TECHNICAL MEMORANDUM

TO: *WWDC* DATE: *May 12, 2010*

FROM: *MWH* REFERENCE: *Wind-Bighorn Basin Plan*

SUBJECT: *Task 6D – Conservation*

This memorandum summarizes municipal and agricultural conservation practices in the Wind-Bighorn Basin. The document fulfills the reporting requirements for Task 6D of the consultant scope of work for the Wind-Bighorn Basin Plan Update (Basin Plan Update).

Contents

Section 1 – Introduction

In general, Wyoming's climate is semiarid, with local desert conditions. The Wind-Bighorn Basin (Basin) has a dramatic spatially variable climate. Most of the region's moisture comes from winter snowfall, which melts in late spring and early summer resulting in high peak streamflow events during this time, and lower streamflow during the remainder of the year. Short, windy, warm summers produce high evaporation rates and high water demand for municipal and agricultural irrigation purposes. Water management in this type of climate is challenging because of the timing of water availability compared to water demand. Because of this, storage and water conservation are the two critical components in water management. This technical memorandum discusses currently practiced and potential conservation efforts within the Basin.

The previous Wind-Bighorn Basin Plan (previous Basin Plan) discussed water conservation from a multi-use perspective including municipal, agricultural and environmental uses. The Wyoming Water Development Commission's 2002 report on public water systems was summarized in the previous Basin Plan and showed that conservation is not emphasized by many public utilities in Wyoming. For example, in the report, there were 188 water systems listed for the entire state of Wyoming. Of these, 29 reported having tiered rates as a water conservation measure, 24 had ordinances prohibiting the wasting of water and two reported providing subsidies for efficiency. There were 25 entities that reported some other form of water conservation measure in place. In the Wind-Bighorn portion of the

survey, three entities reported a tiered rate structure. Accurately metered and appropriately billed water usage was identified as a municipal conservation strategy for discouraging overuse of water. For agriculture, suggestions for conservation included upgrading to more efficient irrigation systems, utilizing gypsum blocks for determining soil moisture, contouring fields to improve water distribution and lining canals and ditches. However, the previous Basin Plan also pointed out that agricultural conservation can have direct effects on recreational, environmental and ecological resources. For example, flood irrigation and unlined ditches can recharge aquifers and create ecological benefits and habitat. Improved agricultural efficiency could reduce these environmental benefits. Environmental conservation suggestions included maintaining, enhancing or creating riparian areas on rangelands, as it can improve the quantity and quality of water in small streams, serve as erosion control, improve wildlife habitat as well as create recreational opportunities (BRS 2003).

In the remaining portion of this memorandum, water conservation measures from the previous Basin Plan are updated, including a review of current and recent conservation efforts and studies, municipal conservation practices and agricultural conservation practices.

Section 2 – Conservation Efforts and Studies

In 1998, the Wyoming Water Development Commission (WWDC) and the Wyoming State Engineer's Office (WSEO), in partnership with the United States Bureau of Reclamation (Reclamation), initiated a water conservation program for the state. The water conservation program has a multi-faceted approach to water management and conservation with the following targets: addressing water conservation practices, investigating strategies, evaluating methodology, analyzing implementation ramifications, evaluating impacts and identifying sources of assistance. The program created a conservation component to the state water plan and provides public outreach and education (WWDC 2009). Wyoming has also been involved with the Bridging-the-Headgate partnership. This program brings together federal, state and local agencies, nonprofit conservation organizations and private industries to expand technical resources for conservation activities and assistance programs. One goal of the partnership is to increase awareness and understanding among all partners of each individual group's mission and goals and to increase collaboration of on-farm conservation assistance programs (Headgate 2009). In Wyoming, the project produced a statewide database of water related activities including recent, current, and on-going water quantity and water quality projects which are available on the WWDC website. A listing of Bridging-the-Headgate projects in the Basin is shown in Table 1. This table is current as of January 2004 (WWDC 2009b).

