2.0 DESCRIPTION OF THE ALTERNATIVES

2.1 OVERVIEW

This chapter describes the alternatives analyzed in detail in this EIS, as well as alternatives considered but eliminated from detailed study. All of the action alternatives meet the purpose and need for this project, and components of these alternatives could be funded by BPA. There are three methods considered in these alternatives for improving fish passage: 1) increasing stream flows in lower Salmon Creek, 2) improving the lower Salmon Creek stream channel, and 3) improving the Salmon Lake feeder canal. To increase stream flows, Alternatives 1 and 2 consider options that would allow the OID to use more water from the Okanogan River rather than Salmon Creek and thus allow flows[1] to be retained in Salmon Creek. Alternative 1 involves construction of a new pump station along the west bank of the Okanogan River to substitute Okanogan River water for Salmon Creek water used in irrigation. Alternative 2 evaluates upgrading the existing OID Shellrock pumping plant along the Okanogan River to allow the OID to withdraw more water from the Okanogan River. Under this alternative, OID would convert the Shellrock facility from supplementary use to serve as its primary source. Alternative 3 presents a proposal to purchase 5100 acre-feet of water rights from the Okanogan Irrigation District in order to maintain water in Salmon Creek. To improve the lower Salmon Creek stream channel, Alternative 1 would remove the gravel bar at the mouth of the creek. Alternative 2 includes full rehabilitation of the lower 4.15 miles of Salmon Creek, with complete reconstruction of the channel along 0.25 miles.[2] Alternative 3 does not include channel rehabilitation. All three action alternatives include improvements to the feeder canal that delivers water from the North Fork of Salmon Creek to Salmon Lake. Alternative 4 is the No Action alternative, under which BPA would not fund any activities related to the proposed project.

Sections 2.2 through **2.5** describe the alternatives considered in detail in this EIS. Alternatives considered but eliminated from detailed study are discussed in **Section 2.6**. **Section 2.7** provides a comparison of the alternatives.

2.2 ALTERNATIVE 1

Alternative 1 is supported by the OID and CCT as their preferred alternative. BPA has not identified its preferred alternative. Alternative 1 would implement the following actions to allow Salmon Creek streamflows to remain in the creek and improve anadromous fish passage:

- Construction of a new 80 cfs pump station for the OID on the Okanogan River,

[1] Flow requirements for salmon and steelhead are expressed in cubic feet per second (cfs). Salmon engage in different activities in each season (e.g., spawning, rearing, wintering, and migration), and these life stages or activities require different amounts and timing of flows. Aggregating these flows over the course of a year yields a total volume of water (expressed in acre-feet) needed to meet life history requirements. The term “flow” is used in discussing the specific instream flow needed at a particular point in time (cfs), and “flow volume” is used in referring to the aggregate amount of water required.

[2] The proposed rehabilitation described under alternative 2 has been developed from initial concepts presented in the *Conceptual Rehabilitation Plan for Lower Salmon Creek, Washington* (ENTRIX 2002)

- ♦ Replace the Salmon Lake feeder canal and headgate,
- ♦ Remove the alluvial fan at the mouth of Salmon Creek.

2.2.1 OKANOGAN RIVER WATER EXCHANGE

Under Action Alternative 1, the OID would receive a portion of its water supply for irrigation use from a proposed new pump station on the Okanogan River. By diverting water from the Okanogan River rather than Salmon Creek, natural flows would be retained in Salmon Creek storage reservoirs and released to the creek as needed to provide passage and overwintering flows. The new pump station would consist of the following three facilities:

- An 80 cfs pump station located on the west bank of the Okanogan River, upstream of the confluence of Salmon Creek;
- A pipeline from the pump station to Diversion 2 on the OID main canal; and,
- A water filtration system located near Diversion 2 to remove sediment from the river water.

2.2.1.1 Pump Station

The new pump station would be located on the west bank of the Okanogan River about 1.25 miles upstream of its confluence with Salmon Creek, within the limits of the City of Okanogan (**Figure 2-1**). The pump house would contain pumps, motors, control centers, valves and related equipment. Removable roof hatches allow for repair and maintenance. This location requires noise abatement, and a concrete block pump house building would be designed to mitigate noise. The building would be climate-controlled with temperature-activated louvres for air circulation. It is assumed that the existing Shellrock pump station would be removed from service under this alternative.

A bathymetric survey of the Okanogan River bottom at this location indicates the presence of a sand bar on the outside bend of the river and a deep hole on the inside bend. Pump intakes would be located over the deep hole. Because State Route 215 runs adjacent to the river and confines the river channel at this location, the deep hole and sand bar are expected to remain in their present locations.

Preliminary geotechnical investigations (URS, 2002) led to a decision to locate the pump station away from the river bank to avoid potential conflicts with stream meander, erosion and sedimentation. The floor of the pump station would be placed above the elevation of the 100-year flood described on available Federal Emergency Management Agency (FEMA) maps. The bank would be shaped and protected from erosion by such methods as boulder and timber armoring or gabion baskets. The topographic survey indicates that the pump intakes can be submerged at this site. The City of Okanogan confirms that the site is properly zoned for use as a pump station and that easements and rights-of-way either exist or can be obtained.

Screens for the intake pipes would be placed in a part of the river channel with a relatively stable bottom. Mat gabions would be placed under the screens to prevent streambed erosion. Piles would be driven into the streambed in front of the screens to prevent damage from floating debris. Activated wedge-wire drum screens were selected for the preliminary design because of their reliability, low maintenance, low capital cost, and proven effectiveness in properly screening juvenile and adult anadromous fish without damage. NOAA Fisheries screen criteria for the protection of anadromous fish were used for the selection of the screens (URS, 2002).

The intake manifold was designed to transfer water from the screens to vertical caissons in which vertical turbine pumps would be placed. The proposed intake structure consists of a four-foot vertical wall made of rock gabions through which the intake manifold protrudes. The cylindrical wedge-wire screens are mounted on the ends of the protruding manifold pipes.

It is estimated that 7,000 horsepower would be required to lift 80 cfs from the river to the OID main canal. The pump station design incorporates six 1,000 hp pumps (1,770 rpm operated from 4,160-volt electric motors) and two 500 hp pumps (1,770 rpm operated from 480 volt electric motors). Each pump would be placed in a vertical caisson connected to the river with a horizontal intake manifold and fish screens.

2.2.1.2 Pipeline

The proposed pipeline route (**Figure 2-1**) is approximately 10,630 feet (about 2.0 miles) long. It follows County roads and existing federal rights-of-way and easements over most of its length. The route crosses State Route 215 from the pump station site and proceeds over flat, undeveloped land. It then rises up a 25-percent grade to Pogue Flat, on the top of a 340 foot high slope. It continues north along Conconully Road and west on Glover Road to the Diversion 3 pump station, then crosses orchard land to terminate at Diversion 2. Approximately 85 percent of the route lies on Pogue Flat, which has a 1.5 percent grade.

The proposed pipeline would be a 48-inch diameter spiral welded steel pipe. A standard concrete outlet structure would allow water to flow from the pipeline into a sediment pond upstream of Diversion 2 and then into the OID main canal with minimal turbulence. Air vacuum release valves and drain valves along the pipeline would allow it to be emptied after the irrigation season and would provide an escape for trapped or entrained air during refilling and operation. The pipeline would be buried at least seven feet deep, with a one-foot layer of bedding material underneath and at least three feet of cover for frost resistance and pipeline protection. To accommodate this design, an eight-foot trench would be excavated.

2.2.1.3 Water Filtration System

Water samples taken from the Okanogan River at Malott (RM 17, approximately 10 miles downstream of the pump station site) show that during high flows the water is murky and has total suspended solids (TSS) levels that are too high for irrigation use.[3] The volume of sediment appears to be highest during May and June.

An airburst would be used to remove debris from the intake screens. Because scour velocity around intake screens is expected to be seasonally high, the accumulation of sediment at the screens is expected to be low. Periodic sediment removal would require mechanical methods such as backhoes, draglines, or suction pumps.

A sediment pond and a filtration system would be located near Diversion 2 on the OID main canal. The OID canal itself would also serve as a sediment basin. Secondary removal of larger remaining particles would be accomplished by self-cleaning filters located along the canal. Effluent from the backwash cycle at the filter stations would either be returned to the canal or captured in a dosing tank for return to the land by sprinklers.

2.2.1.4 Water Supply Operations

Under Action Alternative 1, the construction of the new pump station would help OID to satisfy its irrigation water requirement in part from the Okanogan River, leaving 5,100 acre-feet in Salmon Creek storage reservoirs to provide flows for fish passage and overwintering. This volume of water would be retained in Conconully Reservoir or Salmon Lake, to be released as needed for passage and overwintering flows. A water system model has been used to examine interactions between pumping, irrigation, instream flows, and storage (see **Section 3.1** and **Appendix C**). This alternative takes advantage of opportunities to pump early in the irrigation season when Okanogan River flows are high and releases water from storage in the late season low-flow periods. No operation of the existing Shellrock plant is assumed under this action alternative. This action alternative would be able to deliver water to 4,670 acres (all areas served by diversions 2-5), or 93 percent of OID lands. There would be no critical period shortages (deficit irrigation) under this alternative.

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[3] Monthly monitoring data collected by the Washington Department of Ecology at the Malott long-term monitoring station (approximately 15 miles downstream from Salmon Creek) show consistent sedimentation problems. Suspended solids data have been collected since 1978. Under most flow conditions, the Okanogan River has higher suspended sediment and total suspended solids (TSS) concentrations than Salmon Creek. In 1990, suspended solids ranged from 1 to over 400 mg/L, with the higher values typically in the 50 to 150 mg/L range (see Section 3.2 and Ecology 1995). Washington has no standard for TSS; the standard for turbidity in Class A waters reads "Turbidity shall not exceed 10 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 20 percent increase in turbidity when the background turbidity is more than 50 NTU." Data on background turbidity at this location were not available. As discussed in Section 3.2, the standard may be exceeded annually.

2.2.1.5 Water Rights

OID currently relies on Salmon Creek, Johnson Creek, Duck Lake, and the Okanogan River as sources of supply. Each source has some type of water right claim or certificate associated with it.

OID Salmon Creek water rights may be transferred from one surface source (Salmon Creek) to another (Okanogan River). There is no prohibition in state law against changing a water right from one surface water source to another so long as the two sources are related in some way (this condition is met by the fact that Salmon Creek is tributary to the Okanogan River). Action Alternative 1 would require transferring the point of diversion for at least 45 cfs of OID water rights from Salmon Creek to the Okanogan River, and would use up to the full 35 cfs of existing OID Okanogan River water rights to allow diversion at the new pump station site in the instantaneous and annual quantities required. The transfer of Salmon Creek water rights to a point of diversion on the Okanogan River would be accompanied by a determination by Ecology of an equivalent amount to be dedicated to instream flows in Salmon Creek. The expectation is that this water would be retained in storage for release to provide passage and overwintering flows.

The season, place and purpose of use would probably remain unchanged on the transferred water rights, however Ecology would review the validity of OID's water rights as part of the transfer process and this could change the amounts of the water rights. **Table 2-1** lists OID water rights. See **Section 2.3.1.6** for further discussion of the use of OID's existing Okanogan River water rights.

Water Right Changes

Ecology may consider changes to the following elements of an existing water right permit, certificate, or claim:

- Place of use
- Point of diversion or withdrawal
- Additional point(s) of diversion or withdrawal
- Purpose of use

Table 2-1. Okanogan Irrigation District Water Rights and Claims.

Certificate or Claim	Source	Priority	Instantaneous Quantity	Annual Quantity	Notes
Certificate #55	North Fork Salmon Creek	"not given" (filed April 6, 1926	all flows in excess of 1.33 cfs	not stated	"After Class 1 rights have been filled.," April 15 - Sept 30
Claim #88353	North Fork Salmon Creek, Conconully Reservoir	May, 1888	90 cfs	35,000 acre-feet	Storage and diversion, March 1- October 31
Claim #88354	West Fork Salmon Creek, Conconully Reservoir	May, 1888	90 cfs	35,000 acre-feet	Storage and diversion, March 1- October 31
Claim # (unknown)	Salmon Creek	May, 1888	8 cfs	2,920 acre-feet	Natural stream flow developing below Conconully dam
Claim #88352	Ophir Mining Claim Spring	1897	70 gpm	14 acre-feet	Continuous, domestic purpose
Adjudicated Certificate #75	Johnson Creek	1919	15 cfs	not stated	After Class 7 rights have been filled. (7.74 cfs)
Adjudicated Certificate Record No. XIX, page 16	Duck Lake	August 23, 1918	20.0 cfs (likely reduced to 10 cfs for non-use)	6,356 acre-feet	Supplemental to other OID rights
Orders DE 85-20, DE 95WR-C139	Duck Lake Ground Water Management Subarea	NA	10 cfs	2,700 acre-feet	Artificially stored groundwater
Certificate #384	Okanogan River	July 3, 1926	3.0 cfs	not stated	Change application in process
Certificate #357	Okanogan River	July 3, 1926	7.0 cfs	not stated	Change application in process
Certificate #466	Okanogan River	January 22, 1930	15 cfs	not stated	WDOE questions OID interest
Claim #089802	Okanogan River	1915	10 cfs	1,214 acre-feet	April-October, change in process

Certain aspects of a water right document[4] cannot be changed, such as increasing the withdrawal rate or annual quantity of water currently permitted. The change applicant may be an entirely different person than the one who originally applied for the water right (for example, some of OID's water rights were originally obtained by the Bureau of Reclamation).

Generally, a water user may only change the portion of a water right that has actually been put to beneficial use. In some cases, provisions clarifying when water can be used, based on availability, are added when changing a water right. Undeveloped portions of a water use described within a water right certificate (or claim) generally do not represent a water right and may not be changed or transferred. Water rights may be entirely, or partially, relinquished if the water has not been used for a period of five or more years. The process of quantifying the extent to which a water right is eligible for change is known as a "tentative determination of extent and validity." Ecology is required to make the tentative determination when it makes its recommendation on an application to change any water right under RCW 90.03.380.

Decisions on an application for a change of water right (commonly referred to as a change application) must pass the following legal test:

- The change, as requested, would not impair any existing rights or pending applications (this would include minimum instream flows established by rule).

Ecology considers the following factors when trying to determine a potential detriment or injury to existing rights:

- The change would not increase the instantaneous or annual quantity of water used.
- The water right is eligible to be changed, and has not been abandoned or relinquished for non-use.
- The source of water would not change (e.g., new wells must tap the same aquifer).
- The change would not expand the water right.
- The change would not increase the consumptive use of water.

Changing an existing water right does not change the original priority date. A priority date is the date assigned to a water right based on the date Ecology or a predecessor agency received the original water right application. In the case of vested rights (water rights that pre-date the state's water right laws), the priority date is when water was first put to beneficial use. This date determines the seniority of the water right within a watershed.

[4] Water right documents include certificates, permits, and claims. A permit is issued by the Department of Ecology when it approves a water right application. The permit allows water to be put to beneficial use within a certain period of time. When this has been accomplished a water right is said to be "perfected" and a certificate is issued allowing use to continue in perpetuity. Some water use preceded the State's water code; for such use, a "claim" may be filed (during periods when the claims registry was open) asserting the right to continue historical use. Some of OID's water rights are embodied in certificates or permits, others are claims.

As described above, Ecology would conduct a tentative determination of OID's Salmon Creek water claims in considering an application to transfer a portion of these rights to the Okanogan River. The tentative determination has the potential to lead to other changes, such as in the amount of water considered perfected under the claim and the rate of application of irrigation water per acre considered reasonable.

Ecology must consider detriment or injury to all other potentially affected water rights in approving a change. No impairment to other water rights is allowed. Minimum instream flow rights are among the rights that cannot be impaired, and these have been established by Ecology for the Okanogan River with a 1984 priority date.

Minimum Instream Flows

Alternative 1 assumes that pumping from the Okanogan River is unrestricted by minimum instream flows (this is also true for Action Alternative 2). Regulatory review of an application to change OID water rights would need to analyze whether OID Okanogan River water rights would be interruptible when minimum flows on the Okanogan River are not met. Ecology may waive the instream flow requirement only if it determines that it is in the "overriding public interest" to allow pumping from the river that conflicts with the minimum instream flow.[5] This would require further detailed environmental analysis during the permitting stage. Although pumping under these alternatives would reduce the flow of the Okanogan River whenever irrigation pumping exceeds Salmon Creek return flows, on an annual basis withdrawals should approximate return flows. The net effect would be to replace warmer, sediment-laden Okanogan River with cool, clear water from Salmon Creek. This tradeoff is the basis for the expectation that "overriding public interest" could be demonstrated for pumping at times when Okanogan River minimum flows are not met. Other scenarios under which minimum instream flows would not restrict pumping include:

- If other Okanogan River operations were curtailed when Okanogan River flows are below the minimum set by rule; and,
- If modeling during the permitting stage identifies operation scenarios that avoid conflicts during periods when minimum instream flows are not met on the Okanogan River.

Biological Opinion Regarding Downstream Flow Effects

Both alternatives that pump from the Okanogan River (Alternatives 1 and 2) will shift the timing of flows in the Okanogan and Columbia. Although water pumped for irrigation will be replaced

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[5] Regulatory review of proposed changes to OID water rights would be completed following this EIS if an application is submitted to the Washington Department of Ecology to change OID water rights. An impairment analysis would be conducted by Ecology to determine whether the change would affect any other water rights. The question of overriding public interest would be settled at that time, and could result in conditioning OID's Okanogan River water rights to be interruptible when minimum instream flows established by rule are not met on the Okanogan River. As part of that regulatory proceeding, Ecology also would determine the validity of the District's Okanogan River water certificates and will make a tentative determination regarding OID's Salmon Creek water claims. If water rights are found to be invalid or if recent use cannot be demonstrated to perfect the full water certificates or water claims, then OID may need to obtain new Okanogan River water rights. These water rights could be conditioned by Ecology to be interruptible when minimum flows are not met in the Okanogan River.

by flows released for fish passage and overwintering in Salmon Creek, the fish flows will occur in a different pattern than the irrigation pumping. Therefore, project operation could affect Columbia River flows at times when flow targets may not be met under the current Biological Opinion (BiOp).[6] The involved federal agencies will need to review these effects as part of a Biological Assessment to be conducted for the Salmon Creek project after NEPA review and selection of a preferred alternative. NOAA Fisheries will determine, in consultation with other federal agencies, whether the benefits to listed species offered by the Salmon Creek project offset the potential effects on the timing of flows in the Columbia River with regard to existing BiOp targets. The results of this determination may require the patterns of irrigation pumping and fish flow release schedules to be altered.

2.2.2 FEEDER CANAL UPGRADE

This component of Alternative 1 would involve repairing a deteriorated feeder canal that serves the Salmon Lake storage reservoir and to improve water management flexibility. Salmon Lake, the uppermost of the two storage reservoirs maintained by OID above the middle reach of Salmon Creek, is a storage reservoir with a storage capacity of 10,500 AF. It is situated in a small basin to the east of the North Fork of Salmon Creek and is filled by a feeder canal that delivers water from a diversion in North Fork Salmon Creek (**Figures 2-1 and 2-2**). Because Salmon Lake receives very little runoff from a small basin, the feeder canal is critical to filling this reservoir and to the ability to manage flows in Salmon Creek for fish. Salmon Lake releases water as controlled discharge to Conconully Reservoir.

The Salmon Lake feeder canal's size and condition constrain the flexibility of water management for Salmon Lake and the entire system. The feeder canal is approximately 3,715 feet (0.7 miles) in length, and was constructed in 1920. It is located northeast of the town of Conconully.

The feeder canal requires repair. Canal capacity is designed at about 90 cfs, but OID operates it at 30 cfs due to concerns regarding the potential instability of the slope along the alignment and debris that accumulates in the canal. The potential instability of the canal could affect the safety or property of those living below it if the canal failed or was overtopped by an accumulation of soil and vegetation debris in the canal.

[6] The BiOp for the Federal Columbia River Power System (FCRPS) describes the U.S. Fish and Wildlife Service and NOAA Fisheries' determinations as to whether proposed actions will jeopardize species listed as threatened or endangered. The BiOp prepared for the FCRPS provides operating parameters for the U.S. Army Corps of Engineers (Corps), the Bureau of Reclamation (Bureau), and BPA in the operation of Federal dams on the Columbia River.

Figure 2-2 Existing Salmon Lake Feeder Canal

For approximately 40 percent of its length the canal passes near residences, some as close as 50 feet away. The toe of the slope in which the canal is built is adjacent to many back yards. Large cracks have been observed in the concrete lining of the canal (Dames & Moore, 1999; URS, 2002).

Salmon Creek Phase 1 and Phase 2 reports considered replacing the feeder canal with a buried pipeline along the canal alignment (Dames & Moore, 1999) or upgrading the existing canal and its inlet structure so that it can operate safely at its design capacity (URS, 2002). The Bureau of Reclamation (2003) completed a feasibility study for upgrading the feeder canal and developed preliminary construction cost estimates for a design with a 90 cfs capacity. Replacement of the canal with a pipe would help to control and prevent soil erosion. A pipeline would not be as susceptible to damage from soil slides along the upslope as the open channel. The pipeline would eliminate in-channel erosion and reduce water seeping into the down slope soils. It would protect public health by removing an open canal hazard in a residential area. Additionally, the pipeline would restore the capacity of the feeder canal to fill the Salmon Lake storage reservoir and thereby prevent its impairment.

