Kerber Creek Restoration Project Final Report

Initiated and Implemented By:

Jason Willis

Mine Restoration Project Manager - Trout Unlimited

128 East 1st Street – Suite 203, Salida, CO 81201

December 8, 2014

Authored By:

Jason Willis, Trout Unlimited

Elizabeth Russell, Trout Unlimited

Table of Contents

List of Figures 3
List of Tables 3
List of Acronyms 4
1.0 Project Summary 5
2.0 Background 6
3.0 Project Approach 8
4.0 Tasks 8
4.1 Project Management 8
4.2 Streambank Stabilization 9
4.3 Engineered Rock Structure Installation 13
5.0 Photo Points 15
6.0 Conclusion 17

List of Figures

Figure 1.1: KC 16 Plan View of Site map showing placement of mine waste areas and property boundaries. WSRA funds went towards restoring the stream and floodplain within the Eastern Parcel... 6
Figure 2.1: Kerber Creek Watershed, WQCC Stream Segments, and Tributaries. (Purple circle represents a USGS gauge station which measures stream flow.)..... 7
Figure 4.1: Boy Scouts installing erosion control mats on newly reshaped streambanks..... 10
Figure 4.2: Riparian fence perimeter fencing out Phase 1A and 1B work on KC16-E..... 11
Table 4.2: Soil Amendment amounts per tailings pile used by contractor at site KC 16-E for in-situ restoration 12
Figure 4.3: KC16-E Parcel map identifying mine waste piles that correspond to amendment quantities listed in Table 4.2. 13
Figure 4.4: NRCS plan view of the Phase 1B reach showing rock structure locations..... 14
Figure 4.5: Excavator installing in-stream rock structures along Kerber Creek at KC16-E 15
Figure 5.1: KC16-E looking east at degraded steep banks before restoration (left) and after restoration and installation of 3 rock barbs (right)..... 16
Figure 5.2: KC16-E meander bend before restoration (left) and after installation of two rock barbs and sedge/willow transplants (right)..... 16
Rock structure installations were used throughout the project to create habitat and improve the width to depth ratio in previously featureless zones. Cross vanes were typically used in straight sections, while barbs and j-hooks were used on banks to redirect flow away from newly reshaped unstable banks (Figure 5.3) 16
Figure 5.3: KC16-E Featureless section with extended shallow riffle zone (left) and cross vane installation creating downstream pool habitat and grade control before 90 degree bend (right)..... 17

List of Tables

Table 4.1: Project Management Final Outcomes Schedule.....9
Table 4.2: Soil Amendment Amounts per Pile on KC16-E.....12

List of Acronyms

BLM: Bureau of Land Management
BMP: Best Management Practice
BSG: Bonanza Stakeholders Group
CDOW: Colorado Division of Wildlife
CDNR: Colorado Department of Natural Resources
CDPHE: Colorado Department of Public Health and Environment
CDSS: Colorado Division Support Services
CDWR: Colorado Division of Water Resources
CFI: Cover Frequency Index
CSCVA: Crestone and Saguache County Visitor's Agency
CWA: Clean Water Act
CWCB: Colorado Water Conservation Board
EA: Environmental Assessment
EPA: Environmental Protection Agency
FWS: Fish and Wildlife Service
GIS: Geographic Information Systems
GPS: Global Positioning System
HUC: Hydrologic Unit Code
NEPA: National Environmental Policy Act
NPDES: National Pollutant Discharge Elimination System
NPS: Nonpoint Source
NRCS: Natural Resources Conservation Service
PNC: Potential Natural Community
SAPP: Sampling and Analysis Project Plan
ScSEED: Saguache County Sustainable Environment and Economic Development
TMDL: Total Maximum Daily Load
TU: Trout Unlimited
USACE: United States Army Corps of Engineers
USFS: United States Forest Service
USGS: United States Geological Survey
VCUP: Voluntary Clean Up Program
WSRA: Water Supply Reserve Account
WMP: Watershed Management Plan
WQCD: Water Quality Control Division
WQX: Water Quality Exchange
XRF: X-Ray Fluorescent

1.0 Project Summary

In 2012, Trout Unlimited (TU) was awarded a second Colorado Nonpoint Source (NPS) grant to treat mine wastes and to restore miles of stream bank at site KC16, the largest privately owned parcel of land in the watershed. Site KC16 is divided into three parcels: (1) KC16-E, the easternmost parcel, (2) KC16-M, the middle parcel adjacent to KC16-E, and (3) KC16-W, the western parcel separated from KC16-M by other private lands (Figure 1). The project on KC16 began in the fall of 2012 with the installation of 46 in-stream rock structures on the easternmost 5,170 ft of stream bank located within KC16-E, primarily funded by National Resource Conservation Service (NRCS). Phytostabilization and in-stream improvements were completed in the field seasons of 2013 and 2014 on phases 1B and 1C on the eastern parcel using 319 NPS and Water Supply Reserve Account (WSRA) funds. Throughout this effort an additional 5,000 ft of stream bank was restored in conjunction with the treatment of 19.1 acres of mine wastes at KC16-E. Over this three year effort between 2012 and 2014, the entire KC16-E site, including in-stream work, mine waste treatment, and streambank stabilization, was all completed. NRCS plans to fund the restoration of the in-stream work for the entire length of KC16-M in 2015.

