Yakima River Basin Integrated Water Resource Management Plan

Technical Memorandum:

Appraisal Study of Kittitas Valley Delivery Systems for Groundwater Recharge and Creek Flows

U.S. Bureau of Reclamation
Contract No. 08CA10677A ID/IQ

Prepared by

HDR Engineering, Inc.
Anchor QEA

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Columbia-Cascades Area Office

State of Washington
Department of Ecology
Office of Columbia River

April 2013

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Contents

List of Tables

List of Figures

Appendix A – Appendix Figures

Appendix B – Opinions of Probable Construction Costs

1.0 Introduction

This technical memorandum describes the design criteria, surface geology, facilities, property and easements needed for a proposed project under the Yakima River Basin Integrated Water Resource Management Plan (Integrated Plan) that would divert water from the Yakima River and pump it to the Kittitas Reclamation District (KRD) North Branch Canal. This flow would provide the flexibility to deliver water to five tributary creeks that cross the KRD Main Canal between Easton and Thorp and to replace flow from existing diversions from creeks that cross the North Branch Canal. The project could also provide flow to be delivered through the North Branch Canal to groundwater recharge sites that are under consideration in the Kittitas Valley. The Kittitas Valley Delivery project would benefit fish in the tributary streams as well as improve the efficiency of irrigation deliveries.

The goals of the Integrated Plan are to protect, mitigate and enhance fish and wildlife habitat; provide increased operational flexibility to manage in-stream flows to meet ecological objectives; and improve the reliability of the water supply for irrigation, municipal supply and domestic uses (Reclamation and Ecology, 2012).

The Kittitas Valley Delivery project is located in Kittitas County near Ellensburg, Washington. Using defined site selection criteria, two potential alternative pump station sites have been identified and compared. Site 1 is located near Swauk Creek, adjacent to State Route (SR) 10, approximately 5 miles northwest of Thorp, Washington. Site 2 is located adjacent to SR 10 and the North Thorp Highway at Dudley Road, approximately 3 miles northwest of Thorp.

At either site, the project would consist of a new screened intake structure on the Yakima River, a pump station with a total capacity of 100 cubic feet per second (cfs), a discharge pipeline, and a canal discharge structure at the North Branch Canal. Figure 1 shows the two alternative intake and pump station sites.

Other facilities would be constructed on the KRD Main Canal upstream from the proposed pump station to discharge water to tributaries and on the North Branch Canal downstream from the pump station to discharge water to groundwater recharge sites. Other facilities at creek crossings along the North Branch Canal could be constructed to replace existing creek diversions provided enough conveyance capacity exists in the North Branch Canal to serve those diversions. Additional geotechnical and surveying of a selected site (Site 1 or 2) would be required during the preliminary design phase.

Although this report is based upon diverting up to 100 cfs, there have also been discussions between KRD and Reclamation about diverting as much as 300 cfs. Further discussion of a potential higher capacity system is included in Section 9.0 - Design Considerations.

2.0 Project Objectives and Design Flow

2.1 Project Objectives

The proposed project would convey water from the Yakima River to the North Branch Canal. A pumping capacity of 100 cfs is used for the appraisal study and cost-estimating. Although higher volumes could be considered, the 100-cfs pumping capacity in this report is based upon available capacity in the North Branch Canal to serve potential groundwater recharge sites near Naneum Creek and in Badger Pocket without substantial upgrades to increase capacity of the North Branch Canal. This flow diversion would also provide flexibility to deliver water to five tributaries (Big Creek, Little Creek, Spex Arth Creek, Tillman Creek and Peterson Creek) that cross the Main Canal from Easton to Thorp. This would provide additional in-stream flows to benefit fish habitat during August or when low-flow conditions occur. The existing North Branch Canal capacity would be used to convey this flow when full canal capacity is not needed to deliver irrigation water.

2.2 KRD Canal Capacities

Table 2-1 provides the range of total canal capacities along the Main Canal and North Branch Canal, which decrease from upstream to downstream.

Table 2-2 shows estimates of available canal capacity by month during the KRD irrigation season (mid-April to mid-October). The estimates in Table 2-2 were obtained by reviewing flow records for the canals (including Naneum Creek Gauge, Caribou Creek Gauge, and Johnson Siphon Gauge) and comparing typical operating conditions to total canal capacity. Appendix Figure 2 shows the locations of the canal reaches and canal gauges referenced in Table 2-1 and Table 2-2, as well as proposed turnout and pump station sites. If the pump station were to operate prior to the start of the irrigation season, the available canal capacity in the North Branch Canal would equal its canal capacity shown in Table 2-1.

Table 2-1. Range of Canal Capacities

REACH	CAPACITIES (CFS)
Main Canal Capacity from Diversion Dam to Bifurcation	1,320-1,145
North Branch Canal Capacity from Bifurcation to Caribou Creek	925-400
North Branch Canal Capacity at Johnson Siphon	260

Source: Satnik, personal communication (2012)

Table 2-2. Estimated Available Canal Capacities during KRD Irrigation Season

MONTH	ESTIMATED AVAILABLE CAPACITY (CFS)		
	Main Canal from Diversion Dam to Bifurcation	North Branch from Bifurcation to Caribou Creek	Johnson Siphon
April	340-1,145	100-400	50-260
May	340	20-80	0
June	190-280	20-80	0
July	30-50	0	0
August	0	0	0
September	140	100-125	50
October	300-1,145	100-400	30-50

Source: Satnik, personal. communication (2012)

2.3 Groundwater Recharge

The groundwater recharge program is planned to operate early in the year, after winter conditions have passed and before the annual start of "storage control" in Yakima Project operations. Two potential recharge sites in the KRD that have been identified for initial consideration (Reclamation and Ecology, 2011) are described below.

During the early irrigation season, flow would be released from the North Branch Canal to groundwater recharge sites as shown in Appendix Figure 2. Because groundwater recharge sites are downstream from the pump station, flow would be released only when capacity in the North Branch Canal is available. At least 100 cfs of unused flow capacity is available from the Naneum gauge to the Caribou gauge along the North Branch Canal in April. In May and June the available capacity ranges from approximately 20 to 80 cfs. In July through early September during periods of peak irrigation demand, the North Branch Canal runs full with no available capacity. When irrigation demands decline from mid-September to the end of the irrigation season in mid-October, the North Branch Canal has at least 100 cfs of unused flow capacity.

Further downstream along the North Branch Canal at Johnson Siphon, approximately 50 cfs of unused flow capacity exists in April. The Johnson Siphon is a constriction that limits the ability to deliver flow to the Badger Pocket groundwater recharge site. That would allow 50 cfs to be delivered to both groundwater recharge sites in April. Johnson Siphon typically does not have any available capacity in May through early September. From mid-September to the end of the irrigation season in mid-October, the Johnson Siphon typically has between 30 and 50 cfs of unused flow capacity.

2.4 System Operation

Prior to the start of the irrigation season in April, the North Branch Canal may be able to operate before the Main Canal is ready to operate. In March, the Main Canal typically experiences severe snow and ice conditions that prevent operations, while the North Branch Canal lies at a lower elevation and is less affected by snow and ice. A pump station at either site could potentially

deliver 100 cfs to the North Branch Canal to supply groundwater recharge areas during March and April (after thawing and prior to the start of the irrigation season).

It appears that the Main Canal could divert and convey additional flow April through June that could supply the groundwater recharge areas. However additional review of the availability of water from Kachess or Keechelus reservoirs is needed to determine whether they could provide that additional flow. A pump station on the Yakima River is advantageous as it would provide water from either from one of the upper Yakima River reservoirs (Keechelus, Kachess or Cle Elum) or from unregulated runoff from tributaries that join the Yakima River upstream from the proposed pump station sites.

2.5 Tributary Flow Augmentation

In addition, flow would be delivered to five tributaries along the Main Canal during August or when low-flow conditions occur. Those tributaries are Big Creek, Little Creek, Spex Arth Creek, Tillman Creek and Peterson Creek. That water would need to be replaced by pumping from the Yakima River at a pump station since the Main Canal does not typically have available capacity during August or when water demand is high. The exact flow rate that needs to be delivered has not been determined at this time, but is likely in the range of 10 to 25 cfs, based on supplying 2 to 5 cfs at each of the five creeks.

The delivery of water to those tributaries would benefit adult and juvenile coho and steelhead and rearing spring Chinook that are present in the creeks. These benefits would result from increased streamflow during migration, spawning, and rearing periods. The increased streamflow would help address streamflow and water temperature quality problems that negatively affect fish passage and survival in the tributaries during low-flow conditions during the irrigation season.

Another potential use of the pumped water is to replace water diverted from creeks that cross the North Branch Canal to allow for removal of irrigation diversions and to reduce use of the creeks for irrigation water conveyance. These creeks are Dry Creek, Naneum Creek, Reecer Creek, Cooke Creek, Currier Creek, Caribou Creek, Wilson Creek and Park Creek.

However, more extensive modifications to existing irrigation systems that divert from those creeks may be needed prior to using water from the North Branch Canal. In addition, sufficient capacity in the North Branch does not appear to be available in July through early September to replace tributary diverters. For those reasons, this project is focused on supplying tributaries crossing the Main Canal and supplying groundwater recharge in the Naneum Creek and Badger Pocket areas.

2.6 Review of Pumping Capacity

In summary, a pumping capacity of 100 cfs is a reasonable first criterion to use for preliminary concept-level design and cost estimating. Other flows up to 300 cfs could be considered, but would require further evaluation of the availability of Yakima River water, the additional pumping costs, and the canal upgrades that would be needed to convey the additional water to the recharge sites. The final design pumping capacity should be reviewed after the capacities and operations of the groundwater recharge sites have been determined. This final pumping capacity should be established prior to advancing to the next phase of project design.

3.0 Pump Station Site Selection Criteria

The two alternative pump station sites were selected using the following criteria:

- Proximity to and on the same side of the river as the North Branch Canal.
- Ease of access to a major highway (SR 10).
- An apparently stable section of the Yakima River with sufficient water depth for a fish-screened intake.
- Utilize existing KRD property or easements, if possible.
- Minimize impacts on property owners (Site 2 is a developed parcel).
- Avoid trenchless crossings of highway and/or railroad, if possible.
- Ability to locate the pump station motors and electrical room above the floodplain.
- Relatively flat area with room for construction of the intake and pump station.
- The shortest possible feasible alignment for the discharge pipeline to the canal.
- Proximity to electrical power lines.

Based upon these criteria, the following two alternative sites (see Appendix Figure 1) were selected for this appraisal level comparative analysis:

Site 1 at Swauk Creek is approximately 5 miles northwest of Thorp, adjacent to SR 10, and near the existing North Branch Canal deep tunnel crossing of the Yakima River and the existing U.S. Bureau of Reclamation river gauge (YRWW).

Site 2 at Dudley Road is approximately 3 miles northwest of Thorp, adjacent to SR 10 and near the intersection of the North Thorp Highway and Dudley Road.

4.0 Project Facilities Design Criteria

4.1 Yakima River Intake

The following Yakima River flow information and design criteria were used for the Yakima River intake conceptual design:

- **Yakima River Flows –** Based on average daily flow data from 1990 to present for the Bureau of Reclamation stream Gauge YRWW at Site 1; the flows in the Yakima River have typically varied between approximately 600 cfs (exceeded 90 percent of the time) and 3,900 cfs (exceeded 10 percent of the time). The minimum, average, and maximum recorded flows were 256 cfs, 1,961 cfs, and 21,384 cfs (January 8, 2009), respectively. These are similar to longer-term average daily flows recorded 15 miles upstream at USGS gauge 12479500 at Cle Elum, Washington from 1949 through 1990. Flows are typically lowest in October and November and highest from June through August.
- **River Elevation (NAVD 88 datum) –** The Yakima River water elevation varies with flow rate, but for this conceptual-level analysis, based on USGS mapping of the site, the normal river elevation during pumping was estimated to be approximately

elevation 1,750 at Site 1 and elevation 1,674 at Site 2. The 100-year flood at Site 1 is approximately elevation 1,757 at Site 1 and elevation 1,683 at Site 2.

- **Fish Screening –** The facility would require fish screens to prevent fish from entering the pump station intake. The screen structure, including inclined stainless steel wedge-wire screen, would be designed for 100 cfs capacity with a 0.4 feet per second (fps) approach velocity, 1.75 millimeters or less clear slot openings, and a 2-fps sweeping velocity. Allowing for 20 percent more screen area to account for structural supports results in 300 square feet of fish screen.
- **Fish-Screen Cleaning –** An automatic air-burst system would be used to clean debris that accumulates on the screen surface. After air-bursting, the debris would be carried downstream by normal streamflow currents. A nearby air compressor and controls system would supply pressurized air for the cleaning system manifold.

