2008 Nonpoint Source (NPS) Monitoring Project
for
Acid Mine Drainage

An Evaluation of Water Quality, Biology, and Acid Mine Drainage Reclamation in Four Watersheds: Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run.

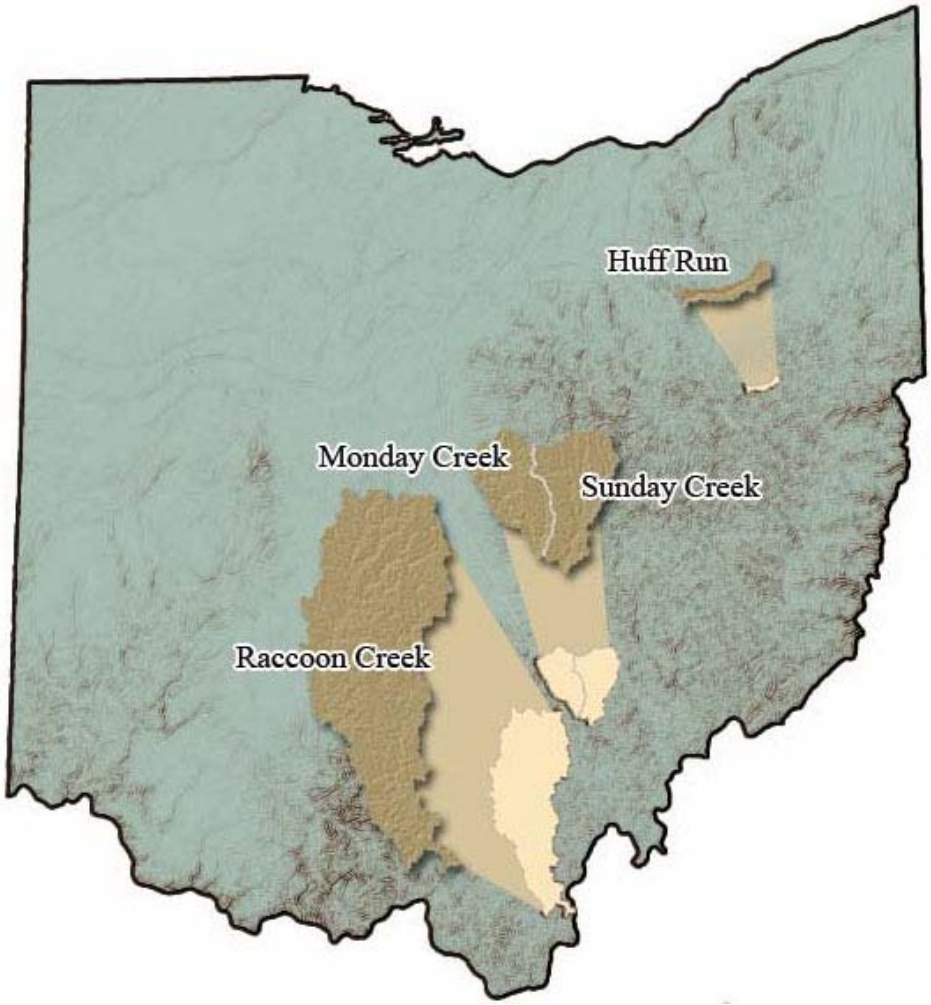

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Table of Contents

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Abstract

The Voinovich School of Leadership and Public Affairs at Ohio University has created an evaluation system to track changes in chemical and biological data for the following watersheds: Monday Creek, Sunday Creek, Raccoon Creek, and Huff Run. The annual monitoring and reporting system was developed for Ohio Department of Natural Resources Division of Mineral Resources Management (ODNR-DMRM) in 2005 to track progress towards the targets of the state's 2005 NonPoint Source (NPS) management plan for acid mine drainage (AMD). The overall goal of the NPS management plan for AMD is, by 2010, 30% of known acid mine impaired streams are in attainment with Warmwater Habitat (WWH).

The NPS annual reporting website (www.watersheddata.com) integrates water quality and biology data from watershed groups' online ArcIMS database with project status details including: maps, graphs, charts, photos, and printable reports to address the progress with respect to AMD treatment and reclamation. Water-quality and biology trends are compared through time at long-term monitoring stations and acid load reductions are measured at AMD reclamation project discharges. Incremental changes in pH, acidity, fish abundance and diversity are reported downstream of AMD reclamation projects at identified river mile markers.

Total number of stream miles impaired by acid mine drainage at baseline condition (1994 -2001) is 341. To reach the NPS goal for mining issues, 102 (30% of 341) stream miles need to meet Full Warmwater Habitat status by 2010. As of 2005, 23.3 stream miles of the 175 miles accessed met Full attainment of the Warmwater Habitat Status. In addition to tracking the overall NPS goal, smaller incremental water-quality changes were also tracked, pH values show 85 miles of stream improved from not meeting the pH 6.5 water quality standard during the baseline time period to meeting in 2005.