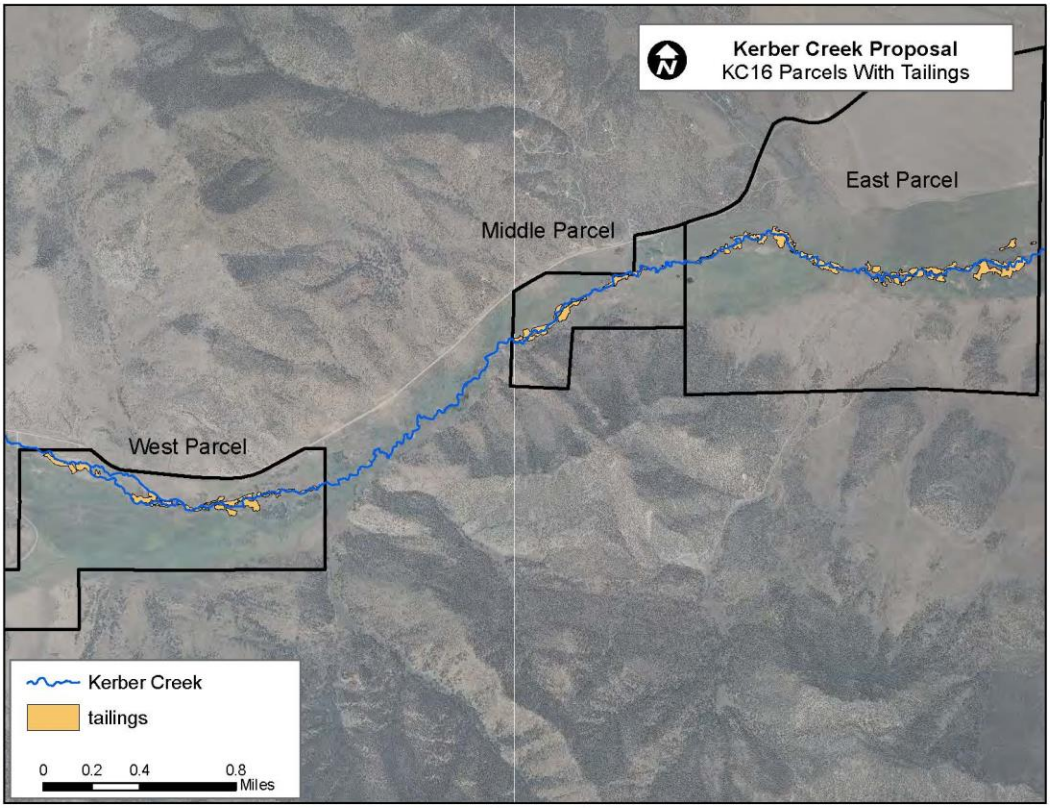
TU received $34,871 from WSRA in 2013 to install 25 in-stream rock structures along KC16-E, and to reshape the associated stream bank. In-stream rock structures redirect the thalweg to the center of the stream, reducing erosion by decreasing the shear stress on stream banks, improving aquatic habitat by creating pool-riffle-run sequences, and decreasing the width-to-depth ratio. Over time, in-stream restoration will also help to reestablish the connection between the stream and its floodplain, thereby increasing groundwater storage during baseflows.

The final construction total for 2013 and 2014 work on the eastern parcel of KC16 ended up being $401,982 to complete 5,000 cubic yards of streambank stabilization, and to install 1,324 cubic yards of rock structures along a 12,672 ft stretch of Kerber Creek. Based on the original WSRA project estimates in the proposal, WSRA funds composed 8.7% of the final construction budget. This equates to 43% of streambank stabilization work and 21% of all in-stream rock structure installations. The remaining amount of approximately $3,400 was used to cover TU administrative, project management, and construction oversight costs.

Goals and objectives listed in the Colorado Nonpoint Source (NPS) grant regarding monitoring are ongoing. NPS and matching funds will continue to be used to monitor progress towards ecological goals as defined in the Project Implementation Plan[1].

[1] Kerber Creek Restoration Project. 2013. Project Implementation Plan. BLM Saguache Field Office.

Figure 1.1: KC 16 Plan View of Site map showing placement of mine waste areas and property boundaries. WSRA funds went towards restoring the stream and floodplain within the Eastern Parcel.