4.2 Yakima River Pump Station Capacity

The pump station would be configured with four 25-cfs pumps that would pump in 25 cfs increments from 0 to 100 cfs. The pump station is a noncritical facility that will only be operated periodically, and major maintenance can be done when the pump station is not in service. Therefore, a standby pump is not required, and the firm capacity with one of the pumps out of service would be approximately 75 cfs. Using four equally sized pumps would minimize the required spare-parts inventory and allow for interchanging parts, if needed.

4.3 Pump Station Hydraulics

A pipeline would convey the pumped 100 cfs flow from the pump station to a new outlet structure at the North Branch Canal. Table 4-1 shows the approximate preliminary hydraulic elevations for the pumping system that would be located at either Site 1 or Site 2. The approximate elevations shown in the table are based on LiDAR and USGS data adjusted to the NAVD 88 vertical datum. These approximate elevations are used only to develop and compare relative pumping heads and costs. Surveying of the selected site would be required to determine site topography prior to beginning preliminary design.

Table 4-1. Approximate Base Hydraulic Elevations (feet)

HYDRAULIC CHARACTERISTIC	SWAUK CREEK (SITE 1)	DUDLEY ROAD (SITE 2)
River Water Surface Elevation	1,750	1,670
Canal Water Surface Elevation	2,100	2,090
100-Year Flood Elevation	1,757	1,683

4.4 Pipeline to Canal Outlet Structure

A concrete outlet structure would be constructed adjacent to the existing North Branch Canal to transition flow from the pipeline into the canal.

If the Yakima River pressure tunnel upstream from the Swauk Creek Site 1 outlet location is dewatered during the operation of the pump station, a check structure would be required on the North Branch Canal upstream from canal discharge structure to prevent backflow and filling of the tunnel while pumping. If the tunnel is kept full of water, a canal check structure may not be required.

For the Dudley Road Site 2, a gated or stoplogged check structure would be constructed in the canal just upstream from the canal discharge structure to prevent pumped flow from backflowing up the canal. This would only be used for pumping during periods when the canal is not already being used for normal irrigation. The check structure stoplogs would be removed, or gates opened, to allow normal flow through canal operations when this pump system is not operating.

4.5 Main Canal and North Branch Canal Turnouts

New canal turnouts would be constructed in the Main Canal and North Branch Canal to discharge water to tributaries and/or groundwater recharge sites.

New canal turnouts would be constructed on the Main Canal at one or more of the following four tributaries: Big Creek, Little Creek, Spex Arth Creek and Tillman Creek.

Peterson Creek currently has a connection to the Main Canal (Peterson Wasteway) and can be supplied water without a new canal turnout.

Additionally, new canal turnouts would be constructed on the North Branch Canal to supply groundwater recharge projects in the Naneum Creek and Badger Pocket areas.

5.0 Local Site Geology

The geology of the area is shown on the USGS geologic map of the East Half of the Yakima Quadrangle (Schuster 1994) and in a USGS hydrogeologic report (Jones et al. 2006). The Washington Division of Geology and Earth Resources (2005) published the same geologic mapping information in the form of a GIS dataset layer.

As summarized in Jones et al. (2006), the Yakima River Basin is part of the Yakima Fold belt, which is a highly folded and faulted region underlain by various consolidated rocks, ranging in age from Precambrian to Tertiary, and unconsolidated materials and volcanic rocks of Quaternary age. In the Yakima River Basin, the headwater areas in the Cascade Range include metamorphic, sedimentary, and intrusive and extrusive igneous rocks.

The central, eastern, and southwestern parts of the basin are composed of basalt lava flows of the Columbia River Basalt Group (CRBG) with some intercalated sediments that are discontinuous and weakly consolidated. The lowlands are underlain by unconsolidated and weakly consolidated valley-fill composed of glacial, glacio-fluvial, lacustrine, and alluvium deposits that exceed 1,000 feet thick in places. Wind-blown deposits, called loess, occur locally along the lower valley.

Figure shows surface geology information for Site 1 and for Site 2 from the Washington State Department of Natural Resources. Based on that information, the pump stations and pipelines would be founded in one of the following surface geologic units:

Swauk Creek (Site 1):

- Intake Pipeline and Pump Station: Grande Ronde Basalt, and/or alluvium.
- Pipeline: Crossing Grande Ronde Basalt, alluvium, and/or pre-Fraser alpine glacial outwash.
- Outlet Structure: Pre-Fraser alpine glacial outwash.

Dudley Road (Site 2):

- Intake Pipeline and Pump Station: Alluvium and/or Fraser-age alpine glacial outwash.
- Pipeline: Fraser-age alpine glacial outwash, volcaniclastic deposits or rocks, and/or continental sedimentary deposits or rocks, conglomerate.
- Outlet Structure: Continental sedimentary deposits or rocks, conglomerate.

Both Site 1 and Site 2 intakes and pump stations would be located in areas of surficial alluvium materials, but likely be founded on either volcanic (Site 1) or sedimentary rock (Site 2). However, the below surface geology is not available and the feasibility of all the proposed structures and pipelines would need to be investigated by conducting detailed, site-specific geotechnical and geological investigations during preliminary design.

6.0 Facilities Description

This section provides a more detailed description of the conceptual facilities required to convey water from the Yakima River near Swauk Creek (Site 1) or from the Yakima River near the intersection of the North Thorp Highway and Dudley Road (Site 2) northeast to the existing North Branch Canal.

Figure 4 and Figure 5 show more detailed plans for Sites 1 and 2, respectively.

In summary, the project includes the following components:

- Fish-screened intake in the Yakima River with air-burst cleaning.
- Pipe to connect the intake to the pump station clearwell.
- Pump station containing four equally sized pumps with a total maximum pumping capacity of 100 cfs.
- Pipeline from the pump station to a discharge structure in the bank of the existing North Branch Canal.
- Pipeline discharge structure (and if necessary, canal check structure) to discharge pumped water into the North Branch Canal.
- Main Canal and North Branch Canal turnout structures to discharge water from the Main Canal to tributaries and from the North Branch Canal to groundwater infiltration facilities.
- Pipelines or canals from the canal turnout structures to tributaries and/or groundwater infiltration points.

Primary access to the project area would be via Interstate 90 and SR 10 to the project site, which is located along SR 10 between 3 and 5 miles northwest of Thorp.

Preliminary site plans have been prepared for both Site 1 and Site 2. The project facilities described below generally apply to facilities that would be constructed at either site. The detailed figures are based on the installation of these facilities at Site 1. Figure 6 shows a larger scale of the Site 1 fish-screened intake and pump station site plan. The Site 2 facilities would be similar, but oriented as shown in the Figure 5.

6.1 Intake and Fish Screens

The Site 1 intake and fish screens would be located just upstream from Swauk Creek on the north bank of the river, approximately 5 miles northwest of Thorp. The Site 2 intake would be located near the intersection of the North Thorp Highway and Dudley Road. Figure 7 shows plan and section views of the inlet and outlet structures, including the fish screen that could be used at each location.

6.1.1 Fish Screens

The fish screen design concept is intended to comply with federal and state fisheries agencies criteria for a 100-cfs-capacity fish screen. The concrete fish intake and screen structure would be approximately 18 feet wide by 42 to 50 feet long. It would be parallel to the stream bank to allow water to enter through the screen while the natural current carries debris past the screen. The need for a screen-protecting trash rack will be investigated during preliminary design.

The screen is arranged at a 45-degree vertical angle to optimize underwater screen area and allow for air-burst cleaning of the screen. The screen criteria approach velocity is 0.4 fps, resulting in a total required net screen area of 250 square feet. The required screen length was determined using an assumed minimum water depth of 6 feet, a 45-degree angled screen, and about 40 percent more area for structural supports and air-burst manifold, resulting in a screen length of 40 to 48 feet. The screen panels could be removed for repair or replacement with a spare panel. The screen material would be stainless steel wedge-wire or profile bar with an open slot width of 1.75 millimeters.

Flow-control baffles behind the screen panel would be adjusted to maintain uniform velocities through the screen panels. Water-surface elevations would be measured upstream and downstream from the screens to monitor head losses through the screens and control and trigger the automatic air-burst cleaning system. The compressed air-burst cleaning cycle would be activated by a water-surface elevation difference through the screens of 1.2 inches or less. Screen-cleaning cycles could also be timed to occur more frequently or activated manually. Debris cleaned from the screen would be carried downstream by the natural river current.

6.1.2 Intake Pipeline

The intake for Site 1 would contain two 42-inch sluice gates and two short 42-inch-diameter pipes that would then connect to a 200-foot-long, 54-inch-diameter steel pipeline that would convey flow under Swauk Creek to the Yakima River Pump Station. Site 2, would be similar, but, the connecting pipeline between the intake and pump station would be approximately 100 feet shorter.

6.2 Yakima River Pump Station

The Yakima River Pump Station would pump up to 100 cfs of water from the Yakima River intake (at either Site 1 or Site 2) through a 48-inch-diameter steel pipeline to the North Branch Canal. Figure 8 shows preliminary pump station plan and section views.

6.2.1 Pump Station

The 55-feet-long, 36-feet-wide pump station would have a concrete clearwell and foundation, concrete masonry unit (CMU) walls, steel roof support structure and metal roof. The pump station would contain four 25-cfs vertical turbine pumps, valves, and pipe manifold. An access driveway would facilitate maintenance access and loading and unloading of equipment, using the building bridge crane. The sloping metal roof of the pump station would have removable hatches to allow installation and/or removal of the pumps using a crane set up next to the building. The pump station ceiling would be high enough that motors can be removed with a portable jib crane inside the building.

The clearwell would contain the pumps and maintain adequate submergence on the pump bowl during pumping. The clearwell water surface elevation would vary depending on the flow in the river and losses through the fish screens and forebay during pumping.

An adjacent 24-foot-wide, 36-foot-long electrical room would be integrally attached to the pump station building, making the combined "L"-shaped building a total of 60 feet wide. The electrical room would contain the pump station electrical power and control panels.

6.2.2 Pumps and Motors

The 25-cfs, vertical-turbine pumps would be selected based on the total dynamic head (TDH) of the pumping system. TDH is the net static head from the clearwell water surface to the canal water surface at the discharge structure, plus the losses in the discharge pipeline. The design set-points for the pumps would be for an estimated average TDH of the average static head plus the hydraulic losses in the pumping suction and discharge systems. The selected pump TDH is based on a conceptual-level hydraulic analysis of the discharge piping, valve, and pipeline losses.

The pump station capacity would vary slightly with changes in TDH and pump efficiencies as the river elevation changes. The pumps would be equipped with soft motor starters to reduce power-system impacts. For conceptual purposes, a combined pump and motor efficiency of 85 percent was used to determine the required approximate 1,250 horsepower capacity of the pump motor.

6.2.3 Power

Both alternative sites are served by transmission lines operated by Puget Sound Energy (PSE). Site 1 has a 34.5-kV transmission line along SR10. This line was recently upgraded from 12- to 34.5-kV to help serve local area wind farm development. There is also a 115-kV transmission line located across the Yakima River from the site. Site 2 is currently still being served by a three phase 12-kV power line along the North Thorp Highway.

At Site 1, the power demand for the four 1,250-HP pumps would be on the order of 950 kilowatts (kW) for each pump – or 3.8 megawatts (mW) if all pumps were operating. At Site 2, the power demand for the four 1,450-HP pumps would be on the order of 1,100 kilowatts (kW)

for each pump – or 4.4 megawatts (mW) if all pumps were operating. PSE representatives said that this would be a very large load for them at either location, which are approximately half-way between their connections to high voltage transmission lines. PSE would need to determine their ability to serve either pump station site; which would depend upon the pump loads as well as how the pump station is to be operated – including the frequency of motor starts and stops. It is assumed that motor soft starters would be required for constant speed pumps and perhaps even VFDs may be required to mitigate for motor starts and stops.

For purposes of this report, it was assumed that at Site 1 an electrical substation and switchyard adjacent to the pump station would accept power from the three-phase 34.5-kV power lines and that the pumps could be constant speed pumps with soft starts. It is yet to be determined if it would be feasible to connect the larger pumps at Site 2 through an electrical substation to the existing 12-kV power lines along the North Thorp Highway. Assumptions used for power service will need to be further verified by PSE.

A 300 cfs pump station at Site 1 would require up to 12.4 mW of power which would likely have to be connected through a new substation and power lines connecting to a 115-kV or larger PSE transmission line.

6.2.4 Flow Metering and Pump Operation

The pump station would have flow meters on each pump and automated data acquisition and control systems to operate the pumps. In addition to local manual operation, the pump station could be remotely monitored and automatically controlled or operated under a pre-programmed plan.

6.2.5 Hydraulic Surge Control

Some measures would be required to control and minimize surge pressures in the event of a rapid change in flow due to a power failure or other reasons. Although this study does not include a surge analysis, the conceptual plans and estimates include pump-control valves, and/or a surge tank.

6.2.6 Security

The intake and pump station would require some level of perimeter security. It is expected that security measures would include fencing and possibly remote camera monitoring and/or a building alarm system.

