Section 7 - Economic Feasibility

General

This section provides a review of estimated capital costs for the necessary improvements and identifies the project benefits for the development of a cost to benefit analysis. Several factors can be taken into consideration when determining the ratio of cost to benefits for a project. Some factors are quantifiable, for example the cost of actually building a dam and the water conveyance systems necessary to make the project viable. There are also unquantified costs and benefits that are not traded in the markets and as a consequence they can be included only as estimated potential costs and potential benefits. This section outlines the capital costs, the potential for hydropower and recreation to offset some of the capital costs, and the benefits to agriculture and fish. This section also presents the financial impacts of possible alternatives to the storage project for stream flow enhancement.

Capital Costs

Capital costs are the estimated costs related to this Feasibility Study that require the outlay of dollars to build the facilities necessary for aboveground storage using water diverted from Fifteenmile Creek. In order to conserve water, the majority of the water will be conveyed in pipes with only a short distance of open channel in the Henderson Hollow Dam project and no open channel conveyance in the Rail Hollow Dam project. This Study looks at the estimated capital costs for delivering all of the water from the storage reservoirs directly to the irrigators through pipelines.

The Henderson Hollow Dam site and the Rail Hollow Dam site have the lowest estimated total project costs and are the two sites discussed in this section. The construction of the Larch Creek Dam, and the pipelines necessary for that project, would add an estimated $2.3 million to the project cost over the other two sites and, therefore, is not included in this economic analysis.

Section 2 of this Study discusses the hydrology of the Fifteenmile Creek watershed. The two methods of determining the volume of water available for storage from Fifteenmile Creek are the Water Availability Method, which estimates approximately 4,300 acre-feet of water is available for storage, and the Seasonally Varying Flow Method, which estimates approximately 1,921 acre-feet of water would be available for storage. For the purpose of determining the cost to benefit relationship in this Study, the dams are sized to store approximately 1,900 acre-feet because this volume is most likely to be the amount that is permitted.

Project Construction Costs

Each storage reservoir requires a dam to store the water, a conveyance system to get the water from the point of diversion at Fifteenmile Creek, and a conveyance system to deliver the water from the reservoir to the place of use. The Orchard Ridge Ditch Pipeline and the Valley Pipeline are two components of the complete project that will be used no matter which dam site is used. Following is a discussion of each of the project components and a table for each showing the estimated cost of the improvements.

Orchard Ridge Ditch Pipeline

The Orchard Ridge Ditch being upgraded from an open ditch to a pipeline is one of the few efficiency upgrade opportunities left to accomplish in this watershed, as discussed in Section 6. As stated in Section 6, it is estimated that piping the Orchard Ridge Ditch could save approximately 227 acre-feet annually. The piping of the Orchard Ridge Ditch is a common project that will be used by both the Henderson Hollow site and the Rail Hollow site. Figure 3-2, in Section 3, shows the location of the existing diversion point on Fifteenmile Creek. The existing ditch diversion will be the inlet for the pipeline also. Table 2-3, in Section 2, estimates the amount of flow that will be required in the pipeline in order to transport the available water to the reservoirs. The table shows that an estimated average flow of approximately 14 cubic feet per second (cfs) is available in January and 19 cfs in February. To be conservative, a 30-inch diameter pipe is used in the cost estimate. Considering the existing slope of the ditch and the length of the pipeline that would be installed, a 30-inch diameter pipe would allow up to 30 cfs to be delivered through the pipeline. The additional pipeline capacity could be used during peak flow periods, if needed, to help fill the reservoir. Figure 7-1 shows the estimated cost for the Orchard Ridge Ditch Pipeline. Included is a cost for the upgrade of the existing fish screen in order to provide the additional capacity required.

Valley Pipeline

The proposed Valley Pipeline is shown on Figure 3-3. The proposed pipeline would be used to deliver water along the valley from a location close to the confluence of Ramsey Creek and Fifteenmile Creek, then downstream to the City of Dufur. The landowners with senior water rights will exchange their live flow water for water stored in the reservoir. Figure 7-2 shows the estimated cost of the Valley Pipeline. This pipeline will be used for both the Henderson Hollow and the Rail Hollow sites. The pipe is sized to be able to convey the 5.5 cfs of senior water rights that may be exchanged for stored water.