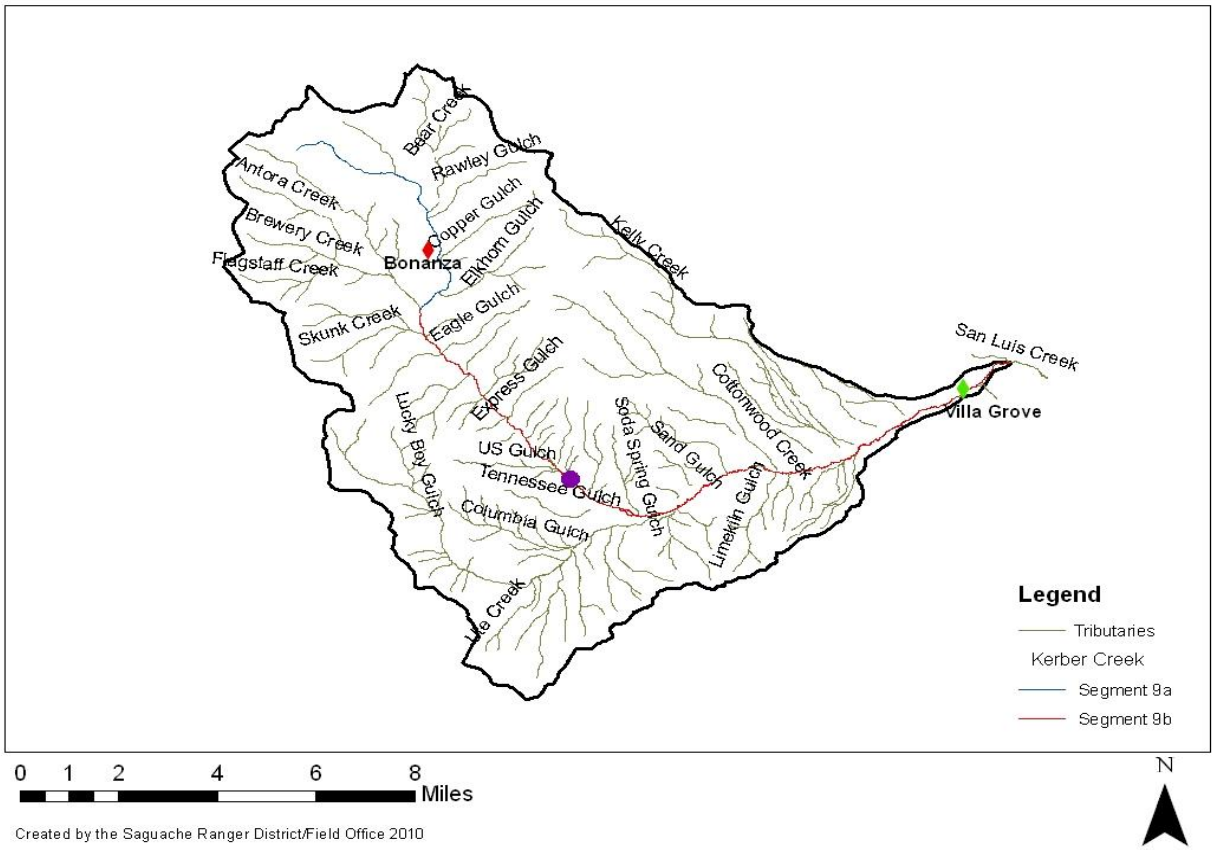


2.0 Background

The Kerber Creek Restoration Project (KCRP) is a collaborative effort dedicated to restoring the Kerber Creek watershed (Figure 2.1). Several tributaries and the main stem of Kerber Creek have been heavily impacted by legacy mining activities stemming from the Bonanza Mining District. Dozens of silver, lead, copper, and zinc mines operated in the District from the 1880s to the 1970s, with major production occurring mainly during the 1920s and 1930s. Mine wastes and tailings, originally sequestered behind dams in the upper watershed, were transported downstream and deposited in the Kerber Creek floodplain during high flow events that caused the dams to fail. These mine waste deposits led to phytotoxic soil conditions that decimated the riparian vegetation, which subsequently destabilized the stream banks and significantly altered channel morphology. In addition to these impacts, groundwater and runoff flowing through and over the mine waste deposits as well as flow from draining adits at former mine sites impaired water quality throughout the watershed. In the 1990s, the American Smelting and Refining Company (ASARCO, Inc.) partnered with local landowners, the US Forest Service (USFS), and the Bureau of Land Management (BLM) to initiate voluntary cleanup efforts in the watershed. These efforts significantly improved water quality and aquatic habitat by plugging the Rawley 12 draining adit and relocating over 100,000 cubic yards of tailings to a repository lower in the watershed. However, additional work on lower watershed mine waste deposits was not possible after 2002, when ASARCO, Inc. declared bankruptcy.

