Friends of the Cheat

Cheat Restoration Sustainability Project
AGO FY09 §319 NPS Program
NPS1333

Final Report
July 1, 2010 to June 30, 2013

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Contents

Summary

The Cheat Restoration Sustainability Project was a multifaceted project focused on FOC's Monitoring and Mapping Program, acid mine drainage projects, and the Doug Ferris Outdoor Classroom. The grant provided funding to allow FOC personnel to continue their work on identifying, cataloging, and prioritizing AMD discharges during a particularly challenging time in the organization's history due to unanticipated and non-overlapping staff transitions. Funds were also used to pay for improvements toward existing AMD treatment projects and for the development of the Doug Ferris Outdoor Classroom located on the FOC Festival Grounds in Albright, WV. During the grant period, the scope of project was amended to include work on FOC's Targeted Watershed Initiative, "Implementing the Watershed Based Plan for Acid Mine Drainage Remediation in the Lower Cheat River Watershed," to study AMD treatment efficiencies for multiple treatment sites within the Muddy Creek subwatershed.

Monitoring Efforts and Results

FOC's sampling efforts were focused on four main tributaries within the Cheat watershed: 1) Sovern Run; 2) Pase Tributary of Pringle Run; 3) North Fork of Greens Run; and, 4) Muddy Creek. FOC collected in-stream samples along selected reaches of these subwatersheds to narrow down pollutant sources. Furthermore, stream walks were conducted to find previously unknown AMD discharges. These AMD discharges were sampled "at-source". All data was recorded in FOC's water quality database which is used to propose new projects and measure improvements to streams after treatment systems have been implemented.

Monitoring in Sovern Run led to a better understanding of improvements made from a series of AMD projects implemented in the small subwatershed draining to Big Sandy Creek.

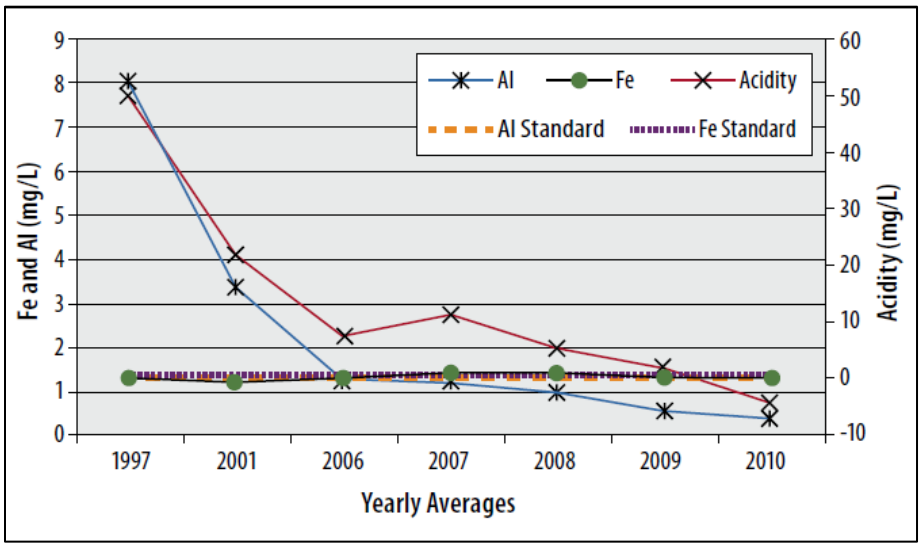

Figure 1. Aluminum, iron, and acidity concentrations measured at the mouth of Sover Run from 1997 to 2010.

Monitoring efforts in the Pase tributary of the Pringle Run subwatershed has characterized headwater streams receiving water from AMD treatment project sites, “Jessop” and “Pase Active” (Table 1; Figure 2).

Table 1. Water quality data averages for selected sites in the Pase tributary of Pringle Run.

	Pase Project S.O.	Pase Trib Below UNT 3	Pase Trib above UNT 3	Pase UNT 3 Mouth
# Samples Collected	5	5	6	5
Temp_°C	15	14	13	14
FieldCon_µS/cm	919	537	200	634
FieldpH	3.73	3.60	5.25	3.34
FlowGPM	20	112	22	84
Alk	<1	4.95	18.47	<1
Acidity	170	80	32	98
SO4	463	224	62	267
AcidTPY	8.16	19.68	3.47	19.25
CalcAcidity	72.57	37.47	10.24	51.35
CalcAcidTPY	3.67	8.82	1.27	10.58
D_Al	4.37	3.08	3.75	3.80
D_Ca	52.94	39.98	12.26	44.88
D_Fe	10.88	0.41	0.27	0.58
D_Mg	15.65	9.66	3.02	11.10
D_Mn	1.41	0.90	0.35	1.05

