Yakima River Basin Study

KRD Canal Modifications
Technical Memorandum

U.S. Bureau of Reclamation
Contract No. 08CA10677A ID/IQ, Task 4.4

Prepared by

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

March 2011

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The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The Mission of the Washington State Department of Ecology is to protect, preserve and enhance Washington's environment, and promote the wise management of our air, land and water for the benefit of current and future generations.

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1.0 Introduction

This technical memorandum describes proposed modifications to the Kittitas Reclamation District (KRD) Main Canal and South Branch Canal systems that were evaluated as part of the Yakima River Basin Study. KRD diverts water from the Yakima River at Lake Easton at River Mile 202.5, near the town of Easton. The KRD system delivers water for irrigation to approximately 55,500 acres in the Kittitas Valley. The proposed modifications consist of improvements to KRD laterals along the canals to reduce seepage losses. The water saved from these improvements would be used to enhance instream flows in tributaries to the Yakima River, including Taneum Creek, Manastash Creek, Big Creek, and Little Creek.

1.1 Background

KRD currently augments flows in tributaries to the Yakima River with operational spills from the canal system. KRD also conveys and discharges excess water at spill locations when requested by Reclamation, but only when excess capacity is available in the system. The KRD system includes approximately 37 open-ditch laterals that distribute irrigation water from the Main Canal and South Branch Canal to KRD water users. Water is currently lost through seepage from these open-ditch laterals.

Improvements to the KRD conveyance system were originally identified in the KRD Water Conservation Plan (CH2M Hill 1999). These improvements were refined and additional projects identified through development of the Yakima River Basin Integrated Water Resource Management (IWRM) Alternative Final EIS (Ecology 2009). Of the projects identified in those studies, three were selected for further analysis. The projects are:

- Piping of irrigation laterals along the KRD Main Canal and South Branch Canal.
- Construction of a re-regulation reservoir to capture KRD operational spills at Manastash Creek.
- Construction of a pump station on the Yakima River to deliver flows to Manastash Creek water users.

This memorandum provides a summary of each of these projects.

1.2 Project Purpose

The improvements described below would reduce seepage and operational losses, and make that water available to directly augment flow in creeks along the Main Canal and South Branch Canal (Taneum, Manastash, Big, and Little creeks). Alternatively, the capacity made available by these improvements could supply water to creek water users through laterals and supplant water they currently divert from creeks.

2.0 Description of Projects

2.1 Lateral Piping

The lateral piping project consists of replacing open-ditch laterals with pipe to eliminate seepage losses. This alternative was initially described in the KRD Water Conservation Plan (1999) and refined in Ecology's IWRM Alternative EIS (2009). For this alternative, five laterals on the Main Canal (M4.9, M6.1, M7.7, M13.6 and M16.9) and five laterals on the South Branch Canal (SB9.9, SB13.8, SB14.3, SB16.7 and SB17.6) would be replaced with pipelines that would be constructed within the existing lateral rights-of-way. Figures 1 and 2 (see Pages 5 and 6) show the Main Canal laterals that would be replaced. Figure 2 also shows the South Branch Canal laterals that would be replaced.

Quantities

Quantities for the lateral piping project (see Table 1) were identified and developed in the KRD Water Conservation Plan (1999) based on the following assumptions:

- The design flow rate equals 70 percent of the original design flow rate.
- The maximum velocity of water through pipelines is 5 feet per second.
- Pipe diameters are rounded up to next largest standard pipe size.
- The pipe material would be pressure-rated PVC pipe with ductile iron fittings.

Table 1. Lateral Piping Quantities

LATERAL	LENGTH (FEET)	DIAMETER (INCHES)
MC 4.9	1,300	21
	488	18
MC 6.1	800	24
	2,100	21
	2,016	15
MC 7.7	725	21
	4,161	15
MC 13.6	1,750	30
	4,250	27
	2,860	21
MC 16.9	677	15
SB 9.9	2,724	27
	4,000	21
SB 13.8	8,200	30
	8,640	24
SB 14.3	3,200	30
	6,838	27
	6,753	21
SB 16.7+17.6	4,500	30
	13,100	27
	8,317	18

Cost Estimates

Cost estimates for lateral piping are outlined in a separate memorandum, *Costs of the Integrated Water Resource Management Plan*.