BOR would replace approximately 3,700 feet of the open channel of the Salmon Lake Feeder Canal for the OID with high-density polyethylene (HDPE) black plastic pipe. BOR would install a 48-inch pipe along two-thirds of the canal, and a 42-inch pipe for the remaining one-third of the canal, with an approximate capacity of 90 cfs. Preliminary plans call for removing the existing canal and burying the pipe in the existing alignment for approximately 40% of its length. The next 35% of the length of the canal would have the pipeline bedded in the existing channel with soil cement and capped with shotcrete for protection from falling rock and vandalism of the pipe. The final 25% of the pipeline would leave the existing alignment and run in a straight line to the groin of the Salmon Lake Dam, where it would be completed with a energy dissipation device that would direct water about 200 feet upstream of the face of the dam. The last section of the existing canal alignment would be abandoned in place. The most probable design for the energy dissipation structure would be a concrete flume with multiple steps to reduce water speed and energy. Work at the inlet to the canal would include raising the level of the creek to allow for greater flow. This would be accomplished by placing rock weirs across the creek below the canal intake. It is estimated that about six such structures would be required in the 200 feet downstream of the intake. Some work may be required on the current culvert under the road such as an increase in the size of the pipe.

This action would save a small amount of water lost from canal leakage (estimated to be about 36 acre-feet per year), but more importantly, it would allow more flexible operations for fish and agriculture.

This component is included in all of the action alternatives.

2.2.3 SALMON CREEK MOUTH REHABILITATION

This alternative would involve rehabilitating the mouth of Salmon Creek by removing the coarse sediment that has accumulated that presents a barrier to fish passage (**Figure 2-3**). Approximately 530 feet of the channel would be excavated. Excavation of the gravel and cobble deposits would require an excavator and/or backhoe within the dry channel and off road dump trucks to transport excavated sediment to an adjacent staging area. A 110-horsepower screening plant would be temporarily sited on the staging area to sort sediment by particle size. A loader would be used to move and stockpile the sediment on-site. The active construction period is estimated to last about 3 weeks.

Pre-construction activities would include preparation of the staging area and screening plants, and clearing and grading of an access route into the channel. Erosion and sediment control fencing would be placed and maintained throughout construction to prevent releases of sediment and/or turbid water to the Okanogan River. An excavator will be used to reconfigure the low flow channel for fish passage and reshape the toe of banks. Upon completion of excavation, the coarsest materials that have been screened, sorted and stored would then be placed along the toe of the bank and within the channel to help define the low-flow fish passage channel. Vegetation would be planted along streambanks that have been disrupted by earth moving equipment during the construction phase. Re-vegetation areas would be supplied with seasonal temporary irrigation for 1-2 years until roots are able to utilize groundwater and the plants are established and can survive dry summer months.

While rehabilitation of the mouth is a key component of improving fish access from the Okanogan River to Salmon Creek, initial sediment removal may need to be followed by re-treatment periodically. Without rehabilitating the rest of the lower Salmon Creek stream channel, redeposition of gravel, cobble or fines near the mouth could occur as future high flow events transport material eroded upstream.

2.2.4 COSTS

2.2.4.1 Construction Cost Estimates

A detailed cost estimate for the pump station facilities prepared by URS (2002) totals $7.3 million dollars.

ENTRIX estimates that the cost for implementing the design approach described above for initial sediment removal would be $64,000, including construction and soft costs. This cost estimate does not include potential costs of future re-treatment, if needed to address erosion and sedimentation that could occur after future high flow events. The cost assumes that the channel work area will be dry and no dewatering or dewatering related water quality mitigations would be required. This cost also excludes cost associated with obtaining access to the adjacent potential staging area.

Cost estimates for the feeder canal replacement range from $1.3 M to $2.3 M.

2.2.4.2 Operation Cost

Additional pumping costs (above the level of pumping required for the No Action Alternative) associated with Alternative 1 are estimated to be approximately $284,393 per year (see **Section 3.8.3**).

Potential re-treatment of the mouth rehabilitation could be required a couple of times over the life of the project, but if annualized, the cost would likely not exceed $4,000.

2.3 ALTERNATIVE 2

Alternative 2 would implement the following actions to allow Salmon Creek streamflows to remain in the creek and improve anadromous fish passage:

- Upgrade the existing OID Shellrock pumping plant to allow more water to be pumped from the Okanogan River,
- Build a new pipeline from Shellrock to a sediment basin in the main canal,
- Replace the Salmon Lake feeder canal and headgate,
- Stream rehabilitation in the lower 4.3 miles of Salmon Creek

2.3.1 UPGRADE SHELLROCK PUMPING PLANT

The OID operates the Shellrock pump station on the Okanogan River, 3.2 miles upstream of the confluence with Salmon Creek (**Figure 2-1**) (the rights-of-way for the pump house and pipeline are owned by the federal government). Shellrock is currently operated by OID as a supplemental supply, to meet irrigation demand during droughts when supply from Salmon Creek is inadequate. The station has a nominal capacity of 24 cubic feet per second (cfs), however OID owns water rights on the Okanogan River amounting to 35 cfs. Under this water supply action alternative, the Shellrock plant would be upgraded to take the full existing OID Okanogan River water rights as a supplementary source of water supply.

2.3.1.1 Existing Infrastructure and Operation

The Shellrock plant was commissioned in early 1978. It is an outdoor, reinforced concrete, wet-sump type pumping plant with four vertical turbine pumps. The pump station diverts water from the Okanogan River near the town of Okanogan, and pumps to the OID system and main canal, providing water to diversions 4 and 5 (which together serve approximately 78 percent of OID irrigated lands). The plant is typically operated during the irrigation season between April and October when needed to supplement flow from the Salmon Creek basin. The plant was designed to provide an output of 24 cfs with three equivalent pumps operating and a fourth pump as a backup. Often only two units are required to meet demand. During wet years, the pump station may not be used at all. Reviews of the Shellrock facility were conducted in October 2002 by the Montgomery Water Group (MWG) and in July 2003 by the BOR. The results of these reviews are summarized below; for a detailed description of the Shellrock facility, refer to BOR (2003).

The Shellrock plant service yard is relatively small and is constrained by Okoma Drive on the west, the Okanogan River on the east, and a private residence on the north. The pump motor deck is at elevation 841.18 feet, one foot above the recorded high-water elevation measured for the 100-year flood. The plant and discharge line were designed to deliver 25 cfs to the upper main canal. There are two gated openings on the river side of the structure and one gated opening about the same size on both the upstream and downstream sides of the structure.

The facility's fish screen was replaced in 2003 with a traveling water screen. The screen can be raised for maintenance by a manually operated hoist. The upstream and downstream side-gated openings produce a sweeping flow across the front of the fish screen.

Directly downstream from the concrete opening for the fish screen are located four vertical turbine pumps. Each pump has a 12-inch discharge line with check valve and butterfly valve that manifolds into a 30-inch main discharge line. Water is conveyed from the pump station to the OID Upper Main Canal via a cement mortar-lined, 30-inch diameter, ductile iron pipe, approximately 10,100 feet long. Diversion 4 laterals serving 925 acres are supplied from this pipeline prior to water reaching the main canal. The ground surface elevation where the main pipe ends at the canal is approximately 1,354 feet.

The Shellrock Pump Station currently experiences significant bedload and suspended sediment accumulation in the sump. Measured accumulation has been reported to be three feet or more. The sediment creates three major problems: (1) Volume of the sump is decreased, (2) sediment brought into the pumps causes damage to the impellers, bearings and seals, and (3) water being delivered to the consumers contains high sediment loads. Sediment may also deposit within the pipes and canals of the irrigation system, thus reducing system capacity. Currently water users on diversion 4 are filtering the sediment from the water at point of delivery, however at certain times of the year this process can require frequent (hourly) filter replacement.

It is likely that the current configuration of the plant is contributing to the sediment problem by creating hydraulic conditions that are conducive to sediment deposition. The Okanogan River tends to deposit sediment at the face of the plant's intakes. Velocities upstream and downstream of the intakes are very low, which create a depositional zone at the intakes. Also, the entrance into the sump is low with respect to the riverbed. Drawings of the current configuration show the floor of the sump at an elevation of 811.18 feet with a front sill rising one foot from the sump floor. This configuration encourages deposition of bedload material into the sump because of its low elevation with respect to the bed of the river.

OID reports that the existing intake for the Shellrock plant is located such that it is unable to obtain sufficient water for the full pumping capacity of the plant at extremely low Okanogan River levels. This was not evaluated by MWG in 2002, but Action Alternative 2 assumes that, as part of the upgrade, the intake would be relocated such that it does not constrain the plant from pumping at full capacity during any season.

BOR's review of the facility recommended the current overall system capacity should be limited to 23 cfs at low river water surface elevation 818.18 feet to meet fish agency criteria, and 24 cfs when the river level at the plant is above elevation 818.43 feet based on the following criteria:

- The plant and discharge system was designed to deliver 25 cfs to the Upper Main Canal [1].
- The existing transformer is too small for simultaneous operation of the four pumping units. Total rated discharge capacity with only three units running is approximately 25 cfs.
- The existing air tank borders on being on the small side for 25 cfs flow (a small negative pressure downsurge may occur at one high point location in the discharge pipeline).
- Using the NOAA Fisheries fish screen approach velocity criteria for fry-sized salmonids of 0.4 ft/s, and an assumed effective screen area of 58 ft^2 for the existing traveling screen at low river water surface elevation of 818.18 feet, the pumped flow from the existing plant should be limited to approximately 23 cfs. For a pumped flow of 24 cfs, an effective screen area of 60.0 ft^2 is required which equates to an approximate minimum river water surface elevation of 818.43 feet.
- Measured pump performance data provided by the Okanogan Irrigation District (OID) indicate an average pump capacity of only about 7.91 cfs (3,550 gpm) at a discharge pressure of 555 feet (240 psi). Single unit operation should produce about 9.47 cfs (4,250 gpm) depending on the river water surface elevation. This implies that unit pumping capacity is being reduced by additional head loss somewhere in the system (i.e., excessive impeller wear due to abrasive sediment erosion or cavitation, sediment in the plant or discharge line, or a combination of factors). Based on the measured pump performance, estimated current unit capacity is approximately 8.0 cfs, and the total capacity of the existing plant with three units operating is approximately 24 cfs.

2.3.1.2 Requirements to Upgrade to 35 cfs

The following modifications were identified that would improve system performance and increase system capacity to 35 cfs. Each is discussed in more detail below.

- Modify plant intake to reduce sediment load entering the sump.
- Modify plant to make it easier to remove accumulated sediment from sump.
- Increase fish screen area to permit 35 cfs at low river water elevation 818.18 feet.
- Modify or replace pumping units and motors to increase total capacity to 35 cfs.
- Replace power transformer to permit concurrent four-unit operation.
- Replace surge tank to protect existing discharge line during 35 cfs operation.
- Eliminate the delivery of sediment-laden water to diversion 4 water users.
- Identify a plan for backup pumping should one of the pumps fail.

Intake Modifications to Reduce Sediment in Sump

Two solutions were identified to reduce sediment in the sump. The first solution is to improve the hydraulic conditions at the face of the plant by constructing concrete wing walls at the upstream and downstream sides of the plant. The existing pump station intake projects out into the river and creates dead water, areas with low water velocities, and eddies around the intake. Construction of upstream and downstream wing walls that are flush with the front of the intake would prevent areas of low velocity and optimize conditions for a sweeping flow at the face of the plant.

The second solution is to modify the intake by raising the concrete sill of the gated openings as high as possible to reduce/prevent bedload from entering the intake. Bedload is the portion of sediment transported by the river, which maintains frequent contact with the bed by rolling, sliding or bouncing along the riverbed and is comprised of larger sized sediment. The maximum sill elevation is controlled by fish screen approach velocity criteria at low river water elevations. Sediment that is transported above the bed in suspension is referred to as suspended load. Although raising the sill would prevent or reduce bedload from entering the sump, suspended sediment would still enter it. Depending on sediment size and plant operation, the suspended sediment would be pumped through the pipeline, deposited within the pipeline, or deposited in the sump. Suspended sediment is smaller than bedload and should create fewer problems for the pumps and water users. It is possible that over time the bed of the river would aggrade to the new elevation of the sill. However, the sweeping flow anticipated at the face of the plant due to the construction of the wing walls is expected to prevent this from occurring.

The modified intake would also include silt barrier gates in front of the trashracks, similar to the existing installation, which should be lowered to prevent sediment and debris from entering the intake during non-pumping times. Past underwater examinations have reported that the existing silt barrier gates could not be fully lowered due to sediment and bedload deposits in front of the intake. The new plant intakes could be provided with an embedded spraybar in the silt barrier gate sills to keep sediment from building up below the gates and preventing their closure. Piping for the high pressure spray water would be similar to the spray water piping used for the traveling water screens and installation costs would be minor compared to other modification costs.

Plant Modifications to Facilitate Sediment Removal From Sump

Based on the existing siting and operation of the plant, it must be assumed that some sediment would be deposited in the sump and annual or bi-annual cleaning of the sump would be required. Past sediment removal operations using a dredge or cone-type separator have taken too long and cost too much.

The modified pump station would split the existing common sump shared by all four units into two separate sumps each with two units. Provisions for dewatering each side of the sump separately would be provided so that total plant shutdown is not required to maintain the sumps. Stoplogs and guides would allow dewatering and clean out of sediment within the sumps. It is assumed that the stoplogs would be stored in the yard and lowered into the guides with a mobile crane.

The current Reclamation design for upgrading Shellrock does not include a sedimentation pond to reduce turbidity in water delivery to irrigation, however it is assumed that a such a facility will be required in order to provide acceptable water quality.

Intake Modifications to Improve Fish Screening

The existing traveling fish screen for the Shellrock Pump Station provides sufficient screen area to meet NOAA Fisheries salmonid fry criteria for flows up to approximately 23 cfs at the assumed low water surface elevation of elevation 818.18 feet. Additional screening area would be required for the pump station flow to be increased to 35 cfs while maintaining the same criteria. The required effective screen(s) area for a flow of 35 cfs should be not less than 87.5 ft^2.

The two modified plant intakes would use the existing continuous belt traveling water screen in one bay and place a similar continuous belt traveling water screen in the other bay. The traveling screens would be positioned closer to the trashracks to eliminate the need for upstream and downstream gated openings to create required sweeping velocities across the screens. Moving the screens forward also would reduce the area downstream of the trashracks where fish may hold, and the close proximity may create hydraulic conditions that the fish would find undesirable, making it less likely that they would enter the intake.

The sill below the trashracks would be raised to elevation 813.58 feet, at or close to the same elevation as the top of the stainless steel drum located at the bottom of the traveling screens. With two screens, the concrete sill below the traveling screens can be raised to elevation 812.58 feet while still providing sufficient screening area to meet approach velocity criteria at the low water surface elevation of 818.18 feet. The existing concrete invert at the pumps would remain at elevation 811.18 feet. By having two independent screen/pump bays (each bay with one screen and two pumps), there should be better hydraulics leading to the pumps and also a better uniform flow through and across the screens. The upstream and downstream wing walls would also improve the sweeping flow at the face of the intake, which should benefit fish protection.

The existing continuous-belt traveling water screen is cleaned by high-pressure spray water. The spraybar is located just below the top drive roller and above the top of the upstream trashrack opening, which results in debris being sprayed off the screen directly into the upstream concrete wall above the trashracks. This arrangement can cause debris to be recycled between the trashracks and the screen and not carried away by the river. The modified intakes would position the spraybar for the traveling water screen(s) above the normal river water surface elevation of 821.18 feet, but below the top of the trashracks, elevation 824.18 feet. The debris then has a chance of being sprayed back through the trashracks where the river can carry it downstream and away from the screen(s). The upstream and downstream wing walls would also improve the sweeping flow at the face of the intake, which should improve debris removal.

The existing trashracks are welded to the embedded steel seat framework. As part of the modified intakes, new trashracks and embedded seats would be provided. The new trashracks would be similar to the existing racks, except they would be designed to be removable by bolting rather than welding the trashrack panels to the embedded seats. The trashracks and seats would also be designed to realign the upstream face of the trashbars to allow the new silt barrier gates to better carry their loadings into the trashracks and make them easier to clean.

The modified plant would be provided with monitoring equipment to measure three water surface elevations: 1) upstream of the trashracks; 2) between the trashracks and the traveling screens, and 3) downstream of the screens. This would allow OID to determine water level differentials across the trashracks and screens so they can assess rack and screen operation and cleaning requirements.

Modifications to Pumps, Motors, Piping and Valves

A major concern in upgrading the pump station to 35 cfs capacity using is the expected increase in pressure that the existing 30-inch ductile iron discharge pipeline would experience. An increase in head loss from the original design with increased flow directly relates to an increase in pressure in the pipeline, which affects its pressure carrying capability under the new operating conditions. BOR (2003, 2004) studied a range of system head losses to identify probable modifications to existing equipment.

There are three upgrading schemes to attain a total plant capacity of 35 cfs. The first two are based on four pumps operating simultaneously to provide the 35 cfs. With all four pumps operating, it would be necessary to increase the design capacity and adjust the associated design head of all four pumping units. In order to minimize unit modifications and reduce associated costs, existing equipment would be reused wherever possible or upgraded, where necessary. One option is based on reusing the existing 800-hp motors and the second on installing new 900-hp motors. The choice depends on the actual overall pumping head. Both of these options would include the purchase of one vertical-turbine pumping unit and a 900-hp motor and storage at an existing warehouse near the OID office to serve as a backup unit. The third upgrading scheme provides for installing four new pumps at the Shellrock Pump Station such that three pumps operating simultaneously could meet the 35 cfs design discharge and the fourth pump would serve as an on-site backup pump. Variable-speed pumps were not considered by BOR because of their anticipated costs and maintenance complexities.

Option 1 - Reuse Existing 800-hp Motors.

It appears the capacity of the existing pumps can be upgraded by changing the impeller diameter for the existing bowl assemblies to achieve the required pumping flow capacity and head. For this option, only the pump impellers would have to be redesigned and replaced; the bowl assemblies could be reused. The first stage or bottom impeller would be replaced with an impeller designed for low-NPSHR (Net Positive Suction Head Required) design. The remaining four impellers would be redesigned to match the new flow capacity and operating head requirements.

This option would require the purchase and storage of an off-site backup pump. The pump would have a rated capacity of 9.35 cfs (4,200 gpm) at a total dynamic head (TDH) of 628 feet. A 15-ton mobile crane would be included to permit easy replacement of the failed pumping unit. The mobile crane would be sized to remove the motor first, then the complete pump and column.

Option 2 – Replace Existing Motors with New 900-hp Motors.

Should the actual head loss in the system be determined to be higher than can be accommodated by the existing pumps, larger impellers for the existing 5 bowl assemblies would be required to provide the nominal 35 cfs capacity. The impellers would be designed similar to Option 1, but new 900-hp motors would be needed to provide the required flow at this higher system head. Keeping the motor upgrade to 900 hp enables reuse of the existing stainless steel line shaft size, which would be cut to length and re-threaded depending on its condition. Alternatively, the line shaft section between the top impeller/bowl assembly and motor shaft coupling could be replaced in its entirety along with new line shaft sleeves and bearings.

Evaluation of the required pump setting from pump manufacturer's data indicates there should be sufficient submergence for the new units when operating at a minimum river water surface elevation of 818.18 feet based on current intake design recommendations. It is recommended that the pump bell diameters be increased in order to reduce the velocity of the water entering the pump bowls over the expected range of pump flows, including runout of the pump when only single-pump operation occurs. Surface generated vortices reducing pump output capacity should not be an issue affecting pump performance at lower bell velocities. The current spacing of the units allows for adequate clearance between individual units and the adjacent sump walls using the larger diameter bells.

A special first stage impeller would be installed in the bottom or first bowl assembly. An impeller designed for the new flow and head conditions should be specified for the first stage to ensure that negative pressure does not exist, which can cause cavitation of the pump impeller, and to provide good flow characteristics into the remaining impellers in-line above it. The existing unit wafer check and butterfly valves are sufficient for the pressure that the new pumps would be putting out. Assuming that the manifold pipeline is schedule 30 carbon steel pipe or better, there would be a more-than-sufficient safety factor for the estimated higher operating pressure of the new pumps. It appears that the existing 4-inch and 2-inch air valves on the unit and manifold piping are sufficient for operation at the higher head of the new pumps. The valves would be replaced with higher pressure class air valves should the design head of the new units be found to exceed the pressure limits of the existing valves.

This option would require the purchase and storage of an off-site backup pump and crane as described in option 1.

Option 3 - Three Unit Pumping Plant Option

The existing four pumps and motors would be replaced with four units sized so three pumps operating simultaneously could meet the 35 cfs design discharge, and the fourth pump could function as a backup unit. The motors would have to be rated 1,250 hp if additional head loss in the existing pipeline at the new condition of 35 cfs (36.75 cfs with 5% wear factor) results in a total pumping head requirement greater than about 600 feet. If the pump tests recommended in **Section 2.3.1.4** determine that the actual head loss in the existing pipeline system is significantly lower than 600 feet, four motors with smaller horsepower ratings could be supplied to meet the rated operating conditions. The entire motor deck slab would be removed and replaced to accommodate the new pumps and motors.

Consideration was given to re-spacing the existing units and adding a fifth unit but it was determined that the existing sump is not wide enough to adequately accommodate 5 pumping units and still provide sufficient spacing between the units for performing maintenance activities. If the existing sump were enlarged approximately three feet, then up to 5 units (or 4 units + 1 spare) could be utilized to provide the 35 cfs pumping plant capacity required. However, the cost of expanding the sump appeared prohibitive so the 3 units + 1 spare option was developed.