6.3 Pump Discharge Manifolds and Pipeline

Each pump would discharge through a 30-inch-diameter pipe that includes a pump-control valve in the pump station and pump isolation valve. Each pump-discharge pipe would connect to a header pipe and then to the 48-inch-diameter steel pipe conveying the flow to the North Branch Canal.

At the end of each pumping season the discharge pipeline could be slowly drained back into the Yakima River through a drain valve and pipe at the pump station. If needed, combination air-release/vacuum valves would be located at any pipeline high points to allow movement of air into and out of the pipeline.

6.4 Pipeline Discharge Structure at North Branch Canal

The transmission pipeline would discharge into the North Branch Canal discharge structure as shown in Figure 9. The flow from the pipe would discharge into a 25-foot-long hydraulic transition structure next to the North Branch Canal and then flow over a weir from the discharge structure into the adjacent canal. The discharge structure would also have a 48-inch sluice gate that would be closed to prevent entry when not in use and to prevent water from entering the pipeline when the canal is used for normal irrigation.

An upstream check structure with removable stoplogs would be installed in the canal just upstream from the discharge structure to prevent water from going upstream during groundwater recharge pumping. The check structure stoplogs would be removed during irrigation season.

6.5 Intake and Pump Station Characteristics

The sizes of the structures are similar for Site 1 and Site 2.

Table 6-1 shows the differing characteristics of the intake, pump station, and pipeline discharge structure for both sites. Elevations and lengths shown in the table are preliminary unsurveyed approximations.

Site 2 would have approximately 70 feet more pumping head than Site 1. As a result, to pump the same flow volumes, Site 2 would require approximately 20 percent more in pumping energy than Site 1.

Table 6-1. Structures Differing Design Criteria and Characteristics (100-cfs Pump Station)

CHARACTERISTIC	SWAUK CREEK (SITE 1)	DUDLEY ROAD (SITE 2)
Intake Top Slab Elevation (feet)	1,758	1,680
Intake Bottom Slab Elevation	1,740	1,662
Intake Structure Length (feet)	42	50
54-inch Intake Pipeline Length (feet)	200	100
Pump Station Floor Elevation	1,762	1,684
Clearwell Floor Elevation	1,736	1,658
Approximate Static Head (feet)	350	420
Approximate Static Head (psi)	155	182
48-Inch Pipeline Length (feet)	2,600	2,000
100 cfs Dynamic Head* (feet)	365	435
Pump/Motor Horsepower (4 each)	1,250	1,450

* Not including hydraulic surge pressures that would be determined during final design surge analysis.

6.6 Canal Tributary and Recharge Turnouts

This section describes the proposed locations and typical configuration of canal turnouts for discharging water to tributaries and for groundwater recharge. Figure 2 shows the locations of the proposed turnouts. Additional turnouts or turnouts at different locations may be included in future project phases.

A canal turnout typically consists of the following:

- A precast or cast-in-place concrete inlet inset into the canal bank with a gate for flow control.
- High-density polyethylene (HDPE), PVC pipe and/or unlined or concrete-lined canal to transport water between the canal and the tributary or groundwater recharge area.
- Erosion protection at tributary discharge locations.

Some tributary locations may require a fish screen or other fish barrier to prevent fish from traveling up the tributary outlet to the canal. Figure 9 shows a plan and section of a typical turnout (inlet and outlet).

The turnout and pipe size would depend on the amount of flow desired to be discharged. It is likely that flow discharged to tributaries would range from a few cfs to about 10 cfs. For a 5-cfs discharge, the turnout would likely have a 14- to-16-inch-diameter pipe and gate. For a 10-cfs discharge, the turnout would likely have a 20-inch-diameter pipe and gate.

The outlet pipe from the canal would spill to the tributary. Erosion protection would likely be needed at the outlet to prevent the tributary bed or bank from eroding. This could consist of rock or wood placed to dissipate the energy from the pipe discharge.

For flow discharged to groundwater recharge sites, the turnout may need to supply up to 100 cfs. The design of the groundwater recharge sites is not complete so these are conservative estimates. A 100-cfs turnout would likely have a 48-inch-diameter pipe or a concrete-lined trapezoidal canal with a 4-foot bottom width and a 4-foot depth, assuming a slope of 0.05 percent, canal side slopes of 1.5:1 (Horizontal:Vertical), Manning's roughness coefficient of 0.014, and 1 foot of freeboard. The pipe or canal outlet would be located in the groundwater infiltration area. The facilities needed for those areas would need to be determined in future studies.

7.0 Property Easements and Purchases

The Kittitas County Assessor's website was used to compile property ownership information to estimate the cost of property acquisition and easements for the project facilities. Information was compiled by using GIS tools on the website. Data was then collected for each parcel along the route and combined with parcel data from other surrounding parcels not on the route to determine realistic property values. Figure 10 shows the known parcel boundaries and parcel ownership at Sites 1 and 2.

For this conceptual study, the property analysis is based on the following assumptions:

- Parcels where the pipelines cross open space would need a 30-foot permanent easement and a 50-foot temporary construction easement.

- Approximately 0.5 to 1 acre of purchased property would be needed for the new intake and pump station and approximately 1 to 2 acres of permanent easement for the pipeline. It was assumed the discharge structure would be on existing KRD property adjacent to the canal.

Table 7-1 lists potential property owners and purchase/easements based on the information in Figure 10.

Based on the preliminary evaluation, Site 1 (Swauk Creek) would require a 0.4 acre site purchase (from BNSF Railway Co.), 2.6 acres of temporary easements, and 1.9 acres of permanent easements from BNSF, Washington State Department of Transportation (SR 10), and the Bureau of Land Management.

Site 2 (Dudley Road) would require a 0.8-acre private parcel purchase, 1.5 acres of private parcel temporary easements, 1 acre of private parcel permanent easements, and a 0.10-acre permanent easement along SR 10.

Table 7-1. Potential Property Purchase/Easements for Pump Station Sites

PROJECT AREA	SWAUK CREEK (SITE 1)		DUDLEY ROAD (SITE 2)	
	Property Owner	Acquisition Need (acres)	Property Owner	Acquisition Need (acres)
Intake, Intake Pipeline, and Pump Station	BNSF Railway Co. (151736)	0.40 purchase or lease	Der Yuen (577934)	0.85 purchase
Discharge Pipeline	BNSF Railway Co.	0.52 TE* 0.32 PE	Pollock (11558)	0.28 TE 0.17 PE
			Basterrechea (506636)	0.04 TE 0.03 PE
	WSDOT (SR 10 ROW)	0.46 TE 0.34 PE	WSDOT (SR 10 ROW)	0.16 TE 0.10 PE
	US (BLM (897734)	1.65 TE 1.00 PE	Pearson (18506)	0.62 TE 0.37 PE
			Havens (18508)	0.32 TE 0.19 PE
New Access Roads	BNSF Railway Co.	Included in PS and pipeline	Der Yuen (577934)	0.23 TE 0.14 PE
Power Line		0.20 PE		Included in road

*TE = Temporary Easement; PE = Permanent Easement

8.0 Preliminary Opinion of Probable Project Costs

Preliminary conceptual project information was used to develop opinions of probable construction costs (OPCCs). The OPCC below includes a 25-percent contingency and a 7.75-percent Kittitas County sales tax. Estimated property/easement acquisition costs were added

along with percentage of construction cost allowances for administrative/legal (5 percent), permitting/environmental (6 percent), surveying/geotech (6 percent), engineering/design (15 percent), and construction management (10 percent). The sum of these values then represents the total approximate opinion of probable project costs.

At this preliminary appraisal study level of project definition, the estimate is considered to be an Association for the Advancement of Cost Engineering (AACE) Class 4 estimate. The expected accuracy range is from -30 to +50 percent. Table 8-1 summarizes major cost items. The detailed estimates are included in the appendix.

Operations and maintenance costs have not been quantified for this appraisal study, but would generally be similar for the two alternatives. An exception would be the relative pumping power/energy costs. Because Site 2 has a higher pumping head, Site 2 would use approximately 20 percent more energy than Site 1.

Table 8-1. Preliminary OPPC Summary ($ million)

COST ITEM	SWAUK CREEK (SITE 1)	DUDLEY ROAD (SITE 2)
Intake, Pipeline, Pump Station, Outlet*	$11.0	$9.8
Tributary Turnouts	$0.42	$0.42
Subtotal Construction Costs	$11.4	$10.2
Property/Easement Acquisition	$0.12	$0.15
5% Project Legal/Administration	$0.57	$0.51
6% Permitting/Environmental	$0.69	$0.61
6% Surveying/Geotech	$0.69	$0.61
15% Engineering/Design	$1.7	$1.5
10% Construction Management	$1.1	$1.0
Approximate Total Project Costs	$16.3	$14.6
Range (-30% to +50%) of Project Costs	$11.4 to $24.5	$10.2 to $21.9

* Includes 7.75% sales tax and 25% contingency

The estimated mean annual volume for the 100-cfs pump station would be approximately 38,800 acre-feet (See Section 9.4.1, Table 9-1). Using an estimated average energy cost of 6.0 cents per kilowatt-hour (kWh), including capacity charges, would result in annual pumping costs of approximately $1.08 million for Site 1 and $1.28 million for Site 2 – a $200,000 annual difference. With a 0.5 percent annual net discount rate (discount rate minus energy cost escalation rate), the present values of the annual pumping costs over 30 years are $30.0 million and $35.7 million respectively – a $5.7-million difference.

Based upon these assumptions, the present value of the pumping energy savings for Site 1 more than makes up for its higher construction cost (approximately $1.7 million higher).

9.0 Considerations for Design

9.1 Special Considerations

Special considerations for implementing this project are as follows:

- Determining the feasibility of all of the project concepts.
- Permitting and constructing a new intake on the Yakima River west of Thorp.
- The feasibility of Confined intake Site 1 between the river and railroad, then crossing under Swauk Creek.
- Permission for Crossing under the BNSF railroad tracks (Site 1).
- Crossing under SR 10 (Site 1 could cross under an existing, elevated, dry wash crossing).
- Minimizing impacts on the Yakima River.
- Providing adequate power to the pump station.
- Defining the amount of water actually needed at each of the recharge sites and tributary stream crossings.

In addition to the items listed above, a larger, 300-cfs pump station would present the following significant challenges:

- Siting a much larger fish screened intake in the Yakima River.
- Siting a larger pump next to the river.
- Power transmission and likely large substation upgrades.

9.2 General Considerations

General considerations for implementing this project are as follows:

- Confirming the overall system operational criteria and project hydraulics for existing and future flows with additional surveying as required.
- Obtaining more detailed geotechnical information for the entire length of the project, including a geotechnical exploration program for critical areas, structures, and tunnels.
- Exploring permitting and engineering requirements for constructing a new diversion dam on the Yakima River.
- Further investigating and refining design for fish screens at the Yakima River diversion.
- Further definition of the power/energy supply costs for the 100 cfs and 300 cfs options. Both may require significant transmission line/substation upgrades.

9.3 Opinion of Probable Costs

As the project design advances, opinions of probable construction costs (OPCCs) should also be updated and refined.

9.4 Higher Capacity (300-cfs) Pump Station

There have been additional discussions between KRD and Reclamation considering a larger 300-cfs pumping and groundwater recharge conveyance system. Although this report focuses on a 100-cfs pump station, this section presents the additional information regarding this larger pump station option.

9.4.1 Recharge Flows

Figure 9-1 and Table 9-1 describe the water volumes that could be delivered to the groundwater recharge sites for both the 100- and 300-cfs pump stations. Figure 9-1 shows the monthly median volumes as well as the range of volumes could be expected for each pump station size. Table 9-1 shows the estimated cumulative median monthly water volumes that could be supplied to the groundwater recharge sites for each pump station capacity given the estimated available KRD canal capacity.