Instream Flow Benefits

Lateral piping would conserve water by eliminating seepage and evaporation loss within the laterals. In addition, pressurized laterals would reduce the volume of water spilled at the end of the laterals and allow that water to be conveyed to where flow is needed. In Ecology's IWRM Alternative EIS (2009), it was estimated that seepage losses would be reduced by 5,312 acre-feet per year (14.9 cfs) by piping the KRD laterals listed in Table 1.

Table 2 lists the estimated flow reductions for each lateral to be piped, which represent the water savings that would be used to supplement flows in tributaries or supplant supply to users that divert water from tributaries. The KRD diversion would not be reduced; the water saved would be conveyed through the KRD system to the water users or tributaries through existing structures. KRD currently has the structures in place to supplement flow to Taneum Creek (via the Taneum Chute) and Manastash Creek (via the Manastash Spill), therefore no additional structures are required at these locations.

Table 2. Estimated Water Savings from Lateral Piping

LATERALS		ESTIMATED SAVINGS (ACRE-FEET PER YEAR)	AVERAGE FLOW SAVINGS (CUBIC FEET PER SECOND)
Main Canal Laterals	MC 4.9	170	0.48
	MC 6.1	368	1.03
	MC 7.7	250	0.70
	MC 13.6	722	2.03
	MC 16.9	60	0.17
	Totals	**1,571**	**4.41**
South Branch Canal Laterals	SB 9.9	965	2.71
	SB 13.8	1,277	3.58
	SB 14.3	692	1.94
	SB 16.7	499	1.40
	SB 17.6	308	0.86
	Totals	**3,742**	**10.50**
Totals for Both Canals		**5,312**	**14.90**

2.2 Manastash Spill Re-regulation Reservoir

Construction of a re-regulation reservoir would capture operational spills from the KRD South Branch Canal and release the spills to Manastash Creek water users at a constant rate, reducing their diversions from Manastash Creek.

The KRD Water Conservation Plan (1999) indicated that the average spill at Manastash Spill is 4.19 cfs. The plan also recommended a re-regulation reservoir at Page Canyon (approximately 6 miles upstream from the Manastash Spill) with a capacity of 125 acre-feet, or 15 days of average spill at Manastash Spill. Based on professional judgment, this size was determined to be too large for this project.

The alternative evaluated as part of this study would include a reservoir with a capacity of 15 acre-feet, which represents 1.8 days of average spill at the Manastash Spill. This size was determined to be more appropriate because it would capture and regulate diurnal flows that make up the majority of spillway flows in irrigation systems. Figure 2 shows the approximate location of the proposed re-regulation reservoir.

Quantities

Table 3 lists the dimensions for a typical 15-acre-foot reservoir.

Table 3. Typical 15-Acre-Foot Reservoir Dimensions

DESCRIPTION	QUANTITY	UNIT
Depth	20	FT
Freeboard	2	FT
Bottom Width	100	FT
Bottom Length	150	FT
Outside Embankment Side Slope	2	H:1V
Inside Embankment Side Slope	2.5	H:1V
Embankment Top Width	15	FT
Maximum Water Surface Area	50,000	SF

Quantities

The reservoir would be constructed near Manastash Spill on the KRD South Branch Canal. An earthen embankment would be constructed to impound the downhill side of the reservoir, and a gated control structure would be installed at the canal to deliver water through an inlet pipe to Manastash Creek water users' canals. A pump station would also be constructed to deliver water from the reservoir through an outlet pipe to the canal. The pump station would be designed to deliver approximately 4 cfs at a total dynamic head of about 60 feet. The reservoir would be equipped with emergency overflow piping, a trash rack at the pump station inlet, and other appurtenances.