Henderson Hollow Dam and Pipelines

In order to store 1,900 acre-feet of water in the Henderson Hollow Dam, at the preliminary site location shown on Figure 3-3, the dam will have a top elevation of 1,840 feet with a base elevation of 1,705 feet. The volume of earth fill required in the dam will be approximately 816,000 cubic yards. The water surface area of the reservoir is calculated to be approximately 56 acres.

Figure 3-3 shows the proposed pipeline alignments to convey the water from the Orchard Ridge Ditch Pipeline to the reservoir and also from the bottom of the reservoir to the proposed Valley Pipeline. The alignment shown for the pipeline taking the water to the Henderson Hollow reservoir leaves approximately 2,500 feet of open channel that would need to be armored to prevent erosion of the channel when large volumes of water are to be transported. Connecting directly to the outlet pipe at the bottom of the reservoir and then to the Valley Pipeline will provide adequate gravity pressure for sprinkler irrigation systems.

Figure 7-3 shows the total estimated cost for the Henderson Hollow Dam and all of the conveyance systems to take water to and from the reservoir. The total estimated cost is $13,112,000. This cost includes the Orchard Ridge Pipeline, the pipeline from the Orchard Ridge

Pipeline to the Henderson Hollow reservoir, the channel armor, construction of the Henderson Hollow Dam, the pipeline from the dam to the Valley Pipeline, and the Valley Pipeline. The estimated cost of the water stored calculates to be $6,901 per acre-foot. Amortized over a 50-year period with a 4 percent interest rate, the annual cost of an acre-foot of water is $325.34.

Rail Hollow Dam and Pipelines

The Rail Hollow Dam constructed at the preliminary location shown on Figure 3-5 will store 1,900 acre-feet and have a top elevation of 1,960 feet with a base elevation of 1,867 feet. The volume of earth fill required in the dam will be approximately 553,070 cubic yards. The water surface area of the reservoir is calculated to be approximately 73 acres. Constructing the Rail Hollow Dam at the location shown on Figures 3-5 and 3-6 would require the relocation of the Rail Hollow Road. The estimated cost of the road relocation is included in the cost estimate for the Rail Hollow Dam.

Figure 3-5 shows the proposed pipeline alignments to convey water from the Orchard Ridge Ditch Pipeline to the reservoir and also from the bottom of the reservoir to the proposed Valley Pipeline. With the alignment shown for the pipeline delivering water to the Rail Hollow reservoir, there will be no need for any open channel water conveyance. All water delivered to and from the reservoir would be piped.

Figure 7-4 shows the total estimated cost for the Rail Hollow Dam and all of the conveyance systems to take the water to and from the reservoir. The total estimated cost is $13,063,000. The estimated cost includes the Orchard Ridge Pipeline, the pipeline from the Orchard Ridge Pipeline to the Rail Hollow reservoir, the construction of the Rail Hollow Dam, the county road relocation around the dam and reservoir, the pipeline from the dam to the Valley Pipeline, and the Valley Pipeline. The cost of the water stored calculates to be $6,875 per acre-foot. Amortized over a 50-year period with a 4 percent interest rate, the annual cost of an acre-foot of water is $324.12.

Hydropower Generation

Since all of the water from either dam is proposed to be delivered to irrigators through pipelines, consideration may be given to hydropower generation. The proposed Rail Hollow Dam site is approximately 141 feet higher in elevation than the proposed Henderson Hollow Dam site. The feasibility of hydropower generation will be considered using the elevation of the Rail Hollow site since there will be more available head to generate power. In order to estimate the amount of power that might be produced, a continuous flow of 5 cfs and a head of 138 feet was used in the calculation. The water for hydropower would be available for approximately 192 days during the irrigation season. Using a generator efficiency of 80 percent, the amount of power that could be produced would be approximately 45 kilowatts. The total kilowatt hours (kWH) generated during an irrigation season would be approximately 207,000. Assuming the power could be sold at a rate of $0.04 per kWH, the total estimated income from the power generation could be $8,280.