Figure 9-1. Groundwater Recharge Volumes

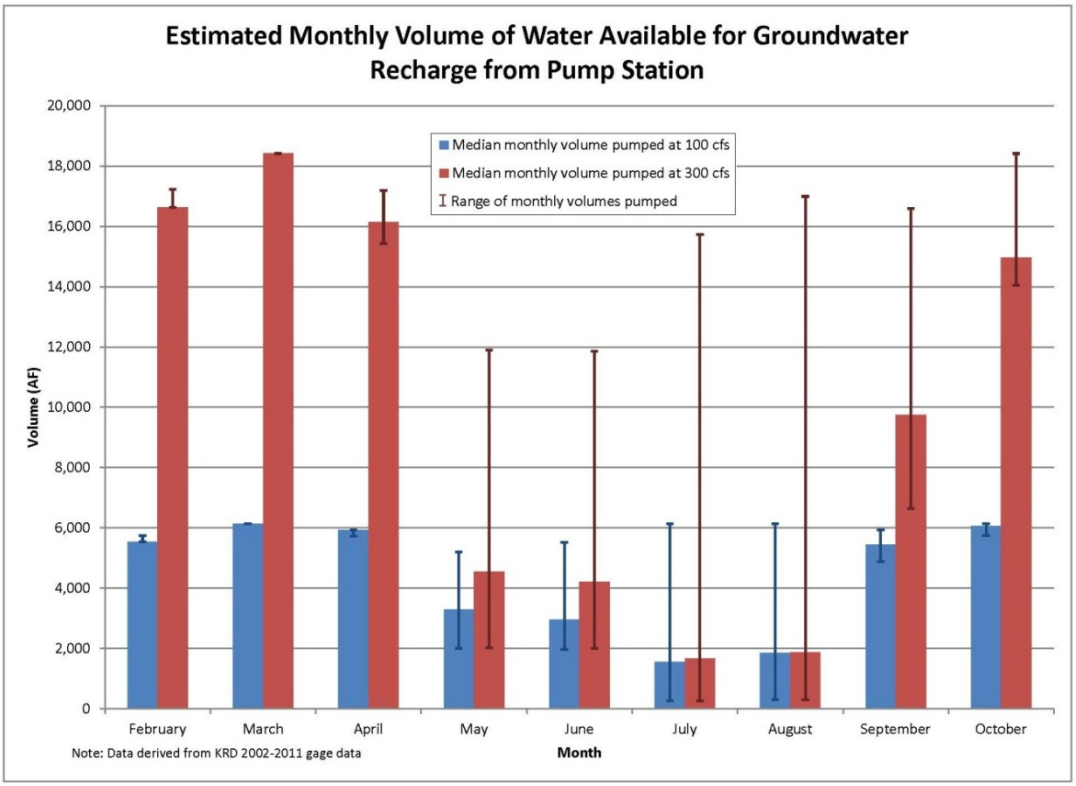

Table 9-1. Cumulative Median Water Volumes (acre-feet) Available for Groundwater Recharge for 100 cfs and 300 cfs Pump Stations

Median Monthly Volumes (acre-feet)		
Month	100 cfs Capacity	300 cfs Capacity
February	5,540	16,630
March	11,680	35,050
April	17,610	51,180
May	20,900	55,730
June	23,870	59,950
July	25,440	61,610
August	27,290	63,480
September	32,740	73,240
October	38,800	88,200

The duration the recharge sites would be operated depends on the time it would take the water to get back to the Yakima River as useful water supply for in-stream flow or irrigation. They may not be operated past May or June.

9.4.2 Estimated Project Costs for a Larger Pump Station

A larger pump station would have proportionally higher construction and engineering costs. Depending upon the cost item, the costs for a 300-cfs facility may increase by factors from two to three times, or more over the costs for the 100-cfs facility.

An example is the cost for the supply of the pumps and motors. A pump manufacturer (Fairbanks Morse) quotation for the 100-cfs facility for four 25 cfs pumps and motors was approximately $900,000 for Site 1 and $1 million for Site 2 (November 2012). For a 300-cfs facility, the same manufacturer did not have pumps capable of serving the higher pumping head at Site 2. They could provide seven 43-cfs pumps for Site 1 to meet the 300-cfs demand. The budgetary quote (January 2013) for those seven pumps and motors was approximately $4 million – more than four times the cost of the pumps for the 100-cfs facility.

The larger pump station would also have much higher power/energy demands. Preliminary discussions with Puget Sound Energy indicate that they have higher voltage lines (34.5 kV and 115 kV) available in the Site 1 area that are currently not as close to Site 2. It is uncertain if the smaller pump station would require a substation, but it is almost certain that the larger pump station would require a substation from either the 34.5 kV or 115 kV lines.

Table 9-2 compares approximate relative costs of the 100-cfs and 300-cfs pump stations located at Site 1. Due to the higher pumping head and pump capacity limitations, higher energy costs, and power supply limitations at Site 2; the following cost comparison was only done for Site 1.

Using an average 80.8 percent combined motor/pump efficiency and $0.06 per kWh, the average Site 1 annual pumping energy costs would be approximately $1.08 million for the 100 cfs (38,800 acre-feet-per-year) and $2.45 million for the 300 cfs (88,200 acre-feet-per-year) pump stations.

Table 9-2. Cost Comparison between 100-cfs and 300-cfs Pump Station at Site 1 (all costs in 2012 $ million)

COST ITEM	SWAUK CREEK SITE 1 100 cfs	SWAUK CREEK SITE 1 300 cfs
Intake, Pipeline, Pump Station, Outlet*	$11.0	$30.5
Tributary Turnouts	$0.42	$0.80
Subtotal Construction Costs	$11.4	$31.3
Property/Easement Acquisition	$0.12	$0.20
5% Project Legal/Administration	$0.57	$1.6
6% Permitting/Environmental	$0.69	$1.9
6% Surveying/Geotech	$0.69	$1.9
15% Engineering/Design	$1.7	$4.7
10% Construction Management	$1.1	$3.1
Approximate Total Project Costs	$16.3 million	$44.6 million
Range (-30% to +50%) of Project Costs	$11.4 to $24.5 million	$31.2 to $66.9 million

10.0 References

Bureau of Reclamation, 1929-1930. North Branch Canal Siphon and Tunnel Drawings, Yakima Project – Washington, Kittitas Division, U.S. Department of the Interior, Bureau of Reclamation, Denver Colorado, May 1929 through January 1930.

Bureau of Reclamation and Washington State Department of Ecology (Reclamation and Ecology). 2011. *Groundwater Infiltration Appraisal Level Study Technical Memorandum*. March 2011. U.S. Department of the Interior, Bureau of Reclamation, and Washington State Department of Ecology.

Bureau of Reclamation and Washington State Department of Ecology (Reclamation and Ecology). 2012. *Yakima River Basin Integrated Water Resource Management Plan Framework for Implementation Report.* October 2012. U.S. Department of the Interior, Bureau of Reclamation, and Washington State Department of Ecology.

Jones, M.A., Vaccaro, J.J., and Watkins, A.M. (2006). *Hydrogeologic Framework of Sedimentary Deposits in Six Structural Basins, Yakima River Basin, Washington*, Prepared in Corporation with the Bureau of Reclamation, Washington State Department of Ecology, and Yakama Nation, U.S. Geological Survey Scientific Investigations Report 2006-5116, 24 p.

Satnik, Roger (2012). Re: KRD North Branch Flow. E-mail communication with Adam Hill, Anchor QEA. August 17, 2012.

Washington Division of Geology and Earth Resources (2005), Digital 1:100,000-Scale Geology of Washington State, Version 1.0: Washington Division of Geology and Earth Resources, Open File Report 2005-3, scale 1:100000.

11.0 List of Preparers

NAME	BACKGROUND	RESPONSIBILITY
HDR ENGINEERING, INC.		
Jim Peterson	Professional Engineer	Task Manager
Keith Goss	Professional Engineer	Task Engineer
John Nelson	Professional Engineer	Intake QC Reviewer
Richard Glassen	Cost Estimator	Cost Estimate
Stan Schweissing	Professional Engineer	QC Reviewer
ANCHOR QEA		
Bob Montgomery	Professional Engineer	Water Resources
Adam Hill	Professional Engineer	Water Resources

Appendix A

Appendix Figures

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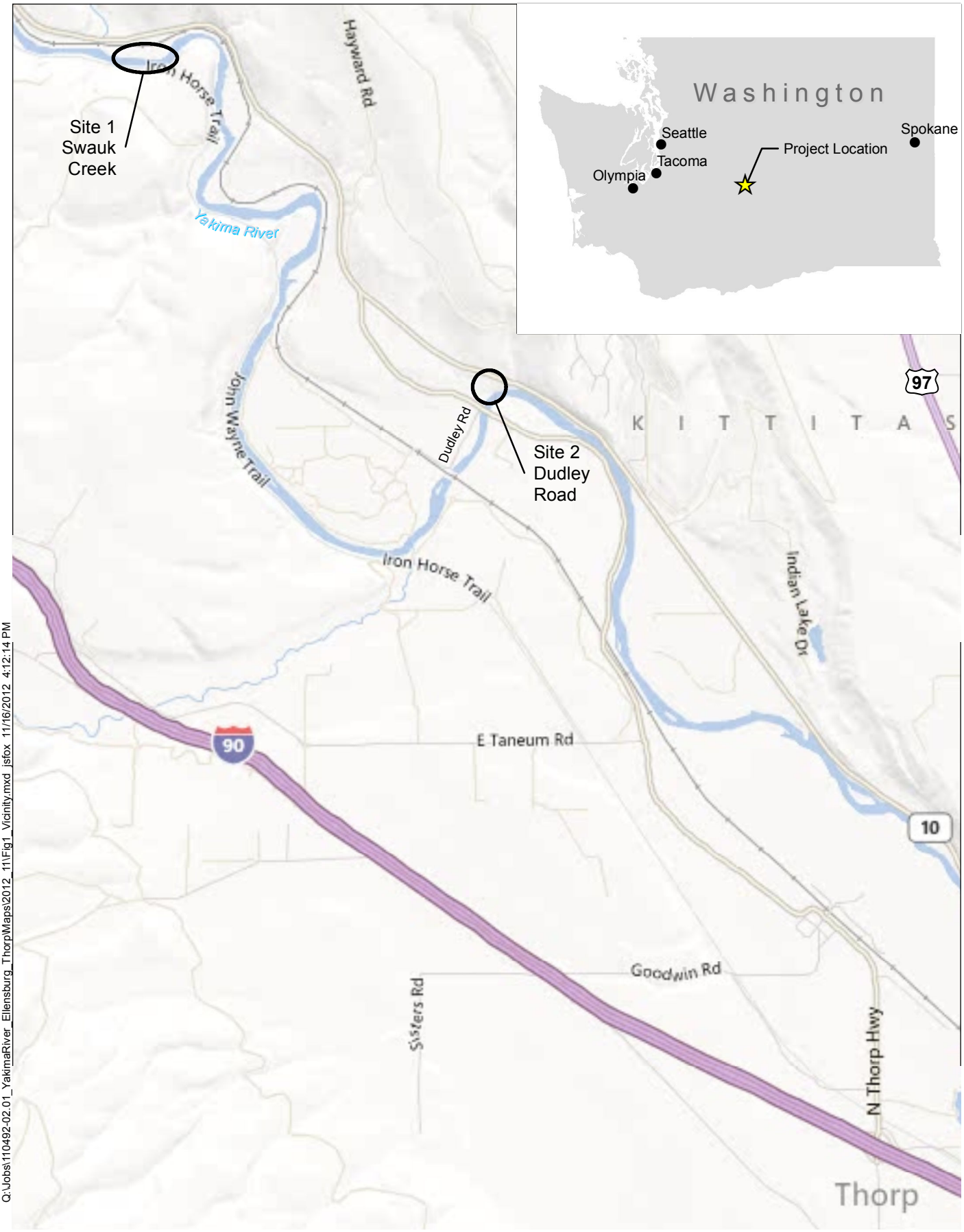

Site Locations
Figure 1

Kittitas Valley Delivery System

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Main Canal at Diversion Dam

Big Creek

Little Creek

Peterson Creek (turnout not needed)

Spex Arth Creek

Tillman Creek

Yakima River

North Branch Canal at Bifurcation

Main Canal at Bifurcation

Pump Station Site 1 Swauk Creek

Pump Station Site 2 Dudley Road

Taneum Creek

Dry Creek

Reecer Creek

Currier Creek

Wilson Creek

Naneum Creek

Naneum Creek Groundwater Recharge Area

Naneum Creek Gauge

Caribou Creek

North Branch Canal at Caribou Creek

Caribou Creek Gauge

Park Creek

Johnson Siphon Gauge

Badger Pocket Groundwater Recharge Area

North Branch Canal at Johnson Siphon

Manastash Creek

Dry Creek

Wenatchee National Forest

Cle Elum

Ellensburg

Thorp

Kittitas

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LEGEND

- Turnout Locations
- Relevant Gauge Locations
- Pump Station Sites
- KRD Main Canal
- KRD North Branch Canal
- KRD South Branch Canal
- Laterals
- Rivers
- Creeks

Miles

0 1 2 3 4

Site Locations of Proposed Canal Turnouts

Figure 2

Kittitas Valley Delivery System

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Swauk Creek Site 1

Qapo(ks)

Mv(gN2)

Qapo(ki)

Qa

Swauk Creek

Iron Horse Trail

John Wayne Trail

Iron Horse

Mvc(e)

Qapt(ks)

10

1900

2000

2100

1800

Dudley Road Site 2

Qapo(ks)

PLcg(t)

Qapo(ki)

Mvc(e)

Qao(lb)

Qa

N Thorp Hwy

Yakima River

wtr

2200

1700

Q:\Jobs\110492-02.01_YakimaRiver_Ellensburg_ThorpMaps\2012_11\Fig3_Geology.mxd jsfox 11/16/2012 2:54:49 PM

100-ft Contours

Syncline—Identity and existence certain, location concealed

Surficial Geology

Mv(gN2), Mv(gR2); Miocene Columbia River Basalt Group, Grande Ronde Basalt

Mvc(e); Pliocene-Oligocene volcaniclastic rocks, lahars, tuffs, and tuff breccias

PLcg(t); Quaternary-Miocene continental sedimentary rocks

Qa; Quaternary alluvium, dune sand, loess, and artificial fill

Qao(lb); Quaternary alpine glacial deposits, Fraser-age or younger

Qapo(ki), Qaop(ks), Qapt(ks); Pleistocene alpine glacial deposits, pre-Fraser

Qls; Quaternary alluvial fans, beach deposits, undifferentiated sedimentary deposits, lacustrine deposits, landslides, peat, terraced deposits, and talus

wtr; Water

NOTES:
1. Contours derived from USGS 10-meter DEM converted to NAVD88 feet (assumed vertical change = +1.125 meters).
2. Surficial Geology information from the Washington State Department of Natural Resources (DNR).