Replacement of Power Transformer

The existing transformer is too small for simultaneous operation of the four pumping units. The existing transformer is rated at 2,500 kVA with secondary full-load current of 346 amperes at 4,160 volts. Each of the existing motors has a full-load current rating of 100 amperes for a total load of 400 amperes. The power transformer would be replaced with a new 3,750 kVA oil-filled transformer with suitable oil-containment provisions.

Replacement of Surge Tank

Assuming that the current maximum capacity of 25 cfs is delivered to the OID upper main canal, the velocity in the main pipeline would be about 4.83 ft/second. This velocity is within the typical range of velocities for pipelines. A change to 35 cfs would increase the pipeline velocity to 6.76 ft/second, still within the range of acceptable velocities for cement-mortar lined ductile iron pipe.

An important safety feature of the discharge line is the air tank located in the plant yard. Available information indicates that the air tank is a horizontal pressure vessel of minimum 2,500-gallon capacity. In the event of a power loss with all pumps operating, the air tank dampens the hydraulic shock for both down- and upsurge conditions. Downsurge occurs when the supply of water is suddenly cut off. Water momentum would tend to keep the pipeline flowing with water supplied from the air tank to the pipeline. Upsurge happens when the water starts to flow back toward the pump station and suddenly slams against the check valve. Air in the air tank dampens this upsurge.

An analysis of the potential effects of a power loss with water in the pipeline shows that at a flow of 35 cfs (and using the existing air tank), the downsurge at one high point in the discharge pipeline would be unacceptably low and there is a danger of "column separation." During column separation, the negative pressure creates a vacuum and the water column temporarily separates. When the column comes back together, the resultant internal pressure increase could exceed the rated pressure of the installed pipe, resulting in a pipe failure.

To protect the existing pipeline from excessive negative pressures, the existing air tank needs to be at least 2.5 times larger if the pumped flow is increased to 35 cfs. A larger standard size would be about 7,500-gallon (1,000 cu ft) capacity and the pressure rating would be the same as the existing tank. Air release and air filling settings would be about the same proportion as the existing tank.

Construction of a Sediment Basin

Water furnished from the Okanogan River contains high sediment loads that create problems at the Shellrock Pump Station and delivery points. There are proposed modifications at Shellrock Pump Station to reduce sediment accumulation problems in the sump, however to adequately address the sediment problems currently being experienced by the water district and water users, a sediment basin should be incorporated into the delivery system to remove suspended sediment.

The proposed action is to widen a portion of the Upper Main Canal to create a continuous flow-through sedimentation basin to settle out coarse sands after pumping but before delivery. The existing pipeline would be terminated via a blind flange below the lowest sub-lateral. At this point, a new pipeline would be constructed about 1,000 feet to the south of the existing line to convey river water to the sedimentation basin for cleanup (See Figure 2-1). After settling out particles, water would continue down the Upper Main Canal to Diversion 4 where gravity would furnish sufficient pressure to supply the deliveries on the existing main transmission pipeline between the canal and pump station in the same manner as present. No significant operational changes would be needed at the pump station or deliveries. That is, when delivery water is needed through pumping, only the route of the flow changes.

The Upper Main Canal sedimentation basin would be lined with a 6-inch reinforced concrete lining. An access ramp would allow motorized equipment to enter the basin during the off-season and remove sediment accumulations. Space for accumulation of sediment sludge is furnished by a 4-foot dropped canal invert. Transitions at each end of the basin bring it back to conformance with the existing canal invert and side slopes. Major items for the basin construction will be excavation, embankment construction, lining placement, and construction of a 30-inch diameter pipe inlet with safety racks. During final design, basin alternatives that would permit basin operation to continue during sediment removal operations (split basin), and use of existing OID equipment (trackhoe) to remove sediment accumulations could be considered. However, these features are not included in this proposed action.

2.3.1.3 Construction Considerations

Construction of the plant modifications assume that work could be accomplished during one irrigation season when the Shellrock plant is not needed and the maximum river water surface during construction is at or below elevation 822.0 feet. Modifications to the plant would require that it be dewatered. An earthen cofferdam with a sheetpile cutoff wall would be needed to channel river flows away from the plant during construction. Once the area between the cofferdam and plant is dewatered, the sediment deposits both inside and upstream of the plant would be removed.

Modification of the existing intakes would require removal of the upstream 11.75 feet of the plant to elevation 811.18 feet. It is assumed that diamond wire concrete cutting methods would be used to remove the concrete and provide sound concrete surfaces to attach the new concrete features. The concrete fillets in the existing sump would be removed by common chipping methods. Once demolition is complete, new reinforced concrete sump walls and motor deck slab would be placed. Reinforced concrete upstream and downstream wing walls would also be placed and backfilled with free-draining material.

After plant sump modifications are complete, the sheetpile cutoff wall and cofferdam would be removed and the cofferdam access ramp reclaimed.

2.3.1.4 Future Investigations and Studies

Further investigation would be required if modifications to the plant are to be implemented. These include:

- Conduct pump tests to confirm existing unit operation, flows and head loss through the system.
- Conduct a more detailed hydraulic study of the discharge line, including all turnouts and valve timing information to properly size the surge tank.
- Conduct a condition assessment of the existing pipeline and perform a detailed analysis of the maximum allowable pressure the existing pipeline can withstand.
- Determine as-built dimensions and elevations of the existing plant and equipment to verify that the plant was constructed in accordance with contract documents. Data developed during the 1996 topographic survey of the site indicate that the motor deck may be slightly lower than its design elevation (elevation 840.78 feet versus elevation 841.18 feet).
- Verify material and thickness of manifold piping.
- Assemble and analyze historical river data to verify appropriate minimum operating, normal operating, maximum operating, and 100-year river flood elevations. Develop a flood frequency curve.
- Conduct sediment sampling to identify gradation of sediment currently being deposited in the sumps. Also determine maximum particle size that can be pumped with nominal additional filtering from water users.
- Obtain geologic foundation data for the proposed cofferdam including soil sampling and determination of top of rock. Investigate dike material sources as well as alternatives to the earthen dam with sheetpile wall cutoff.
- Consider constructing and operating a physical model to better assess hydraulics around the modified intakes with regard to fish protection and sediment deposition.
- Compare benefits of locating stoplog guides downstream of the traveling screens (as proposed), upstream of the trashracks, or between the trashracks and the fish screens.
- Consider alternate impeller and bowl materials to improve resistance to sediment abrasion.

- Frequent four-unit operation of the outdoor plant may create noise levels that adversely impact the private residence located directly north of the plant. The current property owner has constructed a sound barrier using old tires between the plant and his residence. Consideration should be given to installing additional sound dampening features or enclosing the pump station.
- Verify with NOAA Fisheries that the modified intake meets their juvenile fish criteria or is an acceptable variance. Obtain variance if needed.

2.3.1.5 Water Supply Operations

Under Action Alternative 2, OID would satisfy its irrigation water requirement in part from the Okanogan River, leaving 5,100 acre-feet in Salmon Creek storage reservoirs to provide flows for steelhead and (with rehabilitation) chinook passage and overwintering. This volume of water would be retained in Conconully Reservoir or Salmon Lake, to be released as needed for passage and overwintering flows. A water system model has been used to examine interactions between pumping, irrigation, instream flows, and storage (see **Section 3.1** and **Appendix C**). At times when the District's water demand exceeds the instantaneous capacity of the Shellrock pumps, other sources (Salmon Creek, Duck Lake) would need to be accessed to supplement pumping from the Okanogan River. This action alternative would be able to deliver water to 3,927 acres (all areas served by diversions 4 and 5), or 78 percent of OID lands.

There would be critical period shortages (deficit irrigation) under this alternative. A critical period is defined as the sequence of years with the lowest runoff in the 99-year period of record used for water model simulation (1904-2002, inclusive). For a water supply source to be considered firm, it must provide a dependable supply of water during all in this period. The critical period includes 12 straight years (1922 to 1933 of below median runoff) and 10 years (1924 to 1934) when storage in Conconully and Salmon Lake reservoirs did not reach full capacity. It includes the three driest years on record (1929-1931), when aggregate runoff for the three-year period was 7,050 AF, or less than a third of the mean annual runoff of the creek.

Model results indicate that Alternative 2 would not meet firm supply requirements if this critical period were repeated. **Table 2-2** shows critical period shortages for Alternative 2 under conditions of weather and storage that existed from 1928-1933. Shortages were modeled to occur in one- to five-month periods in the four consecutive years from 1930-1933. The annual shortage was highest during 1931, the driest year. Shortages began as early as June (1932 and 1933) and lasted as late as October (1930-1932). A total of 14 months over four years were water-short. In eight months of the 1930-1933 period, shortages approached or exceeded 20 percent of OID monthly demand, and during October for three years shortages exceeded 25 percent and approached 30 percent. August shortages averaged 20 percent over the 1930-1932 period, and October shortages averaged 28 percent. In all other months and years, shortages were less than 10 percent of OID monthly demand. Depending on how one defines "critical

Table 2-2. Salmon Creek Critical Period Shortage v. OID Monthly Demand. Alternative 2: Upgrade Shellrock Pump Station.

Month	1928	1929	1930	1931	1932	1933
Critical Period Shortages (ac-ft)						
Jan	0	0	0	0	0	0
Feb	0	0	0	0	0	0
Mar	0	0	0	0	0	0
Apr	0	0	0	0	0	0
May	0	0	0	0	0	0
Jun	0	0	0	134	80	114
Jul	0	0	0	614	469	0
Aug	0	0	614	614	607	0
Sep	0	0	178	212	126	0
Oct	0	0	113	124	96	0
Nov	0	0	0	0	0	0
Dec	0	0	0	0	0	0
Annual Total	**0**	**0**	**905**	**1698**	**1379**	**114**
Total OID Monthly Demand						
Jan	0	0	0	0	0	0
Feb	0	0	0	0	0	0
Mar	26	23	24	25	23	24
Apr	535	535	535	535	535	535
May	2072	2056	2056	2084	2142	2148
Jun	2340	2246	2282	2287	2201	2235
Jul	3220	2729	2943	2987	2735	2901
Aug	3377	2866	3044	3140	2884	3059
Sep	2474	2326	2382	2405	2298	2353
Oct	447	399	417	419	372	390
Nov	52	51	51	46	35	35
Dec	6	5	5	5	5	5
Annual Total	**14550**	**13236**	**13740**	**13935**	**13231**	**13686**
% of Total OID Monthly Demand						
Jan	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Feb	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Apr	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
May	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Jun	0.0%	0.0%	0.0%	5.9%	3.6%	5.1%
Jul	0.0%	0.0%	0.0%	20.5%	17.2%	0.0%
Aug	0.0%	0.0%	20.2%	19.5%	21.0%	0.0%
Sep	0.0%	0.0%	7.5%	8.8%	5.5%	0.0%
Oct	0.0%	0.0%	27.2%	29.7%	25.9%	0.0%
Nov	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dec	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Annual Total	**0.0%**	**0.0%**	**6.6%**	**12.2%**	**10.4%**	**0.8%**

1928 was first year of drought - see annual runoff running mean plot period" (e.g., with reference to runoff below median, storage less than full, or the level of multiyear running mean total runoff) this alternative began to experience shortages in the third, sixth, or eighth year of the critical period drought. If a pump or motor were to fail, the District could experience a short-term immediate water loss with either of the off-site backup pump options. Extended down time could affect irrigation delivery and yield. Option 3, with the backup pump on-site, would operate similar to the way the system is currently operated should one of the pumps fail.

2.3.1.6 Water Rights

This alternative would not rely upon the transfer of District water rights from Salmon Creek, but would make use of existing OID Okanogan River water rights. It is reasonable for OID to increase the frequency of its Okanogan River pumping, within the limitations of its existing rights, if compelled to do so by the requirements of the ESA to address Salmon Creek fisheries (pers. comm., Bob Barwin, Department of Ecology).

Table 2-3 lists the Okanogan River water rights owned by the OID. The four rights total 35 cfs in instantaneous quantity. Annual quantities are stated for only one of the rights (1,214 AF).

Table 2-3: Okanogan Irrigation District Okanogan River Water Rights.

Certificate or Claim	Priority	Instantaneous Quantity	Annual Quantity
Certificate #384	July 3, 1926	3 cfs	Not stated
Certificate #357	July 3, 1926	7 cfs	Not stated
Certificate #466	January 22, 1930	15 cfs	Not stated
Claim #089802	1915	10 cfs	1,214 acre-feet

OID's existing Okanogan River water rights probably can be used for irrigation supply in lieu of Salmon Creek diversions. Changes to the points of diversion and, potentially, the places of use would be necessary. The histories of use of the certificates and claim listed in the table are somewhat complicated. Some rights relate to pump stations that are not located at the Shellrock site. These rights would require a relatively extensive evaluation of the history of use between the 1920s and 1970s (when Shellrock was constructed) in order to quantify the extent of use and annual quantity they represent.

Since the level of pumping at a given moment from the Okanogan River would very likely not match the level of flow returning to the river from Salmon Creek at the same moment, Okanogan River flows probably would be reduced at times under this action alternative. As discussed above (**Section 2.2.1.5**), it is assumed that pumping would not be constrained by minimum flow requirements on the Okanogan River, although regulatory review of an application to change OID water rights does have the potential of conditioning OID Okanogan River water rights to be interruptible when minimum flows are not met. If Ecology, in its determination of extent and validity, finds that OID's existing Okanogan River water rights are not sufficient to obtain 35 cfs, then the increment between their existing Okanogan River rights and 35 cfs would be subject to restrictions at times when minimum instream flows are not met. Ecology estimates that this would restrict pumping during August and September about one year in four.

2.3.2 FEEDER CANAL UPGRADE

Under this alternative, improvements to the feeder canal that delivers water from the North Fork of Salmon Creek to Salmon Lake would be the same as described for Alternative 1 (see **Section 2.2.2**).

2.3.3 LOWER SALMON CREEK FULL CHANNEL REHABILITATION

Full rehabilitation of the lower reach of Salmon Creek would be intended to facilitate fish passage by reestablishing more natural hydrologic and geomorphic stream processes in the channel downstream of the OID diversion dam. Efforts to increase streamflow and rehabilitate fish habitat in lower Salmon Creek would allow the passage of spring run chinook salmon and summer run steelhead to the middle reach, thereby increasing the amount of spawning and rearing habitat available to these species in the U.S. portion of the Okanogan River Basin.

Above the OID diversion, Salmon Creek is somewhat impaired but overall it is well defined and relatively stable. Site-specific stream bank treatment and voluntary changes in stream corridor land use have been recommended (NRCS, 1999; ENTRIX, Inc., 2002). The Natural Resources Conservation Service (NRCS) is leading stream rehabilitation efforts in the middle reach of Salmon Creek above the OID diversion, primarily using established programs for working with individual landowners.

This alternative includes various rehabilitation treatments that would be implemented in the lower 4.15 miles of Salmon Creek to enable fish access up to the middle reach. At many locations, a combination of site-specific treatment of eroding stream banks, constructing a low-flow channel, floodplain reconnection, and reestablishing riparian vegetation would sufficiently enhance channel and habitat conditions. Full channel rehabilitation would modify the lower channel shape and size and decrease the minimum streamflow required for adequate fish passage. This would reduce the total volume of water needed for fish passage and/or allow greater flow management flexibility.

2.3.3.1 Rehabilitation Recommendations

A *Conceptual Rehabilitation Plan for Lower Salmon Creek* has been developed to describe ways to improve local channel and habitat conditions (ENTRIX 2002), and preliminary design is progressing in parallel with the environmental review. Lower Salmon Creek has been split into four segments based on distinguishing characteristics, notably land use and channel condition (**Figure 2-4**), and each segments has different rehabilitation needs. At many locations, site-specific cut and fill of eroding streambanks would be used to reduce bank heights and angles, and in some select locations, reestablish a floodplain connection with the channel. Treatments will also include geo-technical and bio-stabilization bank strengthening measures, such as rock armoring of streambanks, construction of hard toe structures, geo-textile fabrics and revegetation, and land use management measures (e.g., livestock management, cultivation buffers). Complete reconstruction of both the streambed and streambanks is recommended in a portion of lower Salmon Creek, which can include realigning channel and modifying streambed features and local gradient. Channel design would reconfigure the bed geometry and substrate material in many places to diversify hydraulics and create resting areas and cover for migrating fish.

Under its existing condition, sand and gravel in the streambed surface of the lower 2 miles of Salmon Creek is minimal. Sand and gravel is mostly found beneath the coarse surface deposits of cobble and boulder, or infrequently, as small bars. Reconfiguring the channel to be more asymmetrical, and reducing peak flows by increasing floodplain storage, may increase the amount of sand and gravel stored in bars and floodplain features. However, a combination of steep channel gradients, and the fact that much of the channel will remain somewhat incised, means the dominant bed composition of the rehabilitated channel will still be dominated by cobble, with local areas of sand and gravel.

Table 2-4 describes the levels of treatment types that would be implemented in the full rehabilitation of lower Salmon Creek. The treatment types range from management-only (channel preservation) to full channel reconstruction. The treatment type that is applied to a particular section of the river depends on the existing channel conditions that are impeding fish passage riparian land use constraints and the expected long-term stability of the channel. For example, reaches designated for preservation already have adequate low-flow depths and suitable bed and bank stability to enable fish passage. In some reaches, recontouring the top of the bank/levee would provide floodwater storage areas for peak flows and reduce high flow stress on existing in-channel conditions. For other reaches, though, the channel is incising, the banks are unstable and eroding, and without preventative action, the channel will continue widening and flow depths for fish passage will remain minimal or inadequate. In reaches such as these, geo-technical (e.g. placement of large angular rocks at the bank toe, construction of rock walls) and/or bio-stabilization (e.g. grassy mats, willow staking, or other vegetation plantings) treatments will be implemented to stabilize the channel and prevent further degradation. The highest level of treatment, full channel reconstruction, is recommended for a couple of short reaches that are severely degraded and incised, overwidened, unvegetated, and have highly unstable banks. Full reconstruction of these channel sections will help ensure that long-term, low maintenance fish passage is met. All of the bank stabilization, flood plain reconstruction, and channel reconstruction efforts will work together to decrease sources of future channel instability and sediment to lower areas. Selection of the treatment type must also consider riparian land uses that may affect which treatments are suitable for a particular reach. This is especially important in treatments that call for reestablishing a floodplain connection, since this treatment is only viable where adjacent land use and landowner consent permits. All of the bank stabilization, flood plain reconnection, and channel reconstruction efforts work together to decrease sources of future channel instability and sediment to downstream areas. **Table 2-5** summarizes the amount of each type of treatment proposed by stream segment.

Table 2-4. Treatment Types to be Implemented in the Rehabilitation of Salmon Creek.

Treatment Type	Description of Recommended Treatment Activities/Features
Channel preservation	No direct action. Preservation of existing channel alignment, bank conditions, in-channel habitat, and floodplain areas.
Top of bank/levee recontouring	Locally remove artificially raised top of banks/levees to reestablish the channel's floodplain connection where consistent with adjacent landowner needs. No change to channel alignment or in-channel habitat. Assumes no net impact or export of material.
Bank protection	Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows. No change to channel alignment, in-channel habitat, or floodplain connection.
Bank protection and bed improvements	Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows and constrict low flow channel width. Use excavator to reconfigure bed geometry to create a low-flow channel for fish passage. No change to channel alignment or floodplain connection.
Bank, bed, and floodplain modification	Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows and constrict low flow channel width. Use excavator to reconfigure bed geometry to create a low-flow channel for fish passage. Use local cut and fill to contour portions of leveed or terraced banks to reestablish the channel's floodplain connection. No change to channel alignment.
Full channel reconstruction	Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows and constrict low flow channel width. Use excavator to construct a new channel along a new alignment, reduce channel width, and define a low-flow channel for fish passage. Use local cut and fill to contour leveed or terraced banks and construct a connected floodplain.

Note: Geo-technical includes actions such as placement of large, angular rock at the toe of banks, construction of rock walls, and geo-textiles.

Bio-stabilization includes re-vegetating with treatments such as plant staking and vegetation mats.

Segment 1

Segment 1 is 1.45 miles long and has a valley gradient of 0.8 percent. This segment provides pool/riffle habitat and adequate fish passage with streamflows of at least 10 to 15 cfs under existing conditions. This segment has high potential for reestablishing floodplain connection and providing floodwater storage areas that will attenuate peak flows downstream. About a third (0.55 miles) of Segment 1 has a well vegetated and stable channel that should be preserved (**Figure 2-5**). Between RM 3.9 and 3.3, the channel planform appears to have been straightened, but the riparian corridor is well vegetated. The recontouring of leveed banks in a portion of this reach would re-establish overbank flood processes and functions, and reduce high flow stress on the existing bed and banks. About 0.25 miles of this reach are recommended to have bank, bed, and floodplain modifications in areas that are incised or have experienced prior flood damage. All work in this segment is along private parcels and would require landowner support.

Segment 2

Segment 2 is 0.95 miles long with a steep upstream portion (3.6 percent) that is confined in a narrow valley. Rehabilitation of this segment would primarily feature preservation, but includes an area recommended for bank protection (**Figure 2-6**). Between RM 2.7 and RM 2.45, a bio-engineered hard toe structure for stream bank stabilization would limit sediment input, and reconfiguration of the bed would improve fish passage. The downstream two-thirds of this segment would be preserved in its existing condition. The Watercress Springs area (RM 2.4 to 2.0) has the potential benefit of providing excellent winter habitat and water to irrigate newly planted riparian vegetation. All work in this segment would require landowner support.