Continual tracking of pH, acidity, and biological indicator MAIS were evaluated during 2006, 2007, and 2008. Incremental changes from year to year can be tracked using these indicators. Net acidity and pH values improved during 2006, 2007, and 2008. Values of pH show 88 miles of stream met the pH 6.5 water quality target in 2006, 125 miles in 2007, and 133 miles in 2008. The family-level biological indicator, MAIS, were measured annually from 2005 to 2008, there were slight increases and decreases seen within each watershed. Monday Creek mainstem and Little Raccoon Creek demonstrated improvement in the MAIS score during this time period. The last fifteen miles along Little Raccoon Creek mainstem meets the biocriterion target of twelve. Monday Creek, demonstrates evidence of long-term biological improvement. Of the six mainstem stations, five showed significant improvement. One site showed no improvement (JH00500). The three sites with the greatest improvement occurred at MC00300 (mainstem Carbon Hill, Bucks Inn), MC00510 (mainstem upstream of Lost Run), and MC00580 (Oreville).

Introduction

The Nonpoint Source (NPS) Monitoring Project was created by the Voinovich School of Leadership and Public Affairs at Ohio University in 2005 and funded by the Ohio Department of Natural Resources Division of Mineral Resources Management (ODNR-MRM). This project was developed to address the targets set forth for Abandoned Mine Drainage in the State of Ohio's Non Point Source (NPS) Management Plan 2005-2010. www.epa.state.oh.us/dsw/nps/NPSMP/ET/amdjumppage.html
Abandoned Mine Drainage is one of the six NPS pollutants listed as a key issue to address in Ohio to improve water quality.

The number one existing target in Ohio's NPS management plan for AMD is, "By 2010, 30% of known acid mine impaired streams are in attainment with Warm water Habitat (WWH) aquatic life uses through increasing pH, decreasing metals and sediment loading,

and minimizing degradation of primary headwater habitat." Three sub-targets have been developed to aid in addressing the overarching existing target:

1. By 2010, 20 completed and federally approved Abandoned Mine Drainage Abatement and Treatment (AMDAT) Plans for acid mine drainage (AMD) impaired watersheds.
2. By 2010, 10 AMD impaired watersheds have implemented some or all of the reclamation actions recommended in the endorsed AMDAT.
3. By 2006, report annually on a comparison between acidity and pH concentrations upstream and downstream of AMD project sites and long-term monitoring stations, as compared to acidity and pH reference sites within the Western Allegheny Plateau Ecoregion.

As a result of the NPS Monitoring Project funded by ODNR-MRM, an on-line reporting system, www.watersheddata.com, has been created to track environmental changes in four watersheds: Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run. These four watersheds represent where active AMD reclamation is occurring. Chemical water quality and biological data trends have been evaluated at the AMD project level, watershed level, and collectively to address the targets described above for the State's NPS management plan.

This website provides a center repository of information relating to the AMD targets listed in the State's NPS Management Plan 2005-2010, entry forms for AMD reclamation projects, downloadable reports for: individual AMD projects, watersheds water quality trends, and NPS management plan targets, and ArcIMS database systems; where water quality and biology data can be viewed, entered, edited, mapped and downloaded for each of the four watersheds.

Reports

The NPS monitoring reporting system (www.watersheddata.com) provides four levels of reports: The first level, found in Section I, reports on progress toward the State's NPS

management plan target goals, Level 2 reports, found in Section II, provides a comprehensive watershed level report showing accumulative chemical and biological effects from abandoned mining reclamation, Level 3 reports, found in Section III, lists a summary report of each individual acid mine drainage reclamation project detailing project specifics (i.e. load reductions, costs, etc…), and Level 4 reports, found in Section IV, shows the AMD project form report showing the raw data collected from watershed groups from the ArcIMS database on the website using the NPS entry form report for 2008.

Section I – NPS target and goals

Section I contains an evaluation of four watersheds: Raccoon Creek, Monday Creek, Sunday Creek and Huff Run with respect to meeting the State's NPS management target and goals.

To address the overarching number one target of the State's Nonpoint Source Pollution management plan relating to acid mine drainage, the following activities were conducted. Baseline condition for water quality and biology were established for four watersheds where active reclamation projects are occurring; Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run. Each of these watersheds has had extensive biological and chemical evaluations conducted by the Ohio EPA during different years. Sunday and Monday Creek's baseline conditions were derived from the 2001 TMDL biological data collected. Huff Run's baseline condition was taken from the Ohio EPA 1997 sampling event. Raccoon Creek's baseline condition, being the largest of the four watersheds, was derived from various sources (Ohio EPA and USGS) during the period of 1994- 2000. From the baseline biological data, stream miles were tallied for mining impaired streams to estimate a number of streams that are impacted by abandoned mining. Of the 763 named streams in these four watersheds, 569 miles were assessed during the baseline period (1994-2001) and was determined that 341 miles are impacted by abandoned mining practices. Therefore to set a numeric stream mile attainment goal according to the Target #1 described in the State's NPS management plan, 102 stream miles (30% of 341 stream miles) is the goal for these four watersheds to restore to full WWH.

Target #1: "By 2010, 30% of known acid mine impaired streams are in attainment with Warm Water Habitat (WWH) aquatic life uses through increasing pH, decreasing metals and sediment loading, and minimizing degradation of primary headwater habitat."