In 2005, BLM began an investigation of the environmental condition of the lower watershed, completing a full environmental assessment in 2006. This investigation was the beginning of KCRP, which today functions as a non-legal entity grounded in partnerships among a variety of organizations, including, but not limited to, USFS, BLM, the US Fish and Wildlife Service (USFWS), the Natural Resources Conservation Service (NRCS), TU, Saguache County Sustainable Environment and Economic Development (ScSEED), the Colorado Department of Public Health and Environment (CDPHE), and the Bonanza Stakeholders Group (BSG), a coalition of more than 20 private landowners in the Kerber Creek watershed. Since 2007, the project has successfully treated over 80 acres of mine wastes, restored over 12,000 feet of stream bank, and installed over 300 in-stream rock structures in the lower watershed. These accomplishments have been made possible by the over $2 million in grant funding awarded to the project to date and scores of project volunteers, who have collectively contributed over 13,000 hours.

Figure 2.1: Kerber Creek Watershed, WQCC Stream Segments, and Tributaries. (Purple circle represents a USGS gauge station which measures stream flow.)



3.0 Project Approach

The approach to this project refers to the completion and obtainment of several objectives pertaining to overall stream health. Restoration efforts should help attain the following objectives listed in the original 319 NPS Proposal:

1. Improve water quality by reducing metals contamination from mine waste areas
2. Reduce channel width
3. Improve depth
4. Increase macro-invertebrate density
5. Increase fishery density
6. Increase upland vegetation cover
7. Stabilize stream banks
8. Reduce metal mobility in soil

In order to effectively implement the goals and objectives of this project, a list of tasks were developed. Each task funded by CWCB had a detailed description, method and procedure, and a deliverable. Of the seven tasks delegated for this project, three were funded by CWCB, which included Project Management, Streambank Stabilization, and Engineered Rock Structure Installation. To ensure proper implementation TU employees followed each method and procedure for the corresponding task.

4.0 Tasks

The tasks pertaining to CWCB funds were first delegated in the scope of work (SOW), and used to successfully implement techniques before and during construction. TU, along with their construction partner, RMC Consultants, worked together to make sure the assigned tasks were completed. A description of the specific tasks completed during this project using WSRA funds are listed in the subsequent sections.

4.1 Project Management

This task included the administration of grant funds and the completion of contracts for implementation of project work. TU ensured proper completion of project tasks by adhering to a project schedule (Table 4.1). By acting as the fiscal agent for the project, TU received, held, and distributed grant money. TU was solely responsible for creation of a Request for Proposals (RFP), contractor solicitation, bid evaluation, and contractor selection. RMC Consultants successfully won the bid process and was the contractor used during the 2013 and 2014 construction seasons. Throughout the construction phases, a TU representative was present on-site for at least 1 day per each work week to ensure proper construction methods. While on-site, TU oversaw the contractor's progress with respect to the work plan and other environmental objectives. The contractor interaction proved to be very productive throughout the project. Photo documentation is included in Section 5.0, and photos were taken before ground-breaking, during construction, and after completion of restoration to show improvements throughout the project.

Table 4.1: Completed Project Schedule

Table 4.1: Complete Project Schedule			
Tasks	**Task Description**	**Start Date**	**Finish Date**
1	Project management	6/1/2011	Ongoing
2	Mine wastes treatment	7/1/2013	11/4/2014
3	Stream bank stabilization	7/1/2013	11/4/2014
4	Engineered rock structure installation	7/1/2013	11/4/2014
5	Monitoring	10/29/2012	Ongoing
6	Engineering at source areas	6/1/2013	Ongoing
7	BSG development	5/1/2012	Ongoing

-- Tasks 1, 3, and 4 were partially funded through WSRA funds.

