DRAFT FEASIBILITY STUDY
CAMPBELL CREEK RESERVOIR

Prepared for

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TABLE OF CONTENTS

List of Tables (TOC List)

List of Figures

List of Appendices

1 INTRODUCTION

This draft feasibility study outlines work completed to evaluate the proposed Campbell Creek Reservoir in Chelan County, Washington. This study has been prepared under a grant (Grant G0900155) from the Columbia River Water Management Development Account administered by the Washington State Department of Ecology (Ecology). The objective of the proposed Campbell Creek Reservoir project is to establish off-channel storage for water diverted from Peshastin Creek so that instream flows can be managed to better meet the needs of irrigators and improve late summer fish passage conditions.

The proposed reservoir would be located in Campbell Creek Canyon, approximately ½-mile west of the lower reach of Peshastin Creek and 3.2 miles upstream of the confluence of Peshastin Creek with the Wenatchee River, as shown in Figure 1-1. The reservoir site would be located entirely within federal land managed by the United States Forest Service (USFS). The proposed reservoir would be designed to store up to 1,000 acre-feet of water diverted from Peshastin Creek via the Tandy Ditch Company pipeline. Water would be pumped to the reservoir from the Tandy pipeline during the peak runoff season for use late in the irrigation season when flows in the creek are low. Stored water would be used to directly supplement late summer flows in Peshastin Creek, or supply late season irrigation needs in order to reduce diversions from Peshastin Creek. Either of these uses would increase late summer instream flows and improve fish passage conditions in lower Peshastin Creek.

The proposed Campbell Creek Reservoir project was originally identified as part of the *Multi-Purpose Water Storage Assessment in the Wenatchee River Watershed* (Montgomery Water Group, 2006). That study identified several potential storage projects within the Wenatchee River Watershed "that would benefit multiple uses such as instream flow, water supply, instream and riparian habitat and water quality". The Campbell Creek Reservoir concept was developed further as part of the *Peshastin Subbasin Needs and Alternatives Study* (Anchor Environmental, 2007). That study evaluated the primary summertime needs within the Peshastin Creek subbasin, which include diversions for irrigation and instream flow for passage of bull trout (*Salvelinus confluentus*) and Chinook Salmon (*Oncorhynchus tshawytscha*). Several alternatives were identified that could potentially improve water

management in the subbasin to better meet both instream and out-of-stream needs. The Campbell Creek Reservoir project was evaluated as one of those alternatives.

Chelan County and Ecology are working jointly to study and implement projects throughout the Wenatchee River Watershed that are intended to provide benefit for instream and out-of-stream water needs. Based on information presented in the previous watershed and subbasin studies, Chelan County and Ecology have requested that a feasibility study be prepared to evaluate the Campbell Creek Reservoir project in more detail.

1.1 Project Description

The following includes a brief description of the scope of work and purpose of the feasibility study. In general, the feasibility study was prepared to identify "fatal flaws" or challenges that would prevent implementation of the project and to more clearly define the benefits and costs associated with implementation and long-term operation of the project.

1.1.1 Scope of Work

The scope of work approved by Chelan County and Ecology for development of this feasibility study included the following tasks:

1. Soil Sampling, Hydrologic Data Collection Quality Assurance Project Plan (QAPP) Compilation – This task included preparation and submittal of a QAPP to Ecology to address collection of soil data and hydrologic data.
2. Land Ownership and Rights-of-Way Investigations – This task included identification of affected property owners and coordination with those property owners to outline potential issues, barriers, and costs associated with acquisition of property and right-of-way needed for reservoir construction.
3. Geotechnical Exploration – This task included subsurface soil sampling, testing, and preparation of a report to address the geotechnical suitability of the site for reservoir construction and provide recommendations for design of the reservoir embankment and liners.
4. Hydrology Investigations – This task included field gathering of flow data on Campbell Creek to determine natural inflow and hydrologic conditions of the basin tributary to the proposed reservoir.

5. Wetlands Delineation, Environmental Resources Review, Analysis of Permitting Issues – This task included field delineation of a wetlands that would be affected by reservoir construction, a review of impacts to other environmental resources, and an analysis of permitting issues and requirements for the proposed project.
6. Detailed Engineering Feasibility Study – This task included a detailed engineering analysis of the project, development of preliminary reservoir design drawings to the 30% complete level, and preparation of engineering calculations.
7. Cost Estimate – This task included development of a preliminary estimate of reservoir construction costs and long-term operation and maintenance costs, based on development of the reservoir design to the 30% complete level.
8. Analysis of Benefits to Instream Resources – This task included development of a recommended operating scheme that would maximize the use of the reservoir to benefit instream flow resources and supply irrigation needs.
9. Comparison to Other Alternatives to Improve Streamflow in Peshastin Creek – This task included the evaluation of other alternatives that were identified for improving the management of Peshastin Creek flows to meet instream and out-of-stream water needs. The primary alternative evaluated was pumping from the Wenatchee River.
10. Water Rights Administration – This task included developing recommendations on how to successfully navigate the administrative issues associated with providing permitted water for the project.

This report reflects only partial completion of the scope of work listed above for the feasibility study. An apparent "fatal flaw" or significant barrier to the completion of the feasibility study and implementation of the project was identified during preliminary coordination with affected property owners. The property owners immediately downstream of the proposed reservoir site have expressed opposition to the project and have declined to grant access to the site through their properties for the field investigations needed to complete the feasibility study according to the approved scope of work.

1.1.2 Project Purpose

The overall purpose of the Campbell Creek Reservoir project is to provide off-channel storage for water diverted from Peshastin Creek during high flow periods so that water

storage can be used in the late summer during low flow periods to supply irrigation needs or augment instream flows. The resulting increase in instream flows will improve late summer fish passage conditions in lower Peshastin Creek. The purpose of this feasibility study is to more clearly define the challenges, costs and benefits of implementing the project so that stakeholders can make informed decisions on whether or how to move forward with the project. The feasibility study is also intended to identify and evaluate "fatal flaws" or barriers that could prevent implementation of the project.

1.2 Organization of Report

This report includes the following sections:

- Background Information – This section provides a more detailed description of the project site and existing conditions, based on background data that was available when work on the feasibility study began.
- Site Investigations – This section summarizes the status of site investigations that were to be completed as part of the feasibility study. As was noted previously, key site investigations have not been completed due to property owner issues that have prevented access to the site.
- Reservoir Design Analysis – This section summarizes the status of the reservoir design analysis. The reservoir design analysis has not been completed to the level of detail intended for this feasibility study because the field data necessary to complete the analysis could not be collected.
- Opinion of Probable Costs – This section summarizes the status of the development of opinions of probable cost for the reservoir project. The opinion of probable costs has not been developed to the level of detail intended for this feasibility study because the site investigations and reservoir design analysis have not been completed.
- Streamflow Improvement Alternatives Evaluation – This section outlines the evaluation of other alternatives that were identified for improving the management of lower Peshastin Creek flows to meet instream and out-of-stream water uses, including a preliminary evaluation of the proposed Wenatchee River Pump Station.
- Permitting and Water Rights Evaluation– This section summarizes the status of the evaluation of permitting requirements and water rights. The permitting and water rights evaluation has not been developed to level of detail intended for the feasibility

study because the evaluation requires additional detail that would be gathered through site investigations and detailed design analysis.

- Summary and Recommendations
- References

Tables are included throughout the report and Figures are inserted at the ends of the sections of the report. Appendices follow the main body of the report. The appendices include supplemental information and placeholders for documents that are not available for inclusion in the feasibility study. These documents include design drawings, a detailed cost analysis, and design reports that have not yet been prepared because of property owner issues that have prevented access to the site for site investigations and gathering of field data.

Insert

Figure 1-1

Vicinity Map

2 BACKGROUND INFORMATION

The following includes a brief description of the project site, existing site conditions and existing water needs and availability. The background information was compiled from prior studies, including the *Multi-Purpose Water Storage Assessment in the Wenatchee River Watershed* and the *Peshastin Subbasin Needs and Alternatives Study*, Chelan County GIS data, limited field observations, aerial photography, and other available sources.

