Mailing Address:
Water Resources Data System
University of Wyoming, Dept 3943
1000 E University Avenue
Laramie, WY 82071

Physical Address:
Wyoming Hall, Room 249
University of Wyoming
Laramie, WY 82071

Phone: (307) 766-6651
Fax: (307) 766-3785

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EXECUTIVE SUMMARY
FOR THE
BEAVER CREEK LEVEL I WATERSHED STUDY

PREPARED FOR:
WYOMING WATER DEVELOPMENT COMMISSION
WESTON COUNTY NATURAL RESOURCE DISTRICT

PREPARED BY:
OLSSON ASSOCIATES

IN ASSOCIATION WITH:
STEADY STREAM HYDROLOGY,
RON E. VORE, PH.D.
AND KEITH CULVER

NOVEMBER 1 20 8

OLSSON® ASSOCIATES

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Executive Summary

for the

Beaver Creek
Level I Watershed Study

WWDC Contract for Services
Number 05SC0296974
Olsson Project Number 017-1618

November 1, 2018

I hereby certify that this report was prepared by us or under our direct supervision and that we are duly licensed professional geologists and engineers under the laws of the state of Wyoming.

Karen Griffin 11/1/2018

Karen Griffin, PG

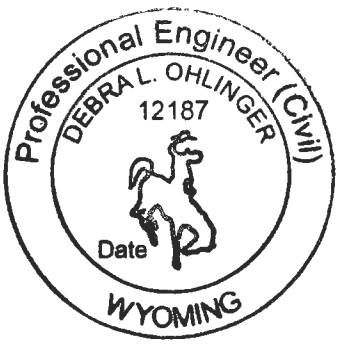
Debra L. Ohlinger 11/1/2018

Debra L. Ohlinger, PE

Olsson Associates

601 P Street, Suite 200
Lincoln, Nebraska 68508

1525 Raleigh Street, Suite 400
Denver, Colorado 80204



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Executive Summary

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1. INTRODUCTION

This Level I watershed study was prepared under contract to the Wyoming Water Development Commission (WWDC). The Weston County Natural Resource District (WCNRD) in Newcastle, Wyoming, is the project sponsor, and the plan was prepared on behalf of the landowners, land managers, stewards, and visitors of the Beaver Creek watershed. Olsson Associates (Olsson) completed the study in collaboration with Steady Stream Hydrology Inc. of Sheridan, Wyoming, Ron E. Vore, Ph.D. of Sundance, Wyoming and Keith Culver of Newcastle, Wyoming.