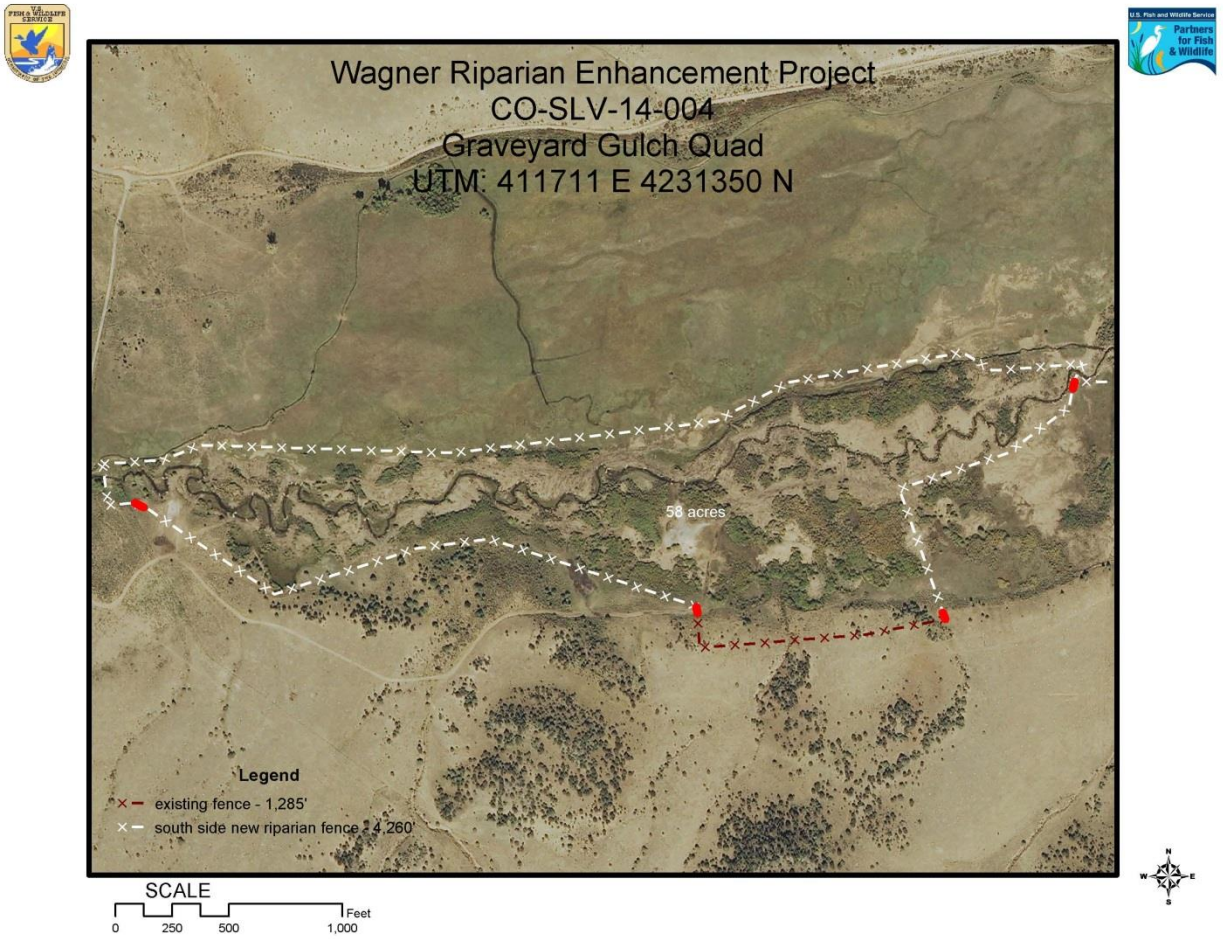
4.2 Streambank Stabilization

RMC Consultants was hired to perform all construction activities along Kerber Creek on KC16-E. Included in the streambank stabilization process were several steps such as, increasing root mass, reshaping to a 3:1 slope, improving riparian habitat, and improving adjacent soil quality to create a good growing medium. Over 5,000 cubic yards of streambank stabilization and reshaping took place throughout KC16-E. Root wads and sedge mats were installed where appropriate in-conjunction with rock structures and NRCS designs. In addition to root wads and sedge mat installation, a Boy Scout Troop spent two days in August 2014 seeding and installing erosion control mats along recently disturbed streambanks (Figure 4.1).

Figure 4.1: Boy Scouts installing erosion control mats on newly reshaped streambanks.

Through this project, TU has developed a great working relationship with USFWS Partners program to fence out and preserve the riparian corridor of recently completed work for 3-5 years post completion. Several planning meetings were conducted with local landowners, grazing partners, and TU, NRCS, and FWS employees to design a fencing system that protected the recently completed work, and proved to be productive for cattle grazing. The current design, which was donated and implemented by USFWS Partners program was fully installed this past August 2014. This design included 9,691 feet of riparian fence that protects recent construction work, and coincides with the grazing management plan created by the landowner (Figure 4.2).

Figure 4.2: Riparian fence perimeter fencing out Phase 1A and 1B work on KC16-E.

