hydropower operations. The lake provides wildlife habitat to a significant number of species, including fish, waterfowl, and terrestrial wildlife that depend on the lake for food, habitat, or water. Further, the lake provides recharge to local aquifers that provide water to surrounding communities including the cities of Auburn, Pacific, Sumner, Puyallup, and Bonney Lake.

Lake Tapps was created as the reservoir for the Hydro Project. Continuing diversion of water from the White River into Lake Tapps is an expensive and resource-intensive effort, since it involves the maintenance of, and periodic capital improvements to, the diversion dam, canal, flume, fish screens, sediment traps, levees and dikes, the intake canal, forebay, penstocks, gates, and the tailrace. Because the Hydro Project is no longer operating, it can no longer be assumed that the lake owner will be willing or able to pay the costs of maintaining the lake.

While it is unlikely that Lake Tapps would cease to exist if the Project failed, the process of developing another alternative for funding lake maintenance would likely be long and involve significant public expenditure. It could possibly even involve purchase of the lake and accompanying infrastructure by another public agency at significant cost and interruption of operations. The Project avoids these future public expenditures by providing a feasible plan for ongoing maintenance of the lake.

Higher Minimum Flows for the White River. Diversions from the White River for the Project would be required to comply with a new and more protective instream flow regime for the Reservation Reach of the White River (*see* Conditions 1 through 4). This flow regime was developed in conjunction with the Puyallup Tribe of Indians and Muckleshoot Indian Tribe. The minimum flows established by Condition 1 are equal to or higher than any minimum flow regime a federal or state governmental agency has recommended to date. The higher flows resulting from the Recommended Flow Regime would protect instream flow and water quality in the Reservation Reach and Lower White and Puyallup Rivers during critical low flow periods.

Protection of Riparian Lands along the White River. As an earlier part of its public interest proposal for this application, Puget placed a restrictive covenant on 500 acres of riparian lands along the White River. The covenant restricts use of the land to fishery and wildlife management; wetlands management; habitat protection, preservation, or enhancement; natural and cultural resource management, protection, preservation, restoration or enhancement; and hunting, fishing, gathering, cultural activities, recreation, and education. This will secure the continued protection of this habitat for fish and other wildlife as well as provide opportunities for other recreation and environmental education.

Benefits to Puyallup River MIFs in Spring. The Project will be required to implement a mitigation program to protect Puyallup River MIFs in early spring (*see* Condition 6), the period when diversions from the White River would be highest. This mitigation element requires that the Project reduce the quantity of flow diverted from the White River by up to the amount of water being withdrawn from Lake Tapps Reservoir for municipal water supply purposes. Model results (*see* Section 4.2) estimate that the Project would reduce the annual volume of Puyallup MIF shortfall by 2%, a small benefit.

5.1.2 Step 2: Analysis of Public Interests Potentially Harmed by the Project

Impacts to Habitat and Water Quality in the Reservation Reach of the White River. The Project would reduce flow in the Reservation Reach by an average of 35 cfs, with the worst days experiencing reductions in flow of up to 980 cfs (caused by Refill starting 2 weeks earlier). More typically, the reductions in flow would be less than 100 cfs. It is predicted that the reductions in flow on average would cause less than 1 day per year of exceedance of the temperature standard at RM 15.5, and up to 1 day per year of exceedance farther downstream at RM 4.9. These reductions would also cause a loss of an average of wetted habitat of about 5 acres, and up to 175 acres on the worst days. The Regional Reserved Water Program, if fully used, would cause an additional loss of 1 acre of wetted habitat in the Reservation Reach, on average, and negligible effects on temperature and dissolved oxygen. These impacts are not anticipated to affect the designated uses of the White River, and would not occur when flow in the White River is below the minimum flow. The loss of habitat is partially offset by the higher minimum flows, conservation of riparian lands, and protection of the Puyallup River MIF in spring.