Water quality stations were analyzed in 2005 and 2006 for biology in Sunday Creek, Monday Creek, Raccoon Creek, and Huff Run watersheds. The total number of AMD stream miles evaluated was 175 in 2005 and 72 in 2006. Comparing the same stream segments from baseline to 2005–2006 shows the change in stream use attainment and narrative conditions, from a biologists' perspective (these changes are not official use attainment status changes made by the Ohio EPA). The biological condition of 23.3 stream miles changed from Non-supportive and Partial attainment to Full WWH use attainment. Although, this number is the ultimate number that is tracked in terms of the NPS management plan Target #1, there are many other significant incremental changes. These changes are tracked and described in this report; for example, attainment use changes from Non-supportive to Partial attainment, narrative description changes, acid and metal loading reductions, pH and acidity improvements, and increases in number of fish and diversity. These incremental changes may not allow a stream segment to change use attainment status, but they do track progress toward the overarching goal and therefore have been tracked at the acid mine drainage project level reports and at the watershed level reports. Biologicial attainment status based on macroinvertebrate (ICI) and fish (IBI) data at the 60 sampling stations within these four watersheds, will not be collected again until 2010.

Family-level biological (MAIS) data collected annually since 2006 have begun to provide a baseline from which to measure trends in water quality. These results are shown in Section II for each watershed.


Huff Run


Monday Creek


Raccoon Creek


Sunday Creek

Table 1. Summary of the NPS targets for each of the four watersheds evaluated in 2005 to 2008: Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run.

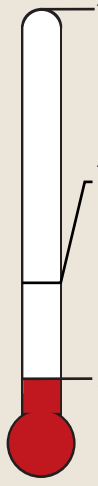
Watershed	Total number of completed projects	Total costs	Total acid load reduction lbs/day	Total stream miles improved in 2005 to meet WWH Full attainment	Goal of number of stream miles to meet WWH Full attainment by 2010
Raccoon Creek	9	$7,674,855	5,592 **	23.3	57.0
Monday Creek	11 (plus 5 subsidence projects, costs are not included)	$3,962,906	2,861	0	25.0
Sunday Creek	4 (3 of 4 are subsidence projects)	$652,180	20	0	18.0
Huff Run	9	$3,495,199*	141	0	2.97
Total	**33**	**$15,785,140**	**8,614**	**23.3**	**102.97**

**excludes Huff Run AML project design costs and Huff Run AML construction costs.*
*** Salem Rd/Middleton Project evaluated at the three separate treatment components*

Reductions

Total acid load reductions = 8,614 lbs/day

Attainment Miles



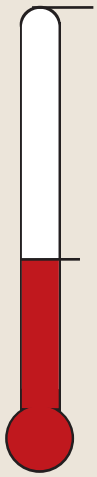
Total AMD impaired stream miles (RC, MC, SC, Huff Run) = **341 stream miles**

Target #1 indicates 30% attainment of impaired streams by 2010 =**102 miles**

Number of stream miles changed from Non-attainment or Partial attainment to Full WWH attainment for 2006 is = **23.3 miles**

(175 miles assessed in 2005)
(72 miles assessed 2006)

Completion



Sub-target 2
Total projects proposed in these four Watersheds AMDATS = **72**

Total projects complete = **33**

Costs

Total reclamation costs = $15,785,140

Sub-Target 1: "By 2010, 20 completed and federally approved Abandoned Mine Drainage Abatement and Treatment (AMDAT) Plans for AMD impaired watersheds".

• Twelve Acid Mine Drainage Abatement and Treatment (AMDAT) plans have been completed (Map 1): Huff Run, Moxahala Creek, Sunday Creek, Monday Creek, Federal Creek, Raccoon Creek Headwaters, Middle Basin Raccoon Creek, Little Raccoon Creek, Leading Creek, Robinson Run, Yellow Creek, and Upper Rush Creek.

• To address sub-target 1, "complete 20 AMDAT plans by the year 2010", 11 watersheds have been selected as priority watersheds to write an AMDAT plan. These 11 watersheds were selected from a list of approximately 20 mining impacted watersheds in Ohio that were identified from these various sources; OEPA 2004 and 2006 integrated report, ODNR-MRM 2002 map showing impairment magnitudes from mining, ODNR's 1974 Land Reborn report (high and medium priority), and OEPA TMDL reports. In order to prioritize these 11 watersheds as candidates for the AMDAT plan, water quality data and information from ODNR-DMRM project officers, Ohio EPA surface water quality database, Ohio EPA TMDL personnel, and US Forest Service personnel were used to determine the extent of mining and its need for further study. Table 2, summarizes this information (page 4 & 5).