2.1 Project Site Description

2.1.1 Description

The proposed Campbell Creek Reservoir site is located in a small canyon in the foothills of the Cascade Mountains within the Peshastin Creek subbasin of the Wenatchee River Watershed. The Wenatchee River Watershed forms a portion of Ecology's Water Resource Inventory Area (WRIA) 45. The location of the proposed project is shown in Figure 1-1. Campbell Creek is a small, intermittent stream that discharges to Peshastin Creek approximately 3 miles upstream of the Wenatchee River. Campbell Creek Canyon is a deep v-shaped canyon, located between two relatively steep hillsides. Typical slopes on the sides of the canyon range from 20% to more than 60%. The hillsides are covered with natural grasses, shrubs, and pine trees. As is typical in the eastern foothills of the Cascade Mountains, tree coverage on south facing slopes is sparser than tree coverage on north facing slopes. The bottom of the canyon also has a relatively steep gradient (average 8-9%), sloping towards Peshastin Creek. The bottom of the canyon is more densely vegetated with grasses, trees and bushes.

An initial site review was completed in November 2006 as part of the *Peshastin Needs and Alternatives Study* to identify significant features in Campbell Creek Canyon. The following summarizes features that were identified as part of that effort:

- Wetlands – The National Wetland Inventory (NWI) mapping (USFWS, 2006) for the area was reviewed to identify wetlands that have been mapped by the United States Fish and Wildlife Service (USFWS). No wetlands appear on the NWI maps in Campbell Creek Canyon. However, the initial site visit and review of aerial photography done as part of the *Peshastin Needs and Alternatives Study* indicate that at least two small wetland areas likely exist in the bottom of the canyon

approximately 100 feet upstream of the Tandy pipeline. The wetland areas in Campbell Creek Canyon may be as much as 150 feet wide and may cover approximately 2.5 acres, as shown on Figure 2-1. A small control structure was observed at the downstream end of the lowest wetland area.

- Existing culverts - A series of at least three culverts convey Campbell Creek under the Tandy Pipeline, through private property and under Campbell Road near the mouth of Campbell Creek Canyon. A 24-inch HDPE culvert at Campbell Road is installed at a steep (approximately 1H:1V) slope. No flow was observed in the channel downstream of the culvert at Campbell Road during the initial site visit.

2.1.2 Location

The proposed project site is located entirely within federal lands administered by the USFS in Section 31, Township 24N, Range 18E, as shown in Figures 1-1 and 2-1. The site is approximately 0.5 miles west of Peshastin Creek and approximately 3 miles southwest of the confluence of Peshastin Creek and the Wenatchee River. The project is also located less than 0.5 miles west of U.S. Highway 97, which runs parallel and adjacent to Peshastin Creek. Local roads near the project site include Campbell Road. Access to Campbell Creek Canyon is currently only available through private properties near the mouth of the canyon.

2.1.3 Hydrology

The Campbell Creek basin includes approximately 520 acres of mostly steep terrain and extends from the mouth of Campbell Creek Canyon up to elevations of more than 3,000 feet. The elevation of Campbell Creek at the mouth of the Canyon is approximately 1,360 feet. The estimated average rainfall at the project site is just over 20 inches per year. The *Peshastin Needs and Alternatives Study* conservatively estimated that "250 acre-feet of natural runoff could be captured from the 520-acre Campbell Creek basin during normal years, provided discharge from the reservoir to Campbell Creek is reduced to a minimum when capturing flow."

2.1.4 Geology

Geology in the vicinity of the project includes low areas of alluvium (Qa) consisting of moderately sorted cobbles and gravels in the Peshastin River Channel and poorly graded

sandy soil at the mouths of tributary canyons. The hills surrounding the reservoir site are part of the Chumstick formation [Ec(2ch)] which is a sedimentary rock formation consisting of sandstone, shale and conglomerate. Bedrock outcroppings are visible on hillsides near the reservoir site. The U.S. Natural Resources Conservation Service (NRCS) *Soil Survey of Cashmere Mountain Area* (NRCS, 2007), lists the surficial soils at the reservoir sit as Cle Elum Loam, Varelum Loam, and Nard Sandy Loam. Cle Elum Loam and Varelum Loam consist of well-drained layers of loam and clay loam over shallow weathered bedrock. Nard Sandy Loam consists of well-drained sandy loam over shallow weathered bedrock.

2.2 Existing Water Needs and Availability

The *Peshastin Subbasin Needs and Alternatives Study* analysis provided a detailed evaluation of water needs in lower Peshastin Creek. Those needs include deliveries for irrigation and instream flow needs for passage of bull trout and Chinook salmon swimming upstream of the Wenatchee River. The following is a brief summary of the water needs evaluation prepared for that study.

2.2.1 Irrigation

There are two primary diversions from Peshastin Creek for irrigation. The Tandy Ditch Company diverts up to 4.6 cfs during the late summer to a pipeline for irrigation. Peshastin Irrigation District diverts up to 40 cfs during the late summer to an open canal for irrigation. Diversions typically occur from April through mid-September. Diversions typically peak in August and September. In addition to flows diverted from Peshastin Creek, Peshastin Irrigation District uses water diverted from a bifurcation structure on the Icicle Diversion 2 Canal when streamflow in Peshastin Creek is not adequate for water supply.

2.2.2 Fish Passage

The instream flow analysis provided as part of the *Peshastin Needs and Alternatives Study* indicated that "wide gravel bars in lower Peshastin Creek likely pose a significant barrier to fish passage at low flows." Chinook salmon require higher flows for passage than bull trout. Increased later summer flows are needed to increase depth to improve passage conditions in lower Peshastin Creek. The analysis indicated that the average flow rate required for Chinook passage across transects where flows were measured was approximately 40 cfs.

That flow requirement was compared against flow measurements from an Ecology gauge at Green Bridge Road, which is downstream of the diversions to the Tandy pipeline and the Peshastin Irrigation District canal. The data indicates that late summer flows at Green Bridge Road dropped below 10 cfs in 2003, 2004 and 2005. Data from an Ecology gauging station near Ingalls Creek, upstream of the diversions to the Tandy Pipeline and Peshastin Irrigation District canal, suggest that natural stream flows in Peshastin Creek typically drop below 40 cfs in the late summer. The analysis of instream flows suggested that modifications to the lower Peshastin Creek stream channel, such as straightening, bank armoring, and floodplain modifications, have likely impacted fish passage, even under normal late summer flow conditions with no diversions.

The proposed reservoir would be designed to supplement instream flows by discharging water back to Peshastin Creek and/or by serving irrigators directly so that streamflows remain in the creek. The reservoir would not have the capacity to ensure that a flow of 40 cfs is maintained in lower Peshastin Creek throughout the Chinook passage window. However, the reservoir would provide capacity to supplement streamflows or reduce irrigation diversions during low flow periods; and, if implemented with other improvement alternatives, would be able to mitigate most of the critical late summer low streamflows.

Insert

Figure 2-1

Conceptual Campbell Creek Reservoir Site Plan

3 SITE INVESTIGATIONS

The following provide a brief summary of the status of the site investigations that were planned to be included as part of this feasibility study. As noted previously, this report represents only partial completion of the site investigations that were included in the approved scope of work for the feasibility study. Site investigations have not been completed because private property owners have not agreed to allow access to the site to complete these investigations.

3.1 Property Ownership

The property owners that would be affected by construction of the reservoir were identified using parcel data available from Chelan County GIS. The initial evaluation of the proposed reservoir prepared for the *Peshastin Needs and Alternatives Study* assumed that the reservoir would be located close to the mouth of Campbell Creek Canyon, partially on private property. Initial discussions with private property owners indicated that they were not in favor of a reservoir that would directly impact their properties. Consequently, the reservoir location was revised, as shown in Figure 3-1. The revised reservoir site would be located entirely within federal land managed by the USFS. Figure 3-2 highlights the properties that would likely be directly or indirectly impacted by the reservoir at the revised location. The affected parcels are also listed in Table 3-1.

Table 3-1

Properties Affected by Proposed Campbell Creek Reservoir

Parcel Number	Owner	Address
241831000000	USFS	215 Melody Lane, Wenatchee, WA 98801
241831140050	Dan Dittrich	6326 Campbell Road, Peshastin, WA 98847
241831140080	Dan Dittrich	6326 Campbell Road, Peshastin, WA 98847
241831140120	Shaun Laird	6294 Campbell Road, Peshastin, WA 98847
241831140125	Piers Living Trust	6260 Campbell Road, Peshastin, WA 98847

Despite efforts to revise the proposed reservoir location to minimize the impact to private properties, the affected property owners have expressed consistent opposition to the reservoir project. Completion of field investigations on the property would not only require permission from the USFS, but would also require access through private properties at the

mouth of Campbell Creek Canyon. Although the property owners have been amiable and willing to discuss the project, they have not been willing to grant access to the site through their properties. Consequently, the additional site investigations included as part of the scope of this feasibility study have not been completed.