Cost Estimates

Cost estimates for the re-regulation reservoir are outlined in a separate cost memorandum, *Costs of the Integrated Water Resource Management Plan.*

Instream Flow Benefits

As previously described, the average spill at Manastash Spill is 4.19 cfs. That is equal to an annual flow volume of 1,496 acre-feet, assuming 180 days of spill per year. The re-regulation reservoir would capture the spill and release it to Manastash Creek water users at a consistent rate and allow 4 cfs additional flow in Manastash Creek.

2.3 Pumping to Manastash Creek or Water Users

The project, which would pump to Manastash Creek or to Manastash Creek water users, consists of installing a pump station at the Yakima River with a transmission pipeline to deliver water to Manastash Creek just upstream from the South Branch Canal. As an alternative, the pump station could discharge to diversion structures along the creek near that point. Both alternatives would result in an increase in instream flow in Manastash Creek. It was initially described in Ecology's IWRM Alternative EIS (2009) as an alternative to pump water into the South Branch Canal. Based on comments received from KRD representatives, pumping directly to Manastash Creek or to the water users who currently divert creek water is preferable to pumping to the South Branch Canal.

The proposed pump station would have a capacity of 8 cfs and would be located near Riverbottom Road in the SW ¼ of Section 11, Township 17 North, Range 18 East. The transmission pipeline would likely follow Riverbottom Road west to Manastash Road, then follow Manastash Road west to Manastash Creek. Figure 2 shows the approximate location of the pump station and transmission pipeline.

Quantities

The pump station would be sized to deliver approximately 8 cfs at a total dynamic head of 650 feet. The pipeline would be 20 inches in diameter and approximately 5.5 miles long. It was assumed that the portion of the pipeline expected to accommodate maximum operating pressures in excess of 150 psi would be constructed with ductile iron pipe. The rest of the pipeline would be constructed with PVC pipe. Table 4 lists the preliminary sizing and hydraulic data for this alternative.

Table 4. Pumping to Manastash Creek (Preliminary Design Data)

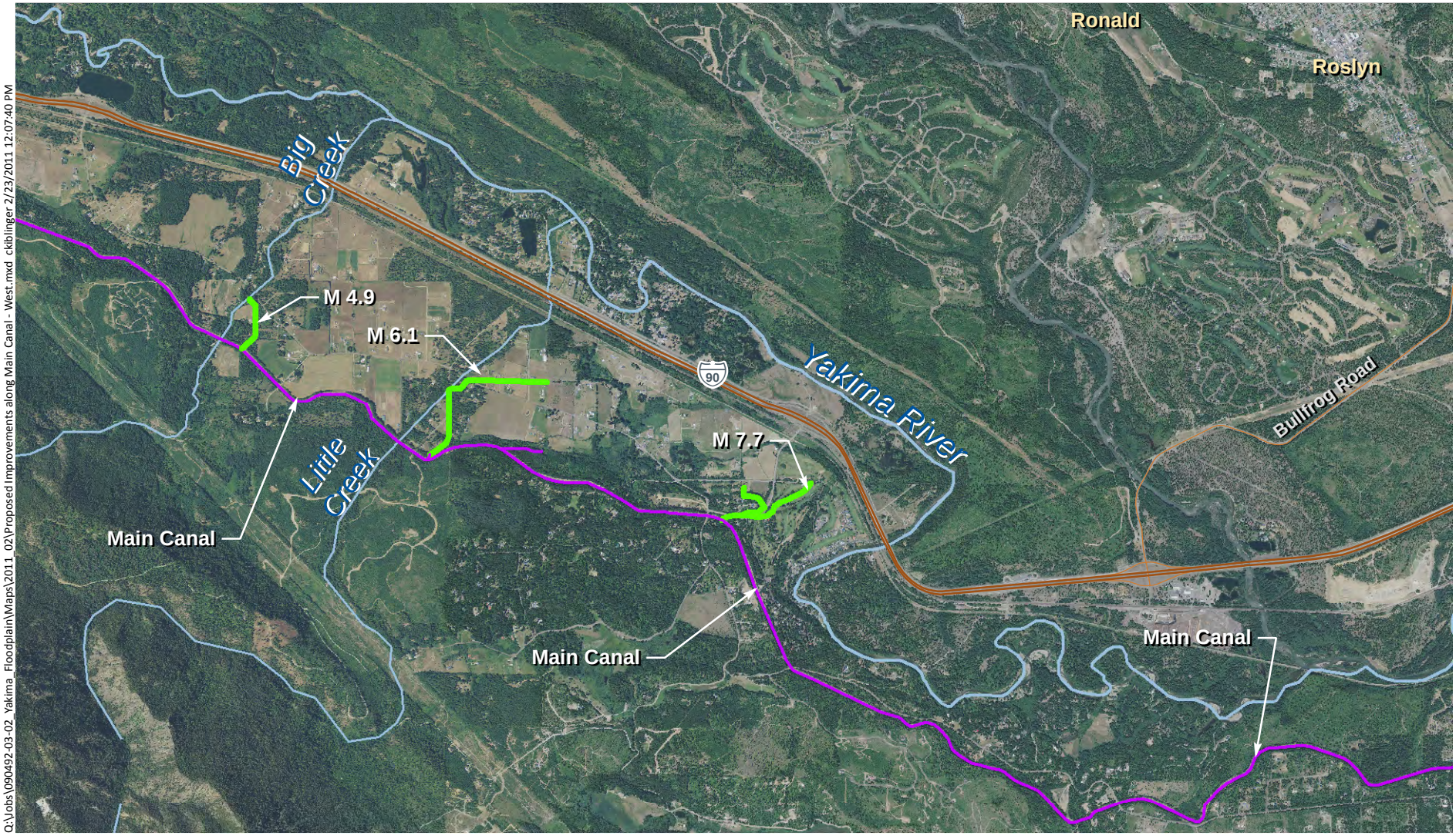
DESCRIPTION	QUANTITY	UNIT
Pump Station Capacity	8	CFS
Yakima River Elevation	1490	FT
Manastash Creek Elevation	2030	FT
Total Dynamic Head	650	FT
Pipe Length – 20-inch diameter	29,000	LF