Impacts to Habitat and Water Quality in the Lower White and Puyallup Rivers. The Project would reduce flow in the Lower White and Puyallup Rivers by 75 cfs on average. This reduction in flow would result in a loss of fish habitat. Because of the higher White River minimum flow and protection of the Puyallup River MIF in spring, these decreases in flow would primarily occur when flows were above the Puyallup River MIF. The reduction in flow could cause an increase in water temperature of 0.1 to 0.2 °C in the Lower White River during summer. Water quality in the Puyallup River is not expected to be affected. The change in water quality should not affect the designated uses of the White River. The loss of aquatic habitat was quantified using wetted area and change in stage approaches. In low flow months, the wetted area would be reduced by an average of 0.3 acre in the Lower White River and 0.2 acre in the Lower Puyallup River. These represent reductions in total wetted area of 0.6 and 0.2%, respectively. This loss of habitat would be small and is of lesser significance, as it would not typically occur when the Puyallup River flow is below the MIF.

Impacts to Puyallup River MIFs in Summer, Fall, and Winter. The Project would cause an increase in the number of days that the Puyallup River is below the MIF in summer, fall, and winter. On average, there would be 4 additional days that Puyallup River flows were below the MIF. Many, but not all, of these additional days below the MIF would be caused by the Project's repairs to stop leakage through the powerhouse (considered a benefit of the project as it prevents the waste of water). Overall, the Project would reduce the volume of MIF shortfall; small MIF excursions would occur slightly more frequently, but there would be fewer large ones.

Potential Impact to Lake Recreation in October. The Project would at times impact lake recreation in October. The Model results suggest that the lake would be drawn down below Normal Full Pool about 30% of the time (primarily in dry and drought years). October is a less critical recreation period as cooler air temperatures and shorter days reduce the desire for lake recreation. Under hydropower operations, Lake Tapps was normally drawn down in September, and lake recreation in October was not possible.

5.1.3 Step 3: Conclusion of OCPI Analysis

The conclusion of the OCPI analysis can only be reached by weighing the potential benefits and harms to the public interest. That evaluation is discussed by topic below.

Water Supply

The Project would provide a significant new source of public water supply for the Puget Sound region. The Members currently provide water to over 370,000 residences and 20,000 businesses in the Puget Sound region. Cascade has identified significant unmet demand by 2060. The Project would allow Cascade to meet its unmet demand and improve regional resilience to the potential effects of climate change.

Flow

On an average basis, the Project would reduce flow in the Reservation Reach, Lower White River, and Lower Puyallup River to a minor degree (2 to 4%) when compared with the total flow in the rivers. However, the impact is variable. The largest impacts on flows would primarily occur in the last 2 weeks of February. On some days, the Project would cause larger reductions, and other days it would increase flows. Eighty percent of the time the change in flow would be between a 100-cfs decrease and a 50-cfs increase. On the worst day simulated, the reduction in flow would be significantly larger (up to 63% in the Reservation Reach).

Mitigation measures are included to ensure that the reductions in flow would not occur at the most critical times (when minimum flows are not being met in the White River or the Puyallup River during spring). The mitigation measures also occasionally increase low flows. The mitigation measures do not fully offset the impact of the Project, but do mitigate impacts at critical times and would establish a minimum flow regime for the White River supported by federal, state, and tribal agencies.

Water Quality

The designated uses in the White or Puyallup Rivers are not anticipated to be affected by the Project's impacts to water quality. In the critical, low flow, period (late summer and early fall), the Project would either not impact or would improve water quality. The Project would be slightly detrimental to water quality the balance of the year. Impacts include a likely increase in water temperatures in the White River Reservation Reach and Lower White River due to a reduction in flow caused by the Project. Temperature increases would generally be minor, but would in some cases cause temperatures to exceed state standards. The reduction in flow also has the potential to decrease DO concentrations, although the predicted changes are small and may not occur. These impacts are partially offset by the minor improvements caused by the higher White River minimum flows.