Feet
0 300 600 900 1,200

Geology
Figure 3

Kittitas Valley Delivery System

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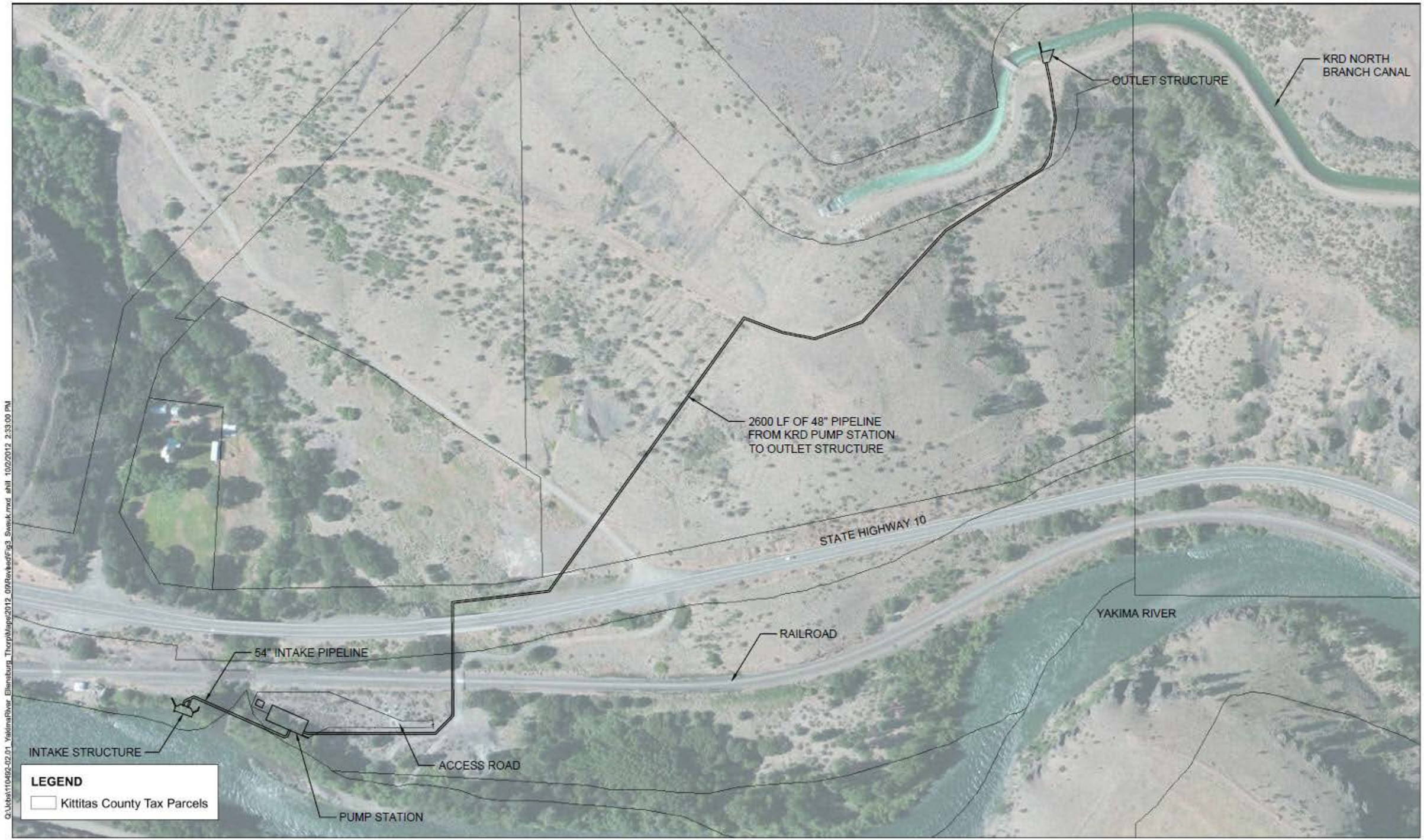

NOTES:
1. Parcel boundaries are from Kittitas County GIS. Kittitas County has indicated that parcel boundaries are off by as much as 100 feet in rural areas.

Feet
0 100 200 300 400

Swauk Creek Site 1
Figure 4

Kittitas Valley Delivery System

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LEGEND

- 20-ft Contours
- 100-ft Contours
- Kittitas County Tax Parcels

2000 LF OF 48" PIPELINE FROM KRD PUMP STATION TO CANAL

PUMP STATION

INTAKE STRUCTURE

KRD NORTH BRANCH CANAL

OUTLET STRUCTURE

N Thorp Hwy

Dudley Rd

Yakima River

10

1700

1800

1900

2000

2100

2400

NOTES:
1. Parcel boundaries are from Kittitas County GIS. Kittitas County has indicated that parcel boundaries are off by as much as 100 feet in rural areas.
2. Contours derived from LiDAR data collected by FEMA in 2011 (NAVD88 feet).

Feet
0 100 200 300 400

Dudley Road Site 2
Figure 5

Kittitas Valley Delivery System

C:\pwworking\seakd0826678\KRD PS.dwg, Overall Dudley, 11/28/2012 1:59:37 PM, kgoss

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Swauk Creek Site 1 Intake and Pump Station Plan
Figure 6

Feet
0 25 50 75 100

Kittitas Valley Delivery System

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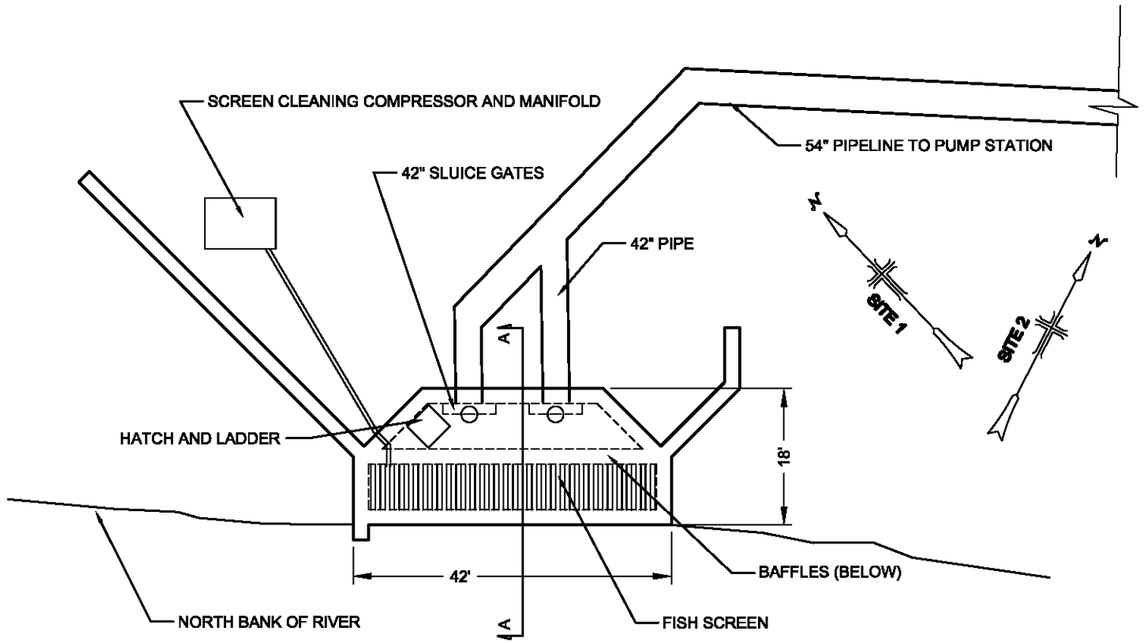
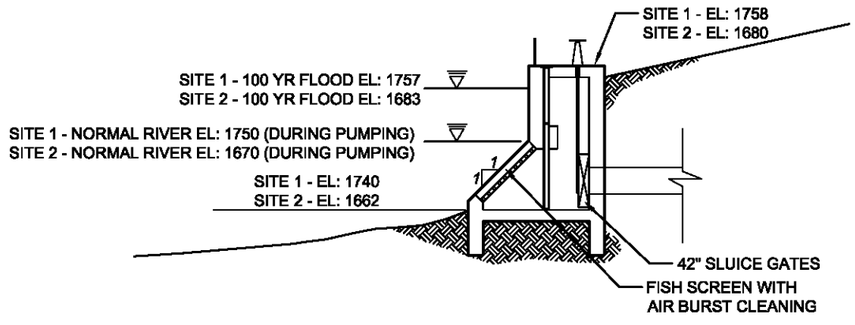
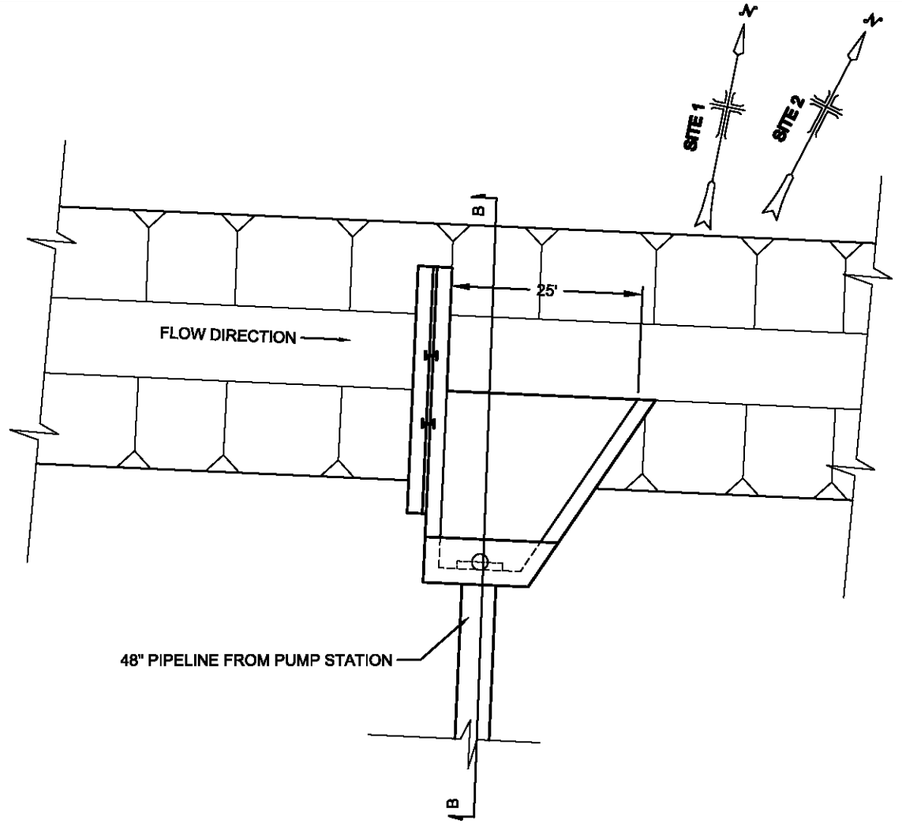


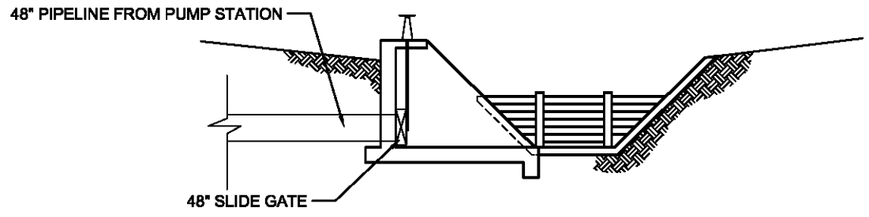
INTAKE PLAN



INTAKE SECTION A-A



OUTLET PLAN



OUTLET SECTION B-B

20 0 20 80 60
SCALE OF FEET

RECLAMATION
Managing Water in the West

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
YAKIMA RIVER BASIN STUDY

Kittitas Reclamation District
River Intake and Canal Outlet
Plan and Sections
Figure 7