1.1. Purpose and Scope of the Study

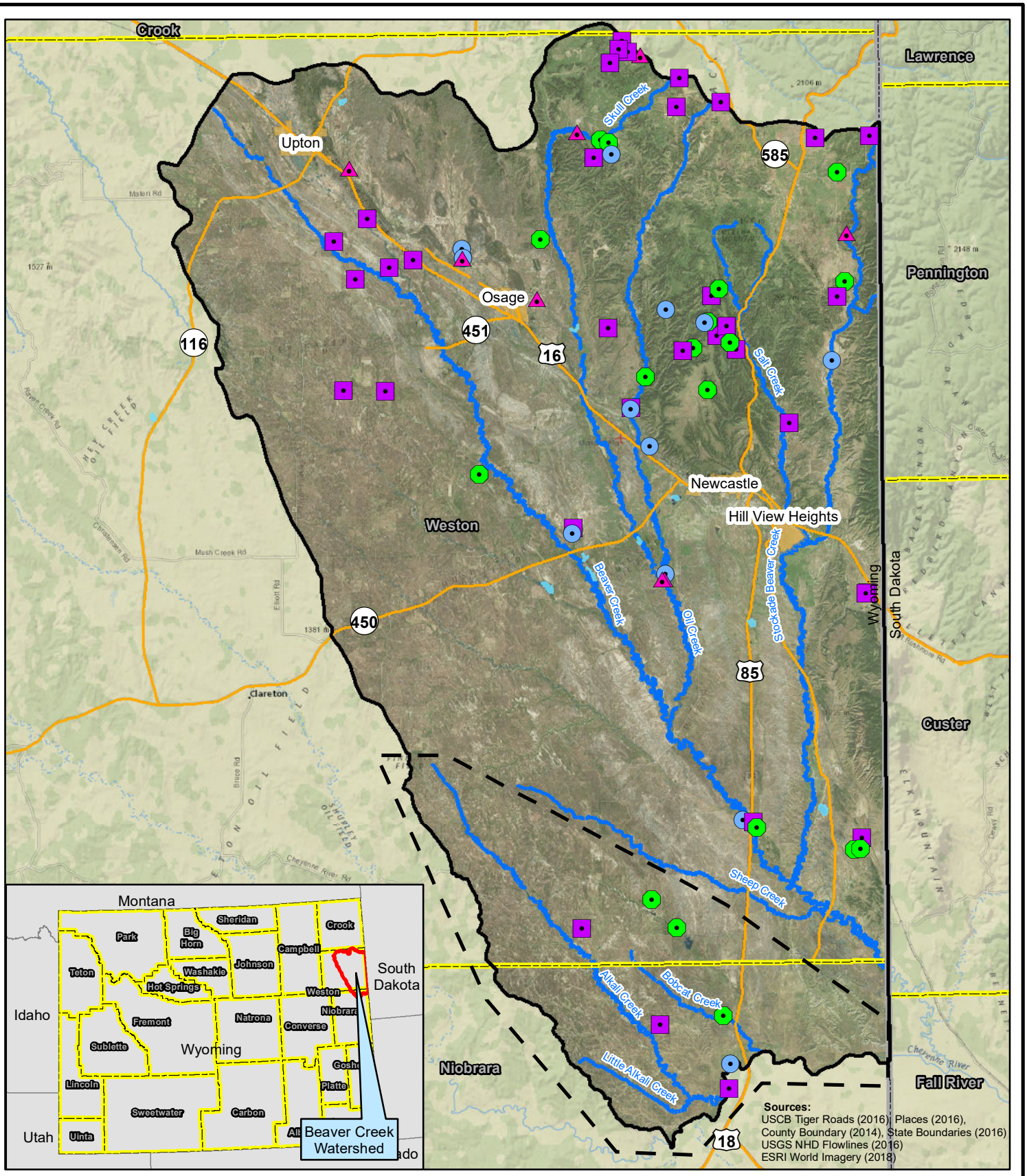
__The purpose__ of this Level I watershed study and management plan is to describe the Beaver Creek watershed in its current condition, to suggest resolutions for water-related issues, and to provide insight into opportunities for improvements.

A watershed study is holistic evaluation of an area that is interconnected by water. A Level I watershed study evaluates the current condition of an area and looks at opportunities for water improvement projects that will restore, maintain, and enhance healthy watershed function. Specifically, a Level I watershed study looks for projects, programs, or activities that support sustainable, beneficial water use for current and future watershed residents – be they human, animal, or plant. The study is comprehensive in that it evaluates many aspects of the natural setting to ensure that any proposed projects that are beneficial to one water user, are indeed beneficial to the watershed as a whole. A holistic approach to watershed management was made a keystone by the WWDC when the watershed program was developed.

The Beaver Creek watershed is located primarily in Weston County, with a small tip on the north end in Crook County and on the southern end of the watershed in Niobrara County. The watershed covers over 884,000 acres and is defined by the interconnected stream drainage area of Beaver Creek and its numerous tributaries, including Skull, Oil, West Plum, Sweetwater, Salt, Stockade Beaver, and Sheep Creek and numerous other drainages. The watershed is connected by the surface water drainages of Beaver Creek, where any raindrop or snowflake that falls within this geographic area, will flow out of the study area into South Dakota just south of the Weston and Niobrara County line.

__The geographic scope__ of the study is illustrated in Figure ES-1. The watershed study area is not defined by political subdivisions or boundaries such as counties or roads but by the water system that sustains it.

At the beginning of this project, the project sponsor, WCNRD and the WWDC, decided to expand the study area to the south to include Bobcat, Alkali, and Little Alkali creeks. These three creeks drain into the Cheyenne River, but they were not included in the adjacent Thunder Basin watershed study. By including this small area of the Cheyenne watershed in the Beaver Creek study area, this project contains drainages that may otherwise have been missed in additional watershed studies. Furthermore, the area that encompasses Bobcat, Alkali, and Little Alkali creeks has issues in common with the Beaver Creek watershed that can be addressed as part of this study. Therefore, for the purposes of this study and this report, the Beaver Creek watershed includes the entire Beaver Creek watershed in the state of Wyoming and the three creeks (Bobcat, Alkali, and Little Alkali) that are adjacent to the south in the Cheyenne watershed.