Fish

The Project proposes a minimum flow that is higher than minimum flow regimes developed by state and federal agencies to be protective of fish, and therefore represents a significant protection to fish. Additionally, the Project includes several mitigation components targeted to improve fish habitat: higher White River minimum flows, limitations on diversions into the reservoir and releases from the reservoir, protective ramping rates, conservation of 500 acres of riparian land, and compliance with the Puyallup River MIF in spring. These elements collectively provide benefits to fish, but do not mitigate or offset all of the impacts to fish. Overall, the impacts are minor and primarily occur at non-critical times. For example, by reducing average flows, the Project would reduce the amount of wetted habitat available to fish by only about 6 acres on average, or approximately 1%, and would mostly affect the Reservation Reach. The worst case reduction in habitat would be larger (up to 175 acres); however, these larger reductions would occur in the last 2 weeks of February, a non-critical period for fish, and only when flow is above the minimum flow. In addition, higher temperatures in the White River could have non-lethal effects on fish. However, reduction in fish habitat and increase in water temperature in the Reservation Reach would only occur when flow in the White River is above the minimum flow.

Recreation (maintaining lake without further expenditure)

The Project increases the likelihood of the lake, and its aesthetic, recreational, wildlife, and recharge benefits, being continued without significant public expenditure. The Project would provide recreational lake levels from April 15 to September 30 in all years, but would draw the lake below recreational levels in October 30% of the time. However, the value of preserving the majority of the benefits provided by the lake greatly overrides the small tradeoff in October recreation. It is concluded that the Project would be a large benefit to recreation on the lake.

Summary of OCPI Analysis

In summary, it is concluded that the public interest benefits of the Project *taken as a whole* clearly override any public interest detriments associated with the Project. The new regional water supply would provide a tremendous benefit and provide the additional benefit of preserving Lake Tapps without substantial public expenditure. The impacts to flow, water quality, and fish are considered minor relative to the benefits and mitigation elements included to ensure that the impacts do not occur during critical low flow periods.

5.2 Beneficial Use

The beneficial use analysis involves answering two questions:

1. Is the proposed use a beneficial use?
2. If so, does a reasonable basis exist to conclude that the Project proposed in the application will beneficially use the water quantity sought within a reasonable period of time?

The proposed use is for public water supply and municipal water supply, including industrial and commercial supply. These purposes are all recognized under RCW 90.54.020 as beneficial uses of water.

As to the second question—the reasonable basis for the projected beneficial use—the demand and supply analysis projects that the supply deficit for Cascade's Members in 2060 will be between 30,700 and 50,400 acre-feet per year (33 to 45 mgd). Considering the potential impacts of climate change or regional demand contingency, the unmet demand could be 47,000 to 68,300 acre-feet per year (42 and 61 mgd). We conclude that the average annual amount of 54,300 acre-feet per year applied for is reasonable in light of this analysis.

With respect to instantaneous quantities, Cascade has proposed that the instantaneous diversion from the White River (Qi for application S2-29920) be generally limited to 1,000 cfs during refill, 400 cfs through the recreation period, and 150 cfs for the remainder of the year (*see* Condition 2 for specifics). These limitations would apply to diversions for municipal water supply and all other beneficial uses (through the Change to Claim 160822), except hydropower generation. Model results have shown that the Project can be fully operated to meet all water supply needs, maintain recreational levels, and provide for other beneficial uses while complying with these limits.

Cascade has also proposed an instantaneous withdrawal (Qi for application S2-29934) from Lake Tapps of 135 cfs. Cascade has provided an estimated peak monthly demand of 117 cfs in August, based on analysis of demand patterns of Cascade's Members and other regional purveyors. The 135 cfs Qi would be 15% higher than the projected monthly peak demand to accommodate higher withdrawals for shorter-term (daily or weekly) peaks. The 135 cfs instantaneous withdrawal is reasonable given the projected demand pattern.

The conclusion that the amount of water applied for and the time to develop the right are reasonable and not speculative is reinforced by the fact that water availability for meeting future population and economic growth in Central Puget Sound is becoming increasingly scarce and the planning horizon has considerably lengthened for locating and permitting new public water supply sources and needed infrastructure. Thus, a longer time horizon for assessing the need for future municipal supplies under these circumstances is appropriate.

