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Executive Summary

Wagoner Cherokee Irrigation District
Level I Master Plan

A Wyoming Water Development Commission Project

November 2002

PMP Civil Engineers
Saratoga, Wyoming

in association with

States West Water Resources Corporation
Cheyenne, Wyoming

Water Right Services, LLC
Cheyenne, Wyoming
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Introduction

The Wagoner Cherokee Irrigation District (District) is located in southern Carbon County near the Towns of Encampment and Riverside as shown in Figure 1. On June 3, 2002 PMPC, in association with States West Water Resources Corporation and Water Right Services, LLC, entered into a Consultant Contract for Services No. 05SC0291673 with the Wyoming Water Development Commission (WWDC) to evaluate the existing river diversions, structures, supply system canals, and major laterals in the District.

The Wagoner and Cherokee Ditches have been in service for many years. Currently, they have a combined diversion water right of 47 cfs from the Encampment River. Together, they irrigate approximately 3,300 acres in the District. Other smaller ditches in the District irrigate approximately 1,200 acres. Thirteen landowners and one subdivision are included within the District. The District is investigating the possibility of counting the subdivision as a single landholder for purposes of the District. The District boundary is shown on Figure 1.

Several existing problems were evaluated as a part of this Project. The District’s main concern is the diversions for the Wagoner and Cherokee Ditches. The existing diversions are unstable and require extensive annual maintenance. When the Encampment River is running at high flows, the ditches function well and the District is able to divert the water they are entitled to, but at low flows they are not able to divert this water.

The District is also concerned with seepage. When the ditches carry water, there is standing water below the ditches, indicating seepage. The extent of the seepage is unknown.

Another concern of the District is the water rights. The water rights on record with the State Engineer’s Office do not correlate with historic irrigation practices. As a by-product of this Project, the District will restructure their water rights to agree with historic irrigation procedures. Also, there are some existing lateral ditches within the District that are not currently utilized and the water rights for these unused ditches are being carried in other ditches. Some ditches are not used because, at low river flows, the water users cannot divert water into the ditches and need to find another means of conveyance, such as another ditch. It is possible that some of these water rights can be moved to the Wagoner or Cherokee Ditches. Finally, some water users are dependant upon return flow from their neighbors, which is not ideal. By restructuring the water rights, land owners can receive their entitled water.

There are insufficient flow measurement devices, making it difficult to regulate ditch flows.

The ditch owners have a gentleman’s agreement for the ditch operation and maintenance, with no dedicated means to access the ditch for operation and maintenance. Typically, access has been through a private roadway on private property. Ideally, incorporation of an access roadway would be included in the Project, as well as a formal operation and maintenance agreement.
The District is investigating the possibility of combining the ditches and constructing a single durable and environmentally sound diversion structure in order to reduce seepage and improve system efficiency. To make the needed improvements, the ditch owners need to form a legal entity such as an Irrigation District that is recognized as a government entity and is eligible for loan and grant funding through the WWDC. The Wagoner Cherokee Irrigation District is in the process of being formed. The WWDC policy requires District formation for WWDC to proceed with the Project beyond this Level I study.

Inventory of Existing System

PMPC reviewed the available data from the Saratoga State Engineer’s Office (SEO) regarding available flow and ditch diversion records. Diversion records are available only for the 2001 irrigation season for the Wagoner Ditch. The SEO’s diversion data were obtained from a six-foot Parshall flume that was installed in the Wagoner Ditch in 2001. The other ditches do not have any flow measurement devices. Operation and maintenance records have not been kept for the ditches.

Water Right Services reviewed SEO and Board of Control (BOC) water rights records. Robert Jack Smith & Associates provided Figure 2 depicting the permitted irrigated lands and use of the water rights within the District.

PMPC conducted a field investigation intermittently from June through September, 2002. During this time the ditches were surveyed, inventoried, and gaged.

The purpose of the field investigation was to examine and inventory ditches and supply canals to assess the condition of the existing structures and operation of the ditches; gage ditch flows from the diversions to Highway 230 to determine the extent of the seepage; and conduct a preliminary survey of the Cherokee Ditch river diversion, supply canals, and headgates of major laterals.

The field investigation was divided into two sections, south and north of Highway 230. Because the District wanted to focus on improvements south of Highway 230, the field investigation was more concentrated and detailed in this area.