Cost Estimates

Cost estimates for pumping to Manastash Creek water users are outlined in a separate cost memorandum, *Costs of the Integrated Water Resource Management Plan*.

Instream Flow Benefits

Pumping to Manastash Creek water users or directly to Manastash Creek would increase the flow in Manastash Creek by the amount of water pumped from the Yakima River (up to 8 cfs). Assuming that the pump station could operate continuously for 180 days at 8 cfs, the estimated volume of water that would be delivered to Manastash Creek by this project would be 2,850 acre-feet per year.



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Proposed Lateral Piping
KRD Canals and Laterals
Rivers and Creeks
Interstates
Roads/Highways

NOTE:
Aerial photo from National Agriculture Imagery Program, June 26 2009.

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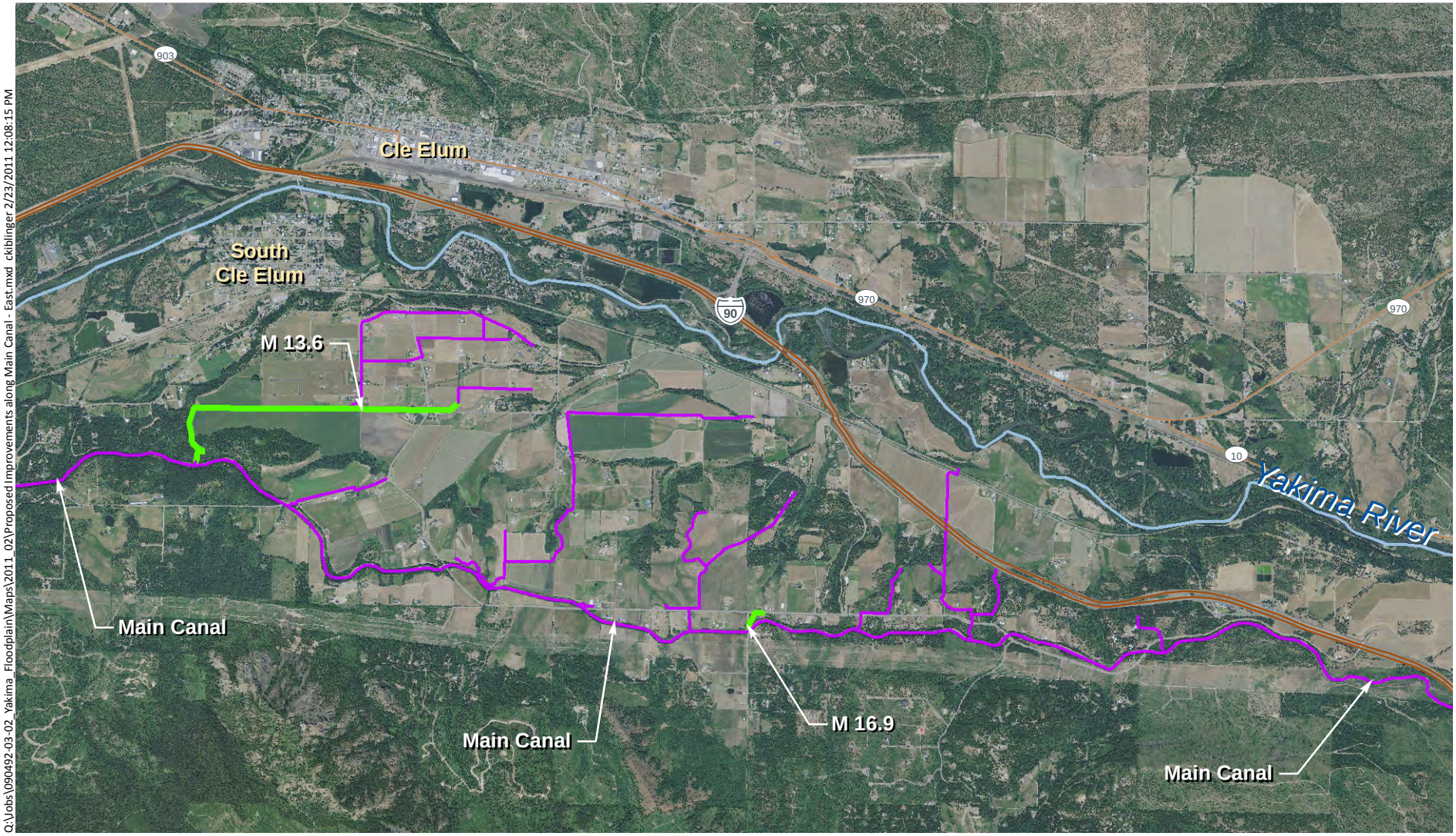
Feet

RECLAMATION
Managing Water in the West

Figure 1
Proposed Improvements along Main Canal - West
KRD Modifications Project
Yakima Basin Study



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Proposed Lateral Piping
KRD Canals and Laterals
Rivers and Creeks
Interstates
Roads/Highways

NOTE:
Aerial photo from National Agriculture Imagery Program, June 26 2009.