Segment 3

Segment 3 is 1.05 miles long and has a steep slope (3.8 percent) and a broad valley floor. Only about 0.05 miles of this segment would be preserved in its existing condition (**Figure 2-7**). The remainder of the segment lacks well-vegetated banks and is experiencing streambank failure that is recommended for treatment. A knickpoint (i.e. an abrupt change in channel bed elevation and gradient) near RM 1.6 is evidence of the continued upstream advance of channel incision. This channel instability causes abandonment of the floodplain and a wide, shallow, or braided channel with lateral and transverse bars that impede fish passage. Bank stabilization to regulate sediment supply and streambed modification to define a low-flow channel would improve fish passage. About 0.25 miles of channel (RM 1.35-1.25 and RM 0.95-0.85) will require full channel reconstruction to provide streambank stability, create a low-flow channel, and reestablish floodplain connection with the channel. Segment 3 also contains the former city dumpsite. Refuse from the dump is evident in the banks along Salmon Creek (RM 1.1 to 1.2). The rehabilitation design would include plans to stabilize and armor the banks along the dumpsite so that refuse is no longer exposed and the possibility of future streambank erosion is prevented. The alignment of the creek through the dumpsite would be stabilized so that the channel would not erode into the dumpsite in the future.

Segment 4

Segment 4 is 0.7 miles long, has an average gradient of 2.4 percent, and a low channel sinuosity that reflects land use encroachment on the stream. Many private properties require protection from high flows and bank erosion (**Figure 2-8**). Downstream of Fifth Avenue (RM 0.35), the channel shape is a trapezoidal design with riprap bank protection from a prior U.S. Army Corps of Engineers project. Urban constraints and maintenance of flood protection limit use of treatment options. About one-third of the segment, in the uppermost portion, would be preserved in its existing condition. Much of the reach would require maintenance of existing rip-rap and additional bank strengthening to arrest active bank erosion. A low-flow channel would also have to be defined throughout portions of the segment, and some vegetation planting will be necessary. As previously described under Action Alternative 1, the large coarse sediment deposit at the mouth of Salmon Creek would have to be excavated. Excavation would be a one-time event if the full rehabilitation program is implemented, since the rehabilitation in segments 1, 2, and 3 will decrease the sediment inputs during floods and reduce the likelihood of new gravel accumulations near the mouth.

2.3.3.2 Rehabilitation Implementation

The preliminary design does not make a final determination of these treatments. However, it does provide estimated locations and extent of various treatment types that would be refined through subsequent design steps following environmental review.

Specific rehabilitation efforts can be independently undertaken in Segment 1 (upstream of Danker cutoff at RM 2.75) without regard for other project timing. Actions to restore channel stability in these portions of the stream can occur in any sequence that opportunity provides.

However, in segments 2, 3, and 4, particularly downstream of Watercress Springs, channel rehabilitation actions would proceed sequentially in the downstream direction, and would comply with a well-integrated design. Rehabilitation actions would affect flow conveyance, sediment supply and sediment transport capacity within the stream. Improper project implementation could undermine the integrity of other site designs within the channel.

2.3.3.3 Construction Activity

Channel construction would take between 1 to 3 construction seasons[7] to complete and would involve several construction phases, including:

1. Obtaining access agreements to begin survey and construction staking
2. Stockpiling of construction materials and equipment
3. Diversion of water from the channel, if necessary
4. Excavation, fill, and reconfiguration of streambed and streambanks
5. Upland and out-of-channel construction
6. Habitat placement construction
7. Planting
8. Cleanup

Instream rehabilitation would be performed in a dry stream channel to reduce short-term impacts to water quality and to minimize costs. A construction schedule would be implemented so that the different construction phases would be coordinated with the wet and dry seasons and to avoid impacts to any migrating fish in the channel. Any construction that occurs during the wet season would require water diversion. To divert the water, a dam would be created and water diverted around the site by pumping through screened pipes. The proper authorities would be notified

[7] Based on the existing hydrologic information, high flows occur during May and June. In-channel construction would not occur during these two months, leaving a construction season of about 10 months per year.

and permits obtained if water diversion is necessary. Fish passage flow regimes should be implemented after completion of channel rehabilitation. Premature streamflow releases may alter design constraints, and would not benefit fish passage.

Construction monitors for biological and archeological finds would be on site for all construction phases to ensure that in the event of uncovering a significant find, construction activity would be halted until the issue is properly handled.

Rehabilitation work would require staging areas at various locations outside the active channel on level ground for storage of equipment, supplies, and stockpiling of material. Materials excavated from one site may be reused in other areas within the lower Salmon Creek project area requiring fill materials. Additional materials may also be needed from off-site sources. Thus, areas to stage and process rock and other substrate materials (e.g., wood, gravel, boulders, plantings, etc.) would be necessary. Considerations for such areas would include haul distance from source and site, heavy equipment, and sufficient space to move, sort and store materials. Preliminary examinations of the work area suggest that sufficient space is available within the plan area. Specific sites would be identified as part of more detailed project design.

Fuels, solvents, and lubricants used by construction machinery would be temporarily stored at the project area. Since the potential exists for exposure due to spillage or leakage, appropriate measures would be taken to limit exposure and prevent groundwater or stream contamination.

Access to project areas would be obtained prior to construction through correspondence and agreement with public and private property owners. Over the length of the project, access may be needed for construction clean-up, vegetation watering, and personal site visits for monitoring purposes. Heavy equipment access to rehabilitation sites is readily available. The portions of the channel proposed for major rehabilitation are accessible directly from the public road west of Salmon Creek. Access within the city of Okanogan may occur at bridge crossings, dead end streets, or other nearby access points. Most of the channel rehabilitation within the city limits would be targeted to specific sites, where access requirements may be on a point-by-point basis. Specific details of site access would be included in the final design.

Traffic in the project area would increase as heavy machinery exits and enters staging areas and access points. Traffic would also increase outside of the project area due to trucks hauling soil, rock, and vegetation to and from the site. Proper signage and traffic control would be enforced for the duration of the project, and the proper authorities would be notified in advance about the projected increase in traffic volume.

Revegetation and Watering

Reestablishing a healthy riparian vegetation corridor in lower Salmon Creek is critical to arresting bank erosion and maintaining channel stability that will allow for successful fish passage. As a result of years of channel dewatering and land use activities that have contributed to channel incision and a lowering of the water table, there has been a dramatic reduction in riparian vegetation along the streambanks. In some reaches, the riparian vegetation has been eliminated all together. Loss of riparian vegetation is a negative feedback on channel stability and is a major factor that causes streambanks to become more prone to erosion. This is particularly true in lower Salmon Creek, where the streambanks are composed of a coarse mixture of unconsolidated sediment that gain much of their cohesive strength from root binding.

Although Action Alternative 2 supplies more water to lower Salmon Creek than under existing conditions, there may still be times in the months of July, August, and September where there is no flow in the channel. However, because lower Salmon Creek would have more water in the channel throughout the year than under the No Action Alternative, it is expected that the groundwater table will rise. Additionally, the stream rehabilitation will reduce bank heights in several reaches, which will bring the elevation of the riparian vegetation closer to groundwater levels. New vegetation native to eastern Washington and adapted to riparian zones will likely have to be planted, rather than seeded, and watered regularly for 3 to 5 years until the plants are established. A combination of direct watering from a water truck and an irrigation system will be used to water the newly establishing vegetation. Irrigation systems will have to be constructed in some reaches, and plants would benefit from watering at progressively lower elevations in the soil profile to promote deep root development and enable the plants to utilize groundwater during the dry months. Plant growth would also benefit substantially if the flow ramping rates were tailored for a gradual rise and fall of the monthly hydrograph to allow plants to adjust to the changing water levels. Riparian land uses, notably grazing, will have to be controlled to protect the vegetation.

There is no guarantee that riparian vegetation will reestablish with stream rehabilitation and the water supply alternatives, since factors such as droughts cannot be predicted nor controlled by the Project. However, a stream rehabilitation that reduces the distance between vegetation's roots and groundwater levels, combined with a strategic watering and flow release schedule, can result in successful reestablishment of riparian vegetation that can persist through seasonal patterns when there is no flow in the channel.

2.3.4 COSTS

2.3.4.1 Construction Cost Estimates

Two field cost estimates were prepared for the plant and system modifications needed to upgrade the Shellrock plant to 35 cfs capacity. Option 1 assumes reuse of the existing 800-hp motors and Option 2 would include replacement of the existing motors with new 900-hp motors. The cost estimate for Option 1 is $1,755,000. The cost estimate for Option 2 is $2,600,000. Both estimates include 10 percent for unlisted items, 20 percent for contingencies, and 30 percent for additional site investigation, environmental studies, and construction management. All costs are based on calendar year 2003 unit prices.

The costs for fully rehabilitating the lower 4.15 miles of Salmon Creek to enable fish passage to the middle reach are outlined in **Table 2-5**. At the preliminary design stage, it is estimated that the total construction cost would be 1.25 million dollars. The associated soft costs and a 25% contingency estimate increases the total implementation cost to 2.35 million dollars. As indicated in **Table 2-4**, some reaches would only require the selected treatment type at site-

Table 2-5. Estimated Costs to Fully Rehabilitate Lower Salmon Creek to Enable Fish Passage to the Middle Reach.

	Upstream River Station (mi)	Downstream River Station (mi)	Reach Length (mi)	Treatment Length of Reach[a] (mi)	Treatment Type	Cost ($)
Segment 1	4.10	3.90	0.20	0.20	Channel preservation	$0
	3.90	3.55	0.35	0.18	Site-specific top of bank/levee bank recontouring	$12,012
	3.55	3.35	0.20	0.20	Top of bank/levee recontouring	$13,728
	3.35	3.30	0.05	0.05	Bank protection	$9,768
	3.30	3.20	0.10	0.10	Channel preservation	$0
	3.20	3.10	0.10	0.10	Bank, bed, and floodplain modification	$86,592
	3.10	2.85	0.25	0.25	Channel preservation	$0
	2.85	2.70	0.15	0.15	Bank, bed, and floodplain modification	$129,888
					Segment Subtotal $	$251,988
Segment 2	2.70	2.45	0.25	0.25	Bank protection and bed improvements	$124,080
	2.45	2.35	0.10	0.05	Site-specific bank protection	$9,768
	2.35	1.95	0.40	0.40	Channel preservation	$0
	1.95	1.75	0.20	0.20	Channel preservation	$0
					Segment Subtotal $	$133,848
Segment 3	1.75	1.65	0.10	0.10	Top of bank/levee recontouring	$6,864
	1.65	1.55	0.10	0.05	Site-specific bank protection	$9,768
	1.55	1.35	0.20	0.20	Bank protection and bed improvements	$99,264
	1.35	1.20	0.15	0.15	Full channel reconstruction	$174,240
	1.20	1.05	0.15	0.15	Bank protection and bed improvements	$74,448
	1.05	1.00	0.05	0.05	Channel preservation	$0
	1.00	0.95	0.05	0.05	Bank protection	$9,768
	0.95	0.85	0.10	0.10	Full channel reconstruction	$116,160
	0.85	0.70	0.15	0.08	Site-specific bank, bed, and floodplain modification	$64,944
					Segment Subtotal $	$555,456
Segment 4	0.70	0.45	0.25	0.25	Channel preservation	$0
	0.45	0.35	0.10	0.10	Bank protection and bed improvements	$49,632
	0.35	0.10	0.25	0.13	Site-specific bank protection and bed improvements	$62,040
	0.10	0.00	0.10	0.10	Bank protection and bed improvements, and remove coarse sediment at mouth	$83,427
					Segment Subtotal $	$195,099
					Installation of irrigation system	$10,000
					Vegetation watering for first 3 years[b]	$105,000
					Construction Costs Total $	$1,251,391
					Soft Costs	
					Temporary facilities, administration, project management, project closeout @ 5%	$62,570
					Design, Permitting, and Construction Management @ 35%	$437,987
					Mobilization/demobilization @ 10%	$125,139
					Soft Costs Total $	$625,696
					Contingency Costs @ 25%	$469,272
					Total $	**$2,346,358**

a Treatment lengths for reaches specified as "site-specific" are estimated at half the reache's total length. Otherwise, the treatment is applied to the entire reach.

b Watering may be necessary for up to 5 years to get plants established depending on streamflow and precipitation.

specific locations within the reach. In areas of site-specific treatment, it has been assumed that the treatment length is 50 percent of the total reach length. Rehabilitation costs in these reaches will vary depending on the actual length of channel treated, and will be refined at a further stage in the design process. This cost estimate does not include funds for mitigation, temporary landowner access permits to the site or staging areas, or property acquisition.

Cost estimates for the feeder canal replacement range from $1.3 M to $2.3 M.

2.3.4.2 Operation Cost

Based on data provided by OID, the variable cost (energy and O&M) of operating the Shellrock plant averaged $40.19 per acre-foot pumped in 2001 and 2002. Additional pumping costs (above the level of pumping required for the No Action Alternative) associated with this alternative are estimated to be approximately $200,000 per year (see **Section 3.8**).

2.4 ALTERNATIVE 3

This alternative would involve:

- Purchase of 5100 acre-feet of OID water rights for Salmon Creek to allow the water that is subject to these rights to remain in Salmon Creek.
- Replace the Salmon Lake feeder canal and headgate.
- No rehabilitation of the lower 4.3 miles of Salmon Creek.

2.4.1 INFRASTRUCTURE

No infrastructural components are included in this Action Alternative. Water obtained through water rights purchase would be stored in existing reservoirs (Conconully Reservoir and Salmon Lake) and released to Salmon Creek using controls already in place.

2.4.2 WATER SUPPLY OPERATIONS

Water rights purchased under Alternative 3 would be retained in storage in Conconully Reservoir or Salmon Lake and would be released as needed to provide passage flows. OID operations would continue using its Salmon Creek and Okanogan River sources to supply a reduced irrigated acreage. Water would be used for passage and overwintering flows. As compared to the No Action Alternative, pumping increases under Alternative 3. This is because the No Action Alternative has no instream flow demands, so Salmon Creek supplies 78 percent of the irrigation water demand while Shellrock supplies only 15 percent (with the other 7 percent coming from Duck Lake). Under Alternative 3, instream flow demands reduce the proportion of the irrigation requirement that can be supplied from Salmon Creek to 41-51 percent of the OID water demand. Shellrock makes up the difference, supplying 44-51 percent of irrigation demand (with another 5-8 percent coming from Duck Lake). Thus, even though the total demand is reduced (i.e., from 15,745 AF to an average of 10,325 AF), pumping from Shellrock must increase (i.e., from 2,414 to an average of 4,882 AF) to make up for the reduced availability of Salmon Creek water.

There would be critical period shortages (deficit irrigation) under this alternative. **Table 2-6** shows critical period shortages for Alternative 3 under conditions of weather and storage that existed from 1928-1933. Shortages occurred in the model in two- to three-month periods in two consecutive years (1931-1932). The annual shortage was highest during 1931, the driest year of the two years that were water-short. In one month (October 1931) shortages reached 20 percent of OID monthly demand. Depending on how one defines "critical period" (e.g., with reference to runoff below median, storage less than full, or the level of multiyear running mean total runoff) this alternative began to experience shortages in the fourth, seventh or ninth year of the critical period drought.

2.4.3 WATER RIGHTS

Under this action alternative, sufficient water rights would be purchased from OID to provide the 5,100 AF of water required for passage flows. This amount of water would require retiring from irrigation about 1,470 acres, or about 30 percent of District lands. This action alternative does not assume that OID develops other sources of water to replace the water rights it sells to provide passage flows.

If public funds are used to acquire the water rights for permanent transfer to instream flow purposes, Washington law requires that they be held by the State in the State Water Trust Program (managed by Ecology). Application was made to place water temporarily leased from OID members in 2000 through 2002 into trust. Holding instream water rights in the trust program protects instream flows as a water right, preventing other applicants from seeking permits and junior water right holders from taking the acquired water out of stream. It also provides a basis for enforcement action against a party that infringes the right. In cases of temporary acquisition, such as through a lease, the transferor can protect itself from relinquishment of the water right only by placing the transferred water into the trust program.

Ecology may reduce the gross amount of water offered to the trust based on return flows, using a "net water savings" analysis. This analysis requires determination that "reasonably efficient practices" have been employed in the use of the irrigation water right. For the purposes of EIS analysis it is assumed that District water use rises to the standard of reasonably efficient use and the full diversion quantity is transferrable (there are no return flows to Salmon Creek below the irrigation diversion dam). The stream reach for which the instream flow right would be protected is limited to the "affected reach" as defined in Ecology's guidelines; this would be the lower 4.3 mile reach of Salmon Creek. Finally the quantity which could be transferred to a trust water right would be limited or conditioned to avoid impairment to other rights.

Alternative 3 would require negotiation of a water right purchase agreement with the District and its members and changing the purpose of a portion of OID's Salmon Creek water rights from irrigation to instream flow. The season, place and purpose of use would all be changed on the transferred water rights. In addition, Ecology would conduct a tentative determination of the extent and validity of the water rights, and this could change the amounts of the water rights. As

Table 2-6. Salmon Creek Critical Period Shortage v. OID Monthly Demand. Alternative 3: Water Rights Purchase.

Month	1928	1929	1930	1931	1932	1933
Critical Period Shortages (ac-ft)						
Jan	0	0	0	0	0	0
Feb	0	0	0	0	0	0
Mar	0	0	0	0	0	0
Apr	0	0	0	0	0	0
May	0	0	0	0	0	0
Jun	0	0	0	0	0	0
Jul	0	0	0	307	0	0
Aug	0	0	0	307	224	0
Sep	0	0	0	0	0	0
Oct	0	0	0	60	41	0
Nov	0	0	0	0	0	0
Dec	0	0	0	0	0	
Annual Total	**0**	**0**	**0**	**674**	**266**	**0**
Total OID Monthly Demand						
Jan	0	0	0	0	0	0
Feb	0	0	0	0	0	0
Mar	18	16	17	17	16	17
Apr	416	416	362	357	354	354
May	1518	1501	1469	1461	1413	1408
Jun	1575	1575	1575	1559	1527	1527
Jul	2092	1877	1959	1991	1835	1914
Aug	2180	1917	2018	2065	1888	1985
Sep	1610	1610	1610	1599	1578	1578
Oct	322	289	301	299	262	274
Nov	48	47	48	43	31	32
Dec	4	3	4	4	3	4
Annual Total	**9783**	**9251**	**9362**	**9395**	**8908**	**9092**
% of Total OID Monthly Demand						
Jan	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Feb	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Apr	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
May	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Jun	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Jul	0.0%	0.0%	0.0%	15.4%	0.0%	0.0%
Aug	0.0%	0.0%	0.0%	14.9%	11.9%	0.0%
Sep	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Oct	0.0%	0.0%	0.0%	20.1%	15.7%	0.0%
Nov	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dec	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Annual Total	**0.0%**	**0.0%**	**0.0%**	**7.2%**	**3.0%**	**0.0%**

1928 was first year of drought - see annual runoff running mean plot part of Ecology's tentative determination or as a part of the negotiated agreement, the purchased water rights would need to be safeguarded to satisfy the action agency that flow volumes purchased for fish passage would not be reduced by the use of any remaining water rights or claims. A trust water right retains the same priority date as the water right from which it originated, but the trust right shall be deemed to be inferior in priority unless otherwise specified by an agreement between the state and the party holding the original right. Because the object of this proposal is to secure water for fish in Salmon Creek, it follows that the irrigation portion of the right would (as a matter choice, not a requirement of water law) be subordinated.

This action alternative assumes that the remaining OID Salmon Creek water rights would be subordinated to the purchased water rights.[8] The purchased water rights would be senior to other Salmon Creek water rights that could affect flow objectives. As the oldest existing non-OID water claims on Salmon Creek date from 1890 and OID water claims date from 1888, the water rights purchased under Action Alternative 3 should be the most senior water rights on the creek.[9]

This alternative would require negotiation of a water right purchase agreement with the District and its members. Individual OID irrigators may not make independent arrangements to sell water appurtenant to their lands, as OID holds all water rights and claims in trust for its members.[10] However, OID can take land out from under assessment and sell water rights in amounts freed up by cessation of irrigation on that land. For example, in 1999 the OID Board passed a resolution to establish a Conservation Water Bank to allow its members to lease water on an annual basis. Members who wish to forego irrigation in a given season are allowed to register their allocation for transfer to the bank.

OID expressed concerns that several kinds of costs would occur and would need to be compensated in a water purchase scenario. These include direct payments to the grower who would be surrendering water; O&M payments to OID to avoid spreading fixed costs across fewer members; and offsets to the County for loss of tax base. Given that these concerns are addressed the OID Board indicated that it would be willing to consider negotiation of a water right purchase.

Analysis of this alternative does not attempt to predict final actual cost and sales of water rights, but works through water right purchase scenarios. The scenarios include:

Broadcast offer to purchase, allowing members to participate regardless of their location within the District. (Participation may need to be limited to a percentage of acreage as necessary to

[8] If the purchased water rights were junior to the other OID rights, OID could take the entire flow of the creek during dry years by exercising its water claims (which would exceed the creek flow during low flow seasons even after sale of a portion of the OID water rights, unless the total OID water rights were reduced by Ecology collateral to the transaction).

[9] It is possible that Ecology could ask for an adjudication if relative priority among claimants to Salmon Creek water became an issue. This could be avoided by an agreement among claimants.