3.2 Topographic Survey

The topography of the site is characterized by a small, relatively narrow canyon between steep hillsides. The slopes of the sides of the canyon are typically in the 20%-60% range. The bottom of the canyon slopes toward Peshastin Creek at an average gradient of 8%-9%. Existing topographic information includes USGS topographic mapping. LiDAR coverage extends up the valley from Peshastin Creek to the mouth of Campbell Creek Canyon.

The detailed engineering analysis that was to be completed as part of this feasibility study included topographic survey of the reservoir site. The topographic survey is needed to prepare quantities and detailed drawings for construction of the reservoir, dam, associated piping, spillway, and pump station. Because access to the site has not been granted by the private property owners at the mouth of the canyon, this task has not yet been completed. A placeholder for topographic survey mapping has been provided as Appendix A.

3.3 Hydrology

As noted in the previous section, the Campbell Creek basin includes approximately 520 acres. The estimated average rainfall at the project site is just over 20 inches per year. The scope of work for the feasibility study included a hydrology investigation. As part of the hydrology investigation, a flow measurement device would have been installed at the mouth of Campbell Creek Canyon to monitor flow rates in Campbell Creek. The flow data would have been used to more precisely estimate the potential yield from natural runoff in the existing drainage basin. Because access to the site has not been granted by the private property owners at the mouth of the canyon, this task has not yet been completed. Appendix B has been provided as a placeholder for a short report summarizing site hydrology and flow measurements that would be completed following the on-site investigation.

3.4 Geotechnical

Based on review of geology mapping for the project site, the site geology includes alluvium (Qa), consisting of moderately sorted cobbles and gravels in the Peshastin River Channel and poorly graded sandy soil at the mouths of tributary canyons, and the Chumstick formation [Ec(2ch)], which consists of a sedimentary rock formation consisting of sandstone, shale and conglomerate underlying the hillsides adjacent to the canyon. The scope of work for the feasibility study included geotechnical exploration and preparation of a soils report. Field sampling and subsequent testing and characterization of on-site soils has not been completed because access to the site has not been granted by the private property owners at the mouth of the canyon. A geology map of the site has been provided as Figure 3-3. Appendix C has been included as a placeholder for the geotechnical report, which has not ~~yet~~ been prepared.

3.5 Wetlands Delineation

An initial site visit made during the preparation of the Peshastin Subbasin Needs and Alternatives Study indicated that there are wetlands present in the bottom of Campbell Creek Canyon. These wetland areas would be impacted by construction of the reservoir. The scope of work for the feasibility study included a survey of wetlands, as well as a review of other environmental resources and permitting requirements. Wetland delineation and other field work needed to complete the evaluation of environmental resources and permitting has not been completed because access to the site has not been granted by the private property owners at the mouth of the canyon. Appendix D has been included as a placeholder for the wetland delineation and environmental resources review.

Insert
Figure 3-1
Revised Reservoir Location

Insert
Figure 3-2
Properties Impacted by Proposed Reservoir

Insert
Figure 3-3
Reservoir Site Geology

4 RESERVOIR DESIGN ANALYSIS

The scope of work for the feasibility study was intended to result in development of engineering analyses and designs for the Campbell Creek Reservoir project to a feasibility level (~~%~~30 complete). Completion of the detailed engineering task would have included analysis and design of the reservoir embankment location and configuration, mapping of existing features using topographic survey information, and development of preliminary plans, sections, and details showing the proposed reservoir, embankment, emergency spillway, pipelines, pump station, and connection to the existing Tandy Ditch pipeline. The results of the site investigations outlined in the previous section are needed to complete the design analysis of the reservoir project and develop feasibility level design drawings. Because the site investigations have not been completed, the reservoir design has not progressed to the feasibility level yet.

This section includes a summary of the design analysis work completed to date. A placeholder has been provided in Appendix E for feasibility level (30% complete) reservoir drawings. Preliminary design calculations are included in Appendix F. These calculations do not represent the level of detail intended for this feasibility study. However, initial calculations were completed to estimate storage capacity, pump sizing, and pipeline sizing for the reservoir concept shown in Figure 2-1.

4.1 Summary of Proposed Facilities

The following is a summary of the major facilities that would likely be constructed as part of the Campbell Creek Reservoir project, per the concept shown in Figure 2-1:

- A 22.4-acre reservoir with a storage capacity of approximately 1,000 acre-feet
- A 140-foot-high, 834-foot-long concrete-faced rock-fill embankment dam
- An emergency spillway
- A 24-inch low level outlet pipe
- A 15-inch inlet pipeline connecting the pump station to the reservoir
- A pump station with two 55-horsepower pumps
- A 15-inch suction connection from the Tandy Ditch pipeline to the pump station
- Site improvements to create access and provide proper spacing, protection and screening for the pump station, pipeline, and reservoir facilities.

4.2 Project Design Criteria

The intent of the project is to provide storage that can be used to augment late summer flows in Peshastin Creek or replace late summer diversions from Peshastin Creek to increase instream flows and improve fish passage conditions. The following are preliminary design criteria or preferences that would be addressed through detailed design of the facilities:

- Storage Capacity – The reservoir capacity would be optimized to provide the maximum storage capacity within the space available, while keeping the costs and design of the project feasible.
- Pumping Capacity – The pumping capacity would be limited by the capacity of the Tandy pipeline, estimated at 4 cfs. If the pump station can consistently deliver 4 cfs to the reservoir during the high flow period, the 1,000 acre-foot reservoir can be completely refilled in approximately 126 days.
- Piping – Pipelines would be sized to minimize headlosses and pumping head, while also keeping pipe sizes and related installation costs to a minimum. As a rule of thumb, pipelines would be sized to limit velocities to approximately 5 feet per second and headlosses to approximately 5 feet per thousand feet of pipe.
- Dam – The dam would be designed to minimize the cost and volume of material required, while working within site limitations and other design constraints.

4.3 Site Preparation

Construction of the reservoir, dam, pipelines, and pump station would require the following site preparation work:

- Clearing and grubbing the footprint of the facilities, a perimeter area within approximately 20 feet of the facilities, and access areas
- Removal and sale or disposal of trees
- Stripping and stockpiling of organic topsoil material
- Diversion and care of surface water and groundwater
- Implementation and maintenance of temporary erosion and sediment control (TESC) measures
- Establishing temporary and permanent access to the site of existing roadways
- Seeding of cleared areas not inundated by the reservoir
- Installation of security fencing

4.4 Reservoir Embankment

The proposed reservoir would be formed by constructing an embankment dam consisting of approximately 390,000 total cubic yards of material, as shown in Figure 2-1. The design analysis of the embankment has not been completed to the level of detail anticipated for this feasibility study. Consequently, the type, dimensions, volume, and material of the embankment dam have not been determined. However, it is anticipated that construction of a concrete-faced rock-fill embankment dam would create a reservoir with sufficient storage capacity within the space constraints of the sight, as shown in Figure 2-1. The dam would be approximately 140 feet high from the downstream toe to the crest and would have an upstream slope of 1.4H:1V and a downstream slope of 1.4H:1V. The dam would create a reservoir with a total storage capacity of approximately 1,000 acre-feet and a high water surface elevation of approximately 1,537 feet. Preliminary reservoir and embankment sizing calculations are included in Appendix F.

4.5 Reservoir Lining

It is anticipated that a portion of the reservoir will require a lining to reduce seepage into the soil below. Because the design analysis of the reservoir cannot be completed to the level of detail intended for this feasibility study at this time, the type and characteristics of the reservoir lining have not been determined.

4.6 Pump Station and Inlet Pipeline

Preliminary sizing calculations for the pump station and inlet pipeline have been provided in Appendix F. The preliminary calculations indicate that a pump station designed to deliver up to 4 cfs from the Tandy pipeline to the proposed reservoir for storage would require two 55-horsepower pumps. A third pump of equal size could be included for redundancy. A detailed analysis of different pump types and configurations has not been completed yet. It is anticipated that the pump station would include a CMU building, an extension of 3-phase electrical power service, electrical and control panels, pumps with variable frequency drives (VFDs), piping, fittings, valves, a meter, and other appurtenances.