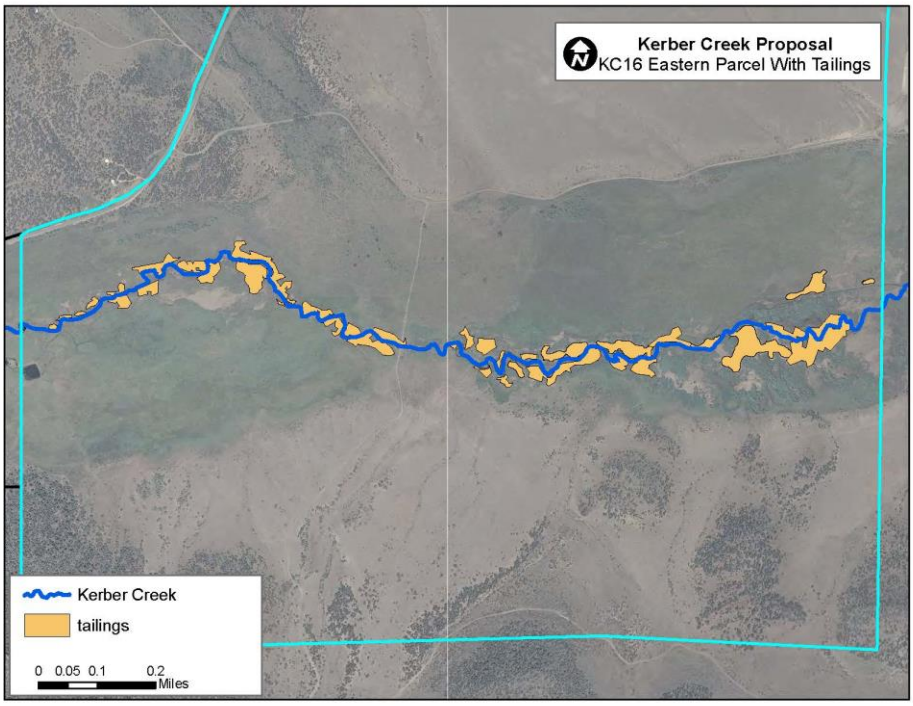


A common practice along with streambank stabilization is phytostabilization, which is an *in-situ* (in-place) treatment of mine wastes consisting of the introduction of lime, limestone and organic compost as amendments to affected soil, usually followed by a site's revegetation. Lime ($Ca(OH)_2$) and limestone ($CaCO_3$) bind to metals, demobilizing them and raising the pH of the soil. This process reduces the mobility of metals by altering them into less soluble, or toxic forms, thus preventing migration to surface or ground water. Because mine wastes commonly compose a good portion of the unstable banks along Kerber Creek, phytostabilization is commonly performed prior to bank stabilization. The result is a good growing medium for riparian vegetation that provides long term stability while reducing bioavailability for entry into the food chain through aquatic life. Amounts of limestone, lime, and compost were calculated based upon initial soil chemistry data for KC16-E (Table 4.2). These amendments were ripped into the soil at depths between 18-24 inches on a site by site basis identified by an aerial image that highlighting specific mine waste piles (Figure 4.3). After streambanks were stabilized, a formulated Kerber Creek seed mix was applied by broadcast application. In addition to the seed, weed-free straw was crimped in on top of mono-ammonium phosphate (MAP) fertilizer.

Table 4.2: Soil Amendment amounts per tailings pile used by contractor at site KC 16-E for in-situ restoration

General Site Information				Actual Required Site Amendments (Tons)			Site Revegetation		
Work Site	Tailing Map Site Designation	Est. Tailing Depth (in)	Area Acres	CaCO3 18" > Depth	Ca(OH)2 18" > Depth	Compost	Seed @ 20#/ac.	Mulch @ 2 ton/ac.	TSP @ 150#/ac.
KC 16	east1	0-36	0.0925	3.80	1.88	8.25	1.95	0.20	14.66
KC 16	east2	0-36	0.7636	31.38	15.55	68.09	16.13	1.61	120.98
KC 16	east3	0-36	0.4777	19.63	9.73	42.59	10.09	1.01	75.68
KC 16	east4	0-36	0.5184	21.30	10.56	46.22	10.95	1.10	82.14
KC 16	east5	0-36	0.2988	12.28	6.08	26.64	6.31	0.63	47.34
KC 16	east6	0-36	0.5337	21.93	10.87	47.58	11.27	1.13	84.55
KC 16	east7	0-36	1.0156	41.73	20.68	90.56	21.45	2.15	160.91
KC 16	east8	0-36	0.8197	33.68	16.69	73.09	17.32	1.73	129.87
KC 16	east9	0-36	0.1559	6.41	3.17	13.90	3.29	0.33	24.70
KC 16	east10	0-36	0.0939	3.86	1.91	8.38	1.98	0.20	14.88
KC 16	east11	0-36	0.4487	18.44	9.14	40.01	9.48	0.95	71.09
KC 16	east12	0-36	0.2405	9.88	4.90	21.44	5.08	0.51	38.10
KC 16	east13	0-36	0.4001	16.44	8.15	35.67	8.45	0.85	63.39
KC 16	east14	0-36	0.2861	11.75	5.82	25.51	6.04	0.60	45.32
KC 16	east15	0-36	0.4365	17.93	8.89	38.92	9.22	0.92	69.15
KC 16	east16	0-36	1.2311	50.58	25.07	109.77	26.01	2.60	195.05
KC 16	east17	0-36	0.4840	19.89	9.86	43.16	10.22	1.02	76.69
KC 16	east18	0-36	0.5232	21.50	10.65	46.65	11.05	1.11	82.89
KC 16	east19	0-36	0.1561	6.42	3.18	13.92	3.30	0.33	24.74
KC 16	east20	0-36	0.1261	5.18	2.57	11.25	2.66	0.27	19.98
KC 16	eastss1	0-36	2.0251	83.20	41.23	180.56	42.78	4.28	320.83
KC 16	eastss2	0-36	2.3202	95.33	47.24	206.88	49.01	4.90	367.60
KC 16	eastss3	0-36	0.5444	22.37	11.08	48.54	11.50	1.15	86.25
KC 16	eastss4	0-36	0.2671	10.97	5.44	23.81	5.64	0.56	42.31
KC 16	eastss5	0-36	1.2215	50.19	24.87	108.91	25.80	2.58	193.52
KC 16	eastss6	0-36	0.2237	9.19	4.55	19.94	4.72	0.47	35.44
KC 16	eastss7	0-36	0.1495	6.14	3.04	13.33	3.16	0.32	23.68
KC 16	eastss8	0-36	0.1428	5.87	2.91	12.74	3.02	0.30	22.63
KC 16	eastss9	0-36	0.0405	1.67	0.83	3.61	0.86	0.09	6.42
KC 16	eastss10	0-36	0.7596	31.21	15.47	67.72	16.05	1.60	120.34
KC 16	eastss11	0-36	0.3164	13.00	6.44	28.21	6.68	0.67	50.13
KC 16	eastss12	0-36	0.0309	1.27	0.63	2.75	0.65	0.07	4.89
KC 16	eastss13	0-36	1.0882	44.71	22.16	97.02	22.99	2.30	172.40
KC 16	eastss14	0-36	0.4657	19.13	9.48	41.52	9.84	0.98	73.78
KC 16	eastss15	0-36	0.3640	14.95	7.41	32.45	7.69	0.77	57.66
		Total:	19.0618	783.20	388.13	1699.60	402.67	40.27	3020.00