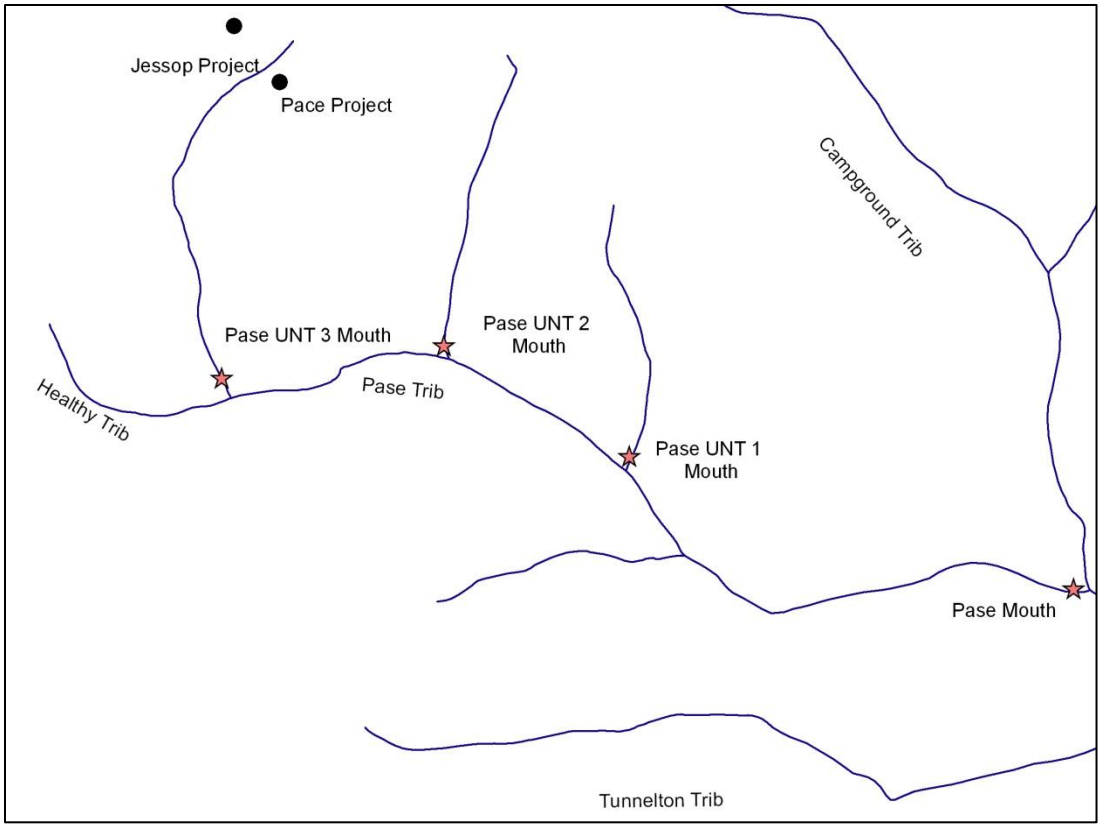

Figure 2. Map of the Pase tributary in the headwaters of Pringle Run.

Focused reconnaissance efforts to locate and characterize new AMD sources were completed in the North Fork of Greens Run. These efforts were especially useful in proposing a new AMD treatment project in the North Fork of Greens Run.

In Muddy Creek, in-stream samples were taken routinely to identify improvements due to AMD treatment projects associated with the Targeted Watershed Initiative Project.

Table 2. Water quality data averages for AMD parameters measured in Muddy Creek above and below nonpoint source pollution sources.

	Muddy at Million Dollar Bridge	Muddy below Martin	Muddy Mouth
# Samples Collected	31	9	37
Temp_°C	14	17	12
FieldCon_µS/cm	237	805	898
FieldpH	7.16	3.98	4.19
FlowGPM	13550	11235	26214
Alk	30.56	0.33	1.78
Acidity	32.59	139.57	121.19
SO4	66.70	414.43	380.28
AcidTPY	760.24	2927.38	5247.28
CalcAcidTPY	-747.67	2168.54	3738.35
D_Al	0.21	10.29	7.76
D_Ca	24.66	71.65	60.96
D_Fe	0.25	15.02	6.08
D_Mg	7.92	27.93	24.07
D_Mn	0.08	3.01	6.56