4.7 Outlet and Spillway

A low level outlet would be provided that would extend from the lower part of the reservoir to Campbell Creek at the downstream side of the embankment dam to allow for release of reservoir water to Peshastin Creek via Campbell Creek. Flow through the low level outlet would be controlled by a gate or valve. A trash rack would be constructed around the entrance to the low level outlet to prevent debris from entering the pipeline. Appendix F includes preliminary sizing calculations for the low level outlet. It is estimated that a 24-inch pipe would provide sufficient capacity to allow for drawing down of the reservoir through the low level outlet. Upgrades to the Campbell Creek channel downstream of the embankment dam would likely be required to ensure that sufficient conveyance capacity is available from the reservoir to Peshastin Creek.

4.8 Reservoir Operations and Controls

A detailed analysis of reservoir operation and controls would need to be completed as part of the development of feasibility level designs for the reservoir facility. The more detailed analysis would determine:

- Analysis of timing and duration of pumping from the Tandy pipeline
- Coordination of pumping with instream flows in Peshastin Creek
- Control of pumping based on reservoir levels
- Timing and duration of deliveries from reservoir storage
- Comparison of deliveries to Peshastin Creek versus deliveries for irrigation

5 OPINION OF PROBABLE COSTS

An opinion of probable costs based on the feasibility level (30% complete) reservoir design has not been completed. However, preliminary opinions of the probable costs for 500-acre-foot and 1,000-acre-foot reservoir concepts were developed as part of the *Peshastin Subbasin Needs and Alternatives Study*. The opinions of total project costs developed as part of that study were as follows:

- $10 million, or $20,000 per acre-foot of storage for a 500-acre-foot reservoir
- $16.6 million, or $16,600 per acre-foot of storage for a 1,000-acre-foot reservoir

The opinion of costs for the 1,000-acre-foot storage reservoir concept was updated based on the current project concept shown in Figure 2-1. The total opinion of cost for the current 1,000-acre-foot reservoir project concept is approximately $18.4 million. The opinion of cost includes an allowance for wetland mitigation; mobilization/demobilization (10%); planning and construction contingency (30%); engineering, design, environmental review, permitting and construction management (20%); taxes (8.0%) and land acquisition. A summary of the opinion of cost is included in Table 5-1. Details are included in Appendix G.

Table 5-1
Campbell Creek Reservoir – Opinion of Probable Costs

Item	Cost
Site Work	$468,800
Reservoir Earthwork	$8,980,870
Pipe and Fittings	$164,250
Pump Station	$150,000
Emergency Spillway/Overflow	$147,000
Wetland Mitigation	$375,000
CONSTRUCTION SUBTOTAL	$10,286,000
Mobilization/Demobilization (10%)	$1,028,600
Contingency (30%)	$3,394,380
Engineering and Admin. (20%)	$2,262,920
Tax (8.0%)	$1,357,752
Land Acquisition	$50,000
TOTAL PROJECT COSTS	$18,380,000

The opinion of probable operating costs for the current 1,000-acre-foot storage reservoir concept was also updated, as summarized in Table 5-2. The opinion of cost includes operations and maintenance (O&M) costs and pumping power costs. O&M are anticipated to be with the range of 1 percent to 2 percent of the construction subtotal plus mobilization/demobilization costs from Table 5-1. The O&M cost below represents 1 percent of the construction subtotal plus mobilization/demobilization costs. Power costs were calculated for three pumping durations based on a pump station with two 55-horsepower pumps and Chelan PUD electrical rate Schedule 2, Part A-2 for general electrical service. At a flow rate of 4 cfs, the pump station would need to operate for approximately 18 weeks to deliver 1,000 acre-feet of water to the reservoir for storage. Details are included in Appendix G.

Table 5-2

Campbell Creek Reservoir – Opinion of Probable Operating Costs

Item	Cost
Annual O&M Costs[1]:	$113,100
Pumping Power Costs[2]:	
12-Week Annual Pumping Duration	$4,732
15-Week Annual Pumping Duration	$5,741
18-Week Annual Pumping Duration	$6,928
Total Annual Operating Costs[3]:	
12-Week Annual Pumping Duration	$117,800
15-Week Annual Pumping Duration	$118,800
18-Week Annual Pumping Duration	$120,000

Notes:

1. Annual O&M Costs estimated as 1% of the estimated construction and mobilization costs, rounded to the nearest $100. See Table 5-1 for construction and mobilization costs.
2. Pumping costs are based on Chelan PUD Electrical Rate Schedule 2 (General Service).
3. Total Annual Operating Costs are rounded to the nearest $100.

6 STREAMFLOW IMPROVEMENT ALTERNATIVES EVALUATION

The *Peshastin Subbasin Needs and Alternatives Study* (Anchor, EES, 2007) identified additional alternatives for improving streamflow in lower Peshastin Creek. These alternatives included piping and/or lining of Peshastin Irrigation District facilities to increase water use efficiency and reduce diversions; construction of a pump station on the Wenatchee River to deliver water to the Peshastin Irrigation District ditch, which would be offset by a reduction of diversions from Peshastin Creek; and modification of the Peshastin Creek Channel to reduce the flow requirement for fish passage. This section focuses primarily on the construction of a pump station on the Wenatchee River.

6.1 Wenatchee River Pump Station

This streamflow improvement alternative that would include construction of a pump station on the Wenatchee River to deliver flows to Peshastin Irrigation District. The pump station deliveries would be offset by a reduction in diversions from Peshastin Creek, which would increase streamflow in the lower reach of Peshastin Creek during the irrigation season and improve fish passage conditions. The following provides a description of the alternative and a summary of the design analysis completed for this study.

6.1.1 Project Description

The Wenatchee River pump station would be located along the Wenatchee River at a suitable location downstream of Peshastin Creek. The project would involve constructing the following facilities:

- Pump Station – The pump station would be designed to deliver water from the Wenatchee River to the Peshastin Irrigation District ditch and would likely include 2 or 3 pumps running in parallel. The pumps would draw water from a wet well fed by flow diverted from the Wenatchee River.
- Fish Screening –The design of the pump station would need to incorporate fish screening capabilities, consistent with National Marine Fisheries Service (NMFS) guidelines and Washington State Department of Fish and Wildlife (WDFW) regulations. The likely screen type for a pump station constructed in a riverbank would be a fixed plate inclined screen. The screen would be self-cleaning to minimize maintenance and ensure adequate performance.

- Pipe – The pumps would discharge through a manifold of valves, fittings, and appurtenances into a transmission line that would convey water to the Peshastin Irrigation District ditch for delivery to irrigators.
- Delivery Structure – The pipeline would require a delivery structure at the ditch to maintain proper hydraulic control and dissipate the energy of the water discharged from the pipeline to prevent ditch erosion.

6.1.2 Design Criteria

The following criteria and assumptions were considered for evaluating the feasibility of the improvements described in this section:

- Pump Station – A range of pump station flow rates, from 10 cfs to 40 cfs, were evaluated. It was assumed that pump station would include 2 or 3 pumps and that the pumps would operate simultaneously to deliver the total flow.
- Fish Screening – The design of fish screening facilities was evaluated based on the *NMFS Anadromous Salmonid Passage Facility Design* guidelines (NMFS, 2008), developed by the NMFS Northwest Region in February 2008. The criteria applicable to the design of a pump station intake constructed on the Wenatchee River would include:
    - Maximum approach velocity = 0.4 feet per second (assumes active screen)
    - Effective Screen Area = Maximum Screen Flow/Approach Velocity
    - Sweeping Velocity = 0.8 feet per second to 3.0 feet per second

  The design area of the screen was calculated by multiplying the effective screen area by 1.27, to accommodate a factor of safety of 27%.
- Pipe – Pipe was evaluated based on balancing pressure loss in the delivery pipeline with the corresponding increase in pumping head required. Pressure pipe is typically sized to limit velocities to 5 feet per second. This was used as a starting point for the hydraulic analysis that was completed to size the pipeline. The Hazen-Williams formula was used for the analysis. Hazen-Williams coefficients (C) were conservatively assumed to be 130 for plastic pipe and 110 for steel pipe.

6.1.3 Water Supply and Yield

The pump station would draw water from the Wenatchee River. Flows diverted from the Wenatchee River by the pump station would be offset by reducing diversions from Peshastin Creek. As a result, the project would increase flows during the irrigation season in the lower reach of Peshastin Creek and in a short reach of the Wenatchee River between Peshastin Creek and the pump station. The project would have no net impact on flows in the Wenatchee River downstream of the pump station.