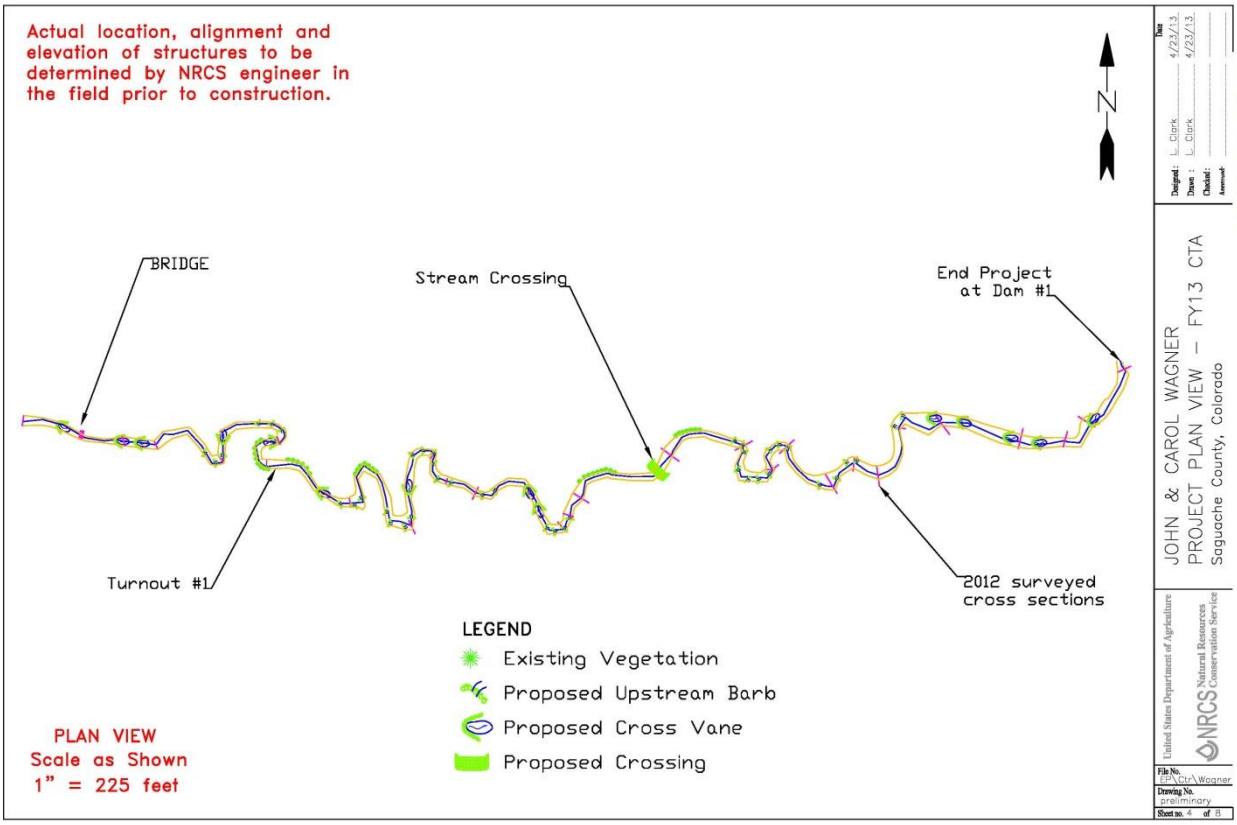
Figure 4.3: KC16-E Parcel map identifying mine waste piles that correspond to amendment quantities listed in Table 4.2.