[10] During an October 3, 2002 conference call with Ecology, Ecology addressed the question of whether the OID water rights are actually owned by the district or by its members (pers. comm. Bob Barwin). Recent case law cited by Ecology suggests that while the district may hold the rights in trust for its members, the water rights are actually owned by the members.

allow equal opportunity to participate to all members, however this limitation would apply only if members offer more water than needed for instream flows).

The water right buyer would be required to pay the annual assessment charge to OID for as long it holds the water right. This addresses the district's concern regarding cost of service impacts to remaining district lands.

The water right purchase itself could be handled through BPA's water rights acquisition program. This program requires that the action alternative: (1) Take account of return flows in calculating the actual instream flow volume that would transfer with a water right acquisition, and (2) complete a valuation or appraisal of the water right(s).

Under this program, it would be necessary for a "qualified local entity" under the BPA Columbia Basin Water Transactions Program (CBWTP) to prepare an application or proposal for the transaction (the CBWTP reviews and funds such proposals). [11]

2.4.4 FEEDER CANAL UPGRADE

Under this alternative, improvements to the feeder canal that delivers water from the North Fork of Salmon Creek to Salmon Lake would be the same as described for Action Alternative 1 (see **Section 2.2.2**).

2.4.5 LOWER SALMON CREEK STREAM REHABILITATION

Under Action Alternative 3, no stream rehabilitation would occur.

2.4.6 COST

2.4.6.1 Water Right Acquisition Cost

A water purchase price is not determined in this analysis for permanently transferred water. However, the decline in net income estimated by the Agricultural Production Model represents the estimated *minimum* level of payment that would be required to leave irrigators with net incomes equal to that which would have been earned through irrigated crop production. A premium above this amount is typically required to bid water away from irrigators. The level of premium depends upon specific water supply and demand factors that were not analyzed in this study. The decline in net income associated with the water right purchase alternative estimated in **Section 3.8** is approximately $250,000 per year. The capitalized cost of annual payments to the OID and decline of net income associated with this alternative would total $5.9 million (see **Section 3.8.3**). There would be an estimated total revenue loss to the local economy of approximately $4.1 million and a loss of approximately 118 jobs.

[11] The actual proposal or application would occur after the EIS ROD and only if BPA decided to pursue this alternative.

2.4.6.2 Operation Cost

Additional pumping costs (above the level of pumping required for the No Action Alternative) associated with this alternative are estimated to be approximately $100,000 per year (see **Section 3.8**). (This assumes that the variable cost [energy and O&M] of operating the new pumping plant are equivalent to the variable costs for the Shellrock plant noted above.)

2.5 NO-ACTION ALTERNATIVE

Under the No Action Alternative, no flows would be provided for steelhead or chinook passage in lower Salmon Creek. The lower creek would continue to be dewatered in most years, and OID would continue to divert its irrigation water supply under existing water claims from its existing diversion dam at RM 4.3 on Salmon Creek, supplemented in dry years by pumping from the Okanogan River at Shellrock. The District would continue to operate with its existing water sources and reservoir storage facilities, and there would be no critical period shortages. The Lower Salmon Creek channel would not be rehabilitated and neither steelhead nor chinook salmon would be able to pass through the lower 4.3 miles of Salmon Creek in most years to reach the high quality habitat in middle reach of Salmon Creek. No additional infrastructure improvements, including the North Fork Salmon Creek feeder canal are expected to be undertaken.

The No Action alternative could seriously impact the Okanogan Irrigation District and rural economy of the region. Under such an alternative, the District's water diversions, which have supported an irrigation economy for the Okanogan area for more than 80 years, would be subject to enforcement under the Endangered Species Act as the Okanogan Basin is listed as "critical habitat" by NMFS for summer steelhead. Enforcement could result in federal reallocation of water to instream flows, without the benefits of planning and investment to offset what certainly would be very significant social and economic effects for the region.

In 1998, OID developed a Draft Conservation Plan detailing some of its conservation efforts to-date. The OID conservation program includes both District-wide and on-farm elements. Most of the District-wide conservation program has been implemented. On-farm conservation represents most future conservation potential in the District, but attempts to engage OID members in implementing on-farm conservation measures have resulted in very limited participation. The on-farm program conservation program has been discontinued and there are no current plans to restart it. Implementation of the existing conservation plan is considered part of the No Action Alternative.

Under the No Action Alternative, OID's existing water supply sources would be adequate to provide a firm supply of water to the irrigation system[12], assuming maximum pumping from the Shellrock plant throughout the irrigation season. It is assumed that:

[12] Firm water supply is further discussed and defined in Appendix A.

- the monthly distribution of canal spill continues to follow current OID practices;
- annual OID crop water requirements are slightly reduced to reflect the predicted needs over the next 5 years rather than the crop water requirements that have occurred over the last 16 years;
- Duck Lake pumping follows the strategy outlined in **Appendix A**;
- maximum pumping from Shellrock occurs when storage reaches a critical level of 9,500 ac-ft; and
- maximum pumping from Duck Lake and Shellrock may occur at any time.

These assumptions maximize the current OID practices and reflect potential management strategies to conserve water for a critical drought period.

A Trust Water Agreement (TWA) may be negotiated between Ecology and OID following the precedent set on the Dungeness River by the Sequim-Dungeness Valley Agricultural Water Users Association. A TWA could include a commitment by OID to a conservation program together with provisions for transferring water that can be documented to be conserved under their Comprehensive Water Conservation Program into trust. Trust water may be allocated to instream flows and to a reserve for future irrigation.[13]

For the No Action Alternative, the water system model predicts a firm yield of 448 ac-ft of flow over the Salmon Creek diversion dam and 354 ac-ft at the mouth of Salmon Creek. Average annual flow over the weir is estimated at 10,501 ac-ft/yr. The predicted average combined storage for the modeling period was 19,178 ac-ft/yr, with a minimum annual storage volume of 1,748 ac-ft. Predicted average annual total OID demand from the water supply system is 15,745 ac-ft/yr, with an overall district efficiency of 70%. Under this alternative, Salmon Creek supplies about 78% of total OID irrigation water supply (12,229 ac-ft/yr), Shellrock 15% (2,414 ac-ft/yr) and Duck Lake 7% (1,101 ac-ft/yr). Predicted average annual efficiencies for on-farm and delivery are 77% and 91%, respectively.

2.6 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Several types of alternatives were considered in the development of this EIS, including:

- Flow alternatives
- Water supply alternatives
- Stream rehabilitation design alternatives

[13] In the case of the Dungeness River, the Trust Water Agreement allocates two-thirds of conserved water to instream flows and reserves one-third for future irrigation up to a maximum irrigated acreage specified in the agreement.

2.6.1 FLOWS

In order to define water supply alternatives, an initial range of potential flow volumes that might be restored to Salmon Creek was considered (**Table 2-7**). Both passage and base flows[14,15] in the lower creek were initially evaluated, but alternatives that provided the (larger) base flows were eliminated from consideration since these flows are not required to meet the purpose and need for the project. It was decided to evaluate one flow volume for the provision of passage flows (5,100 AF), as described further below. The other flows initially considered were eliminated from further consideration

Table 2-7. Initial Range of Flow Volumes Considered for Action Alternatives.

Volume (acre-feet)	Stream Rehabilitation Required?	Benefits
2,300	Yes	Steelhead passage (adult and juvenile) and overwintering
3,460	No	Steelhead passage (adult and juvenile) and overwintering
5,100	(a) Yes (b) No	(a) Steelhead and chinook passage (adult and juvenile) and overwintering (b) Steelhead passage (adult and juvenile) and overwintering
8,700	No	Steelhead and chinook passage (adult and juvenile) and overwintering
10,000	Yes	Steelhead and chinook passage (adult and juvenile) and overwintering, lower Salmon Creek base flows
13,600	No	Steelhead and chinook passage (adult and juvenile) and overwintering, lower Salmon Creek base flows

The 5,100 AF flow volume was chosen because it is the lowest flow volume that can meet the purpose and need for the project for both species of fish (steelhead and chinook salmon), and because it provides benefits both with and without stream rehabilitation. This flow volume provides passage flows for steelhead without stream rehabilitation, and passage flows for both steelhead and chinook with stream rehabilitation. It represents a flow volume that can be achieved by a reasonable range of water supply action alternatives (whereas higher flow volumes could only be provided by few alternatives).

It is important to recognize that 5,100 AF roughly represents the center of a range of flow volumes that could potentially provide the fish benefits analyzed in this EIS. This flow volume has been selected for EIS analysis as a good approximation of the flows that meet the action objectives. It is not intended to indicate that these flows meet the minimum requirements of all lifestages under all circumstances of weather and water system operations and in all reaches of Salmon Creek. Conversely, the selection of the 5,100 AF flow volume target should not be read

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[14] *Passage flows* provide water in lower Salmon Creek to allow up-migration of steelhead and Chinook adults to spawn and out-migration of steelhead and Chinook smolts. The 3,300 AF flow provides passage flows sufficient only for steelhead, and the 5,100 AF flow provides passage flows only for steelhead if no stream rehabilitation is done. The other flows (5,100 AF with stream rehabilitation and the higher flows described in Table 2-1 provide passage flows for both steelhead and Chinook). *Base flows* provide sufficient water for survival of salmonids year-round in lower Salmon Creek. Only the 10,000 AF and 13,600 AF flow volumes would provide base flows. *Overwintering flows* provide water for fish survival over the winter in the middle reach of Salmon Creek (above the diversion dam).

[15] All the flow alternatives considered the provision of overwintering flows for salmonids in the middle reach of Salmon Creek.

as indicating that this amount of water would be needed under all circumstances for all species and lifestages. It is a representative number chosen for EIS analysis. In some circumstances, weather and water system operations lead to water model results that show more than 5,100 AF of water in Lower Salmon Creek. In other circumstances, weather, operations and fish requirements of some scenarios analyzed result in the 5,100 AF supplied to Lower Salmon Creek not meeting fish flow requirements at times. Further detail is provided in **Section 3.5** regarding the monthly flow requirements for steelhead without stream rehabilitation, and for steelhead and chinook with stream rehabilitation.

Table 2-7 lists the flow volumes initially considered, identifies whether there would be a need to rehabilitate the stream to meet the purpose and need at that flow, and the benefits to fish that would result if that flow volume were provided. Two options ("a" and "b") are described for the 5,100 AF flow volume. This flow volume would provide different benefits depending upon whether or not the lower stream channel is rehabilitated. Without stream rehabilitation, the 5,100 AF flow volume would provide passage only for steelhead. With rehabilitation, it would provide passage for both steelhead and chinook. During spring 2003 flow releases of 25 cfs were adequate for adult steelhead migration in the lower reach of Salmon Creek. Assuming that flows would need to be provided for adult up-migration, juvenile out-migration, and overwintering above the diversion dam, it is estimated that flows would be need for about 70 days. At 25 cfs, the spring 2003 results suggest that flow volumes as low as 3,500 AF could be sufficient to meet steelhead requirements and without stream rehabilitation. With stream rehabilitation, assuming a flow of about 16 cfs could provide adequate steelhead passage, the provision of 70 days of flows would require as little as 2,300 AF (pers. comm. Chris Fisher, Colville Confederated Tribes, May 5, 2003). Provision of these lower flow volumes could be considered to implement a project targeted only on steelhead.

2.6.2 OTHER WATER SUPPLY ALTERNATIVES CONSIDERED

2.6.2.1 Screening of Water Supply Alternatives

A large list of water supply action alternatives was initially screened in 1999 (Dames & Moore, 1999). These alternatives are described briefly below and in **Appendix A**. Based on the screening, the following alternatives were carried forward for further analysis and EIS consideration:

- Okanogan River Water Exchange
- Upgrade Shellrock Pumping Plant
- Okanogan Irrigation District Water Right Purchase
- Raise Salmon Lake Dam
- Diversion 5 Reregulating Reservoir
- Replace North Fork Salmon Creek Feeder Canal and Headworks
- Okanogan Irrigation District Water Leasing
- Okanogan Irrigation District Water Conservation (District-wide and On-farm)

Some of these alternatives have been retained as action alternatives and some have been eliminated from further consideration. Each was analyzed to determine if it could provide for the range of flows under consideration. For each flow volume, those action alternatives capable of supplying the flow are identified in **Table 2-8**.

Table 2-8. Water Supply Action Alternatives Capable of Meeting Initial Range of Flows.

Flow Volume (acre-feet)	Alternatives Capable of Providing Flow	Notes
13,600	Alternative 1	Some purchase of OID water rights or drought year lease of water may be required to assure water availability and reliable irrigation supply during a drought if Okanogan River minimum flows are not met.
10,000	Alternative 1	Some purchase of OID water rights or drought year lease of water may be required to assure water availability and reliable irrigation supply during a drought if Okanogan River minimum flows are not met.
8,700	Alternative 1	Some purchase of OID water rights or drought year lease of water may be required to assure water availability and reliable irrigation supply during a drought if Okanogan River minimum flows are not met.
5,100	Alternative 1, 2 or 3	OID irrigators would not receive 100 percent of modeled crop water requirements during a few months of a sustained critical drought under the Shellrock upgrade. Some purchase of OID water rights or drought year lease of water may be required to assure water availability and reliable irrigation supply during a drought if Okanogan River minimum flows are not met.
3,300	Alternative 1, 2 or 3	OID irrigators would not receive 100 percent of modeled crop water requirements during a few months of a sustained critical drought under the Shellrock upgrade. Some purchase of OID water rights or drought year lease of water may be required to assure water availability and reliable irrigation supply during a drought if Okanogan River minimum flows are not met.

These considerations of the initial range of flow volumes and water supply alternatives helped narrow a wide range of possible actions into the range of action alternatives that are presented for detailed consideration in this EIS.

Only three of the water supply action alternatives that had been carried forward from the 1999 screening exercise are considered capable of providing the 5,100 AF flow. These are the Okanogan River water exchange, Shellrock upgrade, and water purchase alternatives. The North Fork Salmon Creek feeder canal is incorporated as an element that can augment flows in all the alternatives. Three alternatives were considered further into the NEPA process but were eventually eliminated (raise Salmon Lake dam, Diversion 5 reregulating reservoir, and water leasing) and are briefly described below. One (water conservation) is an element of the No Action Alternative.

2.6.2.2 Water Supply Alternatives Previously Eliminated from Consideration

In an earlier stage of planning for the Salmon Creek project, twenty-four alternatives were identified, critically reviewed, and characterized as potential sources of water to provide instream flows in Salmon Creek while preserving irrigation deliveries (Dames & Moore, 1999). The alternatives were grouped into six categories as follows (those which have been carried forward in this EIS are identified with bold italics):

<u>WATER CONSERVATION ALTERNATIVES</u>

- District-wide Agricultural Water Conservation
- OID Totally Pressurized Water Delivery System
- Non-Agricultural Water Conservation Purchase and Transfer

<u>WATER EXCHANGE ALTERNATIVES</u>

City of Okanogan Water Exchange

- Reclaimed Water
- Watercress Springs Water Claim

Okanogan River Water Exchange

- Alternative Points of Diversion

Upstream Okanogan River (add new point of diversion for existing OID Okanogan River water rights)

Shellrock pumps (increase use of existing OID Okanogan River water rights)

- Alternative Water Right Actions

    Convert existing Okanogan River emergency water rights to base supply

    Acquire new Okanogan River rights

- Alternative Water Amounts

    Full irrigation service (ca. 80 cfs)

    Fish flow only (ca. 20 cfs)

    Confluence of Salmon Creek and Okanogan River (add new point of diversion for existing OID Salmon Creek water rights and claims)

Salmon Creek/Watercress Springs Water Right Claimants

<u>WATER MANAGEMENT ALTERNATIVES</u>

- Duck Lake Water Management
- OID Diversion 5 Reregulation
- On-Farm Water Management

WATER MARKETING ALTERNATIVES

- OID Member Irrigators Water Bank
- Purchase Groundwater Stored at Duck Lake
- Purvey to City of Omak (involve City in financing new storage)

WATER RIGHTS ALTERNATIVES

- Duck Lake Water Association
- North Fork Salmon Creek water right owners
- Okanogan County

WATER STORAGE ALTERNATIVES

- Aquifer Storage and Recovery
- Brown Lake
- CCT Reservation
- Green Lake
- Interbasin Transfer

    Fish Lake

    Johnson Creek

    Scotch Creek
- Raise Salmon Lake Dam and Replace Feeder Canal
- Scotch Basin
- West Fork Salmon Creek

The review considered both potential benefits to instream flows for salmon restoration and potential effects on the OID water system, water rights, and member irrigators (including the potential for alternatives to promote a net loss of irrigable land). The review also considered the compatibility of alternative water supply opportunities with one another in developing a planning level program. The review considered ways to:

- Improve OID water system infrastructure or operations;
- Creatively use water rights, including new points of diversion;
- Obtain new or supplemental water rights;
- Create incentives for water conservation;
- Use groundwater in conjunction with surface water supplies;
- Engage in water marketing, including leases, buy-backs, and purchases;

- Purchase water conservation outside of the OID.

Results are presented in Dames & Moore (1999), together with overview matrices of the water supply alternatives. An overall summary matrix (**Appendix A**) compares the range of alternatives with one another. The alternative matrices are organized by the following characteristics:

- Source of water, point of withdrawal/diversion, purpose and place of use;
- Potential water amount and timing;
- Cost and schedule;
- Engineering feasibility;
- Regulatory requirements;
- Environmental impacts and benefits.

These alternatives were described at a conceptual "planning level." The purpose was to characterize a range of alternatives sufficiently for comparison with one another, to allow selection of alternatives for further study and more detailed design and to identify fatal flaws and eliminate flawed alternatives. When fatal flaws were identified, no further work was conducted on an alternative; thus, the review sometimes went no further than to document a fatal flaw.

Three of the water supply action alternatives that had been carried forward for EIS consideration were subsequently eliminated. These alternatives are: raise Salmon Lake dam, Diversion 5 reregulating reservoir, and OID water leasing. In addition, several pump station sites and pipeline routes for the Okanogan River water exchange action alternative were considered and eliminated. The rationale for rejecting these alternatives for detailed analysis in this EIS is provided in the following sections.

2.6.2.3 Raise Salmon Lake Dam

Existing mapping was used to evaluate the inundation zone of Salmon Lake with a two-foot raise in elevation. As-built drawings were examined showing the location of the existing lakeshore sewer lines from the City of Conconully, as compared to the inundation zone. Analysis of impacts to physical structures and sewer infrastructure resulting from a two-foot increase in the level of Salmon Lake was based on an increase in the high water line from 2,318.5 feet to an elevation of 2,320.5 feet.[16] Data on structures and sewer system locations were gathered from plans prepared by RW Beck & Associates in 1990 for the construction of a sewer system to serve cabins along the lake[17.]

[16] - elevation figures provided by Tom Sullivan, OID Manager.
[17] - "as-built" plans provided by Lee Moore, Conconully Public Works Director and Okanogan County Public Works Department.

Sewer system: It appears that approximately 550 feet of 3-inch sewer line and eight septic tanks fall within or only slightly above the area that would be impacted by the rise in water. An additional 1,500 or more feet is within a few feet of the high-water line and could be affected at depth. The depth at which the sewer line is buried is not shown on the as-built plans. Depending on depth, more line could be affected. Not all of these septic tanks could be simply moved elsewhere on the property, as they collect and pump effluent from several residences.

Docks: All 35 docks along the upper lake fall below the 2,320.5 elevation. It appears that most of the docks would require some modification and/or reconstruction to accommodate the proposed increase in high water line. Further analysis and site visits would be required to determine the extent of modification/reconstruction necessary.

Cabins: It appears that twelve cabins would be affected by the proposed increase in lake elevation. A few have a small corner that protrudes below the proposed high water line, while others have greater area below the 2,320.5-foot line. Six cabins could be moved, while the remaining cabins (numbers 10, 30, 35, 40, 41, & 49) would face serious constraints due to topography and location of the main road. Along with the cabins, approximately five outbuildings would also be impacted. (Note: all cabins are situated on leased property and all leases are up for renewal in 2003.)

Other: The public boat ramp would be submerged. From the map drawings, up to 24 dry well locations could be impacted. Field reconnaissance indicates that at least six of these would be inundated and an additional six very likely to be affected, with the balance impacted depending on the depth of the well. In addition a couple of irrigation lines and one pump line would be submerged.

Based on this review, it was decided to eliminate this alternative from further consideration. The alternative was eliminated in order not to disrupt lakeshore cabin owners. Also, with the present leases in place and shoreline policy, the alternative would create a permitting challenge in addition to the impact and engineering challenges from the dam raise. It would create long-term operational problems beyond immediate impacts. However, if the BOR were to eliminate lakeshore leases at some future time, this alternative could be reevaluated.

2.6.2.4 Diversion 5 Reregulating Reservoir

This alternative was eliminated from consideration because its expected firm yield is small relative to its cost. During Phase 1, Dames & Moore 1999 estimated a firm yield of 500 AF from a 100 AF reregulating reservoir. A recent engineering report (URS, 2002) estimated a total cost of $1.6 million for a 100 AF reservoir.

2.6.2.5 OID Water Leasing

Water leasing from OID member irrigators began to be implemented in the 2000 irrigation season with funding from BPA to provide water for interim Salmon Creek flows until a more comprehensive water supply program can be implemented. **Table 2-9** documents the number of acres participating in the lease program each year and the total acre-feet of water leased.

Table 2-9. OID Water Leasing History.

Year	Number of acres	Acre-Feet
2000	322	966
2001	573	1,719
2002	624	1,873

The OID Board voted at their March 2003 meeting not to enter into water leasing during the 2003 irrigation season, as this is the third consecutive year of drought. The Board was concerned that the District may have to ration water. Under law, the District must provide water to their membership before excess water can be distributed elsewhere. These circumstances illustrate the uncertainty in relying upon a water-leasing alternative for long-term flows. Due to this uncertainty, this alternative was eliminated from further consideration in the EIS.