With no equipment costs or operation and maintenance costs considered, an income from power generation will decrease the cost of water approximately $4.36 per acre-foot of stored water. When the cost of the equipment and also the cost of operation and maintenance of the generator unit are

removed from the estimated income, the income from power generation would not significantly decrease the cost of the water.

The capital cost for a 45 kilowatt generation system is about $175,000. The expected life of these mechanical systems is about 15 years. Amortizing this capital cost over 15 years provides an annual cost of about $15,740. This is more than the $8,280 that could be made from the power generation system. The power generation from this system would not pay for itself.

Recreation

The potential for recreation was considered so that possible economic benefits of recreation could be evaluated. The recreational benefits include boating, fishing, and swimming. The reservoir would be between 53 and 76 acres in size when full. It would be expected to be full from about March through May before it would be drawn down. These months are not prime boating months and the reservoir sizes are not big enough for active boating. The potential for draining the reservoir completely during the irrigation season would also eliminate fishing as a recreational opportunity, as fish stocks would be difficult to maintain. Swimming could be provided before the reservoir was drawn down, but the water temperature would be low and the quality of the water could be limited. The Oregon Department of Environmental Quality (DEQ) has suggested that public access to this reservoir be restricted due to water quality concerns. The ability to collect fees from users that would pay for more than active maintenance of the recreational area is also a challenge. For these reasons, there is no identified additional benefit from recreational uses.

Project Benefits

Most of the farms in the watershed have already been converted to efficient irrigation methods, and as is discussed in Section 6, those farms that have not already changed to more efficient water application systems are in the process of implementing efficiency projects. The benefits of the water storage project to agriculture will be realized from the availability of late season water to land that, under average conditions, would not have late season water. Using the assumption that an average flow of 5 cfs will be exchanged in stream for flow from senior water right holders for a period of 160 days, the amount of stored water exchanged for in-stream flow will be 1,590 acre-feet. With a reservoir capacity of 1,920 acre-feet, there would be 330 acre-feet of water available to be used by other users who do not have senior water rights. These other users could be junior water right holders, or the water could be applied to ground that does not currently have water rights.

For this Study, the assumed value of irrigation water for farmland is $2,000 per acre. This is the difference between the estimated value of irrigated farm land with about 3 acre-feet of water per acre and dry land. Amortizing the value over 30 years at a 4 percent interest rate, the value of the total water applied to the land is approximately $115 per acre. Using the standard duty of 3 acre-feet per acre, each acre-foot is valued at $38. The construction of a pipeline to deliver water directly from the reservoir to the irrigators in a gravity pressure pipeline is an added benefit of the project. Robert Wallace, from Wy'East Resource Conservation and Development, has calculated the average potential energy savings would be approximately $28 per acre for the water delivered through a gravity pressure pipeline. Assuming an average of two-thirds of the total irrigation volume is pumped, the savings would be $14 per acre-foot of water. Adding the energy savings to the amortized value of the water gives an estimated value of $52 per acre-foot.

The operation and maintenance of the facilities will be an additional annual cost over the cost of construction. The operation and maintenance cost is the cost of maintaining the dam, pipelines, fish screen, and any other facilities associated with the storage and delivery of the water. The reservoir is not anticipated to be filled with sediment over time due to the fact that it is off-channel storage. Minor sedimentation may occur, but the reserve capacity built into the reservoir would account for it, so regular maintenance associated with sediment removal would not be needed. Using a $5 per acre-foot annual operation and maintenance cost increases the annual cost from $324 (the estimated annual cost for the construction of the project) to $329 per acre-foot. Subtracting the $52 agricultural value of the water from the capital and operation and maintenance costs of $329 per acre-foot leaves another $277 per acre-foot to be covered for the project to be cost-effective. The benefits to the stream and fish then need to be determined to see if their value would cover the $277 per acre-foot.