6.1.4 Evaluation of Facility Locations and Alignments

As part of this evaluation, five potential pump station facility locations and pipeline alignments were identified. The pump station locations and pipeline alignments evaluated as part of this study are shown in Figure 6-1. The following provides a description of each:

1. Alignment 1 – Alignment 1 would include a pump station located on the south bank of the Wenatchee River, just southwest side of U.S. Highway 2, approximately 7,490 feet downstream of the confluence of Peshastin Creek with the Wenatchee River. The pump station would deliver water to a pipeline that would extend south and west through an existing orchard. The pipeline would ascend the hill below the ditch at an average slope of 31% and discharge water through an outlet structure to the ditch approximately 19,560 feet downstream of the diversion at Peshastin Creek.
2. Alignment 2 – Alignment 2 would include a pump station located on the south bank of the Wenatchee River, just northeast of U.S. Highway 2, approximately 7,720 feet downstream of the confluence of Peshastin Creek with the Wenatchee River. The pump station would deliver water to a pipeline that would extend south and east between an existing orchard and U.S. Highway 2. The pipeline would cross U.S. Highway 2 at its intersection with Dryden Avenue and extend west across another private orchard to the base of the hill. The pipeline would ascend the hill below the ditch at an average slope of 31% and discharge water through an outlet structure at the same location described for Alignment 1.
3. Alignment 3 – Alignment 3 would include a pump station located on the south bank of the Wenatchee River, just southwest of U.S. Highway 2, approximately 4,675 feet downstream of the confluence of Peshastin Creek with the Wenatchee River. The pump station would deliver water to a pipeline that would extend west along the

south side of U.S. Highway 2 and ascend the hill to an access road for the Dryden Landfill. The pipeline would follow the access road to the south and west and then ascend a hillside at a slope of approximately 56% to an outlet on the ditch approximately 14,900 feet downstream of the diversion at Peshastin Creek.

4. Alignment 4 – Alignment 4 would include a pump station located on the south bank of the Wenatchee River adjacent to an orchard north of Motel Road. The pump station would be approximately 2,860 feet downstream of the confluence of Peshastin Creek with the Wenatchee River. The pump station would deliver water to a pipeline that would extend south and west along the edge of the private orchard to Foster Road. The pipeline would cross U.S. Highway 2 at Foster Road and follow a small dirt access road up the hill to the ditch at an average slope of approximately 17%. The pipeline would terminate at an outlet structure on the ditch approximately 14,210 feet downstream of the diversion at Peshastin Creek.
5. Alignment 5 – Alignment 5 would include a pump station located on the south bank of the Wenatchee River just upstream of the Dryden diversion dam and screening facility. The pump station would deliver water to a pipeline that would extend west along the Dryden dam access road to Saunders Road. The pipeline would follow Saunders Road to U.S. Highway 2 and would cross U.S. Highway 2 to Deadman Hill Road. The pipeline would follow Deadman Hill Road to an outlet structure on the ditch approximately 12,860 feet downstream of the diversion at Peshastin Creek.

Hydraulic analyses were completed to determine the preliminary size of pumps and piping needed to deliver flows from the Wenatchee River to the Peshastin Irrigation District ditch. The analyses were completed for a range of flows, from 10 cfs to 40 cfs. The results of the analyses are included in Appendix H. The challenges and benefits of each alignment were identified based on the results of the hydraulic analysis, an evaluation of property boundaries and other site restrictions, and observations made during a site visit. A comparison of the alignments evaluated is included in Table 6-1.

Table 6-1
Wenatchee Pump Station Alternative – Alignment Comparison

ALGINMENT	1	2	3	4	5
PUMP STATION LOCATION:	South Side of Highway 2, Approx. 7,490 Feet Downstream of Peshastin Creek	North Side of Highway 2, Approx. 7,720 Feet Downstream of Peshastin Creek	South Side of Highway 2, Approx. 4,675 Feet Downstream of Peshastin Creek	North Side of Highway 2, Approx. 2,860 Feet Downstream of Peshastin Creek	North Side of Highway 2, Approx. 680 Feet Downstream of Peshastin Creek
DISCHARGE LOCATION:	PID Ditch, Approx. 19,560 Feet Downstream of Diversion, Elev.~1,148	PID Ditch, Approx. 19,560 Feet Downstream of Diversion, Elev.~1,148	PID Ditch, Approx. 14,900 Feet Downstream of Diversion, Elev.~1,152	PID Ditch, Approx. 14,210 Feet Downstream of Diversion, Elev.~1,156	PID Ditch, Approx. 12,860 Feet Downstream of Diversion, Elev.~1,158
DELIVERY PIPE LENGTH (FT):	1,391	2,607	1,654	3,086	4,876
DELIVERY PIPE SIZE (IN):					
10 CFS	20	20	20	20	20
20 CFS	30	30	30	30	30
40 CFS	36	36	36	36	36
# PUMPS RECOMMENDED:					
10 CFS	2	2	2	2	2
20 CFS	3	3	3	3	3
40 CFS	3	3	3	3	3
PUMPING HEAD, TDH (FEET):					
10 CFS	237	242	227	223	211
20 CFS	234	237	223	217	202
40 CFS	239	243	226	223	210
HORSEPOWER/PUMP:					
10 CFS	192	196	184	180	171
20 CFS	253	256	241	234	218
40 CFS	517	525	488	482	453
# PROPERTIES IMPACTED:	2	5	4	8	5
CHALLENGES:	-Proximity to Highway 2 -Steep, Eroding Bank at Pump Sta. Site -Difficult Access to Pump Sta. Site -Crosses Private Orchard -Steep Pipeline Alignment -Potentially Shallow, Rocky at Intake	-Proximity to Highway 2 -Crosses Highway. 2 -Steep Pipeline Alignment -Highest Horsepower, High Pump $ -Potentially Shallow, Rocky at Intake	-Proximity to Hwy. 2 -Crosses Private Properties -Steep Pipeline Alignment -Difficult Access to Pump Sta. Site	-Crosses Highway 2 -Crosses Private Orchards -Least Accessible Pump Sta. Site -Long Pipe Length, Pipe $ -Most Properties Impacted	-Crosses Highway 2 -Longest Pipe Length, Highest Pipe $
BENEFITS:	-Short Pipe Length, Lower Pipe $ -No Highway Crossing Required -Accessible Delivery Location -Fewest Properties Impacted	-Short Pipe Length, Lower Pipe $ -Accessible Pump Sta. Site -Accessible Delivery Location	-Short Pipe Length, Lower Pipe $ -No Highway Crossing Required -Accessible Delivery Location	-Uses Driveways, Roadways -Less Elevation Gain Required	-Accessible Pump Sta. Site -Accessible Delivery Site -Uses Driveways, Roadways -Least Elevation Gain Required -Lowest Horsepower, Pump $ -Upstream of Dam, Level Control -Favorable Intake Conditions

The following are some of the notable challenges that may be encountered through the implementation of the Wenatchee River pump station alternative:

- The pumps station sites for Alignments 1, 2 and 3 would be located adjacent to U.S. Highway 2. There may be challenges in constructing the pump station within or near the traveled right-of-way adjacent to a highway bridge.
- The pipeline for Alignments 2, 4 and 5 would have to cross U.S. Highway 2. Crossing the highway would likely require directional drilling or jacking, which would add significantly to the cost of pipeline construction.
- Alignments 1, 2, and 3 are relatively steep, especially near the ditch. Construction and maintenance of the pipeline over steep terrain could be difficult.
- All of the alignments would impact private property and would require the cooperation of private property owners.
- Alignments 4 and 5 would require relatively long pipelines, resulting in higher pipeline costs.
- The pump station locations for Alignments 1 and 2 may not have ideal intake conditions under low flows. Field observations and photos taken during low flow conditions indicate that there is a lot of large exposed rock and potentially shallow water conditions at these locations during the late summer. Maintaining consistent flow through the intake to the wet well would be difficult if there wasn't constant submergence on the intake facility. Photos of these locations under late summer flow conditions are included Appendix H.
- The stability of the riverbank near the pump station location for Alignment 1 is questionable. The river makes a wide bend just upstream of this location and significant erosion of the hillside has occurred.