2.6.2.6 Okanogan River Water Exchange Alternative Pump Station Sites and Pipeline Routes

Criteria used by URS (002) for pump station site selection included:

- stable river channel at the location of the pump station
- river depth adequate for intake structures and fish screens
- support a cost-effective route from the river to the irrigation canal
- minimize distance from Salmon Creek confluence to reduce water right and fish impacts in the Okanogan River
- easements and rights-of-way available, and zoning to allow proposed use
- adequate source for electric power supply nearby
- site accessibility for maintenance
- soils suitability for foundation
- located above an elevation that could be impacted by river flooding
- avoid adverse impacts to residential areas

Based on these criteria, two general site areas were selected (URS, 2002) as candidates for further evaluation. Both are on the west bank of the Okanogan River, within the city limits of Okanogan:

- Site 1 is at the confluence of Salmon Creek and the Okanogan River. This site was found to be infeasible during Phase 1 due to the disruption it would create to residential areas and city streets during the installation of a pipeline to serve it.

- Site 2 consists of two potential locations, one of which is the preferred location (2A) and the other (2B) a site that was eliminated from consideration. Site 2A was considered to better meet the criteria listed in the URS report, and on that basis Site 2B was eliminated from consideration.

The engineering report (URS, 2002) also specified criteria for the pipeline:

- pipeline outlet near to the uppermost end of the irrigation canal to reduce need for canal modifications
- bedding materials for pipeline construction available nearby
- as short a length of pipeline as possible
- alignment within existing easements and rights-of-way
- soils suitable for trenching with conventional equipment

Based on these criteria, two possible routes were identified: Route A and Route B. Route A is approximately 9,680 feet (1.8 miles) long. It would be relatively direct but would encroach on private lands and traverse orchards and land that have development potential. Easements and rights-of-way do not exist for this route. For these reasons, as well as cost and technical feasibility, Route A was eliminated from consideration. Route B is the proposed route described in **Section 2.2.1.2**. Although slightly longer, Route B was preferred because it follows county roads and existing OID rights-of-way and easements for most of its length. Route B would minimize impacts on private lands and orchards, and is more cost-effective and technically feasible as well.

2.6.2.7 Other Water Purchase Alternatives Considered

An alternative to limit participation in offering water rights for sale to a particular OID diversion was considered, but was eliminated based on a decision by the OID Board.

2.6.3 Other Stream Rehabilitation Design Alternatives Considered

No other stream rehabilitation design alternatives were developed in conceptual or engineering detail. Engineering constraints to rebuild the existing stream channel in its present condition required that the low end of the design provide salmonid passage at low flows, and the high end of the design be capable of passing flood flows with channel stability. A design for base flows was considered but was not significantly different from the design required for passage flows due to these engineering constraints. An alternative was considered to bring in heavy equipment and deepen the channel at local passage impediments without full channel reconstruction, but was eliminated because this work would need to be repeated after each high flow event (i.e., this was considered ongoing maintenance rather than a design solution).

2.7 COMPARISON OF ALTERNATIVES

Table 2-10. Estimated Outcome of Each Alternative Towards Select Goals and Objectives .

	Alternative 1 New 80 cfs Pump + Alluvial Fan Removal + Feeder Canal Upgrade	Alternative 2 Shellrock Upgrade + Full Rehabilitation of Creek + Feeder Canal Upgrade	Alternative 3 Water Purchase + No Creek Rehabilitation + Feeder Canal Upgrade	Alternative 4 No Action
Passage for steelhead	Yes, in normal and wet years w/ careful mgt. of small deficits.	Yes	Yes, except for driest years	Only in wet years
Passage for Chinook	Only in wet years	Yes, except in driest years	Only in wet years	No
Water delivered for irrigation (acre-feet)	16,165-16,167	14,425-15,225	9,972-10,679	15,745
Source of water for irrigation	33-35% Salmon Creek 8-9% Duck Lake 56-59% Okanogan River	41-46% Salmon Creek 47-52% Shellrock 7% Duck Lake	41-51% Salmon Creek 44-51% Shellrock 5-8% Duck Lake	78% Salmon Creek 15% Shellrock 7% Duck Lake
Okanogan Irrigation District efficiency[18]	89%	92-93%	93%	91%
Conconully Reservoir elevations (feet)	Median 2285 – 2286 Minimum 2246 - 2277	Median 2284 – 2285 Minimum 2242 - 2245	Median 2284 – 2285 Minimum 2243 - 2252	Median 2273 Minimum 2246
Salmon Lake elevations (feet)	Median 2315 – 2316 Minimum 2284 - 2298	Median 2314 – 2315 Minimum 2276 - 2277	Median 2314 – 2315 Minimum 2277 - 2285	Median 2314 Minimum 2282
Cost to implement water supply only ($US)	$7.3 million	$9.3 million - $10.3 million	$5.9 million	$0
Cost of stream channel rehabilitation	$64,400	$2,346,358	$0	$0
Annual increase in pumping cost (over No Action Alternative), including O&M ($US)	+$284,393	+$202,062	+$107,620	NA
Regional economic impacts ($US)	$0	$0	-$4.1 million	$0[19]

[18] *District efficiency* (the efficiency of the overall water delivery system) is defined by the ratio of water delivery to water supply.
[19] There will likely be costs associated with ESA enforcement actions that are not predictable at this time.

Table 2-11 Summary of Potential Impacts and Mitigation Measures by Alternative.

	Alternative 1 New Pump Station	Alternative 2 Upgrade Shellrock	Alternative 3 Purchase Water Rights	Alternative 4 No Action
WATER QUANTITY IMPACTS *Salmon Creek Streamflow*	Reduces unnaturally high summer flows in the middle reach of Salmon Creek and establishes winter base flows in the lower and middle reaches. Re-establishes seasonal fish migration flows. Upgrade of the feeder canal would increase the operational flexibility of Salmon Lake. The feeder canal upgrade would also increase the maximum rate of diversion by 60 cfs, potentially decreasing flows in a short reach (4500 feet) of North Fork Salmon Creek, between the feeder canal intake and the upstream end of Conconully Reservoir. Stream rehabilitation would increase flow depths under low to moderate flow magnitudes at the mouth of Salmon Creek.	Reduces unnaturally high summer flows in the middle reach of Salmon Creek and establishes winter base flows in the lower and middle reaches. Re-establishes seasonal fish migration flows. Upgrade of the feeder canal would increase the operational flexibility of Salmon Lake. The feeder canal upgrade would also increase the maximum rate of diversion by 60 cfs, potentially decreasing flows in a short reach (4500 feet) of North Fork Salmon Creek, between the feeder canal intake and the upstream end of Conconully Reservoir. Stream rehabilitation would increase flow depths under low to moderate flow magnitudes and enhance the ability to manage flow regimes in lower reach.	Reduces unnaturally high summer flows in the middle reach of Salmon Creek and establishes winter base flows in the lower and middle reaches. Re-establishes seasonal fish migration flows. Upgrade of the feeder canal would increase the operational flexibility of Salmon Lake. The feeder canal upgrade would also increase the maximum rate of diversion by 60 cfs, potentially decreasing flows in a short reach (4500 feet) of North Fork Salmon Creek, between the feeder canal intake and the upstream end of Conconully Reservoir.	Upper reach unregulated. High summer flows would continue in the middle reach, Lower reach would continue to be dewatered in most months.
Okanogan River	Decreases streamflow in the Okanogan River from the new pump station to Salmon Creek (1.25 miles) by up to 60 cfs. The frequency of WAC minimum flow violations is very slightly increased in dry years.	The average monthly percentage of the Okanogan River that would be pumped would increase over all water year types. However, the increased percentage would not be of a magnitude or seasonality that adversely affects stream flow in the Okanogan River. Results in a small decrease in streamflow in the Okanogan River from Shellrock to Salmon Creek (3.2 miles).	The number of months with flow below WAC minimums under various water year types would remain identical to the No Action Alternative. Salmon Creek inflow to the Okanogan River would increase.	Higher percentage pumped when compared to District patterns since1987. Salmon Creek inflow would continue to contribute 0.1 to 0.2% to Okanogan River flows in dry and below normal years.

	Alternative 1 New Pump Station	Alternative 2 Upgrade Shellrock	Alternative 3 Purchase Water Rights	Alternative 4 No Action
WATER QUANTITY IMPACTS (cont)		The frequency of WAC minimum flow violations in the Okanogan River is not increased.		
Flooding	The feeder canal upgrade would likely reduce potential flood hazards to persons and property adjacent to the quarter-mile long diverted reach.	The rehabilitated channel would be designed to pass the base flood (100-year flood). The recontouring of channel bed and banks would be designed to increase the frequency of overbank flow and floodwater retention, where valley width is adequate. The feeder canal upgrade would likely reduce potential flood hazards to persons and property adjacent to the quarter-mile long diverted reach.	The feeder canal upgrade would likely reduce potential flood hazards to persons and property adjacent to the quarter-mile long diverted reach.	No Change
Reservoir Levels	Median Salmon Lake elevations higher. Reduces seasonal fluctuations. Minimum Salmon Lake elevations increase in all months. Median monthly Conconully Reservoir water surface elevations increase by 10-20 feet from August through April. Minimum lake levels are increased when flows are provided for steelhead only, but decrease from January to July if flows are provided for steelhead and Chinook. Lake levels could be positively affected by increased flexibility afforded to the management of irrigation water supply through the upgrade of the feeder canal.	Median Salmon Lake elevations higher. Reduces seasonal fluctuations. Minimum Salmon Lake elevations decrease by 8 to 12 feet in February through June. Median monthly Conconully Reservoir water surface elevations increase or remain the same in all months. Lake levels could be positively affected by increased flexibility afforded to the management of irrigation water supply through the upgrade of the feeder canal.	Small changes in median Salmon Lake elevations. Reduces seasonal fluctuations. Minimum Salmon Lake elevations increase in most months for "steelhead only" flow regimes but decrease up to 6 feet when flows are also provided for Chinook. Conconully Reservoir water surface elevations increase by 5-10 feet from August through April. Minimum lake levels are generally decreased (up to 8 feet) in most months, although when flows are provided for steelhead only, lake levels increase up to 10 feet from August through March. Lake levels could be somewhat affected by increased flexibility afforded to the management of irrigation water supply through the upgrade of the feeder canal.	No Change

	Alternative 1 New Pump Station	Alternative 2 Upgrade Shellrock	Alternative 3 Purchase Water Rights	Alternative 4 No Action
WATER QUANTITY IMPACTS *Groundwater*	May create localized seasonal groundwater drawdown in close proximity to the new pump station. Worst case decreases in potential groundwater recharge to this reach of the Okanogan River valley aquifer range from about 1,500 AF to 2,000 AF. Along reservoir margins, increased recharge volumes and reduced fluctuations in local groundwater gradients would be a substantial benefit. Groundwater levels and recharge along the middle reach of Salmon Creek would likely experience a seasonal shift with changing flow regimes. In Lower Salmon Creek, groundwater recharge and levels would increase. No substantial impacts to the Duck Lake aquifer groundwater levels or recharge.	Groundwater recharge along the Okanogan River Valley aquifer could decrease slightly in the vicinity of Shellrock and down gradient towards the mouth of Salmon Creek, at least during dry years or below normal years, although it is unlikely. During dry years, groundwater levels around Salmon Lake will be depressed throughout the year relative to the No Action Alternative. Groundwater levels and recharge along the middle reach of Salmon Creek would likely experience a seasonal shift with changing flow regimes. In Lower Salmon Creek, groundwater recharge and levels would increase. Channel rehabilitation design contains several elements intended to produce increased recharge within the riparian corridor. Duck Lake pumping is maximized under this alternative, but the minimum lake level established by the Department of Ecology is respected.	Groundwater recharge and levels along the Okanogan River Valley aquifer could decrease slightly in the vicinity of Shellrock and down gradient towards the mouth of Salmon Creek, at least during dry years or below normal years, although unlikely. Along reservoir margins, increased recharge volumes and reduced fluctuations in local groundwater gradients would be a substantial benefit. Groundwater levels and recharge along the middle reach of Salmon Creek would likely experience a seasonal shift with changing flow regimes. In Lower Salmon Creek, groundwater recharge and levels would increase. No substantial impacts to the Duck Lake aquifer groundwater levels or recharge.	No Change
Water Supply for Irrigation	Slight improvement in flexibility and storage in Salmon Lake for use downstream. Decreased losses in available water. No critical period shortage would occur under this alternative.	When instream flows are provided for both steelhead and Chinook, a small critical period shortage would occur when conditions are similar to the early 1930's drought period. The shortage is modeled to persist for four years, with a peak critical storage deficit of 1678 acre-feet per year.	When instream flows are provided for both steelhead and Chinook, a small critical period shortage would occur when conditions are similar to the early 1930's drought period. The shortage is modeled to persist for two years, with a peak critical storage deficit of 674 acre-feet per year. Reduces the total acres of irrigated farmland by 1,470 acres.	No change from current use.

	Alternative 1 New Pump Station	**Alternative 2 Upgrade Shellrock**	**Alternative 3 Purchase Water Rights**	**Alternative 4 No Action**
WATER QUANTITY MITIGATION	*Streamflow:* Any possible mitigation measures for dry year impacts would induce additional adverse effects on either OID water supply or fish instream flow needs. Therefore, no mitigation measures are available. *Reservoir Levels:* None. *Flooding:* The reservoir management component of the Stream Management Plan should incorporate a flood storage rule. *Groundwater:* Any drawdown effects on ground water supply at existing wells would be compensated by deepening existing wells and/or by subsidizing the incremental increase in pumping costs. *Water Supply for Irrigation:* Some purchase of OID water rights or drought year lease of water may be required to assure water availability and reliable irrigation supply during a drought if Okanogan River minimum flows are not met.	*Streamflow:* None. *Reservoir Levels:* None. *Flooding:* The reservoir management component of the Stream Management Plan should incorporate a flood storage rule. *Groundwater:* None. Pre- and post-construction monitoring of Salmon Creek rehabilitation area. *Water Supply for Irrigation:* Some mitigation payments to OID irrigators during later years of a sustained critical drought may be required. Some purchase of OID water rights or drought year lease of water may be required to assure water availability and reliable irrigation supply during a drought if Okanogan River minimum flows are not met.	*Streamflow:* None. *Reservoir Levels:* None. *Flooding:* The reservoir management component of the Stream Management Plan should incorporate a flood storage rule. *Groundwater:* None. *Water Supply for Irrigation:* None.	None proposed.
WATER QUALITY IMPACTS *Erosion and Sedimentation*	Short-term erosion and sedimentation impacts could occur during construction activities for the new pump station, intake structures in the Okanogan River, Salmon Lake feeder canal, the North Fork of Salmon Creek below the headworks, and potentially the pipeline from the new pump station. Construction activities at the mouth of Salmon Creek would contribute sediment to the Okanogan River.	Short-term construction impacts may occur during relocation and reconstruction of the intake structures. Increased flows in Lower Salmon Creek would not be high enough to transport much sediment. Bank stabilization, erosion and sedimentation controls, riparian habitat improvements, and channel design in lower Salmon Creek would reduce loadings of sediment and concentrations of suspended sediment during high flow events.	No significant impacts to erosion and sedimentation. Increased flows in Lower Salmon Creek would not be high enough to transport much sediment even if the stream is not rehabilitated.	Channel incision followed by bank erosion would most likely spread upstream. Streambanks at the knickpoint in Watercress Springs could continue to degrade toward the highly unstable and eroding condition of the banks farther downstream. Streambanks would become taller, steeper, have less vegetation, and slough fine material into the channel.

	Alternative 1 New Pump Station	Alternative 2 Upgrade Shellrock	Alternative 3 Purchase Water Rights	Alternative 4 No Action
WATER QUALITY IMPACTS (CONT)	Increased flows in Lower Salmon Creek would not be high enough to transport much sediment.	Short-term erosion and sedimentation could occur during construction activities associated with stream rehabilitation of Salmon Creek.		Further downstream, bank erosion and channel widening may occur. High flows would continue to transport fine sediment, the remaining coarse material would collapse to the bank toe and vegetation would be uprooted.
Water Temperature	The addition of water to Lower Salmon Creek will have generally positive effects on water quality in the creek. Decreased flows in the Okanogan River may have minor impacts on water temperature in the affected reach. Return flows of cool, clean water at the mouth of Salmon Creek would offset any impacts in the affected reach and could provide a thermal refugia near the mouth of the creek.	The addition of water to Lower Salmon Creek will have generally positive effects on water quality. Riparian habitat improvements would shade Lower Salmon Creek, improving water temperatures. Cool water released into the lower creek and other rehabilitation design features would have a positive effect on stream temperatures. Decreased flows in the Okanogan River may have minor impacts on water temperature in the affected reach. Return flows of cool, clean water at the mouth of Salmon Creek would offset any impacts in the affected reach and could provide a thermal refugia near the mouth of the creek.	The addition of water to Lower Salmon Creek will have generally positive effects on water quality in the creek. Return flows of cool, clean water at the mouth of Salmon Creek would have a beneficial impact on the Okanogan River and could provide a thermal refugia near the mouth of the creek.	Existing high stream temperatures would continue unabated and could increase if the stream continues to degrade.
WATER QUALITY MITIGATION	Standard construction BMPs for all construction components would include: • Delineating and preparing appropriate work zones, including staging and access areas • Proper siting of equipment, and chemical storage areas away from surface waters • Minimize slope disturbance from roads	Standard construction BMPs listed in Alternative 1 would be required for all construction components. Additional mitigation for this alternative includes: • A water filtration system, including a sediment pond, would be installed to remove solids from irrigation water. Pump intakes would be located over a deep hole	Standard construction BMPs listed in Alternative 1 would be required for the feeder canal construction.	None proposed.

	Alternative 1 New Pump Station	Alternative 2 Upgrade Shellrock	Alternative 3 Purchase Water Rights	Alternative 4 No Action
WATER QUALITY MITIGATION (CONT)	• Construct roadways with low gradients • Ensure that storm water runoff from roads drains to outlets • Physically screen areas to remain undisturbed • Install erosion and sediment control measures during site preparation • Use silt fences, straw bales, sediment ponds, and other BMPs • Avoid sensitive wetland and riparian areas • Inspect construction site during or immediately after a rain event • Stockpile erosion and sediment control equipment The proposed new pump house station would be located away from the river bank and above the 100-year flood elevation. Additional mitigation for the pump station component includes: • A water filtration system, including a sediment pond, would be installed to remove solids from irrigation water. • Pump intakes would be located over a deep hole on the inside bend of the river to help minimize impacts and disturbances to the bed during construction and operation. • The bank would be shaped and protected from erosion by use of boulder and timber armoring and/or gabion baskets. • Screens for the intake pipes would be placed in a part of the river	on the inside bend of the river to help minimize impacts and disturbances to the bed during construction and operation. • The bank would be shaped and protected from erosion by use of boulder and timber armoring and/or gabion baskets. • Screens for the intake pipes would be placed in a part of the river channel with a relatively stable bed. • Mat gabions would be secured under the screens to prevent streambed erosion. Additional mitigation for stream rehab component includes: • Minimize crossing of stream • Use bridges as much as possible • Steam clean vehicles and equipment offsite regularly • Check for anti-freeze leaks and make any needed repairs • Use adequate slopes, bank stabilization, and revegetation methods to minimize erosion.		

	Alternative 1 New Pump Station	**Alternative 2 Upgrade Shellrock**	**Alternative 3 Purchase Water Rights**	**Alternative 4 No Action**
WATER QUALITY MITIGATION (CONT)	channel with a relatively stable bed. • Mat gabions would be secured under the screens to prevent streambed erosion. Additional mitigation for stream rehab component includes: • Steam clean vehicles and equipment offsite regularly • Check for anti-freeze leaks and make any needed repairs • Use adequate slopes, bank stabilization, and revegetation methods to minimize erosion.			
WETLANDS AND VEGETATION IMPACTS	Construction of the new pump station would result in the permanent loss of riparian vegetation, primarily white alder and cottonwood, at the proposed site. Construction of the pipeline would result in temporary loss of upland vegetation, primarily cheatgrass grassland, in Omak and in an abandoned orchard near the main canal. This impact is expected to be less than significant. Construction of the water filtration system and sediment pond would result in the permanent loss of upland vegetation near Diversion 2. This impact is expected to be less than significant. The feeder canal upgrade would result in temporary disturbance of vegetation along the canal route during removal of existing canal and construction of the proposed pipeline. Channel construction activities would be limited to late summer and	The feeder canal upgrade would result in temporary disturbance of vegetation along the canal route during removal of existing canal and construction of the proposed pipeline. Riparian habitat would be re-established in Lower Salmon Creek. Channel construction activities would be limited to late summer and early fall to minimize impacts to migratory fish. Construction at the Shellrock pump station would result in temporary impacts to riparian vegetation. Construction of the pipeline would result in temporary loss of upland vegetation in Omak and could temporarily impact orchards. The pipeline also would impact two small wetland areas. Direct impacts to sensitive species that occur in wetland or riparian areas could result from this alternative.	The feeder canal upgrade would result in temporary disturbance of vegetation along the canal route during removal of existing canal and construction of the proposed pipeline. Direct impacts to sensitive species that occur in wetland or riparian areas could result from this alternative, although less than Alternatives 1 and 2.	Stream incision and bank erosion downstream of Watercress Springs is likely to continue. Uncontrolled bank erosion could reduce the extent of riparian vegetation along lower Salmon Creek, or result in a change in species composition. Loss of riparian habitat would continue unabated and could worsen.