Many of the benefits derived from more water left in the stream are not easily quantifiable because they are not traded in the markets and have no price data associated with them to indicate a value. In the Yakima River Basin Study prepared by ECONorthwest for the U.S. Bureau of Reclamation in June 2011, the unquantifiable benefits of higher fish populations and also the possible population increase of other important species is valued at approximately 4 to 9 times that of the benefit to agriculture. Using a value range for the additional water left in the stream of between 4 and 9 times the value to agriculture results in a value between $152 and $342 per acre-foot. The estimated $281 per acre-foot project shortfall is in this range, but closer to the high end of the range. The value was developed based on the Yakima Basin Study and may not be applicable to the Fifteenmile Creek Basin, but it is the best available data for evaluating ecological value.

It is evident that the added benefit to agriculture will not come close to paying for the cost of construction and operation and maintenance of the aboveground water storage project. The feasibility of the project will be dependent on the value placed on the unquantifiable benefits of the project to the Fifteenmile Creek watershed and the aquatic organisms living there.

Alternatives to the Storage Project

In-stream Leases

In-stream water leases could be employed to provide in-stream water. Senior water rights could be leased at a rate of about $73 per acre-foot and junior water rights at about $50 per acre-foot. These rates are considered the current market values for water rights. The leasing of 1,350 acre-feet of senior water rights and 550 acre-feet of junior water rights would cost about $126,000 per year. This is significantly less than the amortized annual capital cost of $623,000 that would need to be paid over 50 years. These leases would be coordinated with the individual landowners. The challenge with this option is finding landowners who are willing to lease the water rights in stream at a sufficient quantity to provide adequate in-stream benefit. This option is also just a lease and the in-stream water could be taken upon expiration of the lease and again used for irrigation. The long-term reliability of this option could be a concern.

Property Purchase

Purchasing the property and transferring the water rights to in-stream is an option. If the purchase price of irrigated agriculture with senior water rights is up to $3,000 per acre, then the 450 acres of senior water rights could be purchased for a total of $1,350,000 to get about 1,350 acre-feet of

water. The junior water right holders may have a claim on a portion of this water as return flows, but if 70 percent of the 1,350 acre-feet of water were turned in-stream, a benefit would still be realized at a fraction of the total cost of the storage project. This option relies of the ability to find willing landowners to sell their property.

Revised Project

Another option to consider is to modify the storage project outlined to reduce the capital costs. The estimated cost of the dam and reservoir on Rail Hollow alone is about $3.0 million of the $13.0 million total project. By releasing the water from the Rail Hollow dam directly into the natural Rail Hollow drainage, adding a small surge storage pond on Rail Hollow just upstream of Dufur Valley Road to ensure that none of the water released from the reservoir drains into the creek, and adding a small amount of piping from the surge pond to senior water right holders just across Dufur Valley Road would provide a revised project cost of about $4.2 million. This is about 31 percent of the total project. This eliminates most of the project piping. It also provides for an unlined ditch that could provide some winter aquifer recharge during January and February when the reservoir is being filled, as recommended by the DEQ. The reduction in project cost would reduce the per acre-foot cost of the water to about $103 per acre-foot per year. This is still in excess of the lease rates for water, but could provide a more long-term and reliable solution than leasing alone. It is also still about two times the agricultural value of the water, but is well within the estimated potential ecological value noted. There are also concerns that water released between the dam and surge pond could be considered Waters of the State and need defined water quality standards.

Managed Underground Storage (MUS)

Consideration should also be given to underground storage. Many of the landowners have supplemental groundwater wells that may be conducive to MUS. During the storage periods, shallow groundwater that is directly connected to the stream could be pumped into the deeper wells and then pumped out during the irrigation season. Other possible methods of MUS could also be considered. This option is beyond the scope of this Study.