Table 1. Bridging-the-Headgate Projects in Wind-Bighorn Basin

Agency	Project Mgr	Project	Basin/Sub-Basin	Estimated Completion
Bureau of Reclamation - Wyoming	John Lawson	Highland-Hanover Irrigation District - Water Measure	Wind-Bighorn Basin Upper Bighorn	January 2004
		Remote Access to Midvale Irrigation District Water		May 2004
Dubois Crowheart Conservation District	Tina Melin	Upper Wind River Watershed Assessment	Wind-Bighorn Basin Upper Wind	June 2004
Lower Wind River Natural Resource District	Crystal Robinson	LWRNRD Water Quality Assessment Program	Wind-Bighorn Basin All	January 2005
South Big Horn Conservation District	Janet Hallsted	South Big Horn Basin Water Monitoring	Wind-Bighorn Basin Greybull	September 2005
USDA NRCS-Popo Agie Conservation	Jeri Trebel-cock,	Middle Fork of Popo Agie - Lander Flooding	Wind-Bighorn Basin Popo Agie	December 2004
Wyoming Water Development Commission	Ron Vore	Hidden Valley Pipeline	Wind-Bighorn Basin Lower Wind	December 2003
		Kirby Creek Watershed Management Plan		June 2004
		Midvale Conservation Program		June 2005
		Owl Creek Master Plan		June 2004

Conservation studies are often incorporated as part of the WWDC's watershed studies. The watershed studies involve surface water storage, enhancement of upland water resources and the evaluation of irrigation infrastructure. The watershed study can provide management and rehabilitation plans for irrigation systems and storage facilities. The WWDC "Rehabilitation Program" was established in 1983 to help improve water projects that are 15 years old or older. These improvements insure dam safety, decrease operation and maintenance costs and increase efficiency of water supply systems. Thus, the rehabilitation projects improve conservation within the Basin. Table 2 lists the current active projects that are funded under the Rehabilitation Program within the Basin from the 2009 Legislative Report (WWDC 2009c). These projects include canal linings, pipeline and infrastructure improvements, GIS systems for planning and management and programs for identifying water conservation opportunities.

Table 2. Active Rehabilitation Program Studies for the Wind-Bighorn Basin (WWDC 2009c)

County	Study Name	Project Level[1]
Big Horn County	Shell Valley Watershed Management Plan	I
Big Horn County	Greybull Valley Rehab, GIS	II
Big Horn County	GVID Upper Sunshine Diversion – Phase I	II
Big Horn County	Byron Raw Water Supply	III
Big Horn County	Highline Canal	III
Big Horn and Washakie Counties	Big Horn Canal Rehabilitation 2009	New Application
Big Horn and Washakie Counties	Big Horn Canal Lining	III
Washakie County	Gooseberry Rehabilitation	III
Washakie County	Worland Eastside Transmission Line	III
Park County	Shoshone Rehab and GIS	New Application
Park County	Cody Canal Rehab, GIS	II
Park County	Shoshone Rehabilitation 2009	II
Park County	Willwood Rehabilitation 2009	II
Park County	Willwood Rehabilitation, GIS	II
Park County	Cody Canal Rehabilitation	III
Park County	Heart Mountain Lining	III
Park County	Heart Mountain Rehabilitation	III
Park County	Shoshone Eagle Nest Creek	III
Park/Big Horn Counties	Deaver Rehabilitation 2009	New Application
Park/Big Horn Counties	Deaver Flume Rehabilitation II	III
Park/Big Horn Counties	Lovell Rehabilitation 2009	III
Park/Big Horn Counties	Sidon Rehabilitation	III
Fremont County	Riverton Valley Rehabilitation 2009	New Application
Fremont County	Crowheart Area/Dinwoody Canal System	II
Fremont County	Enterprise Conservation Program	II
Fremont County	Hidden Valley-canal to pipe	III
Fremont County	LeClair Laterals Rehabilitation	III
Fremont County	Midvale Canal Rehabilitation	III
Fremont County	Midvale Conservation Program	III
Fremont County	Riverton Raw Water Supply Rehabilitation	III
Fremont County	Taylor Ditch Siphon	III
Fremont County	Wind River Irrigation Rehabilitation	III
Hot Springs County	Red Lane Master Plan	New Application
Hot Springs County	Kirby Irrigation District Conservation Program	I
Hot Springs County	Owl Creek Irrigation District Storage Study	II
Hot Springs County	South Thermopolis Water Supply	II
Hot Springs County	Thermopolis Storage Replacement and Rehabilitation	III

1) Level I - reconnaissance study, Level II - feasibility study, Level III - project development