	Alternative 1 New Pump Station	Alternative 2 Upgrade Shellrock	Alternative 3 Purchase Water Rights	Alternative 4 No Action
WETLANDS AND VEGETATION IMPACTS (CONT)	early fall to minimize impacts to migratory fish. Construction may result in temporary impacts to riparian vegetation. Direct impacts to sensitive species that occur in wetland or riparian areas could result from this alternative.	Construction of the sediment pond would result in the permanent loss of upland vegetation near the main canal. This impact is expected to be less than significant.		
WETLANDS AND VEGETATION MITIGATION	A special status plant survey would be conducted to locate any plant populations within the feeder canal construction corridor. Areas within the construction corridor containing special-status plant species, if found, would be fenced off so that construction equipment could avoid impacts to such species to the extent compatible with project goals. To ensure no transport of disturbed materials from upland sites into waterways, straw bales and silt fences would be placed downslope of upland grading locations prior to construction activities. Construction equipment and staging areas would be located to avoid impacts to wetland buffer areas and large, well-established vegetation, as well as to avoid priority habitats such as wetlands, riparian areas, shrub-steppe, and native grasslands.	A special status plant survey would be conducted to locate any plant populations within the feeder canal construction corridor. Areas within the construction corridor containing special-status plant species, if found, would be fenced off so that construction equipment could avoid impacts to such species to the extent compatible with project goals. To ensure no transport of disturbed materials from upland sites into waterways, straw bales and silt fences would be placed downslope of upland grading locations prior to construction activities. Best Management Practices (BMPs) for stream channel construction would be implemented during construction of the stream rehabilitation alternative to minimize impacts to riparian vegetation. Construction equipment and staging areas would be located to avoid impacts to wetland buffer areas and large, well-established vegetation, as well as to avoid priority habitats such as wetlands, riparian areas, shrub-steppe, and native grasslands.	A special status plant survey would be conducted to locate any plant populations within the feeder canal construction corridor. Areas within the construction corridor containing special-status plant species, if found, would be fenced off so that construction equipment could avoid impacts to such species to the extent compatible with project goals. To ensure no transport of disturbed materials from upland sites into waterways, straw bales and silt fences would be placed downslope of upland grading locations prior to construction activities. Construction equipment and staging areas would be located to avoid impacts to wetland buffer areas and large, well-established vegetation, as well as to avoid priority habitats such as wetlands, riparian areas, shrub-steppe, and native grasslands.	None proposed.

	Alternative 1 New Pump Station	**Alternative 2 Upgrade Shellrock**	**Alternative 3 Purchase Water Rights**	**Alternative 4 No Action**
WILDLIFE IMPACTS	Riparian habitat would be re-established in Lower Salmon Creek slowly through time, benefiting rare, sensitive, and listed wildlife species. Construction of the new pump station would result in the permanent loss of riparian habitat, primarily white alder and cottonwood. Construction would result in direct impacts to wildlife species present in the project area. Construction of the pipeline would result in temporary loss of upland habitat, primarily cheatgrass grassland, in Omak and in an abandoned orchard near the main canal. Temporary disturbance of wildlife habitat along the canal route during removal of the existing canal and installation of the proposed pipeline may occur. Animals present in the construction zone, or that stray into it, could be impacted during construction activities.	Riparian habitat would be re-established more quickly in Lower Salmon Creek, benefiting rare, sensitive, and listed wildlife species. Construction activities in lower Salmon Creek would result in temporary impacts to riparian habitat, but is offset by the resulting enhancement of riparian habitat. Construction of the pipeline would result in temporary loss of upland habitat and impact two small wetlands in Omak. Construction would result in direct impacts to wildlife species present in the project area. Temporary disturbance of wildlife habitat along the canal route during removal of the existing canal and installation of the proposed pipeline may occur. Animals present in the construction zone, or that stray into it, could be impacted during construction activities.	Riparian habitat would be re-established slowly through time in Lower Salmon Creek, benefiting rare, sensitive, and listed wildlife species. Temporary disturbance of wildlife habitat along the canal route during removal of the existing canal and installation of the proposed pipeline may occur. Animals present in the construction zone, or that stray into it, could be impacted during construction activities.	Stream incision and bank erosion downstream of Watercress Springs is likely to occur. Uncontrolled bank erosion could reduce the extent of riparian habitat along lower Salmon Creek, or result in a loss of riparian wildlife populations or in a change of riparian species composition.
WILDLIFE MITIGATION	Prior to construction a qualified biologist would conduct site-specific surveys to evaluate the potential for special status wildlife to occur within the construction corridors. Any areas within the construction corridor that are occupied by special status species would be fenced off so that construction equipment can avoid impacts to the species.	Prior to construction a qualified biologist would conduct site-specific surveys to evaluate the potential for special status wildlife to occur within the construction corridors. Any areas within the construction corridor that are occupied by special status species would be fenced off so that construction equipment can avoid impacts to the species.	Prior to construction a qualified biologist would conduct site-specific surveys to evaluate the potential for special status wildlife to occur within the construction corridors. Any areas within the construction corridor that are occupied by special status species would be fenced off so that construction equipment can avoid impacts to the species.	None proposed.

	Alternative 1 New Pump Station	**Alternative 2 Upgrade Shellrock**	**Alternative 3 Purchase Water Rights**	**Alternative 4 No Action**
WILDLIFE MITIGATION (CONT)	Sensitive habitats in the Project area that could potentially be impacted would also be fenced for avoidance. Timing of construction or maintenance operation would be adjusted to avoid or minimize disturbances to special status species. A qualified biologist would conduct surveys to locate any active migratory bird nests prior to vegetation removal for construction during the breeding season. Fence off areas within the construction corridor containing active nests. Removal of that vegetation containing active nests would be postponed until after the nesting season. BMPs would be implemented to minimize sediment and pollution during construction activities.	Sensitive habitats in the Project area that could potentially be impacted would also be fenced for avoidance. Timing of construction or maintenance operation would be adjusted to avoid or minimize disturbances to special status species. A qualified biologist would conduct surveys to locate any active migratory bird nests prior to vegetation removal for construction during the breeding season. Fence off areas within the construction corridor containing active nests. Removal of that vegetation containing active nests would be postponed until after the nesting season. BMPs would be implemented to minimize sediment and pollution during construction activities.	Sensitive habitats in the Project area that could potentially be impacted would also be fenced for avoidance. Timing of construction or maintenance operation would be adjusted to avoid or minimize disturbances to special status species. A qualified biologist would conduct surveys to locate any active migratory bird nests prior to vegetation removal for construction during the breeding season. Fence off areas within the construction corridor containing active nests. Removal of that vegetation containing active nests would be postponed until after the nesting season. BMPs would be implemented to minimize sediment and pollution during construction activities.	
FISHERIES IMPACTS *Okanogan River*	Construction design and techniques should minimize impacts. Facility may provide habitat for warm water predators. Temporary increases in TSS and sediment from construction. Increased water withdrawals may have minor impact on flows, levels, and temperature for 1.3 miles to confluence with Salmon Creek. Downstream of confluence, cooler Salmon Creek water will significantly improve river water quality, thermal conditions, and ability to withstand dry year impacts.	Temporary increases in TSS and sediments from construction. Potential improved habitat associated with deeper intake channel. Increased pumping capabilities may intensify withdrawals but reduce length of pumping periods, improving ability to time pumping more favorably for fisheries. Downstream of confluence, cooler Salmon Creek water will significantly improve river water quality, thermal conditions, and ability to withstand dry year impacts.	No construction impacts. Increased water withdrawals may have minor impact on flows, levels, and temperature for 1.3 miles to confluence with Salmon Creek. Downstream of confluence, cooler Salmon Creek water will significantly improve river water quality, thermal conditions, and ability to withstand dry year impacts. Absent stream rehabilitation, restored flows through Salmon Creek could result in undesirable delivery of increased sediment to the river.	Current irrigation pumping would continue to endanger fish at the intake and at the screen. Instream flow violations would persist. There would be no improvements to water quantity or quality downstream of the confluence with Salmon Creek. Alluvial bar at confluence will continue to prevent improved habitat and to constitute a passage barrier.

	Alternative 1 New Pump Station	Alternative 2 Upgrade Shellrock	Alternative 3 Purchase Water Rights	Alternative 4 No Action
FISHERIES IMPACTS (CONT) *Okanogan River*	Some site-specific habitat loss. Reduced sediments and increased flows from restored Salmon Creek would improve habitat, water quality (especially temperature), and water quantity in the Okanogan River, especially from the confluence downstream.	Some potential site-specific habitat loss. Reduced sediments over the long term, and increased flows from restored Salmon Creek would improve habitat, water quality (especially temperature), and water quantity in the Okanogan River, especially from the confluence downstream.		
Lower Reach Salmon Creek	Temporary increases in TSS and sediment from construction at mouth of Salmon Creek. Removal of substrate bar at confluence could improve habitat and migration routes. Flows restored to levels supportive of seasonal fish migration, including adequate winter base flow. Associated benefits of improved water quality, reduced temperature, and habitat improvement. Chinook and steelhead may out-compete kokanee and small trout. Absent stream rehabilitation, restored flows through Salmon Creek could result in a low amount of undesirable delivery of increased sediment to the river.	Temporary increases in TSS and sediment from rehab construction. Reduced channel erosion, increased shade, expanded habitat, increased flows (especially during low flow periods), and improved water quality, including thermal benefits. Chinook and steelhead may out-compete kokanee and small trout. Flows restored to levels supportive of seasonal fish migration, including adequate winter base flow with associated benefits of improved water quality, reduced temperature, and habitat improvement. Increased flows through lower reach will improve habitat, water quantity, and water quality (especially temperature).	No construction impacts. Flows restored to levels supportive of seasonal fish migration, including adequate winter base flow. Associated benefits of improved water quality, reduced temperature, and habitat improvement. Absent stream rehabilitation, restored flows through Salmon Creek could result in a low amount of undesirable delivery of increased sediment to the river. Chinook and steelhead may out-compete kokanee and small trout.	Streamflows would remain low, nearing zero in most months. This represents a loss of 4.3 miles of potential habitat. Flows would be inadequate for supporting migration or spawning of steelhead or chinook.
Middle Reach Salmon Creek	No construction impacts. Reduction of unnaturally high summer flows and restoration of winter base flows. Significant improvement to anadromous passage and habitat for all stocks and stages. Resident fish benefit from expanded habitat.	No construction impacts. Reduction of unnaturally high summer flows and restoration of winter base flows. Significant improvement to anadromous passage and habitat for all stocks and stages. Resident fish benefit from expanded habitat.	No construction involved. Reduction of unnaturally high summer flows and restoration of winter base flows. Significant improvement to anadromous passage and habitat for all stocks and stages. Resident fish benefit from expanded habitat.	Flows would continue to be unnaturally high in summer and low in winter. Minimum flows not met for November – April, significantly reducing migration and spawning potential for adults and outmigration for smolts.

	Alternative 1 New Pump Station	Alternative 2 Upgrade Shellrock	Alternative 3 Purchase Water Rights	Alternative 4 No Action
FISHERIES IMPACTS (CONT)	Water quality benefits including thermal, dissolved oxygen, and sediment. Improved feeder canal may provide some ability to control reservoir storage and provide improved flows downstream with associated benefits to stocking programs, water quality, and habitat.	Water quality benefits including thermal, dissolved oxygen, and sediment. Improved feeder canal may provide some ability to control reservoir storage and provide improved flows downstream with associated benefits to stocking programs, water quality, and habitat.	Water quality benefits including thermal, dissolved oxygen, and sediment. Improved feeder canal may provide some ability to control reservoir storage and provide improved flows downstream with associated benefits to stocking programs, water quality, and habitat.	
Upper Reach Salmon Creek	Short-term, localized increases in TSS and solids from construction in North Fork down to Conconully Reservoir. Potential long-term loss of habitat at canal entrance. Potential streamflow decrease for portion of North Fork at various times throughout the year, resulting in habitat loss, and some migratory limitations. <u>North, West, South Forks</u> Kokanee and resident rainbow trout spawning may be further limited.	Short-term, localized increases in TSS and solids from construction in North Fork down to Conconully Reservoir. Potential long-term loss of habitat at canal entrance. Potential streamflow decrease for portion of North Fork at various times throughout the year, resulting in habitat loss, and some migratory limitations. <u>North, West, South Forks</u> Kokanee and resident rainbow trout spawning may be further limited.	Short-term, localized increases in TSS and solids from construction in North Fork down to Conconully Reservoir. Potential long-term loss of habitat at canal entrance. Potential streamflow decrease for portion of North Fork at various times throughout the year, resulting in habitat loss, and some migratory limitations. <u>North, West, South Forks</u> Kokanee and resident rainbow trout spawning may be further limited.	Reach would continue as naturally-flowing, unregulated stream. Fish production would remain unchanged.
Reservoirs	Greater water supply to reservoirs would enable improved water management of reservoir levels with associated benefits of increased habitat for resident and anadromous stocks, reduced water temperatures (favoring salmonids over warm water species), decreased algae, and increased dissolved oxygen levels. Stocking levels of steelhead trout may be able to be reduced.	Greater water supply to reservoirs would enable improved water management of reservoir levels with associated benefits of increased habitat, reduced water temperatures (favoring salmonids over warm water species), decreased algae, and increased dissolved oxygen levels. Stocking levels of steelhead trout may be able to be reduced	Greater water supply to reservoirs would enable improved water management of reservoir levels with associated benefits of increased habitat, reduced water temperatures (favoring salmonids over warm water species), decreased algae, and increased dissolved oxygen levels. Stocking levels of steelhead trout may be able to be reduced	Surface elevations would continue to fluctuate, resulting in continued impairment of reservoir fisheries. Stocking efforts would likely need to be continued indefinitely.

FISHERIES MITIGATION	*Construction Mitigation* • Have emergency spill containment kits available to contain and remove accidentally spilled fuels, hydraulic fluids, etc. immediately. • All equipment refueling and fuel storage would not occur within 100 ft. of any surface water. • Disposal of waste materials and washing of equipment would not occur within 100 ft. of any watercourse, ravine, drainage ditch, etc. • A spill prevention, control and countermeasures plan (SPCC) would be developed prior to the start of construction. • Construction of steep, straight roads, which could result in concentration of runoff and channelization, would be avoided. • Access roads and pipelines would be sited to avoid water bodies and riparian areas. When in close proximity, sedimentation control structures would be put in place prior to beginning work. • All construction access roads, staging areas, and any other disturbed upland or riparian vegetated area would be revegetated following construction. • Pump intake devices would be located in areas of river where disturbance to the streambed and stream bank are minimized. They would also be located on mat gabions to help prevent disturbance.	*Construction Mitigation* • Have emergency spill containment kits available to contain and remove accidentally spilled fuels, hydraulic fluids, etc. immediately. • All equipment refueling and fuel storage would not occur within 100 ft. of any surface water. . • Disposal of waste materials and washing of equipment would not occur within 100 ft. of any watercourse, ravine, drainage ditch, etc. • A spill prevention, control and countermeasures plan (SPCC) would be developed prior to the start of construction. • Construction of steep, straight roads, which could result in concentration of runoff and channelization, would be avoided. • Access roads and pipelines would be sited to avoid water bodies and riparian areas. When in close proximity, sedimentation control structures would be put in place prior to beginning work. • All construction access roads, staging areas, and any other disturbed upland or riparian vegetated area would be revegetated following construction. • Pump intake devices would be located in areas of river where disturbance to the streambed and stream bank are minimized. They would also be located on mat gabions to help prevent disturbance.	*Construction Mitigation* • Have emergency spill containment kits available to contain and remove accidentally spilled fuels, hydraulic fluids, etc. immediately. • All equipment refueling and fuel storage would not occur within 100 ft. of any surface water. • Disposal of waste materials and washing of equipment would not occur within 100 ft. of any watercourse, ravine, drainage ditch, etc. • A spill prevention, control and countermeasures plan (SPCC) would be developed prior to the start of construction. • Construction of steep, straight roads, which could result in concentration of runoff and channelization, would be avoided. • Access roads and pipelines would be sited to avoid water bodies and riparian areas. When in close proximity, sedimentation control structures would be put in place prior to beginning work. • All construction access roads, staging areas, and any other disturbed upland or riparian vegetated area would be revegetated following construction. • To the greatest extent possible, construction activities would be timed around periods of lowest fish use and instream flows.	*Construction Mitigation* None

FISHERIES MITIGATION (CONT)	• To the greatest extent possible, construction activities would be timed around periods of lowest fish use and instream flows. *Operational Mitigation* • A water filtration system would be constructed to mitigate for water being used from the Okanogan River with a high total suspended solid concentration. • Pump intake and diversion canal fish screens would be designed in accordance with NOAA Fisheries specifications and utilized to prevent fish from entering pumping structures or irrigation canals and to prevent injury. • Pilings would be driven into the streambed in front of fish screens to prevent damage by floating debris, maintaining functionality of fish screens. • Pump intake structures would be located in locations where they would have the least impact when in operation. • The Okanogan Irrigation District Comprehensive Water Conservation Program would be implemented to conserve water and prevent excess irrigation runoff. • Pump station would be located away from the riverbank and above the elevation of the 100-year floodplain. • Streambanks along Project structures would be protected from erosion using methods such as boulder and timber armoring or rock gabions.	• To the greatest extent possible, construction activities would be timed around periods of lowest fish use and instream flows. *Operational Mitigation* • A water filtration system would be constructed to mitigate for water being used from the Okanogan River with a high total suspended solid concentration. • Pump intake and diversion canal fish screens would be designed in accordance with NOAA Fisheries specifications and utilized to prevent fish from entering pumping structures or irrigation canals and to prevent injury. • Pilings would be driven into the streambed in front of fish screens to prevent damage by floating debris, maintaining functionality of fish screens. • Pump intake structures would be located in locations where they would have the least impact when in operation. • The Okanogan Irrigation District Comprehensive Water Conservation Program would be implemented to conserve water and prevent excess irrigation runoff. • Streambanks along Project structures would be protected from erosion using methods such as boulder and timber armoring or rock gabions. • Work with landowners adjacent to the mainstem Okanogan River and Salmon Creek and their tributaries in order to minimize impacts of land use on fisheries resources.	*Operational Mitigation* • The Okanogan Irrigation District Comprehensive Water Conservation Program would be implemented to conserve water and prevent excess irrigation runoff. • Streambanks along Project structures would be protected from erosion using methods such as boulder and timber armoring or rock gabions. • Work with landowners adjacent to the mainstem Okanogan River and Salmon Creek and their tributaries in order to minimize impacts of land use on fisheries resources.	*Operational Mitigation* • The Okanogan Irrigation District Comprehensive Water Conservation Program would be implemented to conserve water and prevent excess irrigation runoff. • Work with landowners adjacent to the mainstem Okanogan River and Salmon Creek and their tributaries in order to minimize impacts of land use on fisheries resources.

FISHERIES MITIGATION (CONT)	• Work with landowners adjacent to the mainstem Okanogan River and Salmon Creek and their tributaries in order to minimize impacts of land use on fisheries resources. *Resource Management Plan (RMP)* • The RMP would provide a framework encompassing and identifying implementation elements and responsibilities ranging from the construction contractor and environmental permit compliance monitoring to water supply system oversight and short- and long-term monitoring programs. • The Streamflow and Reservoir Operation Plan would provide for monitoring streamflows and reservoir water levels and operation, as well as the associated impacts on Project goals. • The Stream Channel and Riparian Management Plan would provide for monitoring impacts associated with streamflow and provide actions to be taken as mitigation. • The Fisheries Management Plan would establish management criteria for each target species. • ***The*** Monitoring ***and Adaptive Management Plan would provide for ongoing adjustments to management plans as necessary***.	*Resource Management Plan (RMP)* • The RMP would provide a framework encompassing and identifying implementation elements and responsibilities ranging from the construction contractor and environmental permit compliance monitoring to water supply system oversight and short- and long-term monitoring programs. • The Streamflow and Reservoir Operation Plan would provide for monitoring streamflows and reservoir water levels and operation, as well as the associated impacts on Project goals. • The Stream Channel and Riparian Management Plan would provide for monitoring impacts associated with streamflow and provide actions to be taken as mitigation. • The Fisheries Management Plan would establish management criteria for each target species. • The Monitoring and Adaptive Management Plan would provide for ongoing adjustments to management plans as necessary.	*Resource Management Plan (RMP)* Not applicable.	*Resource Management Plan (RMP)* • The RMP would provide a framework encompassing and identifying implementation elements and responsibilities ranging from the construction contractor and environmental permit compliance monitoring to water supply system oversight and short- and long-term monitoring programs. • The Streamflow and Reservoir Operation Plan would provide for monitoring streamflows and reservoir water levels and operation, as well as the associated impacts on Project goals. • The Stream Channel and Riparian Management Plan would provide for monitoring impacts associated with streamflow and provide actions to be taken as mitigation. • The Fisheries Management Plan would establish management criteria for each target species. • The Monitoring and Adaptive Management Plan would provide for ongoing adjustments to management plans as necessary.