In summary, there is a reasonable basis to conclude the requested quantity would be put to beneficial use. The supply and demand data indicate a reasonable need for the water sought over the period in question. In the Central Puget Sound region it is appropriate to assess need over a long time frame for new large public water supplies, which require increasingly longer periods to permit and develop.

5.3 Impairment

To grant a permit pursuant to RCW 90.03.290, Ecology must find that the appropriation will not impair any existing water rights. The Project includes two appropriations, a primary diversion from the White River, and a secondary withdrawal from Lake Tapps.

5.3.1 Primary Diversion from the White River

Cascade has applied for an appropriation from the White River for municipal water supply purposes with a maximum Qi that varies from 150 to 1,000 cfs depending on the time of year (*see* Condition 2) and a Qa of 54,300 acre-feet per year.

Until January 2004, Puget diverted 2,000 cfs from the White River for hydropower generation at the same point of diversion that would be used for the public water supply diversion. This diversion was made pursuant to the Puget Claim (number 160822), filed by Puget on June 10, 1974, which asserts a right to divert up to 2,000 cfs for hydropower production. In January 2004, Puget ceased generating hydropower and continued to divert water to maintain the fish screens, water levels, and water quality in Lake Tapps.

Cascade has proposed that the new appropriation for the Project be conditioned so that the combined diversion from the White River under the Puget Claim and the new appropriation would not exceed the instantaneous quantities to be authorized in the change to the Puget Claim.

5.3.2 Secondary Withdrawal from Lake Tapps

The secondary appropriation is for a municipal water supply withdrawal from Lake Tapps at a maximum Qi of 135 cfs and a Qa of 54,300 acre-feet per year.

5.3.3 Review of Potential Impairment

To examine the question of potential impairment of any existing water rights, the effect of the Project was evaluated on the following five groups:

1. The Puyallup River MIF;
2. Senior water right holders along the White River Reservation Reach;
3. Senior water right holders for withdrawals from groundwater or springs in areas recharged by Lake Tapps;
4. Senior water right holders along the Lower White and Puyallup Rivers; and
5. Tribal rights.

The Project contains a number of provisions intended to prevent any reductions or alterations in flow from impairing other existing water rights and in particular the water right established under WAC 173-510-030 to provide MIFs on the Puyallup River. A new appropriation could impair the MIF by increasing the duration or extent of shortfall below the specified flows.

The Project would not impair the Puyallup River MIF. The Project includes higher minimum flows in the White River and a mitigation component protective of minimum flows in the Puyallup River during early spring. When compared with the Baseline condition, the Project would decrease the overall volume of Puyallup River MIF shortfall, but would increase the number of days that the flow is below the MIF. The increase in number of days would largely be caused by elimination of 36 cfs of leakage from the powerhouse valves.

Compared to the Project, hydropower operations (which pre-date, and thus were not subject to, the Puyallup River MIF) diverted more water from the White River, released water from the tailrace in one or two peaks throughout the day, and complied with a lower minimum flow at the diversion dam. Historically, flow in the Puyallup River was below the MIF more frequently and the shortfall volume was greater than it would be with the Project. The Regional Reserved Water Program would not impact the Puyallup River MIF as Regional Reserved Water would not be available for use in any way that would adversely affect attainment of the MIF.

Water right holders along the White River Reservation Reach have historically experienced lower river flows as a result of hydropower operations. Ecology is unaware of any incidence where existing rights have been unable to be fully used due to flow issues. Since, with the Project, flows in the Reservation Reach would be higher than under historical conditions, it is reasonable to conclude that, with the Project, there would be no impairment of senior rights in this reach.

Several municipalities hold senior water rights for spring sources that are in part recharged by Lake Tapps. These sources would not be impaired with the Project because the average water level in Lake Tapps would increase. In addition, water supplied to Lake Tapps from the White River constitutes foreign water to which existing water rights have no legal entitlement, whether through surface water or groundwater connection. *See Elgin v. Weatherstone,* 123 Wash. 429 (1923) (flow augmented water by artificial means, which would never naturally reach the source, is foreign water for which no water right (usufruct) may be acquired); *Dodge v. Ellensburg Water Co.*, 46 Wn. App. 77 (1986) (foreign water is not public water subject to appropriation).