Section 3 – Municipal Conservation Measures

The WWDC conducts water system surveys for quantifying municipal water use. Listed in the survey are any conservation measures the water district employs. These include any programs supported by the entity to reduce water consumption and increase public awareness about water conservation, such as a tiered rate structure, subsidies for efficiency and municipal wasting ordinances. The 2007 and 2009 water use surveys for the Basin are summarized in Appendix A of Technical Memorandum 3B-Municipal and Domestic Water Use Profile. In both surveys, 46 entities within the Basin were listed. Table 3 and Table 4 show the entities that listed conservation measures (WWDC 2007, 2009d). In 2007, six entities reported a tiered rate structure, and three reported a wasting ordinance (two of which also reported a tiered rate structure). There were seven entities that reported some other form of conservation measures. In 2009, five entities reported a tiered rate structure. The wasting ordinance and other categories were the same as in 2007. Education and "encouragement" to conserve were included in the "other" category.

Table 3. Conservation Measures Used by Entities in the Wind-Bighorn Basin-2007

Name of Entity	Total Pop. Served	Conservation Measures
Byron, Town of	600	Municipal Wasting Ordinance
Cody, City of	8,832	Tiered rates
Deaver Municipal Water System	210	Other
Greybull	3,000	Tiered rates, Lawn water conservation
Hudson	500	Tiered rates, Municipal Wasting Ordinance
Hyattville Water Company	48	Other
Kirby, Town of	50	Other
Northwest Rural Water District	4,812	Tiered rates
Raintree Improvement and Service District	72	Other
Riverton, City of		Tiered rates
Shoshone Municipal Pipeline		High Rates
Shoshoni, Town of	550	Other
Thermopolis, Town of	UNK	Other
Washakie Rural Water System	800	Tiered rates, Municipal Wasting Ordinance

Source: WWDC 2007

Table 4. Conservation Measures Used by Entities in the Wind-Bighorn Basin-2009

Name of Entity	Total Pop. Served	Conservation Measures	Estimated water savings from the conservation measures
Burlington	274	Tiered rates, Water Ordinance	Unknown
Byron	600	Municipal Wasting Ordinance	Unknown
Cody		Yearly leak survey performed	Unknown
Deaver	210	Other	Unknown
Dubois	960	Tiered billing, leak detection, meter replacement	Unknown
Fairview	300	Other	10,000,000 gallons. Winter continuously running stock waterers use enormous amounts of water.
Hudson	500	Tiered Rates, Municipal Wasting Ordinance	Unknown
Hyattville Service and Improvement District	50	Other	Unknown
Kirby	50	Other	Unknown
Meeteetse	370	Self Admin	2400 gal
Northwest Rural Water District	5,000	Tiered Rates	Limit outside use by most clients that have irrigation water available.
Raintree Estates Improvement and Service Dist	75	Other	Unknown
Riverton	9,728	Tiered Rates, Voluntary Conservation	10%
Shoshone Municipal Pipeline	24,600	High Rates	33%
Shoshoni	650	Metering water year around	20%
Sun Ridge Estates Homeowners Ass'n	300	Encourage to conserve	Unknown
Ten Sleep	304	Working on installing meters	Unknown

Source: WWDC 2009

1) Differences between 2007 and 2009 conservation measures are due to differences in survey responses by the individual entities.

Most municipal water conservation studies have found that changes in the national plumbing code that require use of certain maximum capacity toilets, appliances and fixtures create reductions in per capita water use as existing appliances and fixtures are replaced and as new buildings make up a larger percent of the building stock. Potential water conservation strategies that could be implemented within the Basin include rebates for water saving devices, leak detection and rehabilitation programs, and water use audits (TWDB 2009). Generally high water rates and accurately metered usage is perhaps the best conservation measure currently used by water providers in Wyoming. Measures that address outdoor water use for landscape irrigation can be particularly effective at reducing peak use rates.

Section 4 – Agricultural Conservation Measures

Most crop production in the Basin requires irrigation. Full crop water requirements for the Basin are detailed in Technical Memorandum 3A - Agricultural Water Use. Agricultural water users can conserve water through improved irrigation efficiency. Sub-surface drip irrigation is the most efficient in water usage (95 percent to 98 percent efficiency), followed by micro-sprinklers (85 percent to 95 percent), pivot sprinkler systems (75 percent to 85 percent), and then furrow and flood irrigation (60 percent to 75 percent, Doll 2009). Typically, center pivot sprinkler irrigation and gated pipes are used in the Basin. While not many such systems are in use in the Basin, micro-irrigation and drip systems with pressure-flow regulation are promising in some situations (BRS 2003).