Cherokee Ditch

Based on the historic irrigation practices, the Cherokee Ditch irrigates 2,150 acres in the District, resulting in a single appropriation water right of 30.71 cfs. The permitted water use for the Cherokee Ditch can be seen in Figure 2. There are no diversion records for the Cherokee Ditch; however, it has been speculated that, at high flows, the ditch carried over 90 cfs during the 2001 irrigation season. In order for the Cherokee Ditch to carry high flows, the water overtops the banks in numerous locations.

The Cherokee Ditch is approximately 8.4 miles long and its cross section varies considerably along its length. From the diversion to Highway 230, the ditch varies anywhere from a bottom width of 7 feet to 20 feet, and the depth varies from 2 feet to 4 feet. The amount of willows, trees, and brush also varies in different stretches of the ditch. The largest variation of the ditch is at the south end near the diversion where the ditch cuts through a large rock outcrop.
The Cherokee Ditch river diversion is a rip rap structure in the Encampment River. This type of structure requires substantial maintenance and has a history of operational problems. The dam washes out annually and has to be at least partially reconstructed every year within the river channel. Upstream of the dam, there is a slide gate and corrugated metal pipe.

All structures were inventoried in the main stem of the Cherokee Ditch. South of Highway 230, the structures are comprised of a concrete and stop log spillway, and a double barrel reinforced concrete box culvert at Highway 230. There are no turnouts in this section of the ditch.

There are many structures in the Cherokee Ditch north of Highway 230. The structures are comprised of turnouts, check structures, and ditch crossings. The conditions of these structures range from poor to excellent. The turnouts range from a single corrugated metal pipe to slide gates to concrete and stop-log structures with check structures.

Preliminary gaging of the Cherokee Ditch was conducted June 21, 2002. Flow measurements were taken at five locations. The stream gaging was limited to the area south of Highway 230 where the potential seepage treatment alternatives would be analyzed.

At the diversion from the Encampment River, 58.1 cfs was flowing in the Cherokee Ditch and a total of 12.5 cfs was seeping from the ditch, resulting in an overall seepage loss of 21.5%. The majority of the seepage is concentrated in two main areas. Forty six percent of the seepage is through the rock outcrop area and forty percent through the last 2,300 feet of ditch south of Highway 230.

Wagoner Ditch
Based on the historic irrigation practices, the Wagoner Ditch provides water to 1,114 irrigated acres in the District, resulting in a single appropriation of 15.91 cfs. The permitted water use for the Wagoner Ditch can be seen in Figure 2. There is only one diversion record for the Wagoner Ditch and it is for the 2001 irrigation season. The Wagoner Ditch is approximately 5.3 miles long and its cross sections vary considerably along its length. From the diversion to Highway 230, the ditch varies anywhere from a bottom width of 9 feet to 13 feet, and the depth varies from 2 feet to 4 feet.

The Wagoner Ditch river diversion is a rip rap structure in the Encampment River. The dam washes out annually and has to be at least partially reconstructed every year within the river channel. This type of structure requires substantial maintenance and has a history of operational problems. The diversion structure is in fair condition. The concrete structure has two openings that control water inflow by wooden slide gates. The structure appears to be structurally sound, except that the wooden slide gates no longer function properly.

North of the Wagoner Ditch diversion is a concrete and stop log spillway, consisting of a concrete structure with stop logs. The only measurement device south of Highway 230 is located in the Wagoner Ditch. There is a 6 foot Parshall flume and stilling well located approximately
FIGURE 2 - WAGONER AND CHEROKEE DITCH WATER RIGHTS