Water right holders along the Lower White and Puyallup Rivers would experience river flows that are, on average, 82 cfs (75 cfs from the Project and 7 cfs from use of Regional Reserved Water) lower than would otherwise occur. However, the lowest flows would be protected by higher minimum flows at the diversion dam, the Early Spring Avoidance Plan, and the relatively consistent discharge rate from the tailrace. Historically, the Puyallup River flows were below the MIF on a daily average basis more frequently than would occur with the Project. Hydropower releases from the tailrace occurred in one or two daily peaks; during non-peak periods, the flow in the Puyallup River would be particularly low, even if the daily average met the MIF. Ecology is unaware of any incidence where existing rights have been unable to be fully used due to flow issues in the Lower White River or Lower Puyallup River. Therefore, the anticipated reduction in flow conditions in the White and Puyallup Rivers would not adversely impact existing rights.

Initially, the Puyallup Tribe of Indians had asserted that the original applications for the Project would impair water rights it claims under treaties, federal reservations, and aboriginal rights. Under the treaties of Medicine Creek (1854) and Point Elliott (1855), the Puyallup Tribe of Indians and the Muckleshoot Indian Tribe retain the right to take fish in their "usual and accustomed" areas, inclusive of the Puyallup/Carbon/White River Basins. The White River and Puyallup River and their tributaries are among the Tribes' usual and accustomed fishing places and the Tribes rely upon fish runs that use the habitat of these rivers in exercising their protected treaty fishing rights. The Puyallup and Muckleshoot Tribes use fish from these basins for commercial, subsistence, and cultural purposes. Based on the protections provided by the Recommended Flow Regime (which was established as a component of the WRMA between Cascade and the Muckleshoot and Puyallup Tribes), the settlement agreements reached between Cascade and the Muckleshoot and Puyallup Tribes, and the limited effects of the Project on low flows, water quality, and aquatic habitat described above, we concluded that Tribal rights would not be impaired.

5.4 Public Interest

The fourth and final test pertaining to the granting of a water right is the requirement that the appropriation not be detrimental to the public interest. The effects of the Project on the public interest are analyzed in Section 5.1, where it was concluded that overriding considerations of public interest clearly support approving the Applications. The adaptive management condition provides an additional tool with regard to satisfying the public interest test.

5.5 Summary

In summary, the preceding analyses reached the following conclusions regarding the key questions of the four part test:

1. Water is not available for appropriation as the White River is closed to further consumptive appropriation by WAC 173-510-040(3), but it is clear that overriding considerations of the public interest will be served by the new appropriation;

2. The proposed use would be a beneficial use;

3. The proposed appropriation would not impair existing water rights; and

4. The proposed appropriation would not be detrimental to the public interest.

6. RECOMMENDATIONS

Based on the investigation and conclusions described above, I recommend that the Applications for the Lake Tapps Reservoir Water Rights and Supply Project be approved pursuant to the Development Schedule and Provisions and Conditions in S2-29920(A) as follows:

- Surface Water Permit S2-29920(A) to divert at a peak rate of 1,000 cfs (Qi), not to exceed an annual quantity of 54,300 acre feet (Qa), of water from the White River for municipal water supply purposes;

- Reservoir Permit R2-29935 in the amount of 46,700 acre-feet per year to store the waters diverted from the White River in Lake Tapps Reservoir for municipal water supply purposes pursuant to application S2-29920; and

- Surface Water Permit S2-29934 to withdraw at a peak rate of 135 cfs (Qi), not to exceed an annual quantity of 54,300 acre feet (Qa), of water from Lake Tapps Reservoir for municipal water supply purposes.

I further recommend that application S2-29920 be approved for Surface Water Permit S2-29920(B) to establish a Regional Reserved Water Program of 10 cfs (Qi) and 5,060 acre feet (Qa) for municipal water supply purposes pursuant to the Development Schedule and Provisions and Conditions included in S2-29920(B).

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Report by: 9/2/2010

Owen Reese, PE — Date
Aspect Consulting, LLC

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