Improving the efficiency of existing sprinkler systems includes improving the system's ability to uniformly distribute water across all plants in the field. This may involve replacing nozzles, ensuring the irrigation pump is in good working condition and not irrigating in high winds. Irrigation scheduling (when

and how much to irrigate) can also help achieve maximum water use efficiency. Monitoring the soil moisture in the field is an important part of determining proper irrigation timing. One method used for monitoring soil moisture is the burial of gypsum blocks in the field. Measurement of water in gypsum blocks reflects the amount of water in the soil. Another method is commercially available soil moisture sensors. The Natural Resource Conservation Service (NRCS) also has several computer models and tools available for download online to help with irrigation scheduling (NRCS 2009).

Canal lining and other conveyance system conservation measures can decrease water loss to seepage. The WWDC performs Irrigation System Survey Reports. The entities within the Basin that provided information in the 2008 report are shown in Table 5 with the estimated losses, issues and whether or not they have a conservation measure or habitat benefit associated with the system. Not all issues listed can be addressed through conservation measures, but many are related to seepage and maintenance. As shown, conveyance losses can be very high and seepage issues are a common problem listed. However, as previously mentioned, reducing conveyance losses in irrigation canals and improving irrigation application efficiencies can impact aquifers, wildlife habitat and other environmental resources. Often another use is dependent on the return flows produced from such inefficiencies. Consideration of the impact of agricultural conservation measures is important for water managers.

Table 5. Irrigation System Survey-2008

Entity	Habitat Benefit	Conser-vation?	Problems	Convey-ance Capacity (cfs)	Length (mi)	Convey-ance Losses (%)
Anita Ditch Company and Gapen Ditch	No	Yes	Drop structures are old concrete and need replacing, and conveyance losses	60	8	50
Bench Canal Company	No	Yes	Needed improvements, Maintenance requirements; Water is conveyed through dirt ditches and aging concrete headgates	300	75	15
Big Horn Canal Irrigation District	No	No	Needed improvements, Unwritten easements, Maintenance through subdivisions, Legal problems, Subdivided land		60	10
Bluff Irrigation District			Needed improvements, Maintenance requirements	150	17	
Butte Ditch	Yes	Yes	Shrinkage and constant upkeep, late water rights when river flow is inadequate, low reservoir level	40	6	20
Cemetary Ditch	Yes	Yes	Maintenance, Subsidence, seepage, sediment, repairs	22	6	
Chalmers-Fogg Ditch	No	No	Maintenance requirements, Assessments		3.5	
Cody Canal Irrigation District	Yes	No	Needed improvements, Inadequate water sources, Subdivided land, Water rights	280	70	
Deaver Irrigation District	Yes	Yes			250	20% to 40%
Dutch Flat/Taylor	Yes	No	Water Shortage			
Elk Water Users Assoc. (1)	No	Yes	Inadequate water sources; Aging Structures	300	26	probably high
Elk-Lovell Irrigation District (1)	No	Yes	Reduce seepage, installation of wires and control devices	400	50	
Enterprise Irrigation and Power CO.	Yes	Yes	Maintenance through subdivisions; 50% water conveyance loss	50	20	50