<table>
<thead>
<tr>
<th>DITCH</th>
<th>PERMIT NO.</th>
<th>PRIORITY</th>
<th>AMOUNT</th>
<th>ACRES</th>
</tr>
</thead>
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<tr>
<td>WAGONER DITCH</td>
<td>188603</td>
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<td>715</td>
<td>10.03</td>
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<tr>
<td></td>
<td>188708</td>
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<td>3.98</td>
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<td></td>
<td>196406</td>
<td>12</td>
<td>1.40</td>
<td>98.4</td>
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<tr>
<td>CHEROKEE DITCH</td>
<td>189611</td>
<td>11</td>
<td>4.51</td>
<td>320.0</td>
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<tr>
<td></td>
<td>190108</td>
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<td>0.43</td>
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<td>4.07</td>
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<td>9.98</td>
<td>698.6</td>
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<tr>
<td></td>
<td>196908</td>
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<td></td>
<td>198806</td>
<td>3</td>
<td>259.0</td>
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<td>OTHER APPROPRIATORS</td>
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<td>DULLES - 297.0 ACRES</td>
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<td>FRANCE - 114.8 ACRES</td>
<td>196406</td>
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<td>LAZY II - 183.1 ACRES</td>
<td>196406</td>
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<td>DESIGNATION</td>
<td>WAY - 234.6 ACRES</td>
<td>196406</td>
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<td></td>
<td>SILVER SPUR - 702.6 ACRES</td>
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<td>PERYAM - 242.0 ACRES</td>
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<td></td>
<td>PLATT - 218.0 ACRES</td>
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<td></td>
<td>DALKE - 227.0 ACRES</td>
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<td></td>
<td>YVVEY - 136.0 ACRES</td>
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<td></td>
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<tr>
<td></td>
<td>CARBON COUNTY, WYOMING</td>
<td>196406</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
800 feet downstream of the diversion. There are two main turnouts in this stretch of the ditch. At Highway 230, there is a double barrel reinforced concrete box culvert.

There are a large number of structures in the Wagoner Ditch north of Highway 230. The types and condition of the structures are similar to those in the Cherokee Ditch.

Preliminary flow gaging of the Wagoner Ditch was conducted June 26, 2002. Flow measurements were taken at seven locations. The stream gaging was limited to the area south of Highway 230 where the potential seepage treatment alternatives would be analyzed.

At the diversion from the Encampment River, 42.2 cfs was flowing in the Wagoner Ditch and a total of 6.6 cfs was seeping from the ditch resulting in an overall seepage loss of 15.6%. The seepage from the Cherokee Ditch may seep into the Wagoner Ditch and further investigation is recommended to determine if this is the case.

**Other Ditches in the District**

There are other ditches within the District that supply water to irrigated lands in the District. Ditches on record with the SEO include the Peryam No. 2, Mill Ditch, Mill Race Ditch, Wagoner No. 3 Ditch, Topfield Ditch, and Tomahawk Ditch. Many of these ditches divert water from the East Channel of the Encampment River. There are also many other supply ditches that are not on record with the SEO.

**Water Rights**

The Wagoner Ditch has priority dates from 1885 through 1954 with a total appropriated amount of 15.41 cfs (1,079.0 acres), and the Cherokee Ditch has priority dates from 1895 through 1968 and has a total appropriated amount of 23.6 cfs (1,659.0 acres) plus 7.21 cfs (505.0 acres) of supplemental supply. A total of 3,243.0 acres, including the supplemental supply, can be irrigated through these ditches. During times of low flows in the Encampment River, numerous downstream ditches are diverted through the Cherokee Ditch without a proper change of point of diversion being recorded with the State Board of Control.

**Rehabilitation Alternatives**

The purpose of the system design was to identify potential improvements to the existing irrigation facilities. More specifically, evaluate improvements designed to increase system efficiency by possibly combing the Wagoner and Cherokee Ditches and reducing seepage.

The rehabilitation alternatives were developed using two primary strategies for the diversion structures. One was to maintain separate diversion structures for the two ditches and the other was combining the ditches and utilizing one diversion structure.

Combining the diversions into one could potentially reduce the total cost of the improvements. However, the combined ditch would need to be enlarged to carry appropriations for both ditches and the water would have to be separated at some location. Two possible locations for this diversion are prior to the Wagoner Ditch spillway and at Highway 230.
For design purposes, the capacities for the ditch alternatives were developed using the permitted use of the water rights and the lands historically being irrigated from those water rights. Table 1 summarizes the design capacities for the historically irrigated lands. The areas (irrigated acres) for Table 1 are taken from Figure 2. The single appropriation is based on one cfs per 70 acres. For purposes of this report, the surplus water capacity is based on two cfs per 70 acres and three cfs per 70 acres for the excess water capacity.