LAND USE and SHORELINES IMPACTS	Short-term construction impacts would occur to land uses adjacent or near the new pump station, at the mouth of Salmon Creek, or along the pipeline route. Such impacts might include temporary increases in localized noise levels and increases in traffic congestion as a result of construction-related truck traffic/routing or heavy equipment use. Properties along Lower Salmon Creek may experience increased regulation to protect habitat and water quality. Short-term, construction-related activity could indirectly affect nearby and adjacent land uses in the Town of Conconully. Such impacts might include temporary increases in localized noise levels and increases in traffic congestion as a result of construction-related truck traffic/routing or heavy equipment use.	Short-term construction impacts would occur to land uses adjacent or near the Shellrock pump station, along the pipeline route, and along the lower 4.3 miles of Salmon Creek. Such impacts might include temporary increases in localized noise levels and increases in traffic congestion as a result of construction-related truck traffic/routing or heavy equipment use. As a result of channel rehabilitation, land uses along portions of Salmon Creek may require greater regulation under the City's and County's Critical Areas Ordinance. Parcels adjacent to Lower Salmon Creek may require increased setbacks, new permits, review and mitigation, which may limit land use. Short-term, construction-related activity could indirectly affect nearby and adjacent land uses in the Town of Conconully. Such impacts might include temporary increases in localized noise levels and increases in traffic congestion as a result of construction-related truck traffic/routing or heavy equipment use.	Properties along Lower Salmon Creek may experience increased regulation to protect habitat and water quality. Short-term, construction-related activity could indirectly affect nearby and adjacent land uses in the Town of Conconully. Such impacts might include temporary increases in localized noise levels and increases in traffic congestion as a result of construction-related truck traffic/routing or heavy equipment use.	None.
LAND USE and SHORELINES MITIGATION	Because no significant land use impacts have been identified, no land use mitigation measures are required or proposed. Measures to address short-term construction impacts are addressed elsewhere within the appropriate DEIS section.	Because no significant land use impacts have been identified, no land use mitigation measures are required or proposed. Measures to address short-term construction impacts are addressed elsewhere within the appropriate DEIS section.	Because no significant land use impacts have been identified, no land use mitigation measures are required or proposed. Measures to address short-term construction impacts are addressed elsewhere within the appropriate DEIS section.	None proposed.
VISUAL RESOURCES IMPACTS	Construction of a new pump house station would remove existing riparian vegetation and alter the visual landscape. The new structure would be visible from the Okanogan River, and to properties adjacent and/or near the site.	Upgrading the Shellrock pump station would not change the visual landscape of the existing site. Construction of a new pipeline would result in short-term scarring of the landscape along the pipeline route.	Approximately 1,400 acres of farmland would be removed from production returning to the more arid, sparsely vegetated landscape characteristic of undeveloped land in the area.	Minimum monthly stream flows in Lower salmon Creek would remain at zero during most months, and the visual landscape would continue to present a degraded, dewatered view. Salmon Lake and Conconully

VISUAL RESOURCES IMPACTS (CONT)	Construction of a new pipeline would result in short-term scarring of the hillside as the pipeline climbs a 25% grade. A portion of the existing concrete canal feeding Salmon Lake would be removed and replaced with a buried pipeline. No long-term visual impacts would result from upgrading the existing canal. Regulating flow and re-establishing seasonal flows in Lower Salmon Creek would be a positive impact. Median reservoir elevations would be higher and seasonal fluctuations would be reduced, positively impacting the visual landscape. Minimum reservoir levels would decrease in some months.	Regulating flow and re-establishing seasonal flows in Lower Salmon Creek would be a positive impact. A portion of the existing concrete canal feeding Salmon Lake would be removed and replaced with a buried pipeline. No long-term visual impacts would result from upgrading the existing canal. Median reservoir elevations would be higher and seasonal fluctuations would be reduced, positively impacting the visual landscape. Minimum reservoir levels would decrease in some months. The Lower Salmon Creek visual landscape would be positively impacted by a combination of the reestablishment of riparian vegetation, site-specific treatment of eroding stream banks, floodplain reconnection, and land use management practices to enhance channel and habitat conditions. The addition of water to Salmon Creek would generally have positive impacts on the visual landscape by re-establishing a green riparian zone along the banks of the creek.	A portion of the existing concrete canal feeding Salmon Lake would be removed and replaced with a buried pipeline. No long-term visual impacts would result from upgrading the existing canal. Regulating flow and re-establishing seasonal flows in Lower Salmon Creek would be a positive impact. Median reservoir elevations would be higher and seasonal fluctuations would be reduced, positively impacting the visual landscape. Minimum reservoir levels would decrease in some months.	Lake reservoirs would experience lower lake levels during dry seasonal periods.
VISUAL RESOURCES MITIGATION	Other than short-term construction mitigation no other measures are proposed. Landscaping and screening would lessen the visual impact of the new pump house.	Other than short-term construction mitigation no other measures are proposed.	Other than short-term construction mitigation no other measures are proposed.	None proposed.

SOCIO-ECONOMIC IMPACTS	No effect on revenues or net income to district growers as compared to the No Action Alternative Pumping from the Okanogan River would increase, leading to higher costs to deliver the water for irrigation. There are no indirect and induced effects on output, income, and employment. There would be virtually no effect on reservoir recreation and the associated tourism-based economy in and around Conconully during wet or normal water years as compared to the No Action Alternative. In dry years, a small positive effect on recreation may be realized, as lake levels are stabilized and relatively higher than the comparable No Action Alternative dry water years.	No effect on revenues or net income to district growers as compared to the No Action Alternative. Pumping from the Okanogan River would increase, leading to higher costs to deliver the water for irrigation. There are no indirect and induced effects on output, income, and employment. There would be virtually no effect on reservoir recreation and the associated tourism-based economy in and around Conconully during wet or normal water years as compared to the No Action Alternative. In dry years, a small positive effect on recreation may be realized, as lake levels are stabilized and relatively higher than the comparable No Action Alternative dry water years.	Total crop revenue from production within the district is reduced by as much as a fourth, although net income to remaining district growers is unaffected. Pumping from the Okanogan River would increase, leading to higher costs to deliver the water for irrigation. Total output in the county is reduced annually by nearly $4.1 million, primarily affecting the agriculture sector. This output reduction represents about 0.3 percent of total output in the county, but the loss in the agricultural sector accounts for approximately 1.4 percent of total agricultural output. Income is reduced by nearly $1.8 million annually, and there is an associated loss of about 118 jobs. Most of these job losses are in the agriculture sector, and account for about two percent of employment in that sector. Impacts on property taxes are realized where formerly agricultural land changes to non-productive status. However, tax base impacts are negligible. There would be virtually no effect on reservoir recreation and the associated tourism-based economy in and around Conconully recreation during wet or normal water years as compared to the No Action Alternative. In dry years, a small negative effect on recreation may be realized as compared to the comparable No Action Alternative dry water years.	Agricultural crops may vary based on local and regional economic trends. There is an unknown impact of what would be required in the future for Endangered Species Act enforcement.
SOCIO-ECONOMIC MITIGATION	Higher pumping costs may be mitigated by the public sector covering additional costs that would be incurred over and above the No Action Alternative.	Higher pumping costs may be mitigated by the public sector covering additional costs that would be incurred over and above the No Action Alternative.	Lost income from agricultural land that is no longer in service would be offset by the water right purchase amount going to the owners of idled land.	None proposed.

SOCIO-ECONOMIC MITIGATION (CONT)	No mitigation is proposed for income and job losses.	No mitigation is proposed for income and job losses.	Higher pumping costs may be mitigated by the public sector covering additional costs that would be incurred over and above the No Action Alternative. No mitigation is proposed for income and job losses.	
PUBLIC SERVICES and UTILITIES IMPACTS	The demand for power would increase with increased pumping at the new station site. Short-term construction impacts may result in disruption of some public service utilities during excavation and trenching of the pipeline.	Increased pumping at Shellrock would raise demand for power. Short-term construction activities associated with rehabilitation of Salmon Creek or excavation and trenching of the pipeline could cause a temporary disruption in public services.	No impacts to public services and utilities have been identified.	Public utilities and services along Lower salmon Creek would remain relatively unchanged. The Feeder Canal would continue to slowly degrade and eventually become unstable without major repair work.
PUBLIC SERVICES and UTILITIES MITIGATION	Other than short-term construction mitigation no other measures are proposed.	Contractors and local officials would work with fire services to establish alternate routes to minimize any disruptions in public services along Salmon Creek. Short-term construction mitigation will also be required.	Other than short-term construction mitigation no other measures are proposed.	None proposed.
CULTURAL RESOURCES IMPACTS	The location of the proposed new pump station is in an area of high potential for cultural resources. Much of the route of the proposed new pipeline is in areas of moderate to high potential for cultural resources. The historic qualities of the feeder canal will be altered, however that impact has already been mitigated via completion of HABS/HAER documentation. Channel rehabilitation at the mouth of Salmon Creek will be conducted in areas of high potential for presence of cultural resources.	The upgrade to the pump station is not expected to have any impact. Much of the route of the proposed new pipeline is in areas of moderate to high potential for cultural resources. The historic qualities of the feeder canal will be altered, however that impact has already been mitigated via completion of HABS/HAER documentation. Channel rehabilitation in the area of the town dumpsite may expose areas containing cultural resources of unknown quality, composition, or significance.	Absent stream rehabilitation, higher flows would be present in Salmon Creek and any consequent erosion could produce an associated increase in unintended exposure of buried cultural resources. The historic qualities of the feeder canal will be altered, however that impact has already been mitigated via completion of HABS/HAER documentation.	Streambank erosion will continue to threaten unintended exposure of buried cultural resources. In particular, the current pace of exposure of unknown items and materials from the town dumpsite will continue. Cultural resources on the site of the proposed pump station and along the route of the proposed pipeline will not be disturbed. The historically significant feeder canal may continue to deteriorate. Any further bank deterioration/erosion associated with the existing feeder canal will threaten unintended exposure of buried cultural resources.

CULTURAL RESOURCES IMPACTS (CONT)	Higher flows would be present in Salmon Creek and any consequent erosion could produce an associated increase in unintended exposure of buried cultural resources	Channel rehabilitation in the lower portion of the creek will be conducted in areas of high potential for presence of cultural resources.		
CULTURAL RESOURCES MITIGATION	Comprehensive field investigation prior to conducting work, specifically including: • Intensive pedestrian survey of the identified APE areas. • Shovel test probes at the Okanogan pump station site. • Shovel test probes along the proposed pipeline near the town of Okanogan on banks, terraces, and landforms with less than 10% slope. Recommended spacing of test holes at 20-40 meter intervals. As an alternative to test probes, full cultural resource monitoring of all pipeline excavation on banks, terraces, and landforms with less than 10% slope would be appropriate. • Conduct further discussions with the Colville Tribe to determine the location of the TCP and to include any ethnographic information the Tribe is willing to share within this section or to be included within a Technical Report. • Additional field survey for historical resources. • Care should be taken to avoid any known cultural resources within the APE. This analysis is preliminary because of the difficulty in clearing assessing effects prior to selecting a preferred alternative and identifying the local commitment to avoidance or mitigation	Comprehensive field investigation prior to conducting work, specifically including: • Intensive pedestrian survey of the identified APE areas. • Shovel test probes at any areas that would be disturbed by the proposed upgrade to the Shellrock pump station. • Shovel test probes along the proposed pipeline near the town of Okanogan on banks, terraces, and landforms with less than 10% slope. Recommended spacing of test holes at 20-40 meter intervals. As an alternative to test probes, full cultural resource monitoring of all pipeline excavation on banks, terraces, and landforms with less than 10% slope would be appropriate. • Shovel test probes along those alluvial benches of Salmon Creek that will be affected by stream rehabilitation. Some benches have been noted to have little soil deposition and should be considered as having low probability of containing subsurface cultural resources. • Avoidance of the historic Okanogan Town trash dump located along the north bank of Salmon Creek. • Conduct further discussions with the Colville Tribe to determine the location of the TCP and to include	None proposed.	None proposed.

CULTURAL RESOURCES MITIGATION (CONT)	measures. • HABS/HAER documentation should be undertaken for demolition or alteration of historical resources. Salvage of building parts or the moving of historical resources is another form of mitigation. • In the event that human remains are discovered during the conduct of any of the fieldwork proposed, the protocol detailed within an Unanticipated Discovery Plan should be followed. The plan should be developed as part of an MOA prior to the completion of the Final EIS. Construction monitoring of areas with high sensitivity for archaeological resources should also be included within the MOA. • Have a cultural resource monitor be present on site if any work is conducted in the area of the town dumpsite. An option would be to conduct backhoe trench testing prior to bank stabilization. • Conduct an intensive pedestrian survey prior to starting construction on any component of this project that would disturb ground, including rehabilitation work at the mouth of Salmon Creek, the pipeline, and the pump station location. • Conduct a hydraulic assessment of the creek taking into account the proposed increase of stream flows and its effects on bank erosion. Increases in the water table should be considered. • If further testing determines there are very old (19th century)	any ethnographic information the Tribe is willing to share within this section or to be included within a Technical Report. • Additional field survey for historical resources. • Care should be taken to avoid any known cultural resources within the APE. This analysis is preliminary because of the difficulty in clearing assessing effects prior to selecting a preferred alternative and identifying the local commitment to avoidance or mitigation measures. • HABS/HAER documentation should be undertaken for demolition or alteration of historical resources. Salvage of building parts or the moving of historical resources is another form of mitigation. • In the event that human remains are discovered during the conduct of any of the fieldwork proposed, the protocol detailed within an Unanticipated Discovery Plan should be followed. The plan should be developed as part of an MOA prior to the completion of the Final EIS. Construction monitoring of areas with high sensitivity for archaeological resources should also be included within the MOA. • Conduct an intensive pedestrian survey prior to starting construction on any component of this project that would disturb ground, including rehabilitation work along the streambanks of Salmon Creek, the pipeline, and		

CULTURAL RESOURCES MITIGATION (CONT)	artifacts, avoid disturbance of the Okanogan town dumpsite, if possible. • Minimize disturbance to any discovered cultural resources, if possible.	Shellrock station. • Conduct a hydraulic assessment of the creek taking into account the proposed increase of stream flows and its effects on bank erosion. Increases in the water table should be considered. • Minimize disturbance to any discovered cultural resources, if possible.		
HEALTH AND SAFETY IMPACTS	Temporary increased noise, transport of large equipment, and degradation of air quality near construction sites. Increased risk of fire near construction operations. Increased stream flows in Lower Salmon Creek could raise the overall water table in the vicinity of the town dumpsite and/or speed streambank erosion near the dumpsite. Increased chance of hazardous spills of gas, oil, and hydraulic fluids due to presence of construction equipment. New pump station will introduce a new source of noise in Okanogan area. The pumps will be housed in a concrete structure to lessen noise.	Temporary increased noise, transport of large equipment, and degradation of air quality near construction sites. Increased risk of fire near construction operations. Increased stream flows in Lower Salmon Creek could raise the overall water table in the vicinity of the town dumpsite. Increased chance of hazardous spills of gas, oil, and hydraulic fluids due to presence of construction equipment. Operations within lower Salmon Creek will increase noise and risk of spills in this area for a couple months or more.	Temporary increased noise, transport of large equipment, and degradation of air quality near construction sites. Increased risk of fire near construction operations. Increased stream flows in Lower Salmon Creek could raise the overall water table in the vicinity of the town dumpsite and/or speed streambank erosion near the dumpsite. Increased chance of hazardous spills of gas, oil, and hydraulic fluids due to presence of construction equipment.	Erosion of the Salmon Creek stream bank is occurring and exposing some items that were deposited in the Okanogan town dumpsite. According to state and federal records, no evidence of leaching or contamination from hazardous or toxic materials has been detected thus far. Taking no action would result in the bank continuing to erode at its current rate, further exposing buried items and unknown other materials. Sloughing of the hillside into the feeder canal and potential failure of the canal would remain as a concern. Annual maintenance to keep the feeder canal functioning would be required.
HEALTH AND SAFETY MITIGATION	• Conduct a hydraulic assessment of Salmon Creek taking into account the proposed increase of stream flows and its effects on bank erosion and determine whether there would be increases in the water table and potential resultant leachates from the dumpsite.	• Investigate and identify possible contaminants in the Okanogan town dumpsite if proposed rehabilitation would impact the area. • Conduct a hydraulic assessment of Salmon Creek taking into account the proposed increase of stream flows and its effects on bank erosion and determine	• Conduct a hydraulic assessment of Salmon Creek taking into account the proposed increase of stream flows and its effects on bank erosion and determine whether there would be increases in the water table and potential resultant leachates from the dumpsite. • Any spills or releases of hazardous materials would be cleaned up and	None proposed

HEALTH AND SAFETY MITIGATION (CONT)	• Any spills or releases of hazardous materials would be cleaned up and disposed of or treated according to applicable regulations. Accidental releases of hazardous materials to the environment would be prevented or minimized through the proper containment of oil and fuel in storage areas. • A spill prevention, control, and countermeasures (SPCC) plan would be prepared prior to the start of construction, and implemented to minimize the potential for hazardous materials to enter surface or groundwater. • When working within or adjacent to any drainage ditch, watercourse, ravine, etc., the construction contractor would have an emergency spill containment kit to contain and remove any accidentally spilled fuels, hydraulic fluids, etc. • Equipment refueling and storage of fuels and hydraulic fluids or any other toxic or deleterious materials would not occur within 100 feet of surface water. • Strict procedures for disposal of common construction materials (e.g., concrete, paint, and wood preservatives) and petroleum products (e.g., fuels, lubricants, and hydraulic fluids) or any other hazardous materials used during construction would be followed. • Discharge of solid materials including building materials into waters of the United States would be avoided unless authorized by a Clean Water Act Section 404	whether there would be increases in the water table and potential resultant leachates from the dumpsite. • Any spills or releases of hazardous materials would be cleaned up and disposed of or treated according to applicable regulations. Accidental releases of hazardous materials to the environment would be prevented or minimized through the proper containment of oil and fuel in storage areas. • A spill prevention, control, and countermeasures (SPCC) plan would be prepared prior to the start of construction, and implemented to minimize the potential for hazardous materials to enter surface or groundwater. • When working within or adjacent to any drainage ditch, watercourse, ravine, etc., the construction contractor would have an emergency spill containment kit to contain and remove any accidentally spilled fuels, hydraulic fluids, etc. • Equipment refueling and storage of fuels and hydraulic fluids or any other toxic or deleterious materials would not occur within 100 feet of surface water. • Strict procedures for disposal of common construction materials (e.g., concrete, paint, and wood preservatives) and petroleum products (e.g., fuels, lubricants, and hydraulic fluids) or any other hazardous materials used during construction would be followed. • Discharge of solid materials	disposed of or treated according to applicable regulations. Accidental releases of hazardous materials to the environment would be prevented or minimized through the proper containment of oil and fuel in storage areas. • A spill prevention, control, and countermeasures (SPCC) plan would be prepared prior to the start of construction, and implemented to minimize the potential for hazardous materials to enter surface or groundwater. • When working within or adjacent to any drainage ditch, watercourse, ravine, etc., the construction contractor would have an emergency spill containment kit to contain and remove any accidentally spilled fuels, hydraulic fluids, etc. • Equipment refueling and storage of fuels and hydraulic fluids or any other toxic or deleterious materials would not occur within 100 feet of surface water. • Strict procedures for disposal of common construction materials (e.g., concrete, paint, and wood preservatives) and petroleum products (e.g., fuels, lubricants, and hydraulic fluids) or any other hazardous materials used during construction would be followed. • Discharge of solid materials including building materials into waters of the United States would be avoided unless authorized by a Clean Water Act Section 404 permit. • To the extent possible, excavation and grading would be timed to coincide with the dry seasons to reduce the potential for water	

HEALTH AND SAFETY MITIGATION (CONT)	permit. • To the extent possible, excavation and grading would be timed to coincide with the dry seasons to reduce the potential for water erosion. Water would be applied to control dust and minimize wind erosion. • To the extent feasible, slopes would be graded to no steeper than 2 horizontal: 1 vertical • All noise producing equipment and vehicles using internal combustion engines would be equipped with mufflers and air inlet silencers, where appropriate; be in good operating condition; and meet or exceed original factory specifications. Mobile or fixed "package" equipment (e.g., arc welders and air compressors) would be equipped with shrouds and noise control features that are readily available for that type of equipment. • To prevent accidental fires during construction of the Project, workers would be required to avoid idling vehicles in grassy areas and to keep welding machines and similar equipment away from dry vegetation.	including building materials into waters of the United States would be avoided unless authorized by a Clean Water Act Section 404 permit. • To the extent possible, excavation and grading would be timed to coincide with the dry seasons to reduce the potential for water erosion. Water would be applied to control dust and minimize wind erosion. • To the extent feasible, slopes would be graded to no steeper than 2 horizontal: 1 vertical • All noise producing equipment and vehicles using internal combustion engines would be equipped with mufflers and air inlet silencers, where appropriate; be in good operating condition; and meet or exceed original factory specifications. Mobile or fixed "package" equipment (e.g., arc welders and air compressors) would be equipped with shrouds and noise control features that are readily available for that type of equipment. To prevent accidental fires during construction of the Project, workers would be required to avoid idling vehicles in grassy areas and to keep welding machines and similar equipment away from dry vegetation.	erosion. Water would be applied to control dust and minimize wind erosion. • To the extent feasible, slopes would be graded to no steeper than 2 horizontal: 1 vertical • All noise producing equipment and vehicles using internal combustion engines would be equipped with mufflers and air inlet silencers, where appropriate; be in good operating condition; and meet or exceed original factory specifications. Mobile or fixed "package" equipment (e.g., arc welders and air compressors) would be equipped with shrouds and noise control features that are readily available for that type of equipment. • To prevent accidental fires during construction of the Project, workers would be required to avoid idling vehicles in grassy areas and to keep welding machines and similar equipment away from dry vegetation.	