Irrigation System Improvement
Livestock/Wildlife Watering Improvement
Other Management Practice Improvement
Water Supply/Storage Improvement
Major Rivers and Streams
Major Road
Municipal Area
Major Body of Water
Area Added to Watershed Study
State Border
County Border
Beaver Creek Watershed

OLSSON ASSOCIATES

N

0 1.5 3 6 Miles

1 " = 35,000 '
Original Published Resolution
NAD 1983 UTM Zone 12N
ESRI World Imagery

WWDC Beaver Creek Watershed Study
Niobrara and Weston Counties, Wyoming
Proposed Project Locations

FIGURE
ES-1

F:\20171501-2000\017-163740-Design\GIS\2018-07-19_BeaverCreekWatershedLocationMap.mxd PUBLISHED BY: gmalek-madani DATE: October 30, 2018

1.2. Key Issues in the Watershed

The WCNRD requested this Level I watershed be conducted to address specific issues that are affecting the area. Initially, the WCNRD board of directors was asked to identify its top concerns. The issues were summed up in the watershed study application as follows:

> *We have minimal precipitation in our area, we do not have much surface water available for crops or livestock/wildlife. Water development is crucial to our communities, ranches, and wildlife.*

Throughout development of this watershed study, public meetings were held at the Natural Resources Conservation Service (NRCS) office in Newcastle, Wyoming, where landowners, ranchers, and interested citizens were invited to identify potential water development projects that would benefit their properties, their operations, and/or the area. The following list and Table ES-1 summarize the recurring themes and issues identified by the attendees at the public meetings.

- There is a lack of adequate water for livestock and wildlife across most of the watershed
- Pipelines are needed to provide water to tanks across several pastures for rotational grazing
- Spring developments would benefit livestock and wildlife across dry areas
- Stock dams are silted in or washed out and no longer provide water for livestock/wildlife
- Irrigation diversion structures require replacement where damage has occurred
- Irrigation system improvements would provide optimization and conservation
- Converting windmills to solar power would provide a reliable energy source for stock wells

Table ES-1 Beaver Creek Watershed Issues, Opportunities, and Resolutions

Landowner Identified Issue or Opportunity	Proposed Resolution
There is a lack of water in specific areas that could be resolved with pits, ponds, and/or solar wells.	Over 90 percent of the proposed rehabilitation projects include wells, tanks, and/or small stock dams to provide a water supply in specific areas.
The biggest issue in the Beaver Creek is the quantity and distribution of water.	Over 90 percent of the proposed projects involve developing new water sources in areas that currently do not have an adequate water supply.
The best water source is very deep, and the cost is prohibitive.	One solution is to build pipelines to supply water from these deep, expensive wells across many landowners to share the cost of well installation.
It is unknown whether rebuilding a breached dam or replacing the source with a well and pipeline is better.	What might work best in one area may not in another due to the depth to groundwater or other factors. In general, the best solution is typically to build pipelines and stock tanks to better distribute the supply water.
The Beaver Creek Reservoir study from 1991 can be updated to determine the feasibility and cost at present.	A fully revised engineering cost estimate and feasibility study was not within the scope of this project; however, a current cost for the project was estimated to be $30-$40 million.