DESIGNED
DRAWN
CHECKED
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APPROVED ADMINISTRATIVE APPROVAL – NAME – TITLE
BOISE, ID 06.25.2009

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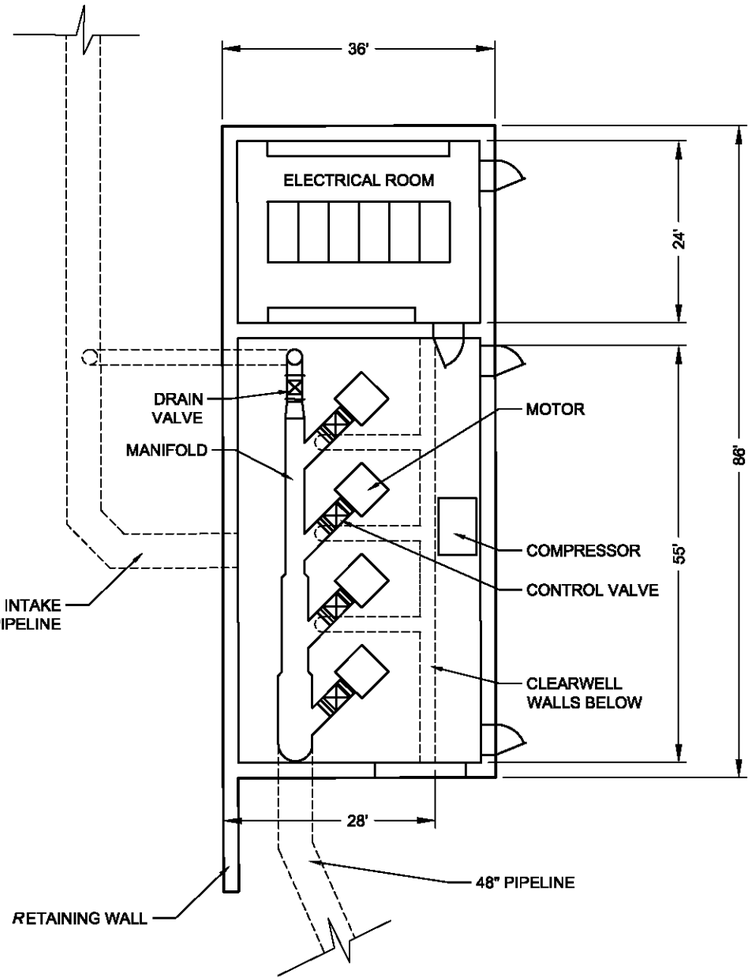
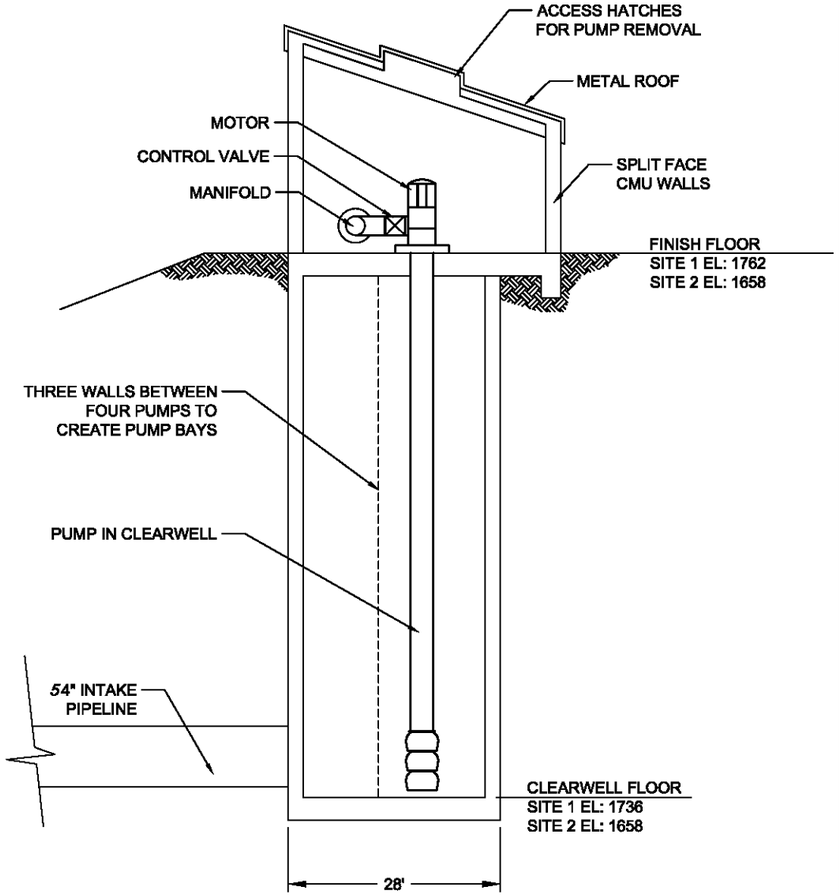


FLOOR PLAN



PUMP STATION SECTION

20 0 20 80 60
SCALE OF FEET

RECLAMATION
Managing Water in the West

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
YAKIMA RIVER BASIN STUDY

Kittitas Reclamation District
Pump Station Plan and Section
Figure 8

DESIGNED
DRAWN
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APPROVED — ADMINISTRATIVE APPROVAL – NAME – TITLE
BOISE, ID 06.25.2009

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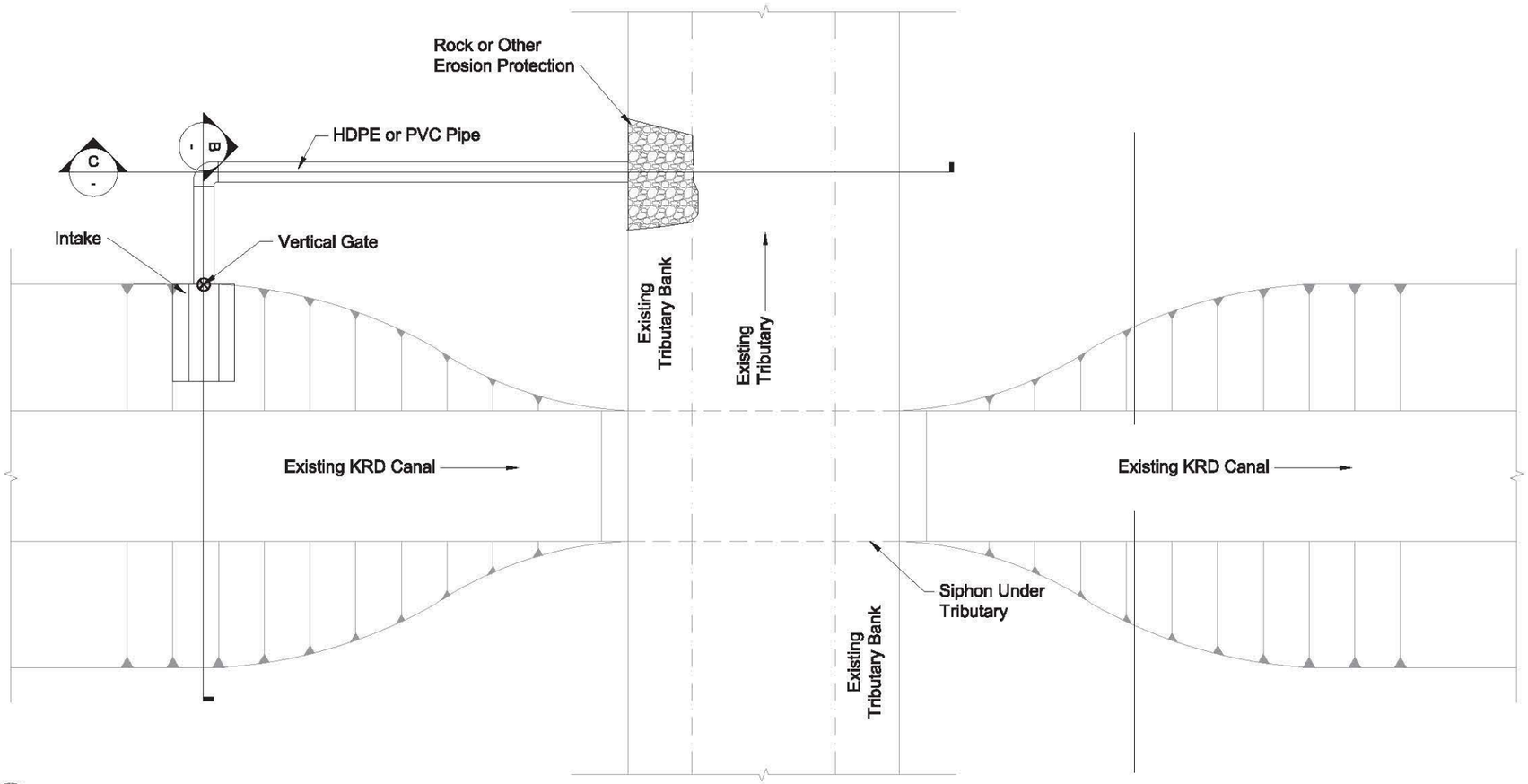

A PLAN VIEW
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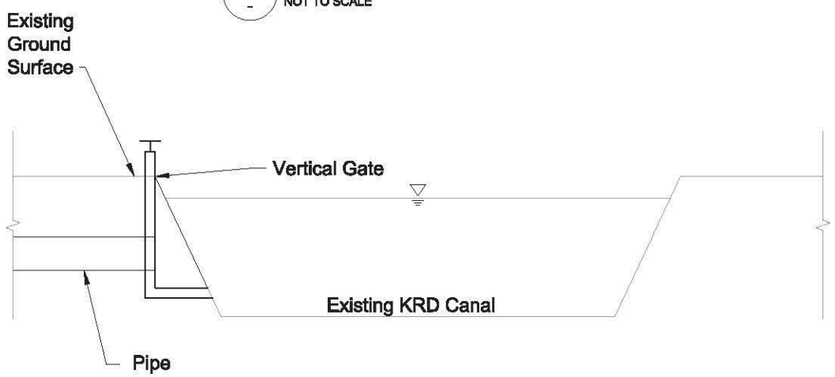

B SECTION
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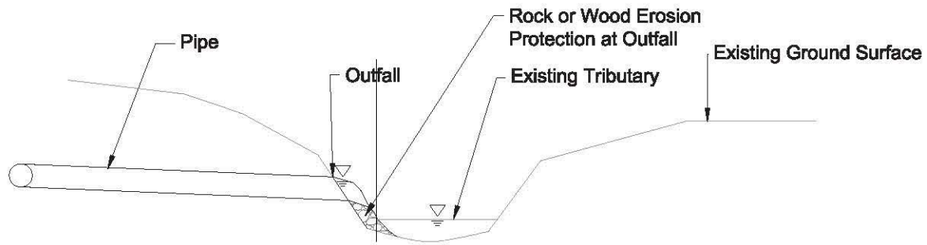

C SECTION
NOT TO SCALE

RECLAMATION
Managing Water in the West

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KITTITAS VALLEY DELIVERY SYSTEM

CANAL TO TRIBUTARY TURNOUT
FIGURE 9

DESIGNED
DRAWN
CHECKED
TECH. APPR. — NAME – TITLE
APPROVED — ADMINISTRATIVE APPROVAL – NAME – TITLE
BOISE, ID 10.11.2012

FIGURE 9

SHEET X OF X

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Swauk Creek Site 1

Dudley Road Site 2

847734
227734
207734
897734
USA (BLM)
887734
877734
151736
BNSF RAILWAY
COMPANY
907734
177734
167734
228336
238336
197734
Swauk Creek
John Wayne Trail
Iron Horse Trail
10

16487
887834
18499
18508
HAVENS, H J ETUX
087834
897834
18501
18502
18503
18504
18506
PEARSON, EDWARD I
18507
952404
949449
297834
907834
137834
167834
506636
BASTERRECHEA, JOHN J ETUX
337934
507934
11558
POLLOCK, KENNETH
497934
367934
577934
DER YUEN, DOUG ETUX
952413
Yakima River
N Thorp Hwy
537934
527934
517934
Dudley Rd
587934
867934
877934
887934
897934
907934
167934
707934
21202
281736
377934
847934
857934
416036
547934
477934

LEGEND

Kittitas County Tax Parcels

NOTES:
1. Parcel boundaries are from Kittitas County GIS. Kittitas County has indicated that parcel boundaries are off by as much as 100 feet in rural areas.
2. Ownership names are included on potential property purchase/easements required for project.