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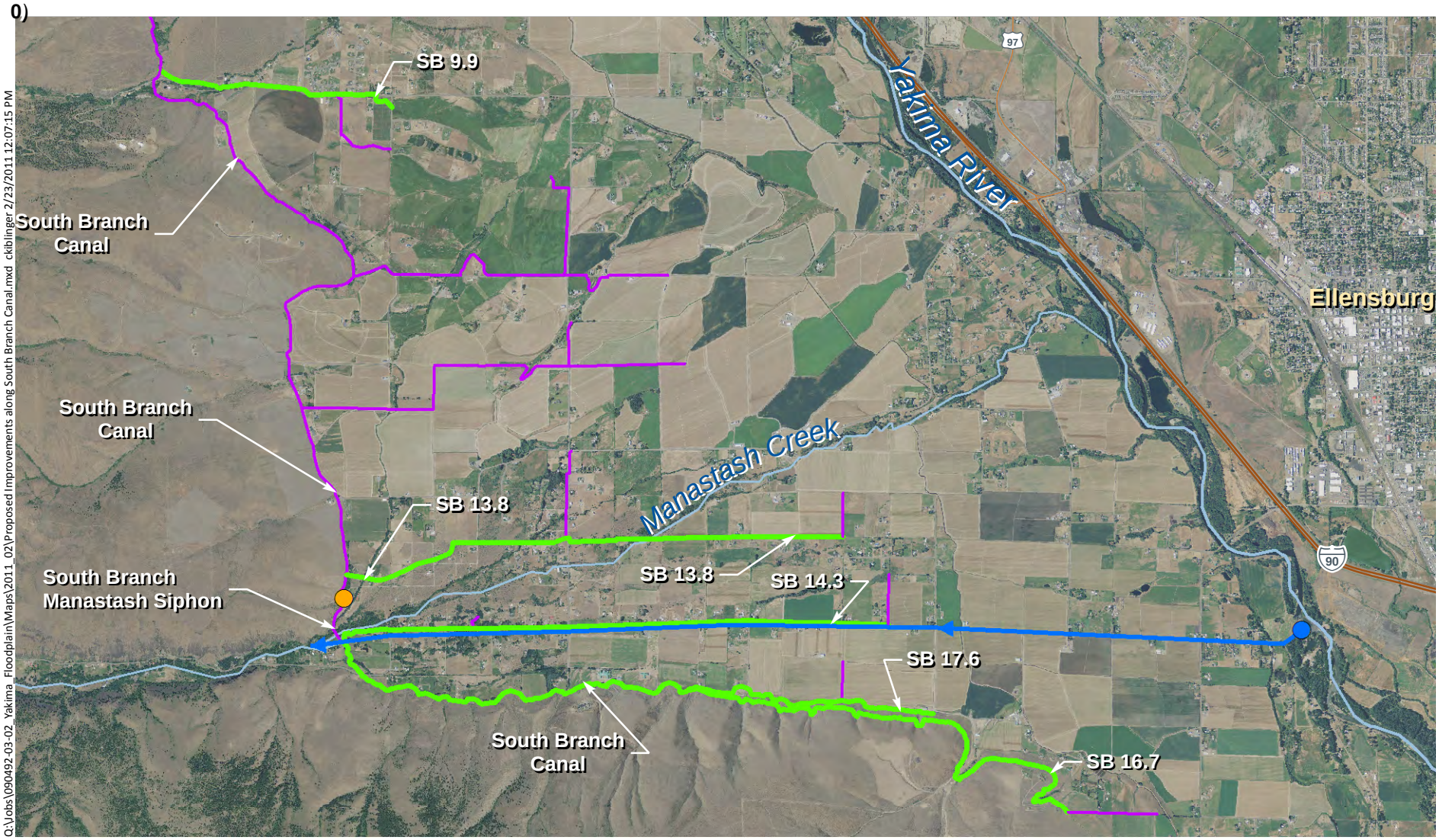
RECLAMATION
Managing Water in the West

Figure 2
Proposed Improvements along Main Canal - East
KRD Modifications Project
Yakima Basin Study



Proposed Re-regulation Reservoir
Proposed Pump Station
Proposed Pipeline to Supply Manastash Creek or Manastash Creek Water Users
Proposed Lateral Piping
KRD Canals and Laterals
Rivers and Creeks
Interstates
Roads/Highways

NOTE:
Aerial photo from National Agriculture Imagery Program, June 26 2009.

0 4,000
Feet

RECLAMATION
Managing Water in the West

Figure 3
Proposed Improvements along South Branch Canal
KRD Modifications Project
Yakima Basin Study

3.0 References

CH2M Hill, 1999. *Kittitas Reclamation District Water Conservation Plan Irrigation Water Conservation Plan of System Improvements*.

Washington State Department of Ecology (Ecology), 2009. *Final Environmental Impact Statement Yakima River Basin Integrated Water Resource Management Alternative*. Publication Number 09-11-012.

4.0 List of Preparers

NAME	BACKGROUND	RESPONSIBILITY
ANCHOR ENVIRONMENTAL		
Bob Montgomery, P.E.	Water Resources Engineer	Task Manager
Adam Hill, P.E.	Water Resources Engineer	Civil Engineering
Dave Rice, P.E.	Water Resources Engineer	Civil Engineering