Landowner Identified Issue or Opportunity	Proposed Resolution
Many of the windmills have leather that need to be replaced often. Converting them to solar power wells would be much more cost effective.	Ten windmill conversions to solar power pumps were proposed in the watershed management and rehabilitation plan.
There are many small- and medium-size pits and ponds that are silted in and need to be cleaned out.	Twenty pond rehabilitations that include dredging were proposed in the watershed management and rehabilitation plan.
Old springs can be developed as a water source to fill ponds.	Five projects were proposed to develop existing springs to supply water to new and existing ponds in the watershed management and rehabilitation plan.
There are concerns about water quality and quantity during times of drought.	The water quality issue addressed through some of the projects was sedimentation due to excessive erosion. Quantity issues were addressed through many of the water supply and upland water projects.
Across the watershed there are breached dams because of disintegrating galvanized outlet pipes. These pipes should be replaced to avoid additional damage.	Twenty pond rehabilitations were proposed in the watershed management and rehabilitation plan.
Cottonwood tree populations are declining, and trees are not regenerating.	This issue was not specifically addressed as part of this watershed study. It was discussed, but the issue may have to do with the changing flow regime of the Beaver Creek and Cheyenne River and other ecological factors.
The USDA Weston County Farm Service Agency representative noted that the area lacks adequate automated weather stations to document climate data for disaster relief.	The Director of the Water Resources Data System (WRDS) & State Climate Office was contacted concerning the need for an automated weather station. Currently WRDS is working with several states on a project to get federal funding for improvements to weather stations located in the Upper Missouri River Basin. If federal funding becomes available in 2020, as part of Wyoming's share of that funding, a request will be made for a weather station in the NE portion of the state.
Increased storage and decreased runoff should be balanced with habitat maintenance and enhancement of riparian areas.	To ensure there is a balance, the proposed watershed improvement projects include both small dams and upland well/pipeline projects.
Less reliance on shallow stock ponds to water livestock and more reliance on wells and pipelines will reduce evaporation and the creation of mud flats.	Numerous pipeline projects were proposed as part of the watershed management and rehabilitation plan.

Landowner Identified Issue or Opportunity	Proposed Resolution
Water quality enhancements will increase livestock growth and health performances.	Overall, the projects proposed in this watershed study are designed to increase the health and function of the watershed for livestock production and wildlife habitat.
Most of the streams are already fully-appropriated and many areas that have irrigation water rights are seldom irrigated due to lack of adequate water.	One resolution proposed was to develop deeper wells that service multiple landowners and places less demand on alluvial water.

2. WATERSHED MANAGEMENT PLAN AND MORE

Ultimately, the final objective of this Level I watershed study is to provide plans for watershed management and rehabilitation that are practical, technically sound, feasible, and cost effective. Watershed management plans for the Beaver Creek watershed incorporate a wide variety of project types including the following:

- Livestock/Wildlife Watering Improvements
- Water Supply and Storage Improvements
- Irrigation System Improvements
- Other Management Project Improvements

The conceptual plans for the improvements were developed by the Olsson project team of scientists and engineers in collaboration with local agencies and partners described throughout this document. Collaboration was important to ensure that the proposed projects were practical and feasible in the unique ecological setting and regulatory environment of the Beaver Creek watershed.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

This Level I watershed study evaluated the current condition of the Beaver Creek watershed and looked at opportunities for water improvement projects to restore, maintain, and enhance healthy watershed function. The current condition of the watershed was evaluated and summarized in the inventory, descriptions and streamflow hydrology of the watershed study. The datasets and reports evaluated for the inventory and descriptions were incorporated into a GIS dataset and digital library provided electronically to the WCNRD and WWDC. The datasets and digital library will provide the WCNRD, WWDC, and cooperating agencies information for planning and implementation of the watershed improvements outlined in this report.

3.1. Recommendations

A Level I watershed study looks for projects, programs, or activities that support sustainable, beneficial water use for current and future watershed residents–human, animal, or plant. The following recommendations are made to help foster this goal. At the end of this section, Table ES-2 lists the specific project recommendations developed for the Beaver Creek watershed. Landowners or leasees of the proposed projects and cost estimates are provided for reference.

3.1.1. Livestock/Wildlife Watering Opportunities

One of the best options to enhance rangeland is to ensure adequate watering opportunities for livestock and wildlife. With dispersal of livestock watering sources away from riparian zones, these zones are relieved of grazing and trampling pressure. Little used forage on upland areas have a greater chance of being accessed by foraging animals with these proposed water sources. For these reasons, livestock/wildlife watering development projects in underserved areas are recommended.

An example of a proposed spring development project.

The 39 proposed livestock/wildlife projects include the combinations of the following elements: development of existing springs; modification of oil wells; windmill conversions; and installation of groundwater wells, solar powered pumps, stock tanks, piping and fencing to maximize water distribution for livestock and wildlife. The cost estimates for the projects range from less than $5,000 to rehabilitate an existing spring near Newcastle to a pipeline project at Mule Creek Junction that would cost over $700,000. Cost estimates varied greatly depending on the length and type of proposed pipeline. Additional livestock/wildlife water development improvements could be made, as needed, using the plans and cost estimates provided in this report as a guide for conceptual design, cost and financing opportunities.