Feet
0 300 600 900 1,200

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Sites 1 and 2 Property Boundaries and Ownership
Figure 10

Kittitas Valley Delivery System

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Appendix B

Preliminary Opinions of Probable Construction Costs

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CONC2012

CONC2012

KRD Canal GW
Recharge from Yakima
Intake from YR Pump
to KRD Canal
Yakima
WA, 98903
Conceptual
Swauk Creek
1
40
20
4th Qtr 2012 Union
4th Qtr 2012

Any opinions of probable construction cost or cost estimates provided by HDR, Inc. are made on the basis of information available to HDR, Inc. and on the basis of cost estimator's experience and qualifications, and represents its judgment as an experienced and qualified professional engineer. However, since HDR, Inc. has no control over the cost of labor, materials, equipment or services furnished by others, or over the contractor(s') methods of determining prices, or over competitive bidding or market conditions, HDR, Inc. does not guarantee that proposals, bids or actual project or construction cost will not vary from opinions of probable cost or cost estimates prepared by HDR, Inc.

989-WA-YAKIMA

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

Description	Quantity		Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Amount
001 PUMP STATION SITE 1 - SWAUK CREEK								
DIVISION 01	**GENERAL REQUIREMENTS**							
01500.000 Temporary Facilities & Controls	12.00	mo					912,497	912,497
DIVISION 01 GENERAL REQUIREMENTS							**912,497**	**912,497**
DIVISION 02	**SITE CONSTRUCTION**							
02110.010 Site Clearing - Intake, PS, Outlet Sites	3.00	ac	14,462			13,444		27,906
02200.050 Earthwork - Fine Grading - Intake, PS, Outlet	2,500.00	cy	24,626			17,191		41,816
02200.505 Earthwork, Structural Excavation - Pump Station inside Sheeting	4,666.66	cy	71,958			97,173		169,131
02200.510 Earthwork, Structural Excavation - Pump Station @Gde	219.00	cy	365			427		792
02200.535 Earthwork, Structural Excavation-Intake, Outlet	985.00	cy	528			1,279		1,807
02200.605 Earthwork, Structural Backfill, Native, compaction, Pump Station	4,666.00	cy	69,100			81,179		150,279
02200.610 Earthwork, Structural Backfill, Native,Pump Station @ Gde	80.00	cy	190			135		325
02200.635 Earthwork, Structural Backfill, Native Matl, compaction-Intake, Outlet	985.00	cy	1,922			1,560		3,482
02361.000 Driven Steel Sheet Piling	8,564.00	sf	60,281	148,795		56,505		265,580
02361.200 Cofferdam - Shore Driven	1,920.00	sf	7,781	38,020		7,295		53,096
02513.000 Asphaltic Concrete Vehicular Paving	1,600.00	sy	4,524	26,021		4,370		34,915
02585.000 Groundwater Dewatering Wells	120.00	vlf	17,489	5,778		2,791		26,058
DIVISION 02 SITE CONSTRUCTION			**273,225**	**218,614**		**283,347**		**775,186**
4,796.80 Labor hours								
3,520.244 Equipment hours								
DIVISION 03	**CONCRETE**							
03002.115 Concrete_Foundations - River Intake Slab, Turndowns, Wall Fdn	84.00	cy	20,226	21,141		866		42,233

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

Description		Quantity		Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Amount
03002.120	Concrete_Foundations - Outlet Section B-B	56.00	cy	8,722	13,776		977		23,474
03002.125	Concrete_Foundations - Canal Gate Gd Beam	5.00	cy	978	1,220		52		2,249
03002.130	Concrete_Foundations - Pump Station Wetwell	137.00	cy	20,535	37,473		1,591		59,599
03002.310	Concrete_Walls Exterior - River Intake	175.00	cy	59,455	40,890		2,655		103,000
03002.315	Concrete_Walls Exterior -Outlet Section B-B	37.00	cy	12,600	8,841		561		22,002
03002.330	Concrete_Walls Exterior Pump Station Wetwell	237.00	cy	76,747	64,225		2,388		143,360
03002.430	Concrete_Walls Interior - Pump Station Wetwell	30.00	cy	13,904	7,499		262		21,666
03002.605	Concrete_Elevated Slab-River Intake	12.00	cy	4,006	3,782		145		7,932
03002.615	Concrete_Elevated Slab - Outlet Section B-B	4.00	cy	1,196	1,149		48		2,393
03002.705	Concrete_Slab on Grade - Screen Cleaning Equipment Pad	1.00	cy	191	242		17		450
03002.730	Concrete_Slab on Grade - Pump Station	138.00	cy	16,010	28,335		1,063		45,409
03002.830	Concrete_Equipment Pads - Pump Station	8.00	cy	1,443	1,741		14		3,198
DIVISION 03 CONCRETE				**236,014**	**230,312**		**10,639**		**476,966**
4,808.131	Labor hours								
294.813	Equipment hours								
DIVISION 04	**MASONRY**								
04220.030	Concrete Masonry - 12" Split Face CMU	5,280.00	sf	61,249	59,740		1,142		122,131
04220.080	Concrete Masonry (8" CMU)	748.00	sf	6,595	4,441		151		11,188
DIVISION 04 MASONRY				**67,844**	**64,181**		**1,293**		**133,319**
1,632.152	Labor hours								
76.84	Equipment hours								
DIVISION 05	**METALS**								
05505.000	Metal Fabrications	1.00	ls	698	1,908		54		2,660

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

Description		Quantity		Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Amount
05522.000	Aluminum Railings	110.00	lf	1,324	6,436		103		7,863
05900.000	Miscellaneous Metal	1.00	ls	1,710	6,853		48		8,611
DIVISION 05 METALS				**3,732**	**15,197**		**205**		**19,134**
51.11	Labor hours								
12.771	Equipment hours								
DIVISION 07	**THERMAL& MOISTURE PROTECTION**								
07412.000	Metal Roofing	3,096.00	sf	14,116	30,025		424		44,565
07720.000	Roof Hatches (Scuttle)			751	3,680				4,431
DIVISION 07 THERMAL& MOISTURE PROTECTION				**14,867**	**33,705**		**424**		**48,995**
303.76	Labor hours								
10.43	Equipment hours								
DIVISION 08	**DOORS & WINDOWS**								
08110.030	Metal Doors & Frames (3070)	2.00	ea	409	3,136				3,545
08110.060	Metal Doors & Frames (6070)	1.00	ea	376	3,046				3,422
08305.000	Access Doors	1.00	ea	391	5,538				5,930
DIVISION 08 DOORS & WINDOWS				**1,176**	**11,721**				**12,897**
24.21	Labor hours								
DIVISION 09	**FINISHES**								
08110.030	Metal Doors & Frames (3070)	2.00	ea	27	4				31
08110.060	Metal Doors & Frames (6070)	1.00	ea	27	4				31
09904.030	Painting and Protective Coatings - CMU	6,794.00	sf	4,633	2,602				7,235
09904.033	Painting and Protective Coatings - Bar Joists, Metal Deck	1.00	ls	680	384				1,064
DIVISION 09 FINISHES				**5,367**	**2,994**				**8,361**
187.931	Labor hours								
DIVISION 11	**EQUIPMENT**								
11072.000	Pumping Equipment: Vertical Turbine (Line Shaft)	4.00	ea	24,299	866,000	15,126	21,253	4,396	931,074
Budget Pricing good until November 2013									
DIVISION 11 EQUIPMENT				**24,299**	**866,000**	**15,126**	**21,253**	**4,396**	**931,074**
544.000	Labor hours								
256.000	Equipment hours								
DIVISION 13	**SPECIAL CONSTRUCTION**								

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

					Labor	Material	Subcontract	Equipment	Other	Total
Description		**Quantity**			**Amount**	**Amount**	**Amount**	**Amount**	**Amount**	**Amount**
13442.100	Instrumentation and Integration Subcontract	1.00	ls		6,413	50,099		315		56,827
15509.100	Fish Screen Fixed Plate Inclined	360.00	sf				691,284			691,284
DIVISION 13 SPECIAL CONSTRUCTION					**6,413**	**50,099**	**691,284**	**315**		**748,111**
106.000	Labor hours									
21.00	Equipment hours									
DIVISION 15	**MECHANICAL**									
02110.040	Site Clearing - Force Main	3.58	ac		9,838			17,146		26,984
02140.020	Dewatering - Intake	15.00	dys		11,176	577		10,512		22,265
02221.020	Trenching, Backfilling, Compacting for Utilities - Pump Station Intake	3,219.00	cy		9,457			19,617		29,074
02221.040	Trenching, Backfilling and Compacting for Utilities - FM	6,799.00	cy		36,280	7,759		46,000		90,039
02221.060	Trenching, Backfilling, Compacting for Utilities - Air Piping	105.00	cy		412	119		590		1,121
02445.000	Horizontal Bore and Jack	240.00	lf		68,422	112,243	31,620	29,003		241,287
03002.905	Concrete_Pipe Encasement and Blocking	13.23	cy		1,169	2,360		7		3,535
15062.020	Pipe: Ductile - Pump Station Intake	600.00	lf		65,324	357,098		53,770	133	476,325
15062.040	Pipe: Ductile - PS FM	2,600.00	lf		241,700	741,605		203,495	46	1,186,847
15062.100	Pipe: Ductile - Interior with Valves, Couplings, Hangers and Supports	1.00	ls		24,385	175,443			999	200,827
15066.000	Pipe: Stainless Steel - Screen Air cleaning Pipng	80.00	lf		12,761	12,801		346		25,909
15103.000	Butterfly Valves	5.00	ea		7,532	74,318		737		82,587
15111.000	Pump Control Valves	4.00	ea		7,781	120,396		2,904		131,081
15111.100	Surge Relief Valves	1.00	ea		1,012	18,099		363		19,474
15115.000	Water Control Gates	2.00	ea		5,487	30,839		1,494		37,819
15605.000	HVAC: Equipment	1.00	ls		3,018	9,772				12,790
DIVISION 15 MECHANICAL					**505,755**	**1,663,429**	**31,620**	**385,983**	**1,178**	**2,587,965**
9,735.16	Labor hours									
3,393.38	Equipment hours									
DIVISION 16	**ELECTRICAL**									
16000.110	Electrical Subcontractor - Process	1.00	ls		33,638	306,000		1,668		341,306

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

Description	Quantity	Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Amount
DIVISION 16 ELECTRICAL		**33,638**	**306,000**		**1,668**		**341,306**
556.00 Labor hours							
111.20 Equipment hours							
001 PUMP STATION SITE 1 - SWAUK CREEK		***1,172,329***	***3,462,252***	***738,030***	***705,128***	***918,071***	***6,995,810***
100.00 CFS							
22,745.243 Labor hours							
7,696.671 Equipment hours							

Partial Totals

Description	Amount	Totals	Hours	Rate
Labor	1,172,329		22,745.243 hrs	
Material	3,462,252			
Subcontract	738,030			
Equipment	705,128		7,696.671 hrs	
Other	918,071			
Contractor's Fee	1,049,372			15.000 %
Contractor's Bonds & Insurance	120,678			1.500 %
Undefined SOW (Contingency)	1,224,879			15.000 %
Subtotal		**9,390,739**		
Escal Mid-Pnt Const (NOTINCLU)				
Sales Tax Estimate (TOTAL)	727,782			7.750 %
Current OPCC Estimate Budget		**10,118,521**		

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

CONC2012

CONC2012

KRD Canal GW
Recharge from Yakima
Intake from YR Pump
to KRD Canal
Yakima
WA, 98903
Conceptual
Dudley Road
1
40
20
4th Qtr 2012 Union
4th Qtr 2012

989-WA-YAKIMA

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

Description	Quantity	Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Amount
002 PUMP STATION SITE 2 - DUDLEY ROAD							
DIVISION 01 GENERAL REQUIREMENTS							
01500.000 Temporary Facilities & Controls	12.00 mo					812,510	812,510
DIVISION 01 GENERAL REQUIREMENTS						**812,510**	**812,510**
DIVISION 02 SITE CONSTRUCTION							
02110.010 Site Clearing - Intake, PS, Outlet Sites		14,462			13,444		27,906
02200.050 Earthwork - Fine Grading - Intake, PS, Outlet		24,626			17,191		41,816
02200.505 Earthwork, Structural Excavation - Pump Station inside Sheeting		71,958			97,173		169,131
02200.510 Earthwork, Structural Excavation - Pump Station @Gde		365			427		792
02200.535 Earthwork, Structural Excavation-Intake, Outlet		528			1,279		1,807
02200.605 Earthwork, Structural Backfill, Native, compaction, Pump Station		69,100			81,179		150,279
02200.610 Earthwork, Structural Backfill, Native,Pump Station @ Gde		190			135		325
02200.635 Earthwork, Structural Backfill, Native Matl, compaction-Intake, Outlet		1,922			1,560		3,482
02361.000 Driven Steel Sheet Piling		60,281	148,795		56,505		265,580
02361.200 Cofferdam - Shore Driven		7,781	38,020		7,295		53,096
02513.000 Asphaltic Concrete Vehicular Paving		4,524	26,021		4,370		34,915
02585.000 Groundwater Dewatering Wells		17,489	5,778		2,791		26,058
DIVISION 02 SITE CONSTRUCTION		**273,225**	**218,614**		**283,347**		**775,186**
4,796.80 Labor hours							
3,520.244 Equipment hours							
DIVISION 03 CONCRETE							
03002.115 Concrete_Foundations - River Intake Slab, Turndowns, Wall Fdn		20,226	21,141		866		42,233