4.3 Engineered Rock Structure Installation

TU and NRCS representatives performed a site walkthrough in the fall of 2012 to determine placement, type, and number of rock structures/bank stabilization needed at KC16-E. NRCS then provided designs and drawings of bank stabilization and rock structure placement to protect against excessive erosion, and provide a more natural and stable stream channel. The design was broken up into two phases, 1B and 1C, which were implemented in 2013 and 2014, respectively. NRCS designs commonly consisted of several pages with detailed designs, photos, and plan views of the entire reach (Figure 4.4).

Figure 4.4: NRCS plan view of the Phase 1B reach showing rock structure locations.



Final project totals for 2013 and 2014 construction work were 1,324 cubic yards of rock for structures, and over 5,000 cubic yards of bank reshaping and stabilization. As mentioned before, an NRCS design was completed for each construction season for Phases 1B and 1C. We were able to source our rock from Tezak Construction's rock quarry. Tezak's knowledge of the project was beneficial in getting the proper rock sizing for a stream like Kerber Creek. RMC Consultants appropriately followed NRCS designs, and installed rock structures in the 12,672 ft section of Kerber Creek at the appropriate bank-full water mark. A breakdown of structures per year and phase is listed below.

2013 – Phase 1B
- 55 Rock Structures
- 10 Cross vanes
- 38 Rock barbs
- 1 Cattle Crossing
- 1 Low head dam
- 4 J-hooks
- 1 Toe Rock

2014 – Phase 1C
- 42 Rock Structures
- 4 Cross vanes
- 32 Rock barbs
- 1 Cattle Crossing
- 4 Low head dams
- 1 J-hook

Most of the rock placement and in-stream work performed by RMC was with the use of an excavator and loader for rock transportation (Figure 4.5). Rocks were properly installed per NRCS design specs using footer rocks and keying the feature into the bank.

Figure 4.5: Excavator installing in-stream rock structures along Kerber Creek at KC16-E

Prior to restoration, a high width/depth ratio was recorded, and long riffle sections were predominant in this section of Kerber Creek. Without sufficient depth and small numbers of pool habitats, over-wintering of a trout population was unsustainable. However, installation of these structures will help shield fragile banks from excessive erosion, while improving fish, and macroinvertebrate habitat. The restoration also helped to reshape the degraded stream channel by establishing a predominant thalweg and an alternating pool-riffle-run-pool sequence that is typical of healthy river systems. Immediate impacts were observed after installation of rock structures as numerous fish were noticed within the newly formed habitats.

5.0 Photo Points

The photos shown below represent a brief snippet of the work that was over the course of two years at KC16-E to improve degraded conditions that were present such as, incised stream channel, cutbanks, and mine waste areas with no vegetation. The stream restoration photos display the high vertical wall banks in the before photos, while the after photos show bank stabilization by rock structures and re-grading.

As mentioned earlier, fine grained mine wastes are a poor growing medium and provide poor bank stability. It is not uncommon to find four to six foot cut banks throughout the Kerber Creek watershed. These soils were treated, reshaped to a 3:1 slope, and further stabilized with rock barbs to protect against high flows.

Figure 5.1: KC16-E looking east at degraded steep banks before restoration (left) and after restoration and installation of 3 rock barbs (right)

Another high cutbank area was reshaped and stabilized using rock structures and a combination of willow bulb and sedge mat transplants. The willows and sedges provide immediate vegetation giving the newly vegetated bank time to develop (Figure 5.2).

Figure 5.2: KC16-E meander bend before restoration (left) and after installation of two rock barbs and sedge/willow transplants (right)

Rock structure installations were used throughout the project to create habitat and improve the width to depth ratio in previously featureless zones. Cross vanes were typically used in straight sections, while barbs and j-hooks were used on banks to redirect flow away from newly reshaped unstable banks (Figure 5.3)

Figure 5.3: KC16-E Featureless section with extended shallow riffle zone (left) and cross vane installation creating downstream pool habitat and grade control before 90 degree bend (right)

6.0 Conclusion

The Kerber Creek Restoration project at site KC16-E has resulted in a major improvement in one of the largest private parcels in the lower watershed. About 12,672 feet of stream within the eastern parcel of KC16 has been fully restored. This includes 97 rock structures installed, and 19.1 acres of mine wastes treated using in-situ soil amendments specific to the site soil chemistry. KC16-E work connects several miles of Kerber Creek that have already been rehabilitated downstream on other private properties (KC17 and KCHN). This result provides long reaches of stream that are now suitable habitats with stable banks and improved soil quality. In addition to the benefits to trout habitats, the width-depth ratio and streambank stabilization have visually improved since construction concluded. Improving the overall stream health of this section will only help Kerber Creek achieve State water quality standards for Segment 9b. The 282 cubic yards of rock purchased using WSRA funds made up 21% of the total rock structure installation project budget, while the estimated 2,172 cubic yards of bank stabilization ended up being 43% of that particular budget. In conclusion, WSRA funds were able to provide 8.7% of the total construction budget, which was a great help. TU is grateful for the funding and the opportunity to work with CWCB on projects like Kerber Creek. We look forward to continuing our great relationship on similar projects in the future.