Summary

Due to the high capital costs for this project, the agricultural value of the water alone will not pay for the project. There are no anticipated financial benefits from hydroelectric generation or recreational uses. The ability of this project to be paid for is heavily dependent on the value placed on the unquantified benefits derived from the project. Based on the work done in the Yakima Basin in attempting to quantify the ecological value of surface water, it appears that the project benefits may be worth the costs. There are alternatives to the storage project that could be more cost-effective, if they could be implemented. These include in-stream leases and/or property purchases. A survey of the senior water right holders should be pursued to determine the viability of these options.

WASCO COUNTY SWCD
ORCHARD RIDGE DITCH PIPELINE
COST ESTIMATE
MAY 2015

NO.	DESCRIPTION	UNIT	UNIT PRICE	ESTIMATED QUANTITY	TOTAL PRICE
1	Mobilization/Demobilization @ 5%	LS	$ 168,000	All Req'd	$ 168,000
2	Clearing and Grubbing	LS	35,000	All Req'd	35,000
3	Excavation, Backfill, Compaction (Pipe Installation)	LF	50	25,000	1,250,000
4	County Road Crossing	EA	9,000	1	9,000
5	30-inch SDR 32.5 HDPE Pipe and Delivery	LF	60	25,000	1,500,000
6	HDPE Fittings	LS	125,000	All Req'd	125,000
7	HDPE Welding (15% of Pipe Cost)	LS	205,000	All Req'd	205,000
8	Air/Vac Assemblies	LF	1,500	24	36,000
9	Surface Restoration/Seeding	LS	15,000	All Req'd	15,000
10	Fish Screen Renovation to Add Capacity	LS	180,000	All Req'd	180,000
				Total Estimated Construction Cost	**$ 3,523,000**
				Construction Contingency @ 15%	528,500
				Administration, Legal, and Engineering @ 25%	880,700
				TOTAL ESTIMATED PROJECT COST (2015)	**$ 4,932,000**

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WASCO COUNTY SOIL AND WATER CONSERVATION DISTRICT
FIFTEENMILE CREEK WATERSHED
ABOVEGROUND STORAGE FEASIBILITY STUDY
ORCHARD RIDGE DITCH PIPELINE
COST ESTIMATE

FIGURE 7-1

WASCO COUNTY SWCD
VALLEY PIPELINE
COST ESTIMATE
MAY 2015

NO.	DESCRIPTION	UNIT	UNIT PRICE	ESTIMATED QUANTITY	TOTAL PRICE
1	Mobilization/Demobilization @ 5%	LS	$ 69,000	All Req'd	$ 69,000
2	Clearing and Grubbing	LS	50,000	All Req'd	50,000
3	12-inch PVC Pipe, Delivery, and Installation	LF	45	24,000	1,080,000
				Total Estimated Construction Cost	**$ 1,199,000**
				Construction Contingency @ 15%	179,850
				Administration, Legal, and Engineering @ 25%	299,700
				TOTAL ESTIMATED PROJECT COST (2015)	**$ 1,679,000**

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WASCO COUNTY SOIL AND WATER CONSERVATION DISTRICT
FIFTEENMILE CREEK WATERSHED
ABOVEGROUND STORAGE FEASIBILITY STUDY
VALLEY PIPELINE
COST ESTIMATE

FIGURE 7-2

WASCO COUNTY SWCD
1,900 ACRE-FOOT HENDERSON HOLLOW DAM
COST ESTIMATE
MAY 2015

NO.	DESCRIPTION	UNIT	UNIT PRICE	ESTIMATED QUANTITY	TOTAL PRICE
1	Mobilization/Demobilization @ 5%	LS	$ 177,000	All Req'd	$ 177,000
2	Clearing and Grubbing	LS	20,000	All Req'd	20,000
3	Earthwork	CY	2	816,000	1,632,000
4	Upstream Dam Face Riprap	CY	40	11,000	440,000
5	Dam Outlet Piping and Controls	LS	175,000	All Req'd	175,000
6	30-inch SDR 32.5 HDPE Pipe (Orchard Ridge Pipeline to Henderson Hollow Reservoir)	LF	110	11,600.00	1,276,000
7	Open Channel Riprap	CY	40	4,200.00	168,000
				Total Estimated Construction Cost	**$ 3,888,000**
				Construction Contingency @ 15%	583,200
				Administration, Legal, and Engineering @ 25%	972,000
				TOTAL ESTIMATED PROJECT COST (2015)	**$ 5,443,000**