Map 1. Status of AMDAT Plans in Ohio 2008

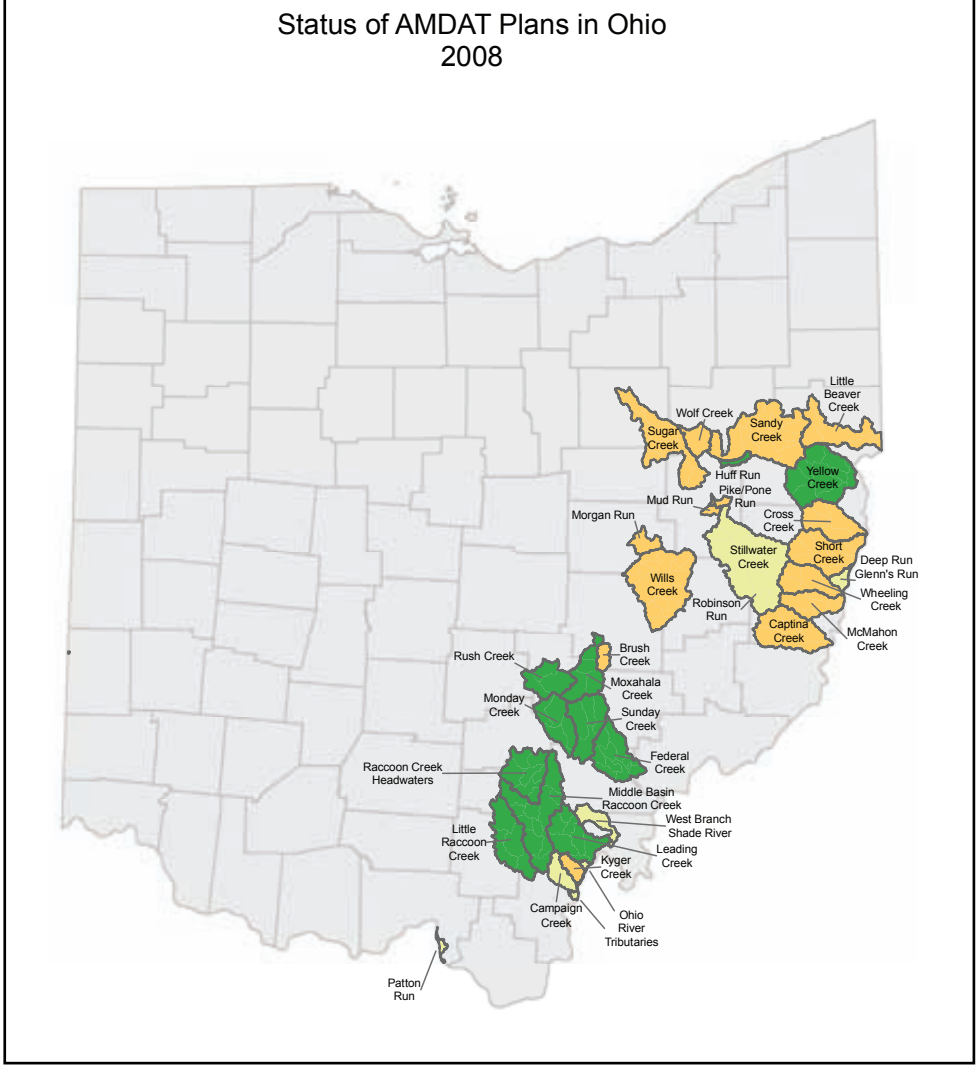


Table 2. Supporting information to determine AMDAT plan needs in Ohio watersheds

Watershed Name	Personal contact information	Water quality data and source	Recommended for an AMDAT plan (Y or N)
Duck Creek	Bill Jonard (ODNR-DMRM) - Sediment issues present not acid mine drainage issues.	184 acres of strip mine land	No
Wills Creek	Ed Rankin and Chris Yoder biology data indicated AMD stressors in Buffalo Creek	OEPA Database: 1999 showed high conductivity in Buffalo Fork, Leatherwood Creek, Rannells Creek, Miller Creek, and Collins Fork no pH values were collected	Yes
Captina Creek	Mike Mozena (ODNR-DMRM) recommended for an AMDAT plan	OEPA database: as of 2000 pH values meeting standards	Yes
Stillwater		OEPA database: no pH values collected, sporadic conductivity ranges	Need more data
Little Beaver Creek	Cheryl Socotch (ODNR-DMRM) recommended for an AMDAT plan	OEPA Database: 1999 high conductivity, no pH values collected in Honey and North Fork of Little Beaver Creek	Yes
Sugar Creek		OEPA database: 1998 South Fork Sugar Creek (RM 0.27) pH 5.04, Trib. to Indian Trail Creek (RM 6.08) pH 5.18, and Cherry Run (RM 0.22) pH 5.54	Yes
Tuscarawas Tributaries White Eyes Evans Pike Run Pome Run Wolf Creek Mud Run Trib. to Morgan Run	Kelly Capuzzi (OEPA) provided initial water quality information – TMDL in preparation	Full WWH Full WWH pH 5.93 pH 5.42 pH 3.67 High TDS, Fe, mining pH 5.3-5.7	No No Yes
Salt Creek	Kelly Capuzzi (OEPA) TMDL complete – not recommended for an AMDAT plan		No
Pine Creek	Pam Stachler (USFS) – not recommended for an AMDAT plan, isolated mining issues in Kimble Creek	OEPA database: 2000 Kimble Creek pH 2.46	No
West Branch Shade River	Matt Raymond (ODOT) – recommended for and AMDAT plan		Need more data
Meigs Creek	Jen Bowman (Voinovich School) – high sediment loads, no acidity, under active reclamation by Consol		No

Table 2. (continued) Supporting information to determine AMDAT plan needs in Ohio watersheds