The following summarizes some of notable benefits of the alignments considered:

- Alignments 1 and 3 would not cross U.S. Highway 2 and would be relatively short in length, resulting in lower pipeline costs.
- Alignments 4 and 5 would require less elevation gain between the pump station and the ditch. As a result, pumping head and horsepower requirements would be less.
- Alignment 5 would have the most suitable intake conditions because it would be located upstream of Dryden Dam and would benefit from the water level control the dam provides.

6.1.5 Intake and Screening

The pump station facility would be built into the riverbank and would include a fish screen consistent with NMFS and WDFW guidelines. Different types of screens are available that meet NMFS and WDFW guidelines. A fixed plate screen and a cylindrical end-of-pipe screen were both considered for this application. Based on the flows desired, an inclined fixed plate screen would be a more likely screen configuration. The proposed screen and intake facility would be constructed of reinforced concrete placed on structural fill. The facility would conform to the general slope of the riverbank, with screened inlets inclined to generally match the topography of the riverbank.

As was noted previously, in order to minimize maintenance and ensure proper performance, the screen would need to be self cleaning. Likely self-cleaning options for an inclined, fixed plate screen would include a mechanical air-burst system, or mechanical brush. Another similar option would include a traveling water screen that would rotate on a conveyor. Debris would be lifted out of the water and removed with a self-cleaning mechanism. Table 6-2 provides a summary of the design parameters and sizes required for fixed plate screen for flows up to 40 cfs. Figure 6-2 provides a conceptual sketch of an intake and pump station constructed in the riverbank with a self-cleaning, inclined fixed plate screen.

Table 6-2
Wenatchee Pump Station Alternative – Fish Screen Sizing

Maximum Screen Flow (cfs)	Maximum Approach Velocity (fps)	Effective Screen Area (ft^2)	Screen Area With F.O.S. (ft^2)	Total Screen Height (feet)	Total Screen Length (feet)
10	0.4	25.00	31.75	4.0	7.9
15	0.4	37.50	47.63	4.0	11.9
20	0.4	50.00	63.50	4.0	15.9
25	0.4	62.50	79.38	4.0	19.8
30	0.4	75.00	95.25	4.0	23.8
35	0.4	87.50	111.13	4.0	27.8
40	0.4	100.00	127.00	4.0	31.8

Table notes:
F.O.S. = Factor of Safety

6.1.6 Pumps and Pump Station Equipment

The pump station would include two or three pumps designed to draw water from a wet well, as shown in Figure 6-2. Table 6-1 outlined preliminary sizing for the following pumping configurations for each alignment:

- A total pump station capacity of 10 cfs, with two 5.0-cfs pumps
- A total pump station capacity of 20 cfs, with three 6.7-cfs pumps
- A total pump station capacity of 40 cfs, with three 13.3-cfs pumps

The pumps would be vertical turbine pumps with a motor and pump discharge head installed on a reinforced concrete slab over the wet well. The pump column and impeller would extend into the wet well. A pump manufacturer was contacted to provide information for a pump that would deliver 6.7 cfs (2992 gpm) at 223 feet of total dynamic head (TDH), which represents one of the three pumps that would be required to deliver a total of 20 cfs from the Wenatchee River to the Peshastin Irrigation ditch via Alignment 3. Pumps required for other alignments under a 20-cfs pump station scenario would be similar. The pump curve and other pump information are included in Appendix H.

It is anticipated that each of the pumps would be driven by an electric motor energized by a three-phase electrical service. Because extending three-phase power to a site can be relatively expensive, it would be beneficial to locate the pump station near the Highway or Dryden Dam where it is more likely that three phase power is already available. It is also anticipated that the pumps would be equipped with automatic controls and variable frequency drives (VFDs) to allow the pumps to meet a variety of inlet conditions and provide more flexibility in delivering a range of flows.

The pump station would also include pipe, fittings, valves, a flow meter, and other appurtenances. The pipe and fittings with the pump station would likely be welded steel. Exposed fittings and valves would be flanged. A check valve or pump control valve would be installed on the discharge side of the pump to protect each pump from water hammer. Butterfly valves would also be installed for isolation and maintenance. A discharge header would convey flows to a flow meter and transmission pipeline

6.1.7 Pipeline and Delivery to PID Ditch

Table 6-1 outlined preliminary sizing for transmission pipelines sized to deliver a range of flows from the Wenatchee River to the Peshastin ID ditch. The following sizes were selected:

- A 20-inch pipeline for delivery of 10 cfs
- A 30-inch pipeline for delivery of 20 cfs
- A 36-inch pipeline for delivery of 40 cfs

Depending on the flow rate and alignment of the pipeline, maximum pressures could be as high as 105 psi in the pipeline near the pump station. Consequently, it is recommended that the pipeline be rated for at least 150 psi. Pipeline materials will also depend on the flow rate chosen for design. Pipe material options would include PVC, ductile iron, HDPE, and welded steel.

Delivery to the PID ditch would require an outlet structure that would dissipate the energy of the water from the pipeline before discharging the water to the ditch to prevent ditch erosion. The outlet structure would likely be a reinforced concrete structure with baffles or a riser designed to dissipate energy. A typical energy dissipating structure design by the United States Bureau of Reclamation is included in Appendix H.

6.1.8 Opinion of Probable Construction Costs

Tables 6-3 through 6-5 include opinions of probable costs for a typical 10-cfs, 20-cfs and 40-cfs pump station, delivery pipeline and outlet structure for each alignment. The costs include a 7.5% allowance for mobilization/demobilization, a planning contingency of 30%, a 20% allowance for engineering and construction administration, and an 8.0% sales tax. The opinion of probable costs also includes an allowance of $50,000 for property acquisition required for a pump station and pipeline easements.

The opinion of the probable costs for implementing this alternative ranges from $1.5 million for a 10-cfs facility constructed along Alignment 1 to $5.1 million for a 40-cfs facility constructed along Alignment 5. Detailed cost information, including and list of major construction items and associated unit costs, are included in Appendix H.

Table 6-3

Wenatchee Pump Station – Opinion of Probable Costs (10-cfs)

Item	Alignment 1	Alignment 2	Alignment 3	Alignment 4	Alignment 5
Misc. Site Work	$56,353	$65,341	$56,389	$69,951	$67,588
Earthwork	$34,723	$58,146	$39,789	$67,373	$101,853
Pump Station	$634,600	$634,600	$634,600	$634,600	$634,600
Pipeline	$79,983	$449,903	$95,105	$477,445	$580,370
Outlet Structure	$4,500	$4,500	$4,500	$4,500	$4,500
CONSTRUCTION SUBTOTAL	$810,000	$1,212,000	$830,000	$1,254,000	$1,389,000
Mobilization/Demobilization (10%)	$81,000	$121,200	$83,000	$125,400	$138,900
Contingency (30%)	$267,300	$399,960	$273,900	$413,820	$458,370
Engineering and Admin. (20%)	$178,200	$266,640	$182,600	$275,880	$305,580
Tax (8.0%)	$106,920	$159,984	$109,560	$165,528	$183,348
Land Acquisition	$50,000	$50,000	$50,000	$50,000	$50,000
TOTAL PROJECT COSTS	$1,493,000	$2,210,000	$1,529,000	$2,285,000	$2,525,000

Table 6-4

Wenatchee Pump Station – Opinion of Probable Costs (20-cfs)

Item	Alignment 1	Alignment 2	Alignment 3	Alignment 4	Alignment 5
Misc. Site Work	$58,353	$68,341	$58,389	$72,951	$71,588
Earthwork	$49,121	$82,276	$56,292	$95,337	$144,143
Pump Station	$1,004,200	$1,004,200	$1,004,200	$1,004,200	$1,004,200
Pipeline	$121,017	$586,809	$143,898	$628,482	$784,212
Outlet Structure	$6,000	$6,000	$6,000	$6,000	$6,000
CONSTRUCTION SUBTOTAL	$1,239,000	$1,748,000	$1,269,000	$1,807,000	$2,010,000
Mobilization/Demobilization (10%)	$123,900	$174,800	$126,900	$180,700	$201,000
Contingency (30%)	$408,870	$576,840	$418,770	$596,310	$663,300
Engineering and Admin. (20%)	$272,580	$384,560	$279,180	$397,540	$442,200
Tax (8.0%)	$163,548	$230,736	$167,508	$238,524	$265,320
Land Acquisition	$50,000	$50,000	$50,000	$50,000	$50,000
TOTAL PROJECT COSTS	$2,258,000	$3,165,000	$2,311,000	$3,270,000	$3,632,000

Table 6-5
Wenatchee Pump Station – Opinion of Probable Costs (40-cfs)