Entity	Habitat Benefit	Conser-vation?	Problems	Convey-ance Capacity (cfs)	Length (mi)	Convey-ance Losses (%)
Fairview Irrigation District	Yes	Yes	Maintenance through subdivisions, Subdivided land; Diversion structure needs to be replaced. It is on the verge of washing out. The concrete is crumbling so regulation of flow is very hard.		9	20% to 100%
Farmer's Canal Company	Yes	Yes	Inadequate water sources; Drought, moss in canals, trees, maintenance, conveyance loss within system	350	80	5% to 30%
Globe Canal (Farmers Protective Assoc.) [(2)]	Yes	Yes	Canal through town. The use & seepage in winter time threatens homeowners near canal. Hill slide into canal resulting in major unrest of people in town and work for canal board.		13	3
Gooseberry Irrigation District	No	No	Subdivided land, Water rights	unknown	0	25
Greybull Valley Irrigation District			Needed improvements, Maintenance requirements, Inadequate water sources, Unwritten easements, Maintenance through subdivisions ,Subdivided land	1000	20	
Hanover Irrigation	Yes	No	Fed Req, Flood water, pump water, sub-divisions, flume relining	575	42	
Heart Mountain Irrigation District	Yes	Yes	Moss and More Government Financial Aid	870	330	
Highland Hanover Irrigation	Yes	Yes	Contract negotiation	134	17	
Hunt Canal Irrigation District	Yes		Inadequate water sources	150	13	
Kirby Ditch Company	Yes	No	Seepage, Russian Olives, Drought	80	8	20
Lakeview Irrigation District	No	No				
Lander Ditch Company	Yes	No	Municipal area fragmented, voluntary contributions, water quality, instream flow in river	Unknown	5	
LeClair Irrigation District			Upstream water storage. The only feasible dam sites would be in the NF, as they control erosion, help stream bank stabilization and insure adequate water. Would also help relations with Native Americans			
Little Popo Agie Irrigation District	Yes		State and federal requirements		0	
Lovell Irrigation District	Yes	Yes	Water at the head varies sometimes inadequate, distribution, water loss	350-400	45	
Lower Hanover Canal	Yes	No	Assessment collection, loss of easement or row, federal	235	24	
Midvale Irrigation District	Yes	Yes	Needed improvements, Maintenance through subdivisions, Subdivided land	2200	400	23
Nez Perce Irrigation	No	Yes	Need another head gate, takes 25 days for everyone in subdivision to get water.		1	

Entity	Habitat Benefit	Conser-vation?	Problems	Convey-ance Capacity (cfs)	Length (mi)	Convey-ance Losses (%)
Nicol & Table Mountain Ditch	Yes	Yes	Needed improvements, Maintenance requirements, Unwritten easements, Maintenance through subdivisions, Subdivided land; storage	varies	7	40-50%
North Fork Valley Ditch Company	Yes	Yes	Maintenance requirements; Lining ditch w/ pipe where it is known to leak	50	4.5	
Owl Creek Irrigation District	Yes	Yes	Seepage from dam; seepage in canyon below Dam	Unknown	70	25
Riverton Valley Irrigation District	No	Yes		185	28	
Rodgers and Gregg (Wise Ditch)	Yes	Yes	Water Loss, Maintenance, Subdivisions	40	8	
Sandstone Ditch Company	Yes	Yes	Reservoir storage and flow control; structures and headgate flow control; spillways flood control; improve access on system	80		10
Shell Canal Company	Yes	Yes	Conveyance losses, evaporation, vegetation seepage, flood control	130	33	50% to 75%
Shell Valley Watershed Improvement District	Yes	No	Property sales and water rights	150	0	
Shoshone Irrigation District	Yes	Yes		900	260	15
Sidon Irrigation District	No	Yes	Repairs	350	108	
Snavely/Grant Young Ditch	Yes	Yes	New headgate and spillway, lined or piped ditch, only have perpetual easements, recent subdivisions, future subdividing		5	50
Taylor Ditch	Yes	Yes	Slide area above ditch		14	
Tillard Canal	No	No	Needed improvements, Maintenance requirements, Unwritten easements, Maintenance through subdivisions, Subdivided land	Unknown	8	5
Upper Bluff Irrigation District	Yes	No		120	20	
Victoria Ditch Co.	No	No			3	unknown
Whaley Ditch	Yes	Yes	Moss affecting flow, high price of chemical for control of moss, lack of organizational structure - by laws	35	7	Un-known
Willwood Irrigation District	No	Yes	Needed improvements, Maintenance requirements, Inadequate water sources	400	78	20
Wyoming Game and Fish Commission [3]	Yes	Yes		450	12	

Source: WWDC 2008

[1] Elk Water Users and Elk-Lovell Irrigation District is listed separately but is a single system. The Elk-Lovell Irrigation District serves the old shorter Elk Canal through one diversion, the Elk-Lovell Canal. It has a 300-400 cfs normal operating range and the 26 mile length is the Elk Canal portion while the entire canal system is in the 50 mile neighborhood.