Watershed Name	Personal contact information	Water quality data and source	Recommended for an AMDAT plan (Y or N)
McMahon Creek	Mike Mozena (ODNR-DMRM) –Recommended for an AMDAT plan, specifically Little McMahon Creek	OEPA database: 1983 Kings Run pH 4.0, 2.8, 3.0, 3.2, Trib. to Little McMahon Creek (RM 2.28) pH 3.9	Yes
Wheeling Creek	Mike Mozena (ODNR-DMRM) –Recommended for an AMDAT plan: Fall Run, Steep Run, Cox Run, Jug Run, Crabapple Creek, Sloan Run	OEPA database: 1999 Wheeling Creek (RM 12.3) high conductivity downstream of Fall Run and at the mouth of Fall Run no pH values were collected	Yes
Short Creek	Hal Miller (ODNR-DMRM) extensive mining throughout, have been developing projects in the area, no coordinator.	OEPA database: 1999-2000 Short Creek (RM 4.96)high conductivity, no pH data collected	Yes
Cross Creek		OEPA database: 1983 Dry Fork pH 3.7 and Trib to Cross pH 2.8	Yes
Symmes Creek	Pam Stachler (USFS) – not recommended for an AMDAT plan, isolated mining issues		No
Sandy Creek		OEPA database: 1992 Nimishillen Ck (RM 6.72) pH 5.5, high conductivity and 1987 Huford Run pH 3.8	Yes
Kyger Creek	Barb Flowers – localized AMD with sediment issues	OEPA database: 1982 Jessie pH 4.5 Turkey Run pH 4.3	Yes
Campaign Creek	Barb Flowers (ODNR-DMRM) recommended for an AMDAT plan		Need more data
Ohio River Tributaries Stories Run Patton's Run Glenn's Run Deep Run	Barb Flowers (ODNR-DMRM) recommended Stories Run, Mike Mozena (ODNR-DMRM) recommended Patton's, Glenn's, and Deep Run)		Need more data
Brush Creek	Max Luehrs (OSM) and Bill Jonard (ODNR-DMRM) – severe AMD impacted (Muskingum Tributary)		Yes

Sub-Target 2: "By 2010, 10 AMD impaired watersheds have implemented some or all of the reclamation actions recommended in the endorsed AMDAT".

As of 2008, the following eight watersheds are implementing reclamation actions endorsed in their AMDAT plan: Little Raccoon Creek, Headwaters of Raccoon Creek, Middle Basin of Raccoon Creek, Monday Creek, Sunday Creek, Huff Run, Leading Creek, and Moxahala. Yellow Creek is planning for reclamation activities and making efforts to secure funding for projects in 2009 and beyond.

Sub-Target 3: "By 2006, report annually on a comparison between acidity and pH concentrations upstream and downstream of AMD project sites and long-term monitoring stations, as compared to acidity and pH reference sites within the Western Allegheny Plateau Eco-region".

This report and website (www.watersheddata.com) were created to provide ODNR-DMRM, watershed groups, watershed professionals, Ohio EPA, USEPA and all of Ohio's citizens an annual report of the reclamation efforts resulting in water quality and biological changes in Ohio's streams due to abandoned mine reclamation. This report is available on the website under the reports tab.

Section II – Watershed reports

Section II contains four watershed level NPS reports detailing the chemical and biological data trends from baseline condition to 2008.

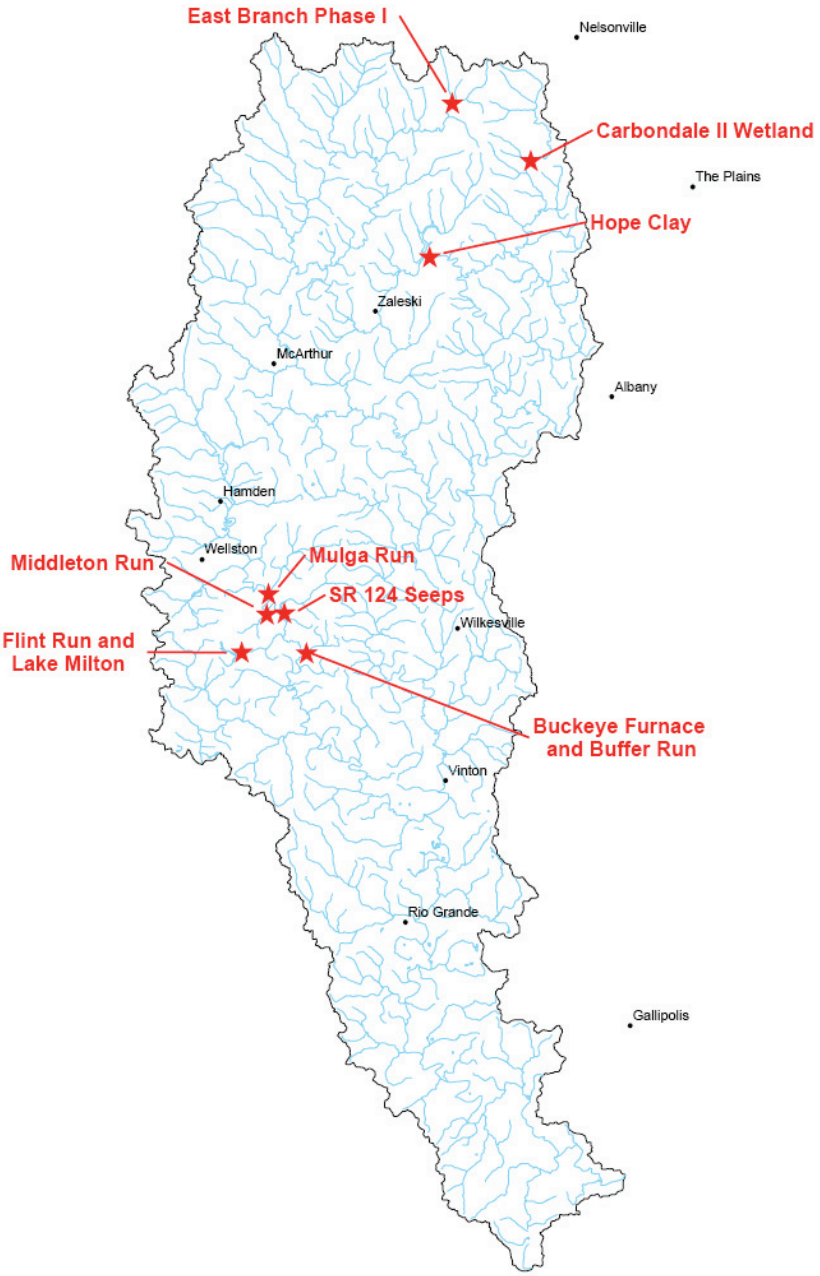
1. Raccoon Creek Watershed
2. Monday Creek Watershed
3. Sunday Creek Watershed
4. Huff Run Watershed