3.1.2. Water Supply and Storage Improvements

The Beaver Creek watershed is unique for watershed studies because there have been no requests for large surface-storage improvements. In contrast, the 18 proposed water storage projects involve the construction and rehabilitation of small ponds. Existing ponds in the study area need to be dredged to increase storage capacity. In some cases, rehabilitation also includes lining the pond to prevent water loss to seepage.

An example of a breached dam recommended for repair.

The cost estimates for the projects range from less than $15,000 for a small reservoir rehabilitation to over $350,000 to rehabilitate 12 ponds on one property.

Surface water supply and storage improvement projects could be made in other parts of the watershed, as needed, using the plans and cost estimates provided in this report as a guide for conceptual design, cost and financing opportunities.

3.1.3. Irrigation System Improvements

Ten specific irrigation improvements are proposed as requested by ranchers/landowners/agencies in the Beaver Creek watershed. The irrigation improvements focus on rehabilitation/replacement of existing structures, enhanced delivery of water, and economic practicality and physical feasibility. The specific recommendations include repairs to spreader dike breaches, replacing diversion structures, regrading ditches, and several options for upgrading irrigation systems. The cost estimates for the projects range from just over $1,000 to install a new diversion pipeline to an option presented for a new irrigation system, if implemented, is estimated to cost over $120,000.

Additional irrigation system improvements could be made across the watershed using the plans and cost estimates provided in this report as a guide for conceptual design, cost, and financing opportunities.

3.1.4. Other Management Opportunities

Other management practices and improvements are in various stages of implementation across the watershed. The specific improvements and/or best management practices recommended in this report include additional vegetation restoration projects, sediment reduction measures, habitat enhancements for wildlife (including beaver), repair of headcutting occurring at the confluence of Oil and Skull creeks, plugging an abandoned well and installing an automated weather station.

Cost estimates for these other management improvements are very site-specific and range from just over $1,000 for revegetation to over $150,000 to construct a sediment basin.

An abandoned beaver dam in an area recommended for habitat restoration.

3.1.5. Estimated Total Cost by Project Category

The total cost to complete all the proposed project improvements, grouped by project type, is as follows:

- Livestock/Wildlife Watering Improvements = $2,260,946
- Water Supply and Storage Improvements = $1,086,915
- Irrigation System Improvements =$380,973
- Other Management Project Improvements = $236,064

Table ES-2 Brief Descriptions of the Proposed Projects and Cost Estimates

Project Number	Landowner or Leasee	Brief Proposed Project Description	Cost Estimate ($) *
LWW-1.1	Cammack	Pipeline extension and stock tank	10,347
LWW-1.3	Cammack	Pipeline extension and stock tanks	9,326
LWW-1.4	Cammack	Pipeline extension and stock tanks	9,326
LWW-1.5	Cammack	Spring development	9,336
LWW-2.1	Peterson	Pipeline extension and stock tank	10,347
LWW-3.1	Burleson	New pipeline and stock tanks	32,259
LWW-4.1	Lewis, J	Well and pipeline project	55,079
LWW-6.1	Tavegia/Geier	New well, pipeline and stock tank	96,369
LWW-9.1	Lewis, BJ	Pond and pipeline development	228,693
LWW-10.1	Neal	Spring development	4,495
LWW-12.1	Calmus	Spring Rehabilitation	5,263
LWW-14.1	Mills	Pipeline and stock tanks	54,599
LWW-14.2	Mills	Pipeline and stock tanks	42,801
LWW-14.3	Mills	Pipeline and stock tanks	27,624
LWW-14.4	Mills	Pipeline and stock tank	20,793
LWW-14.5	Mills	Middle Cordingly Pasture Project	30,660
LWW-14.6	Mills	Mills Reservoir Solar Pumps	30,660
LWW-15.1	Inyan Kara	Inyan Kara pipeline and stock tanks	169,634
LWW-16.1	Bau	Surface repair of abandoned oil well	13,152
LWW-16.2	Bau	Surface repair of abandoned oil well	13,152
LWW-17.1	Branscom	Well conversion to solar power	17,499
LWW-17.2	Branscom	New solar well pump and tank	25,002
LWW-19.1	Larsen	Pipeline rehabilitation	23,471
LWW-21.2	Rawhouser	Pipeline and stock tanks	32,369
LWW-22.1	Rossman	Pipeline and stock tank	12,190