Table 1 – Design Capacities for Ditch Alternatives

<table>
<thead>
<tr>
<th>Ditch</th>
<th>Irrigated Acres</th>
<th>Single Appropriation (cfs)</th>
<th>Surplus Water Capacity (cfs)</th>
<th>Excess Water Capacity (cfs)</th>
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</thead>
<tbody>
<tr>
<td>Wagoner</td>
<td>1114</td>
<td>15.9</td>
<td>31.8</td>
<td>47.7</td>
</tr>
<tr>
<td>Cherokee</td>
<td>2150</td>
<td>30.7</td>
<td>61.4</td>
<td>92.1</td>
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<tr>
<td>Other Appropriators</td>
<td>1173.3</td>
<td>16.8</td>
<td>33.6</td>
<td>50.4</td>
</tr>
<tr>
<td>Totals</td>
<td>63.4</td>
<td>126.8</td>
<td>190.2</td>
<td></td>
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</table>

As a solution to the seepage problem, different types of ditch treatments were evaluated. The seepage treatments range from concrete lining to bentonite treatment. Other options include a geosynthetic clay liner and a polypropylene liner. An analysis of no treatment with ditch cleaning was also considered for economic purposes, which would provide a clean, larger, and more uniform ditch. These possible solutions were evaluated for both the surplus water capacity and excess water capacity.

For the diversion structure, two methods of checking up the lowered section were investigated. “Obermeyer”-type gates are steel overflow gates that are raised and lowered by air bladders. The gates in the lowered position are flat on the bottom of the channel and protect the bladders. The gates can be operated automatically to maintain the water at the crest elevation by use of a bubbler system. A small building is required to house a compressor, air tank, and controls. Electric power is desirable for this system. This system has a higher initial cost, but has low operation costs.

The second type of system investigated is a stop-log check-up system. The lowered sections incorporate stop-log guides that are swiveled to a vertical position when in use and horizontal when not in use. The logs are placed by hand labor when the river flow drops below the crest elevation. Typically, the structure is checked up by placement of part of the stop logs, and additional logs installed as flows continue to drop. The logs must all be removed in the fall and the stop log guides lowered. This system is more economical, but is much more labor intensive.

**Conceptual Design**

The preferred diversion dam alternative is a combined diversion structure at the Cherokee site incorporating the “Obermeyer”-type overflow gates. The structure height was determined by the required head to divert 126 cfs to the canal. The headgate and flume would be capable of diverting up to 190 cfs at higher river stages.
Combining the ditches from the proposed combined Cherokee Ditch Diversion then spilling back in the Wagoner Ditch prior to the Wagoner Ditch spillway is the best solution to meet the District’s goals. The District has expressed concerns for the need to design the proposed ditch for excess water. Therefore, the excess water ditch capacity of 190 cfs is the recommended alternative. The proposed ditch section is trapezoidal. The bottom width is 15 feet; the depth is 3.5 feet with 1 foot of freeboard. The side slopes are proposed as 1:1, but could be vertical through the rock outcrop, if necessary, to minimize the rock excavation.

The flow measurement analysis shows that a large portion of the water seeping from the Cherokee Ditch is through the rock outcrop area. Therefore, it is recommended to include a seepage treatment option. The GCL is the most economical for the benefits it provides. Therefore, the recommended alternative is a GCL ditch from the combined diversion structure to the Wagoner Ditch spillway with a design capacity for excess water conditions.

For the recommended preliminary rehabilitation plan, the water for the Wagoner Ditch will be carried in the Cherokee Ditch until it spills back into the Wagoner Ditch at the existing Wagoner Ditch spillway. At the location where the single ditch branches into two ditches, a diversion structure is required. The diversion structure was designed to divert half of the design capacity, 95 cfs, back into the Wagoner Ditch while maintaining the other half in the Cherokee Ditch. The diversion structure will be constructed of reinforced concrete with slide gates. A five-foot Parshall flume to measure the water diverting into the Wagoner Ditch is proposed at this location.

**Conceptual Cost Estimates**

Table 2 summarizes the total project costs and details a repayment plan. Figures include an assessment with and without the United States Fish and Wildlife (USFW) Section 7 depletion payment for both a 20 and 30-year repayment period.

The total projected cost is $550,000. The WWDC funding for the Project was assumed to be 50% WWDC grant and 50% WWDC loan. The figures in Table 2 are based on the assumption that 3,264 acres (2,150 acres for the Cherokee Ditch and 1,114 acres for the Wagoner Ditch) as shown on Figure 2 will benefit and be assessed for the proposed improvements. The costs of the improvements will only be assessed to the benefited acres in the District.
Table 2 – Total Project Cost Estimate and Repayment Plan