[2] Globe Canal was piped the canal through town of Lovell in 2008 reducing seepage and other issues.

[3] Refers to the Wardwell Ditch on the Shoshone River which serves lands on west side of Big Horn Reservoir. There remains about 3000 acres under this facility which would be for about 45 cfs (Smith 2009).

Section 5 – Industrial Conservation Measures

Among the biggest industries in Wyoming is the oil and gas industry. To promote conservation, there is a Wyoming Oil & Gas Conservation Commission (WOGCC 2008). The commission regulates underground injection class II wells on behalf of the EPA. This agency encourages the beneficial and environmentally responsible development of the state's oil and gas resources. It strives to generate revenue for the general fund which supports other agencies and the benefits they provide to Wyoming. The commission has two major goals:

- to protect human health and the environment by avoiding contamination of the soils and underground and surface water at drilling and producing locations
- to ensure those locations are properly reclaimed at the end of production activities so that the land can be returned to beneficial use.

The Commission is charged with preventing waste of hydrocarbons beneath the state's lands and protecting correlative rights as well as maximizing the state's resources (WOGCC 2008).

Unlike municipal and agricultural conservation, there is no survey report conducted by WWDC to solicit information on industrial water use conservation. In general, industrial water users in the Basin are actively seeking ways to conserve water. However, the types and amount of conservation generally is not available to the general public. There are various ways industries can conserve water. For example, treated waste water from industrial processes can be used for landscape watering, cooling systems can utilize recycling equipment and evaporative cooling systems can recirculate water. Natural gas producers in Southeastern New Mexico have reported in the Sustainable Global Performance report to have utilized innovative water treatment technologies to remove the hydrogen sulfide gas that is entrained in the produced water (API 2006). This water can then be used in the company's drilling operations, thereby reducing the amount of fresh ground water that has to be used. Produced water from coal bed natural gas operations, if treated to meet water quality standards, can also be managed for beneficial uses. For example, it can be utilized for aquifer recharge, constructed wetlands, irrigation water or to augment instream flow targets (Kuipers et al. 2004, ALL 2003).

Section 6 – Environmental and Recreational Considerations

The economic value of recreational opportunities involving water in Wyoming has increased in recent years. Wyoming's sparse population allows for more secluded, unaltered nature experiences for vacation getaways. Tourism has become a major portion of Wyoming's economy. Instream flow water rights are important to preserve water related outdoor recreation as well as to protect ecological resources. The economic development generated by the fishing industry and recreational activities in the Basin includes jobs, business earnings and personal income to Wyoming. A detailed account of the environmental and recreational uses in the Basin can be found in Technical Memorandum 3D/3E - Recreational and Environmental Water Use.

The NRCS runs the Environmental Quality Incentives Program (EQIP) in Wyoming. The program provides technical assistance, cost sharing and incentive payments to farmers and ranchers that implement conservation practices on their land. Since 1997, over $70 million of EQIP financial assistance has been distributed across Wyoming to address natural resource concerns. These dollars allow private landowners to implement prescribed grazing and other land treatments on rangeland; install improved irrigation and water management systems on cropland; address water quality concerns, including livestock waste management; and improve riparian area health and wildlife habitat. Since the 2002 Farm Bill was adopted and implemented in Wyoming, nearly all of the EQIP funds have been used for conservation practices that enable producers to better deal with drought. EQIP was reauthorized in the 2008 Farm Bill (NRCS 2009). This program is instrumental in promoting

conservation of environmental resources by collaborating with the Basin's largest industry, which is agriculture.

Section 6 – Summary

Conservation in the Basin involves water users from all areas. Conservation can assist the region economically by delaying the date new capital projects are needed to meet growing water demands. Being the largest water user in the Basin, agriculture has the most opportunity to conserve water. There are many rehabilitation projects to address inefficiencies and aging infrastructure in the agricultural community within the Basin. Agricultural water use can also have the biggest impact on other uses. In some cases, agricultural conservation can have beneficial impacts, like the goals in the EQIP program. Other times the effects of water conservation by agriculture can be detrimental to the environment. These are important considerations in water conservation and management in the Basin. To date there has been relatively low emphasis on water conservation in the municipal use sector compared to other western states. Costs and benefits of conservation measures must be considered to optimize water management within the Basin.

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