• The Raccoon Creek Watershed Project is a local partnership working towards conservation, stewardship, and restoration of the watershed for a healthier stream and community. The partnership consists of multiple agencies and individuals working to restore and promote the waters of Raccoon Creek. Encompassing over 683 square miles, the watershed lies in portions of six southeast Ohio Counties (Athens, Hocking, Meigs, Vinton, Jackson and Gallia). Raccoon Creek is one of Ohio's longest streams, measuring 112 miles draining into the Ohio River in Gallia County. Major sources of impairment to the stream include acid mine drainage (AMD), drainage from wastewater treatment facilities, and industrial discharges. By and large, AMD contributes to the vast majority of pollution issues in the watershed.

• The watershed currently has over 25,610 acres of underground coal mines and 21,550 acres of surface coal mines within its boundaries. About 110 acres of abandoned coal refuse piles also lie in the watershed. These abandoned mines and refuse piles leach thousands of pounds of sulfuric acid and metals into the creek daily, significantly degrading the water quality of streams. In the late 1990's representatives from several partnering agencies, including the Institute for Local Government and Rural Development (ILGARD), Ohio Department of Natural Resources, Division of Mineral Resource Management, and Ohio EPA, prioritized sites that contributed the most AMD pollution to Raccoon Creek and began to implement restoration strategies on these sites. Because the watershed is so large, three major sub-shed divisions are used to break up the region into more manageable sections. These consist of the Headwaters, Little Raccoon, and the Middle Basin sub-sheds. Each of these sections has priority AMD projects. Some of these projects have been completed, some are in progress, and some are anticipated future projects.

• Headwaters

• The major priority sites in the headwaters sub-shed include East Branch, where several impacted tributaries contribute to significant acid and metal loadings in Raccoon Creek. Brushy Creek and the Mainstem of Raccoon



Raccoon Creek near Moonville, Photo by Ben McCament

Creek above Brushy Creek are also priority AMD abatement sites.

• Little Raccoon

• Flint Run is the largest contributor of AMD in the Little Raccoon Creek watershed. A majority of this (90%) is attributed to a 240-acre site in the headwaters. This site, called Broken Aro, previously housed a coal preparation facility and mine tailings dump. Other major AMD contributors in this basin include Mulga Run, Buffer Run and Goose Run.

• Middle Basin

• Major acid contributors in the middle basin include Rock Camp and Pierce Run. Rock Camp is the most consistent contributor of AMD, and has net acidic water regardless of flow. Pierce Run has experienced some net alkaline flows; it is thought that this might result from current mining operations in the area.

• Watershed Outreach

• In addition to the technical work of AMD remediation, other activities in the watershed are geared toward meeting goals of stewardship and conservation in the region. Annual litter pick-ups, tree-plantings and canoe-floats all encourage residents to become stewards of our watershed. School programs for youths help educate students about water quality, acid mine drainage, and the value of clean water. In addition, a new community group has formed to address access issues for canoers and kayakers who wish to paddle on the creek.

For further updates on the progress in Raccoon Creek,
please visit our webpage at:
www.raccooncreek.org

Reductions

Total acid load reduction = 5,592 lbs/day

Total metal load reduction = 1,001 lbs/day

Data derived using the Mean Annual Load Method (Stoertz, 2004).

Attainment Miles

Total stream miles assessed impacted by mine drainage = **190 miles**

Target #1 indicates 30% attainment of impaired streams by 2010 = **57 miles**

2006 progress = **23.3 miles** meeting Full WWH attainment

(48 miles assessed in 2006)

Completion and Costs

Sub-target 2
Total projects proposed in three Raccoon Creek Watershed
AMDATS = 25

Total projects complete = 9

Design = $1,421,573
Construction = $6,253,282

Total Costs through 2008 = $7,674,855

Timeline of the Raccoon Creek Watershed Project Milestones & AMD Projects

This timeline demonstrates the history of the Raccoon Creek Watershed Restoration Partnership started almost two decades ago by a group of concerned local citizens. Today, the partnership consists of multiple state and local agencies and private citizens. AMD projects have been administered through the Vinton Soil and Water Conservation District and Ohio University's Voinovich Center (ILGARD), with funding from various state and federal grants but mostly from Ohio EPA's 319 program and ODNR-MRM's AMD program.