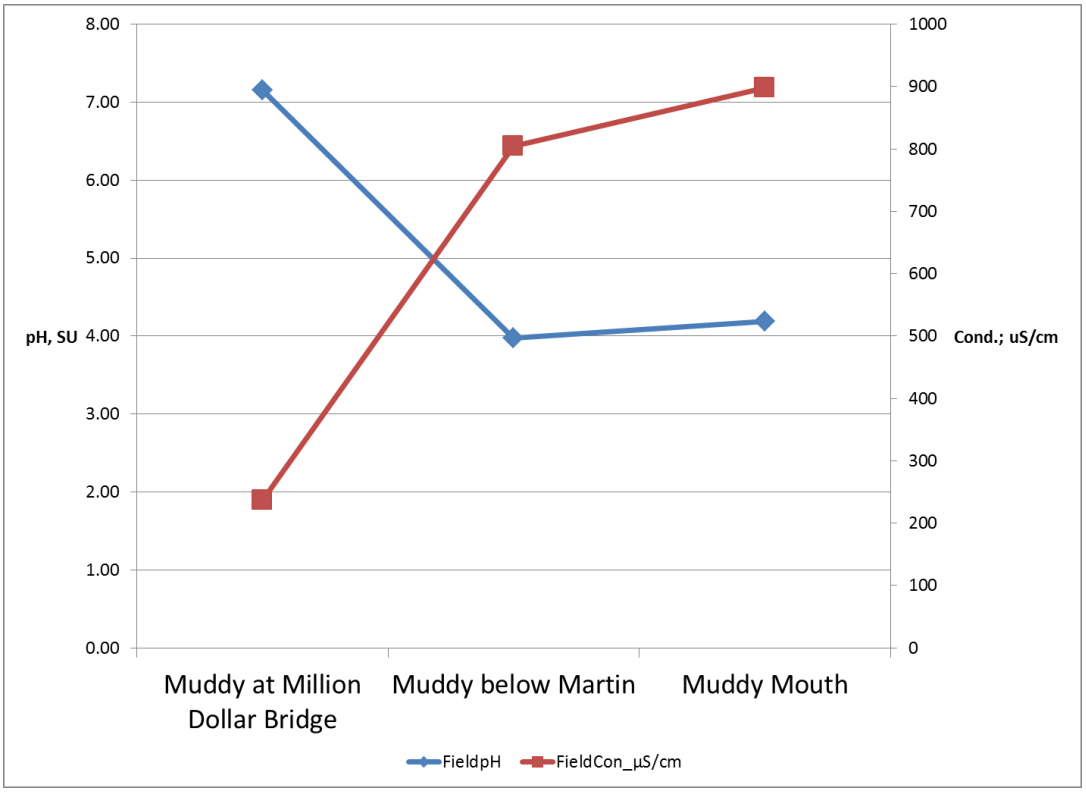

Figure 3. Plot of pH and electrical conductivity showing a decrease in average pH and increase in average conductivity below Muddy Creek's confluence with Martin Creek.

Dream Mountain Passive AMD Treatment System Improvements

Friends of the Cheat hired C. E. Bolyard and Sons to repair a breech in an open limestone channel on the Dream Mountain Passive AMD Treatment System. During high flows, the channelized mine water jumped out of the channel and ran down the road. The repair built up rocks along the channel to prevent this from happening during future high flow events. The property manager was pleased with the work.

Doug Ferris Outdoor Classroom (DFOC)

FOC staff worked with Rowlesburg School art students to create stepping stones depicting local animals and insects that live within the Cheat River watershed. These stepping stones are now placed in the DFOC rain garden.

A stainless steel sign with summary text explaining the Eloise Morgan Milne Pavilion was made to showcase the history of the FOC Festival Grounds. A dedication ceremony was held during the 2012 Cheat River Festival. Eloise grew up along the banks of Muddy Creek and was instrumental in funding the construction of the Eloise Morgan Milne pavilion – the centerpiece of the Doug Ferris Outdoor Classroom (Figure 4).

Figure 4. Sign honoring major donor and Muddy Creek historian, Eloise Morgan Milne.

Targeted Watershed Initiative: Executive Summary

A long history of unregulated surface and underground coal mining within the Cheat River watershed has left many streams impaired due to untreated acid mine drainage (AMD). Within the lower Cheat River, Muddy Creek contributes the most pollutants of any tributary impaired by AMD. Muddy Creek's history of severe pollution and notorious mine seal failures make it a high priority for restoration. Muddy Creek's key position at the head of the Cheat River canyon also makes it an important target from improving local economic conditions related to outdoor and tourist industries. The objectives of the Lower Cheat Remediation Plan, funded by the US Environmental Protection Agency's Targeted Watershed Grant Program, were set to accelerate restoration of AMD-impaired streams in the Muddy Creek drainage, evaluate treatment system efficiency, and communicate these results to the public and other stakeholders within and outside of the Cheat watershed.