Pipe from Henderson Hollow Dam to the Valley Pipeline

1	Mobilization/Demobilization @ 5%	LS	$ 36,000	All Req'd	$ 36,000
2	Clearing and Grubbing	LS	15,000	All Req'd	15,000
3	18-inch PVC Pipe and Installation	LF	75	9,400	705,000
				Total Estimated Construction Cost	**$ 756,000**
				Construction Contingency @ 15%	113,400
				Administration, Legal, and Engineering @ 25%	189,000
				TOTAL ESTIMATED PROJECT COST (2015)	**$ 1,058,000**

1,900 Acre-Foot Henderson Hollow Dam + Orchard Ridge Pipeline + Pipe to Valley Pipeline + Valley Pipeline:	**$ 13,112,000**
Cost Per Acre-Foot of Storage	**$ 6,901.05**
Annual Cost Per Acre-Foot Amortized over 50 Years at 4% Interest	**$ 325.34**

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WASCO COUNTY SOIL AND WATER CONSERVATION DISTRICT
FIFTEENMILE CREEK WATERSHED
ABOVEGROUND STORAGE FEASIBILITY STUDY
HENDERSON HOLLOW DAM
COST ESTIMATE

FIGURE
7-3

WASCO COUNTY SWCD
1,900 ACRE-FOOT RAIL HOLLOW DAM
COST ESTIMATE
MAY 2015

NO.	DESCRIPTION	UNIT	UNIT PRICE	ESTIMATED QUANTITY	TOTAL PRICE
1	Mobilization/Demobilization @ 5%	LS	$ 143,000	All Req'd	$ 143,000
2	Clearing and Grubbing	LS	30,000	All Req'd	30,000
3	Earthwork	CY	2	553,070	1,106,140
4	Upstream Dam Face Riprap	CY	40	10,600	424,000
5	Dam Outlet Piping and Controls	LS	185,000	All Req'd	185,000
6	30-inch SDR 32.5 HDPE Pipe (Orchard Ridge Pipeline to Rail Hollow Reservoir)	LF	110	8,300	913,000
7	County Road Relocation	LF	50	4,000	200,000
				Total Estimated Construction Cost	**$ 3,001,140**
				Construction Contingency @ 15%	450,171
				Administration, Legal, and Engineering @ 25%	750,200
				TOTAL ESTIMATED PROJECT COST (2015)	**$ 4,202,000**

Pipe from Rail Hollow Dam to Valley Pipeline

1	Mobilization/Demobilization	LS	$ 77,000	All Req'd	$ 77,000
2	Clearing and Grubbing	LS	30,000	All Req'd	30,000
3	18-inch HDPE Pipe and Installation	LF	75	20,000	1,500,000
				Total Estimated Construction Cost	**$ 1,607,000**
				Construction Contingency @ 15%	$ 241,050
				Administration, Legal, and Engineering @ 25%	401,700
				TOTAL ESTIMATED PROJECT COST (2015)	**$ 2,250,000**

Orchard Ridge Pipeline + 1,900 Acre-Foot Rail Hollow Dam + Pipe to Valley Pipeline + Valley Pipeline:	**$ 13,063,000**
Cost Per Acre-Foot of Storage	**$ 6,875.26**
Annual Cost Per Acre-Foot Amortized over 50 Years at 4% Interest	**$ 324.12**

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WASCO COUNTY SOIL AND WATER CONSERVATION DISTRICT
FIFTEENMILE CREEK WATERSHED
ABOVEGROUND STORAGE FEASIBILITY STUDY
RAIL HOLLOW DAM
COST ESTIMATE

FIGURE 7-4