1980s
Formation of Raccoon Creek Improvement Committee (RCIC): Grassroots citizens group to address water quality in Raccoon Creek

Early 1990s
RCIC invites citizens from all six counties to join efforts

Late 1990s
Formation of Raccoon Creek Watershed Partnership, a loosely based partnership of agencies to address technical AMD issues

1999 State Route 124 Strip Pit and Buckeye Furnace Project completed

2000 Little Raccoon Creek AMDAT completed

Watershed Coordinator position funded for six years

2001 Headwaters AMDAT completed

State Route 124 seeps project completed

2003 Mulga Run project completed

Middle Basin AMDAT completed

Completed management plan for Raccoon Creek Watershed

2004 Carbondale II project completed

2005 Middle Run-Salem Road project completed

2006 Raccoon Creek Water Trail Association formed

Mission to Establish a water trail on Raccoon Creek

Flint Run and Lake Milton Projects completed

Watershed Coordinator three year extension funded

2007 Raccoon Creek Watershed Partnership formed 501 (c) 3

2008 East Branch Phase I AMD Project

2009 Pierce Run AMD Project

East Branch Phase II Project

Projects Completed Jan. 1, 2007 – Dec. 31, 2007

East Branch Phase I	**$ 976,725**

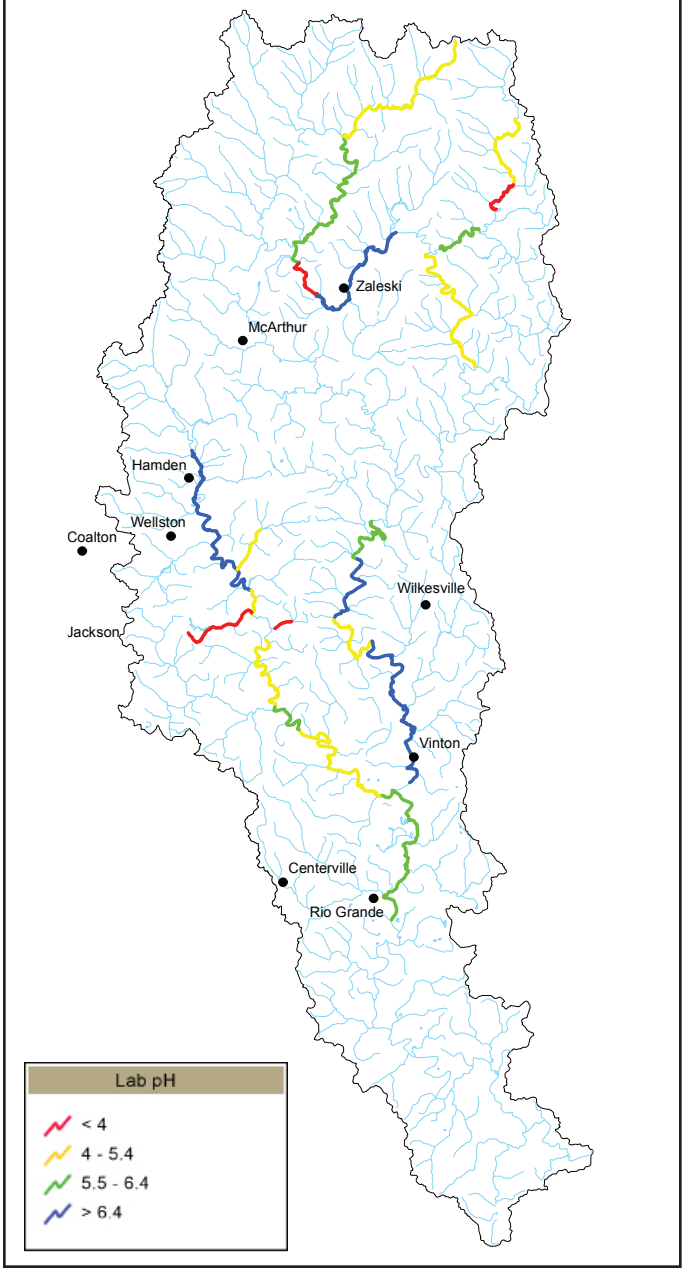
Load Reductions will be evaluated in 2008 for this project