Friends of the Cheat (FOC) has worked to implement passive treatment system technologies, remediate AMD from abandoned mine lands (AMLs), and facilitate collaboration among state and federal agencies, private industry, non-governmental organizations and researchers to address the multiple AMD sources within the Muddy Creek watershed. FOC and its partners at the National Mine Land Reclamation Center (NMLRC) chose three non-point sources of AMD for remediation through passive treatment (Gary Conner, Allen Conner – Messenger, and Dream Mountain). A treatment site maintained by the West Virginia Department of Environmental Protection's Office of Special Reclamation (WVDEP OSR), Rockville S-65-82, was chosen as a representative active at-source treatment system. A separate WVDEP OSR active treatment system was modified to treat a combination of AMD sources in Fickey Run through in-stream dosing with hydrated lime slurry (Figure 5).

For each of these systems, basic monitoring was completed before and after treatment implementation to determine water discharge, basic water quality indicators, metal concentrations, and calculated pollutant loads. Stream dwelling animals (benthic macroinvertebrates) were collected to detect ecological improvements due to treatment implementation at the watershed scale. Finally, treatment efficiencies ($ amount per ton of acid treated per year) were calculated for each treatment type and evaluated based on advantages and disadvantages for each treatment method.

Water quality results indicate that, at the watershed scale, the combined effects of WVDEP efforts, reduced industrial activity, FOC's AMD treatment projects, and efforts by other private and public groups have improved the water quality in Muddy Creek. Reductions in pollutant loads were observed for all passive and active treatment systems evaluated in this study (Figure 6). However, many acid sources from abandoned mine lands and bond forfeited mines still remain to be fully addressed.

The evaluation of treatment system efficiency supported generalizations about differences between active and passive treatment technologies; however, the evaluation did not provide sweeping conclusions concerning AMD treatment strategy. Instead, it is

evident that differences in individual treatment site characteristics heavily influence treatment type and efficiency.

The impact of sludge accumulation as a result of in-stream lime dosing of a stream severely impacted by AMD was striking. It is the opinion of the authors that in-stream lime dosing is better suited for slightly to moderately impaired streams where any resulting sludge is frequently flushed downstream and does not threaten aesthetic characteristics or the health of wildlife and humans.

The restoration of Muddy Creek from the legacy impacts of coal mining is important to the local community and critical to maintaining good water quality in downstream reaches of the Cheat River. Given the recent changes in regulation, the development of updated Total Maximum Daily Loads (TMDLs) for the Cheat River watershed, and the recent remediation efforts and respective water quality improvements implemented through the Lower Cheat Remediation Plan, an updated watershed based plan for the Muddy Creek watershed is needed. Muddy Creek will not be remediated by any single treatment strategy or stakeholder, and Friends of the Cheat and its partners continue to seek innovative solutions to remediate acid mine drainage in the Cheat River watershed.

Figure 5: In-stream lime dosing on Fickey Run of the Muddy Creek watershed.