Item	Alignment 1	Alignment 2	Alignment 3	Alignment 4	Alignment 5
Misc. Site Work	$63,353	$72,341	$63,389	$77,951	$76,588
Earthwork	$63,101	$102,071	$70,981	$117,697	$176,093
Pump Station	$1,608,400	$1,608,400	$1,608,400	$1,608,400	$1,608,400
Pipeline	$159,965	$719,805	$190,210	$774,890	$980,740
Outlet Structure	$10,000	$10,000	$10,000	$10,000	$10,000
CONSTRUCTION SUBTOTAL	$1,905,000	$2,513,000	$1,943,000	$2,589,000	$2,852,000
Mobilization/Demobilization (10%)	$190,500	$251,300	$194,300	$258,900	$285,200
Contingency (30%)	$628,650	$829,290	$641,190	$854,370	$941,160
Engineering and Admin. (20%)	$419,100	$552,860	$427,460	$569,580	$627,440
Tax (8.0%)	$251,460	$331,716	$256,476	$341,748	$376,464
Land Acquisition	$50,000	$50,000	$50,000	$50,000	$50,000
TOTAL PROJECT COSTS	$3,445,000	$4,528,000	$3,512,000	$4,664,000	$5,132,000

6.1.9 Opinion of Probable Operational Costs

Tables 6-6 through 6-8 include opinions of the probable annual operational costs for a typical 10-cfs, 20-cfs and 40-cfs pump station, delivery pipeline and outlet structure for each alignment. Costs were estimated for annual pumping durations of 2 weeks, 4 weeks, 6 weeks, and 8 weeks. The costs include an allowance for operations and maintenance equal to 1 percent of the estimated construction and mobilization costs and power costs, estimated based on Chelan PUD electrical rate Schedule 2, Part A-2 for general electrical service.

Total estimated operational costs for operating a 10-cfs pump station for two weeks a year range from $20,900 to $33,400. Operational costs for operating a 10-cfs pump station eight weeks a year range from $28,600 to $40,200.

Total estimated operational costs for operating a 40-cfs pump station for two weeks a year range from $54,200 to $73,500. Operational costs for operating a 40-cfs pump station eight weeks a year range from $85,300 to $100,800.

Table 6-6

Wenatchee Pump Station – Opinion of Probable Operating Costs (10-cfs)

Item	Alignment 1	Alignment 2	Alignment 3	Alignment 4	Alignment 5
Annual O&M Costs[1]:	$8,900	$13,300	$9,100	$13,800	$15,300
Pumping Power Costs[2]:					
2-Week Annual Pumping Duration	$3,133	$3,196	$3,008	$2,953	$2,796
4-Week Annual Pumping Duration	$5,482	$5,594	$5,259	$5,161	$4,882
6-Week Annual Pumping Duration	$8,480	$8,655	$8,132	$7,979	$7,543
8-Week Annual Pumping Duration	$10,829	$11,052	$10,382	$10,187	$9,629
Total Annual Operating Costs[3]:					
2-Week Annual Pumping Duration	$12,000	$16,500	$12,100	$16,800	$18,100
4-Week Annual Pumping Duration	$14,400	$18,900	$14,400	$19,000	$20,200
6-Week Annual Pumping Duration	$17,400	$22,000	$17,200	$21,800	$22,800
8-Week Annual Pumping Duration	$19,700	$24,400	$19,500	$24,000	$24,900

Notes:

4. Annual O&M Costs estimated as 1% of the estimated construction and mobilization costs, rounded to the nearest $100. See Tables 6-3 through 6-5 for construction and mobilization costs.
5. Pumping costs are based on Chelan PUD Electrical Rate Schedule 2 (General Service).
6. Total Annual Operating Costs are rounded to the nearest $100.

Table 6-7

Wenatchee Pump Station – Opinion of Probable Operating Costs (20-cfs)

Item	Alignment 1	Alignment 2	Alignment 3	Alignment 4	Alignment 5
Annual O&M Costs[1]:	$13,600	$19,200	$14,000	$19,900	$22,100
Pumping Power Costs[2]:					
2-Week Annual Pumping Duration	$6,065	$6,144	$5,799	$5,634	$5,250
4-Week Annual Pumping Duration	$10,701	$10,841	$10,227	$9,934	$9,250
6-Week Annual Pumping Duration	$16,632	$16,850	$15,891	$15,433	$14,365
8-Week Annual Pumping Duration	$21,268	$21,547	$20,319	$19,732	$18,365
Total Annual Operating Costs[3]:					
2-Week Annual Pumping Duration	$19,700	$25,300	$19,800	$25,500	$27,300
4-Week Annual Pumping Duration	$24,300	$30,000	$24,200	$29,800	$31,300
6-Week Annual Pumping Duration	$30,200	$36,000	$29,900	$35,300	$36,500
8-Week Annual Pumping Duration	$34,900	$40,700	$34,300	$39,600	$40,500

See Notes Table 6-6

Table 6-8
Wenatchee Pump Station – Opinion of Probable Operating Costs (40-cfs)

Item	Alignment 1	Alignment 2	Alignment 3	Alignment 4	Alignment 5
Annual O&M Costs[1]:	$21,000	$27,600	$21,400	$28,500	$31,400
Pumping Power Costs[2]:					
2-Week Annual Pumping Duration	$12,274	$12,478	$11,592	$11,466	$10,784
4-Week Annual Pumping Duration	$21,754	$22,117	$20,540	$20,316	$19,102
6-Week Annual Pumping Duration	$33,893	$34,460	$31,997	$31,648	$29,752
8-Week Annual Pumping Duration	$43,373	$44,098	$40,944	$40,498	$38,070
Total Annual Operating Costs[3]:					
2-Week Annual Pumping Duration	$33,300	$40,100	$33,000	$40,000	$42,200
4-Week Annual Pumping Duration	$42,800	$49,700	$41,900	$48,800	$50,500
6-Week Annual Pumping Duration	$54,900	$62,100	$53,400	$60,100	$61,200
8-Week Annual Pumping Duration	$64,400	$71,700	$62,300	$69,000	$69,500

See Notes Table 6-6

6.2 Other Alternatives

Other alternatives for improving streamflow identified in the *Peshastin Subbasin Needs and Alternatives Study* (Anchor, EES, 2007) included piping and/or lining of Peshastin Irrigation District facilities to increase water use efficiency and reduce diversions; modifications to increase the delivery from the Icicle Canal to Peshastin Irrigation District; and modification of the Peshastin Creek Channel to reduce the flow requirement for fish passage. The last two alternatives will be addressed in other studies. Piping and/or lining of Peshastin Irrigation District facilities is underway. Peshastin Irrigation District has installed more than 10,000 feet of pipe downstream of the Brender Canyon Spill. An additional 4,000 feet of pipeline has been designed and is scheduled to be constructed prior to the 2011 irrigation season. That project will complete piping of the Peshastin Irrigation District Ditch downstream of Brender Canyon.

The *Peshastin Irrigation District Comprehensive Conservation Plan* (Klohn Leonoff, 1993) indicates that eliminating seepage and operational spills by completely piping or lining the ditch could save approximately 10 cfs during peak flows. Estimated water savings from piping projects that have been installed or are slated for construction downstream of Brender

Canyon are estimated at approximately 3 cfs. Piping or lining the ditch upstream of Brender Canyon could result in an additional 7 cfs of water savings. The most recently constructed project included 6,000 feet of 36-inch diameter low-head corrugated high-density polyethylene (HDPE) pipe. Based on the bids received for that project, the estimated cost of installing 36-inch diameter pipeline with all associated items and appurtenances is within the range of $105 to $135 per linear foot. The estimated cost of installing 36-inch diameter corrugated HDPE pipe in the 55,000 feet of ditch upstream of Brender Spill would be in the range of $5.8 million to $7.4 million, or $825,000 to $1.1 million per cfs of water saved.