Project Number	Landowner or Leasee	Brief Proposed Project Description	Cost Estimate ($) *
LWW-22.2	Rossman	Pipeline and stock tank	28,474
LWW-22.4	Rossman	Well conversion to solar pump	11,786
LWW-23.1	Merrill	Proposed livestock water supply well	91,519
LWW-23.2	Merrill	Proposed pipeline and tanks	86,299
LWW-25.3	Sandrini	Proposed new well and pipeline rehabilitation	62,016
LWW-26.1	Culver	New well and stock tank	39,148
LWW-31.1	Vore	Pipeline, storage and stock tanks	46,696
LWW-34.1	Sudbrink	Proposed expansion of pipeline and tanks	10,632
LWW-34.2	Sudbrink	Proposed spring rehabilitation	4,495
LWW-35.2	Tidyman	Proposed pipeline and stock tank	14,752
LWW-36.1	Hollenbeck	Proposed pipeline and stock tank project	60,351
LWW-37.1	Simon	Conversions to solar pumps	70,714
LWW-39.1	Tysdal	Proposed pipeline and storage tank project	706,810
LWW-40.1	Harris	Proposed windmill conversions	42,807
WSS-5.1	Tlustos	Proposed new pond	53,042
WSS-7.1	Braun	New dam with spillway	55,361
WSS-8.1	Schaeffer	Dam rehabilitation	73,944
WSS-11.1	Cruzen	Pond rehabilitation	18,391
WSS-21.1	Rawhouser	Proposed spring-fed pond	14,413
WSS-22.3	Rossman	Reservoir rehabilitation	77,823
WSS-22.5	Rossman	Small reservoir rehabilitation	14,966
WSS-25.1	Sandrini	Proposed new dam	33,657
WSS-25.2	Sandrini	Pond rehabilitation	44,096
WSS-28.1	Hiser	Proposed new stock pond	38,073
WSS-32.1	Millett	Proposed breach dam rehabilitation	67,736
WSS-35.3	Tidyman	Proposed new headgate and pond	53,432

Project Number	Landowner or Leasee	Brief Proposed Project Description	Cost Estimate ($) *
WSS-36.2	Hollenbeck	Proposed pond rehabilitation	27,870
WSS-36.3	Hollenbeck	Proposed new stock pond	13,713
WSS-37.2	Simon	Proposed pit excavations	28,522
WSS-37.3	Simon	Proposed pond rehabilitations	373,783
WSS-39.2	Tysdal	Breached dam repair	20,824
WSS-41.1	Thares	Proposed pond rehabilitations	77,269
ISI-8.2	Schaeffer	Rehabilitate spreader dikes	1,648
ISI-23.3	Merrill	Proposed irrigation system	25,034
ISI-24.1	Perino	New irrigation system	122,597
ISI-26.2	Culver	Irrigation diversion rehabilitation	1,125
ISI-29.1	Engle	Rehabilitate irrigation	10,102
ISI-30.1	Popma	New irrigation system	78,500
ISI-32.2	Millett	Rehabilitate spreader dikes	10,137
ISI-33.1	Livingston	Replace diversion structure	8,663
ISI-35.1	Tidyman	Proposed new irrigation system	97,360
ISI-38.1	Bayne	Irrigation system rehabilitation	25,807
OMP-1.2	Cammack	Vegetation restoration	2,910
OMP-13.1	Frederick	Sediment basin construction	155,526
OMP-16.3	Bau	Plug abandoned oil well	9,103
OMP-18.1	Hennessey	Sediment reduction	35,674
OMP-20.1	Weyrich	Wildlife and vegetation restoration	7,231
OMP-33.2	Livingston	Headcuts at confluence of Oil and Skull Creek	14,510
OMP-33.3	Livingston	Revegetation	1,280
OMP-42.1	Weston Co FSA	Weather station	9,829

* See Study, Section 5.0 of the Beaver Creek Level I Watershed Study for details on cost estimates.