<table>
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<tr>
<th>Preliminary Rehabilitation Plan</th>
<th>Cost</th>
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<tr>
<td>Combined Diversion Structure</td>
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<tr>
<td>GCL Ditch Lining</td>
<td>$150,000</td>
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<tr>
<td>Wagoner Ditch Diversion Structure</td>
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<td><strong>Total</strong></td>
<td><strong>$550,000</strong></td>
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<td>WWDC 50% Loan*</td>
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<table>
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<tr>
<th>Annual Payments</th>
<th>Repayment Period</th>
<th>20 year</th>
<th>30 year</th>
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<td>Annual Loan Payment</td>
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<td>Annual Operation and Maintenance</td>
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<td>$2,000</td>
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<td><strong>Section 7 Depletion Payment</strong></td>
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<td><strong>Section 7 Depletion Payment</strong></td>
<td>$10.78</td>
<td>$9.55</td>
</tr>
</tbody>
</table>

*The loan is based on a 6% interest rate.

**The assessment per year is based on assumed benefited area of 3,264 acres.

Permits for Construction

For construction of the proposed improvements, the District may need to obtain permits or authorization from the following agencies: Corps of Engineer’s (COE), United States Fish and Wildlife, Wyoming Game and Fish Department, Wyoming DEQ, Water Quality Division, State Historic Preservation Office, State Engineer’s Office (SEO), and Property Owners. This list may not be inclusive.

Economic Analysis

A cost/benefit analysis is essential for the District to determine whether or not to continue with the Wagoner Cherokee Ditch improvements. Projected costs are included in this report. Historic data is not available to effectively quantify the benefits of the improvements. By constructing a combined diversion structure, the District will have the ability to divert the water they are entitled to during low flows, which they have historically not been able to do. Therefore, depending on the year, the District can divert more water during the irrigation season and for a longer period of time. Also, the proposed diversion structure will provide ease of operation and maintenance and reduce the annual operation and maintenance costs. Also, by obtaining District formation the District will have the advantage of administering the water in the District.

At the time of the report, the District has not committed to a funding amount and has not given any indication as to what the additional water, made available for irrigation resulting from the improvements, is worth.
Conclusions and Recommendations

The Wagoner Cherokee Irrigation District should continue with District formation. With District formation, they will have the ability to proceed with a WWDC Level II study. The Level II study will give the District the opportunity to further investigate seepage loss, alternate funding sources, more specific priorities, and more defined costs estimates based on a selected alternative. The Level II study is solely funded by the WWDC. By pursuing a Level II study the District is not obligated to proceed with Level III construction.

The preliminary rehabilitation plan recommends a combined diversion structure at the location of the existing Cherokee Ditch diversion and a combined ditch to the Wagoner Ditch spillway, where the Wagoner Ditch will be diverted from the combined ditch. This recommendation includes a geosynthetic clay lining. From the seepage analysis, forty six percent of the total seepage in the Cherokee Ditch is through the section containing a rock outcrop. It is recommended that, as part of the Level II study, the District further investigate seepage loss. They can then isolate the stretches of ditch that have the most loss and consider treatment options in those specific areas.

To determine if the seepage from the Cherokee Ditch seeps into the Wagoner Ditch, it is recommended that, during the next irrigation season, the Wagoner Ditch be turned on prior to the Cherokee Ditch and the flow in the Wagoner Ditch measured and the seepage loss calculated. Then, turn on the Cherokee Ditch and measure flows in the Wagoner Ditch and in the Cherokee Ditch and calculate seepage from both ditches. Then, the two seepage losses can be compared and verify this speculation and determine the extent of the seepage into the Wagoner Ditch. The consultant chosen for the Level II study will not be able to provide services for this task because the contract notice to proceed will be awarded in early June after irrigation season starts and both ditches are turned on. Also, flow measurements could be taken at varying flows in the ditch to determine the seepage loss at varying high and low flows.

Prior to the Level II study, the District needs to organize their water rights and identify historically irrigated lands. The District has broadly discussed the possibility of transferring water rights from the ditches within the District to the Wagoner or Cherokee Ditches. The Level II study could better define the cost assessments based on more accurately defined benefited acres.

A ditch maintenance agreement was not proposed during the Level I study. Further consideration should be given to a formal agreement for operation and maintenance, of the ditches, including a dedicated means of access.

One further recommendation is that the District reevaluate the District boundary. Consideration should be given to omit the area west of the Encampment River and include the small area of the Cherokee Ditch that is outside the proposed boundary at the north end of the Project area.

A final recommendation is for the District to investigate alternate funding sources.