6.3 Recommendations for Further Study

This section provides a preliminary review of projects that could be implemented as an alternative to or in combination with the Campbell Creek reservoir project to improve the use of water in lower Peshastin Creek. The Wenatchee Pump Station project was evaluated as an alternative supply to Peshastin Irrigation District. Operation of the pump station would allow for a reduction in diversions from lower Peshastin Creek, particularly during low flow periods when streamflows are needed to improve fish passage conditions. Further study to the feasibility level is needed to more clearly define the benefits and costs associated with implementing the project and identify fatal flaws. It is recommended that a feasibility study focused on the pump station project include the following tasks:

- A detailed review of water supply needs and instream flow needs
- A detailed definition of project design criteria and requirements
- An evaluation of project alternatives that builds on the analysis done in this study
- Selection of one or two preferred alternatives
- A more detailed evaluation of the preferred alternatives
- Development of a feasibility study report specific to the pump station project

In addition to further study of the Wenatchee Pump Station alternative, it is recommended that Peshastin Irrigation District continue work on piping portions of their canal. Additional pipe will be installed prior to the 2011 irrigation season at the downstream end of the canal. Piping projects for reaches of the canal upstream of Brender Canyon should be reviewed and considered for implementation.

Insert

Figure 6-1

Alignment Options

Insert

Figure 6-2

Conceptual Pump Station Section

7 PERMITTING AND WATER RIGHTS

This section was intended to outline permitting and water right requirements associated with the implementation of the Campbell Creek Reservoir project. Completion of site investigations and feasibility level design analysis are required to more clearly define the extent of the project, impacts to environmental resources, and impacts to existing water supplies before a more thorough evaluation of permitting and water rights requirements can be completed.

7.1 Permitting Requirements

Although a thorough evaluation of permitting requirements has not been completed for the Campbell Creek Reservoir project, it is anticipated that permitting requirements may likely include the following:

- Local Permits – Building Permit, Right-of-Way Use Permit, Critical Areas Permits
- State Environmental Policy Act (SEPA) Compliance
- State Department of Ecology Construction Stormwater General Permit
- State Department of Ecology Reservoir Permit
- State Department of Ecology Dam Construction Permit
- State Department of Archeology and Historic Preservation Section 106 Review
- Joint Aquatic Resources Permit Application (JARPA) for local government critical areas approval, Washington State Department of Fish and Wildlife (WDFW) Hydraulic Permit Approval (HPA), and U.S. Army Corps of Engineers Section 404 approval
- State Department of Ecology Change of Water Right Permit

7.2 Water Right Requirements

Changes to existing water rights will be required to divert water from Peshastin Creek for storage in Campbell Creek Reservoir. Existing irrigation water rights that permit the diversion of water from Peshastin Creek for irrigation use by Peshastin Irrigation District and the Tandy Ditch Company restrict diversions to a window of time that extends only through the irrigation season (April 15 through September 15). Existing water rights also specify the place and type of use for the water that is diverted. A change would be required to allow for diversion to storage during high flow periods (winter and early spring)

8 SUMMARY AND RECOMMENDATIONS

This report outlines the work completed to date to evaluate the feasibility of the proposed Campbell Creek Reservoir project. The proposed reservoir would be located in Campbell Creek Canyon, approximately ½-mile west of the lower reach of Peshastin Creek and 3.2 miles upstream of the confluence of Peshastin Creek and the Wenatchee River. The project would be located entirely within federal land managed by the USFS. The proposed reservoir would be designed to store up to 1,000 acre-feet of water diverted from Peshastin Creek via the Tandy Ditch Company pipeline. Water would be pumped to the reservoir from the Tandy pipeline during the peak runoff season for use late in the irrigation season when flows in the creek are low. Stored water would be used to directly supplement late summer flows in Peshastin Creek or supply late season irrigation needs in order to reduce diversions from Peshastin Creek. The project is intended to provide a more reliable supply of irrigation water and increase late summer flows in lower Peshastin Creek to improve passage conditions for Bull Trout and Chinook Salmon.

The original scope of this feasibility study included site investigations and gathering of data needed to complete a detailed evaluation of the design, costs, environmental impacts, and permitting requirements for the proposed project. The design analysis was intended to be developed to the 30% complete level as part of this study. However, early coordination with property owners adjacent to the proposed site revealed that the property owners are opposed to the project. Although the property owners were amiable and willing to discuss the project, they have not been willing to grant access to the site for site investigations needed to complete the feasibility study. Consequently, this report represents partial completion of the intended scope of the feasibility study. Preliminary work has been completed to evaluate the location and size of the reservoir and related facilities. The current reservoir concept is shown in Figure 2-1. Current preliminary design information has been provided in this report and deficiencies have been noted.

Completion of this study to the level of detail intended would require the cooperation of private property owners. It is recommended that Chelan County continue periodic discussions with affected property owners to monitor opposition to the project. If, in the future, property owner concerns can be addressed sufficiently to allow for access to the

proposed project site, it is recommended that the site investigations be completed and that a revision of this report be issued that evaluates the reservoir to the level of detail intended in the original scope of the project.

This report also includes preliminary information for other alternative projects that are intended to improve flow conditions in lower Peshastin Creek. The primary alternative that was evaluated would include constructing a pump station and transmission line to deliver water from the Wenatchee River to Peshastin Irrigation District at a location downstream of the confluence of Peshastin Creek and the Wenatchee River. Water diverted from the Wenatchee River through the pump station would replace diversions from Peshastin Creek and allow for increased flow and improved fish passage conditions in lower Peshastin Creek during the late summer.

Five potential pump station locations and pipeline alignments were identified. Pump stations ranging in capacity from 10 cfs to 40 cfs were evaluated. Preliminary hydraulic analysis was completed to determine the sizing of pumps and pipelines. An opinion of probable costs was completed that indicates that the cost of a project designed to deliver water from the Wenatchee River to Peshastin Irrigation District would range from $1.5 million for a 10-cfs pump station located on the south side of Highway 2 in closest proximity to the Peshastin Irrigation District canal to more than $5.1 million for a 40-cfs pump station located upstream of the Dryden diversion dam.

The primary recommendation for further development of the Wenatchee Pump Station project would include preparation of a detailed feasibility study specific to the project. The feasibility study would include site visits, a more detailed evaluation of the pump station locations and pipeline alignment alternatives studied in this report, selection of one or two preferred alternatives, evaluation of geomorphic conditions, identification of potential environmental impacts, geotechnical investigation, development of designs to the 30% complete level, and refined opinions of probable project costs. It is anticipated that some of the funding and resources intended for the completion of this feasibility study will be used to study the Wenatchee Pump Station project in more detail.

Other projects identified that would also reduce diversions from lower Peshastin Creek and improve fish passage conditions include piping and/or lining of the Peshastin Irrigation District canal, modifications to increase the delivery from the Icicle Canal to Peshastin Irrigation District, and modification of the Peshastin Creek Channel to reduce the flow requirement for fish passage. Piping projects are currently being implemented on the Peshastin Irrigation District canal. It is recommended that Chelan County continue to work with Peshastin Irrigation District to implement piping projects and other conservation measures. Additional studies are also moving forward to address deliveries from Icicle Canal and modifications to the Peshastin Creek channel.

9 REFERENCES

Anchor Environmental, LLC. January 2007. *Peshastin Subbasin Needs and Alternatives Study*. Prepared for Chelan County Natural Resources Department.

Montgomery Water Group, Inc. June 2006. *Multi-Purpose Water Storage Assessment in the Wenatchee River Watershed*. Prepared for Chelan County Natural Resources Department.

Klohn Leonoff. 1993. *Peshastin Irrigation District Comprehensive Conservation Plan*.

APPENDIX A
TOPOGRAPHIC SURVEY

(PLACEHOLDER – NOT YET AVAILABLE)

APPENDIX B
HYDROLOGY REPORT

(PLACEHOLDER – NOT YET AVAILABLE)

APPENDIX C
GEOTECHNICAL REPORT

(PLACEHOLDER – NOT YET AVAILABLE)

APPENDIX D
WETLANDS AND ENVIRONMENTAL RESOURCES REPORT

(PLACEHOLDER – NOT YET AVAILABLE)

APPENDIX E
CAMPBELL CREEK RESERVOIR
30% DESIGN DRAWINGS

(PLACEHOLDER – NOT YET AVAILABLE)

APPENDIX F
RESERVOIR ANALYSIS AND DESIGN INFORMATION

(PARTIALLY COMPLETE – NOT COMPLETED TO FEASIBILITY LEVEL)

APPENDIX G
DETAILED OPINION OF PROBABLE COST

(PARTIALLY COMPLETE – NOT COMPLETED TO FEASIBILITY LEVEL)

APPENDIX H
WENATCHEE RIVER PUMP STATION ANALYSIS AND DESIGN INFORMATION

APPENDIX I
WATER RIGHTS INFORMATION

(PLACEHOLDER – NOT YET AVAILABLE)