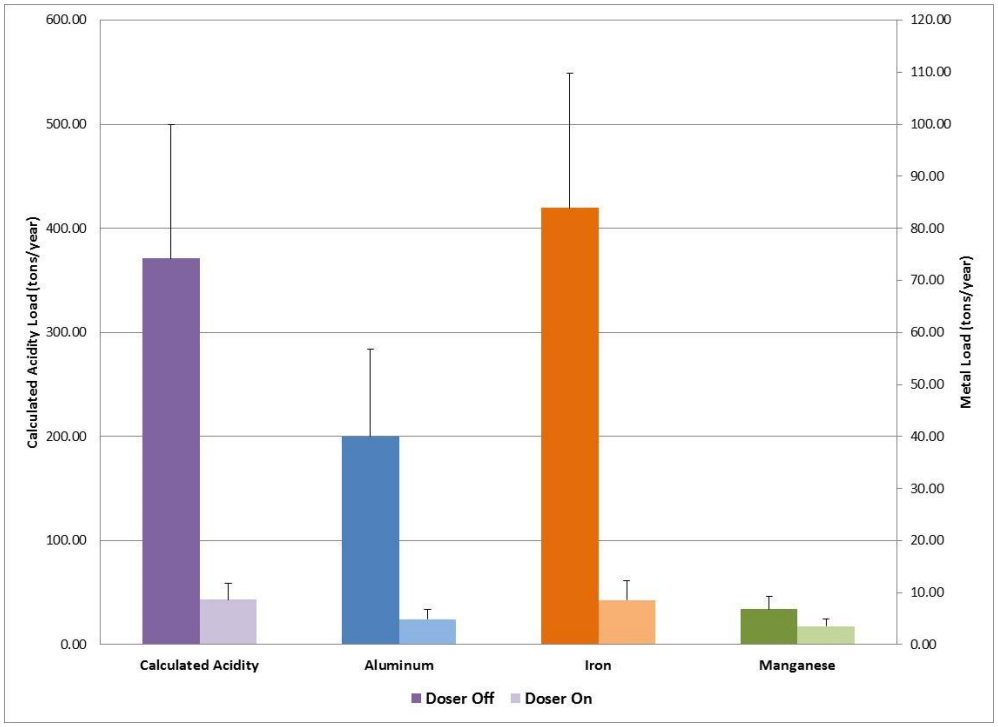

Figure 6: Fickey Run Average Pollutant Load Reductions. Average pollutant loads for Fickey Run Active In-stream Lime Dosing AMD Treatment for sampling events when no lime slurry was added to Fickey Run (Doser Off) and during sampling events when lime slurry was added to the stream (Doser On). Error bars indicate standard error for calculated loads.

Load Reductions

Load reductions associated with this project are summarized in the following table developed for the Targeted Watershed Initiative Project.

Calculated Reductions

	Average Load, tons/yr No Treatment	*n*	Average Load, tons/yr Treatment	*n*	Target Reduction	% Reduction
Active Treatment						
Fickey Run In-Stream Lime Dosing						
CalcAcidity	370.89±128.56	4	43.28±15.85	9	-	88%
Alkalinity	0.00	3	194.77±62.46	10	-	-
Aluminum	40.04±16.74	4	4.88±1.90	9	-	88%
Iron	83.89±25.83	4	8.60±3.69	9	-	90%
Manganese	6.78±2.50	4	3.52±1.41	9	-	48%
Passive Treatment						
Dream Mountain						
CalcAcidity	48.86±21.93	21	39.41±13.75	8	80%	19%
Alkalinity	0.00	21	0.00	8	-	-
Aluminum	6.42±3.60	21	4.11±1.40	8	80%	36%
Iron	4.33±0.96	21	2.07±1.45	8	80%	52%
Manganese	0.23±0.05	21	0.20±0.07	8	-	13%
Gary Conner						
CalcAcidity	133.49±24.74	14	26.27±10.30	7	80%	80%
Alkalinity	0.00	14	6.88±3.17	7	-	-
Aluminum	17.29±3.46	14	3.23±0.86	7	80%	81%
Iron	0.72±0.13	14	0.26±.12	7	80%	64%
Manganese	10.32±1.98	14	3.02±0.80	7	-	71%
Allen Conner - Messenger						
CalcAcidity	67.40±13.65	15*	3.37±0.74	3	80%	95%
Alkalinity	0.00	15*	15.71±2.57	3	-	-
Aluminum	8.57±1.79	15*	0.15±0.10	3	80%	98%
Iron	1.89±0.42	15*	0.09±0.03	3	80%	95%
Manganese	1.05±0.24	15*	0.49±0.12	3	-	53%

Milestone Schedule

The submission of this final report completes the project. FOC will continue to work toward its monitoring objectives to reduce nonpoint source pollution in the Cheat River watershed through other projects and initiatives.

Expenditures

319 Financial Report			
Project:	Cheat Restoration Sustainability		
Date:	07/31/13	NPS Number:	1333
Fiscal Year:	2009	Phone:	304-329-3621
E-mail:	kevin@cheat.org		
Grantee:	Friends of the Cheat		
Contact:	Kevin Ryan, FOC Project Manager		
319 Grant Funds Awarded:	$45,000.00		

Items for match	Match $
Donated Software from Adobe	$1,013.00
In-kind Monitoring Services from Camp Dawson Natural Resources Program and WV Division of Natural Resources	$19,566.20
In-kind goods from Ron's Auction of Kingwood, WV	$200.00
In-kind services from Volunteer Monitors	$1,645.75
Totals	$22,424.95

Expenditures (Invoices)	Spent $
Personnel	$15,399.21
Fringe Benefits	$3,114.37
Monitoring Supplies	$1,937.75
Targeted Watershed Initiative	$8,653.15
Doug Ferris Outdoor Classroom	$5,000.00
Laboratory Analysis	$5,151.46
Project Maintenance	$5,744.06
Totals	$45,000.00
Remaining Balance	$0.00