Description		Quantity	Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Amount
03002.120	Concrete_Foundations - Outlet Section B-B		8,722	13,776		977		23,474
03002.125	Concrete_Foundations - Canal Gate Gd Beam		978	1,220		52		2,249
03002.130	Concrete_Foundations - Pump Station Wetwell		20,535	37,473		1,591		59,599
03002.310	Concrete_Walls Exterior - River Intake		59,455	40,890		2,655		103,000
03002.315	Concrete_Walls Exterior -Outlet Section B-B		12,600	8,841		561		22,002
03002.330	Concrete_Walls Exterior Pump Station Wetwell		76,747	64,225		2,388		143,360
03002.430	Concrete_Walls Interior - Pump Station Wetwell		13,904	7,499		262		21,666
03002.605	Concrete_Elevated Slab-River Intake		4,006	3,782		145		7,932
03002.615	Concrete_Elevated Slab - Outlet Section B-B		1,196	1,149		48		2,393
03002.705	Concrete_Slab on Grade - Screen Cleaning Equipment Pad		191	242		17		450
03002.730	Concrete_Slab on Grade - Pump Station		16,010	28,335		1,063		45,409
03002.830	Concrete_Equipment Pads - Pump Station		1,443	1,741		14		3,198
DIVISION 03 CONCRETE			**236,014**	**230,312**		**10,639**		**476,966**
4,808.131	Labor hours							
294.813	Equipment hours							
DIVISION 04	**MASONRY**							
04220.030	Concrete Masonry - 12" Split Face CMU		61,249	59,740		1,142		122,131
04220.080	Concrete Masonry (8" CMU)		6,595	4,441		151		11,188
DIVISION 04 MASONRY			**67,844**	**64,181**		**1,293**		**133,319**
1,632.152	Labor hours							
76.84	Equipment hours							
DIVISION 05	**METALS**							
05505.000	Metal Fabrications		698	1,908		54		2,660

Description	Quantity	Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Amount
05522.000	Aluminum Railings	1,324	6,436		103		7,863
05900.000	Miscellaneous Metal	1,710	6,853		48		8,611
DIVISION 05 METALS		**3,732**	**15,197**		**205**		**19,134**
51.11	Labor hours						
12.771	Equipment hours						
DIVISION 07	**THERMAL& MOISTURE PROTECTION**						
07412.000	Metal Roofing	14,116	30,025		424		44,565
07720.000	Roof Hatches (Scuttle)	751	3,680				4,431
DIVISION 07 THERMAL& MOISTURE PROTECTION		**14,867**	**33,705**		**424**		**48,995**
303.76	Labor hours						
10.43	Equipment hours						
DIVISION 08	**DOORS & WINDOWS**						
08110.030	Metal Doors & Frames (3070)	409	3,136				3,545
08110.060	Metal Doors & Frames (6070)	376	3,046				3,422
08305.000	Access Doors	391	5,538				5,930
DIVISION 08 DOORS & WINDOWS		**1,176**	**11,721**				**12,897**
24.21	Labor hours						
DIVISION 09	**FINISHES**						
08110.030	Metal Doors & Frames (3070)	27	4				31
08110.060	Metal Doors & Frames (6070)	27	4				31
09904.030	Painting and Protective Coatings - CMU	4,633	2,602				7,235
09904.033	Painting and Protective Coatings - Bar Joists, Metal Deck	680	384				1,064
DIVISION 09 FINISHES		**5,367**	**2,994**				**8,361**
187.931	Labor hours						
DIVISION 11	**EQUIPMENT**						
11072.000	Pumping Equipment: Vertical Turbine (Line Shaft)	28,349	995,000	15,126	28,338	4,396	1,071,208
Budget Pricing good until November 2013							
DIVISION 11 EQUIPMENT		**28,349**	**995,000**	**15,126**	**28,338**	**4,396**	**1,071,208**
624.00	Labor hours						
320.00	Equipment hours						
DIVISION 13	**SPECIAL CONSTRUCTION**						

Description		Quantity		Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Amount
13442.100	Instrumentation and Integration Subcontract			6,413	50,099		315		56,827
15509.100	Fish Screen Fixed Plate Inclined					691,284			691,284
DIVISION 13 SPECIAL CONSTRUCTION				**6,413**	**50,099**	**691,284**	**315**		**748,111**
106.000	Labor hours								
21.00	Equipment hours								
DIVISION 15	**MECHANICAL**								
02110.040	Site Clearing - Force Main	2.50	ac	6,870			11,973		18,844
02140.020	Dewatering - Intake	5.00	dys	3,810	289		3,528		7,626
02221.020	Trenching, Backfilling, Compacting for Utilities - Pump Station Intake	1,031.00	cy	3,026			6,277		9,304
02221.040	Trenching, Backfilling and Compacting for Utilities - FM	5,230.00	cy	27,903	5,949		35,384		69,235
02221.060	Trenching, Backfilling, Compacting for Utilities - Air Piping	105.00	cy	412	119		590		1,121
02445.000	Horizontal Bore and Jack	160.00	lf	45,614	69,443	21,080	17,848		153,985
03002.905	Concrete_Pipe Encasement and Blocking	8.50	cy	751	1,516		4		2,271
15062.020	Pipe: Ductile - Pump Station Intake	220.00	lf	21,359	127,661		17,006	52	166,078
15062.040	Pipe: Ductile - PS FM	2,000.00	lf	181,854	514,914		153,025	46	849,839
15062.100	Pipe: Ductile - Interior with Valves, Couplings, Hangers and Supports			24,385	175,443			999	200,827
15066.000	Pipe: Stainless Steel - Screen Air cleaning Pipng			12,761	12,801		346		25,909
15103.000	Butterfly Valves			7,532	74,318		737		82,587
15111.000	Pump Control Valves			7,781	120,396		2,904		131,081
15111.100	Surge Relief Valves			1,012	18,099		363		19,474
15115.000	Water Control Gates	1.00	ea	5,487	23,295		1,494		30,276
15605.000	HVAC: Equipment			3,018	9,772				12,790
DIVISION 15 MECHANICAL				**353,577**	**1,154,014**	**21,080**	**251,479**	**1,097**	**1,781,247**
6,752.81	Labor hours								
2,090.403	Equipment hours								
DIVISION 16	**ELECTRICAL**								
16000.110	Electrical Subcontractor - Process			33,638	306,000		1,668		341,306

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

Description	Quantity	Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Amount
DIVISION 16 ELECTRICAL		**33,638**	**306,000**		**1,668**		**341,306**
556.00 Labor hours							
111.20 Equipment hours							
002 PUMP STATION SITE 2 - DUDLEY ROAD		***1,024,201***	***3,081,837***	***727,490***	***577,709***	***818,003***	***6,229,240***
100.00 CFS							
19,842.893 Labor hours							
6,457.695 Equipment hours							

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

Partial Totals

Description	Amount	Totals	Hours	Rate
Labor	1,024,201		19,842.893 hrs	
Material	3,081,837			
Subcontract	727,490			
Equipment	577,709		6,457.695 hrs	
Other	818,003			
Contractor's Fee	934,386			15.000 %
Contractor's Bonds & Insurance	107,454			1.500 %
Undefined SOW (Contingency)	1,090,662			15.000 %
Subtotal		**8,361,742**		
Escal Mid-Pnt Const (NOTINCLU)				
Sales Tax Estimate (TOTAL)	648,035			7.750 %
Current OPCC Estimate Budget		**9,009,777**		

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

CONC2012

CONC2012

KRD Canal GW
Recharge from Yakima
Intake from YR Pump
to KRD Canal
Yakima
WA, 98903
Conceptual
KRD Canal Turnouts
1
40
20
4th Qtr 2012 Union
4th Qtr 2012

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989-WA-YAKIMA

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

Description		Quantity		Labor Amount	Material Amount	Subcontract Amount	Equipment Amount	Other Amount	Total Amount
003 KRD CANAL TRIBUTARY TURNOUTS									
DIVISION 02	**SITE CONSTRUCTION**								
02200.500	Earthwork, Structural Excavation	1,140.00	cy	866			1,878		2,744
02200.600	Earthwork, Structural Backfill, Native Material includes compaction	875.00	cy	1,373			2,986		4,359
02271.000	Stone Revetment (Rip Rap)	282.00	sy	15,733	4,617		3,921		24,271
DIVISION 02 SITE CONSTRUCTION				**17,973**	**4,617**		**8,785**		**31,375**
336.02	Labor hours								
75.222	Equipment hours								
DIVISION 03	**CONCRETE**								
03002.105	Concrete- Foundation-Turnout Inlet	28.00	cy	5,650	7,741		730		14,121
03002.305	Concrete_Walls Exterior-Turnoout Inlet	60.00	cy	26,574	14,976		910		42,461
DIVISION 03 CONCRETE				**32,224**	**22,717**		**1,640**		**56,582**
659.523	Labor hours								
40.264	Equipment hours								
DIVISION 15	**MECHANICAL**								
02221.000	Trenching, Backfilling and Compacting for Utilities	792.00	cy	2,890			3,189		6,079
15062.000	Pipe: Ductile	1.00	ls	6,551	42,588		3,706	99	52,943
15064.000	Pipe: Plastic	400.00	lf	7,212	59,570				66,781
15115.000	Water Control Gates	4.00	ea	3,817	11,772		1,039		16,628
DIVISION 15 MECHANICAL				**20,469**	**113,929**		**7,934**	**99**	**142,431**
387.354	Labor hours								
94.94	Equipment hours								
003 KRD CANAL TRIBUTARY TURNOUTS				***70,666***	***141,264***	***0***	***18,360***	***99***	***230,388***
4.00	***EA***								
1,382.893	Labor hours								
210.421	Equipment hours								

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

Partial Totals

Description	Amount	Totals	Hours	Rate
Labor	70,666		1,382.893 hrs	
Material	141,264			
Subcontract				
Equipment	18,360		210.421 hrs	
Other	99			
Contractor's Fld Ovhd & Mob	34,558			15.000 %
Contractor's Fee	39,742			15.000 %
Contractor's Bonds & Insurance	4,570			1.500 %
Undefined SOW (Contingency)	46,389			15.000 %
Subtotal		**355,648**		
Escal Mid-Pnt Const (NOTINCLU)				
Sales Tax Estimate (TOTAL)	27,563			7.750 %
Current OPCC Estimate Budget		**383,211**		

AACE Classification Accuracy Range

Upper Range +40% **Lower Range -20%**

Yakima Basin Kittitas Valley Delivery Systems for Groundwater Recharge			
Kittitas Pump Station Budgetary Cost Comparison			
Item	**100 cfs Cost Est**	**100 to 300 cfs Multiplier**	**300 cfs**
General Requirements	**$912,497**	2	**$1,824,994**
Site Work	**$775,187**		**$1,900,397**
Intake	$350,023	3	$1,050,069
Pump Station	$355,442	2	$710,884
Outlet	$69,722	2	$139,444
Concrete	**$476,965**		**$1,109,794**
Intake	$155,864	3	$467,592
Pump Station	$273,232	2	$546,464
Outlet	$47,869	2	$95,738
Pump Station Masonry	**$133,319**	2	**$266,638**
Misc. Metals	**$19,134**	2	**$38,268**
PS Roofing and Hatches	**$48,995**	2	**$97,990**
Doors, Windows, Finishes	**$21,258**	2	**$42,516**
Pumps and Motors	**$931,074**	4	**$3,724,296**
Fish Screens	**$748,111**	3	**$2,244,333**
Mechanical Subtotal	**$2,587,964**		**$5,446,889**
Pipelines	$2,281,948	2	$4,563,896
Valves	$270,961	3	$812,883
Other	$35,055	2	$70,110
Electrical	**$341,306**	2	**$682,612**
Switchyard/Transmission			**$2,000,000**
Subtotals	**$6,996,000**		**$19,379,000**
15% Contractor's Fee	$1,049,400		$2,906,850
1.5% Bonds/Insurance	$120,681		$334,288
25% Undefined SOW	$2,041,520		$5,655,034
Subtotals	**$10,208,000**		**$28,275,000**
7.75% Sales Tax	$791,120		$2,191,313
Total	**$10,999,000**		**$30,466,000**
Tributary Turnouts	$420,000		$800,000
Property	$120,000		$200,000
5% Project Legal/Admin	$570,950		$1,563,300
6% Permtting/Env	$685,140		$1,875,960
6% Survey/Geotech	$685,140		$1,875,960
15% Engineering	$1,712,850		$4,689,900
10% Const. Management	$1,141,900		$3,126,600
Totals	**$16,300,000**		**$44,600,000**