	East Branch Phase I
Acid Load	1,174 lbs/day
Metal Load	143 lbs/day

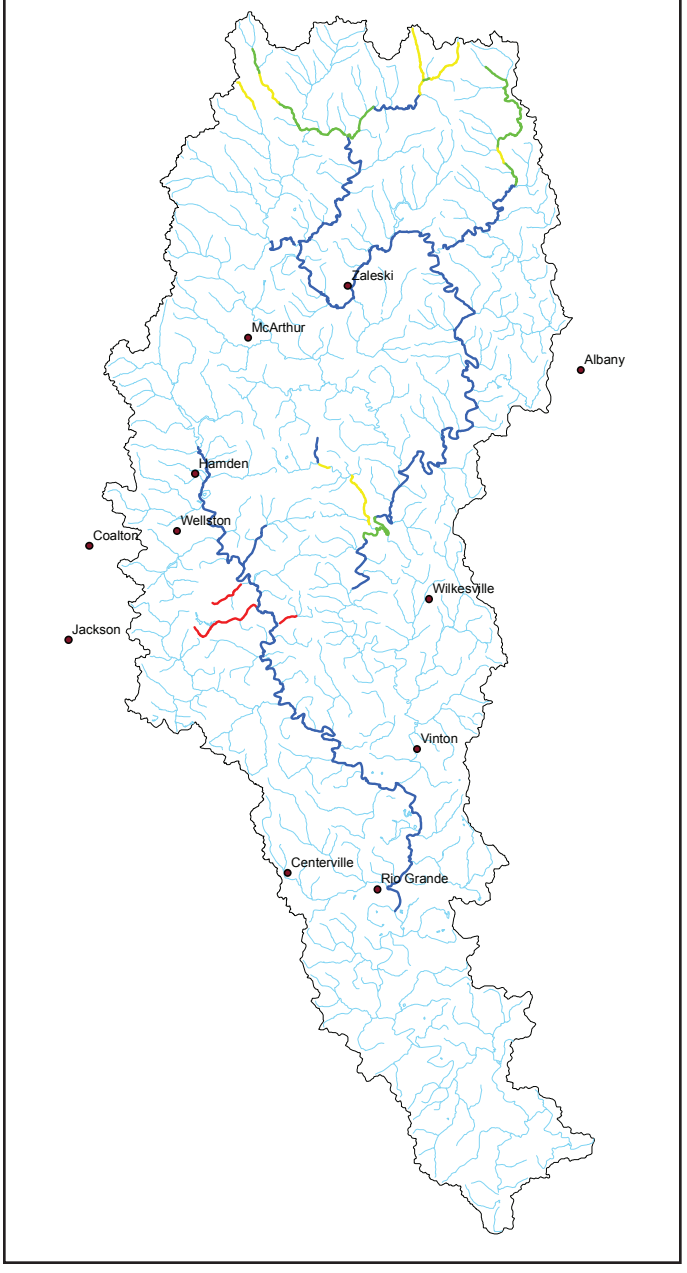
Cumulative BMP's installed

Treatment Installed	East Branch Phase I
Open Limestone Channel	1,100 *linear feet*
Steel Slag Leach Bed	16,251 *square feet*
Settling pond with limestone berms	42,000 *square feet*
Reclaim gob pile	4.8 *acres*
Limestone J-trench	12 *linear feet*

Raccoon Creek baseline pH

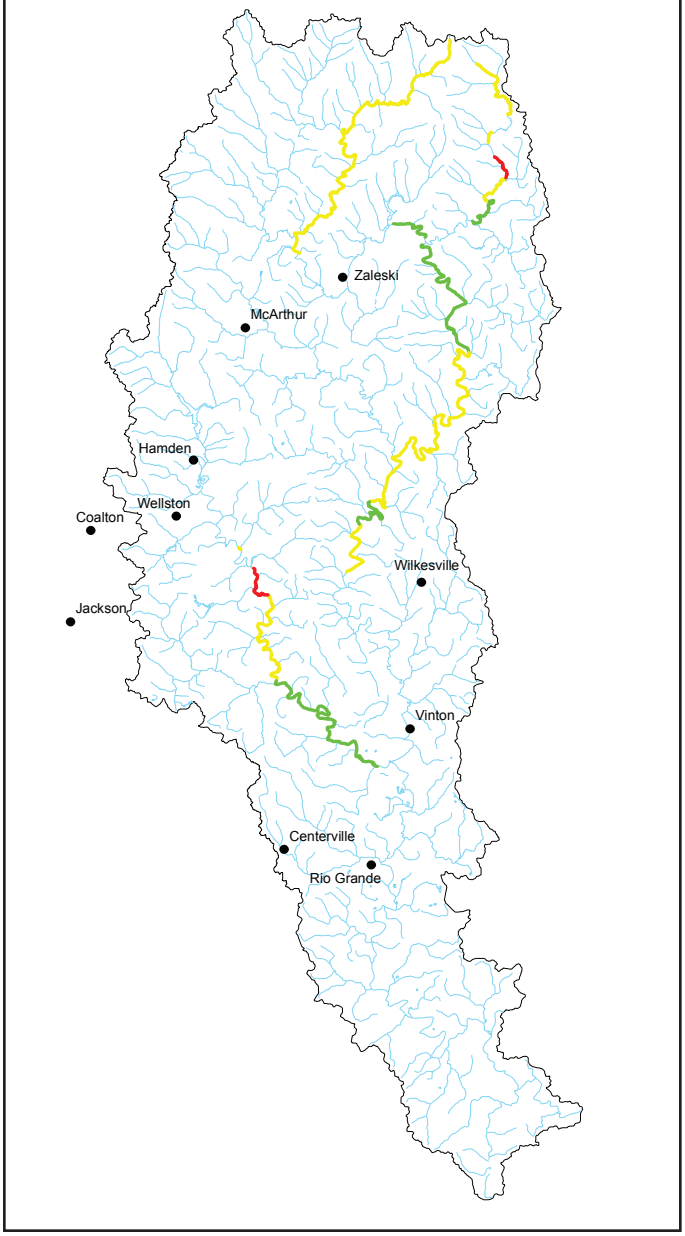


Raccoon Creek 2008 pH

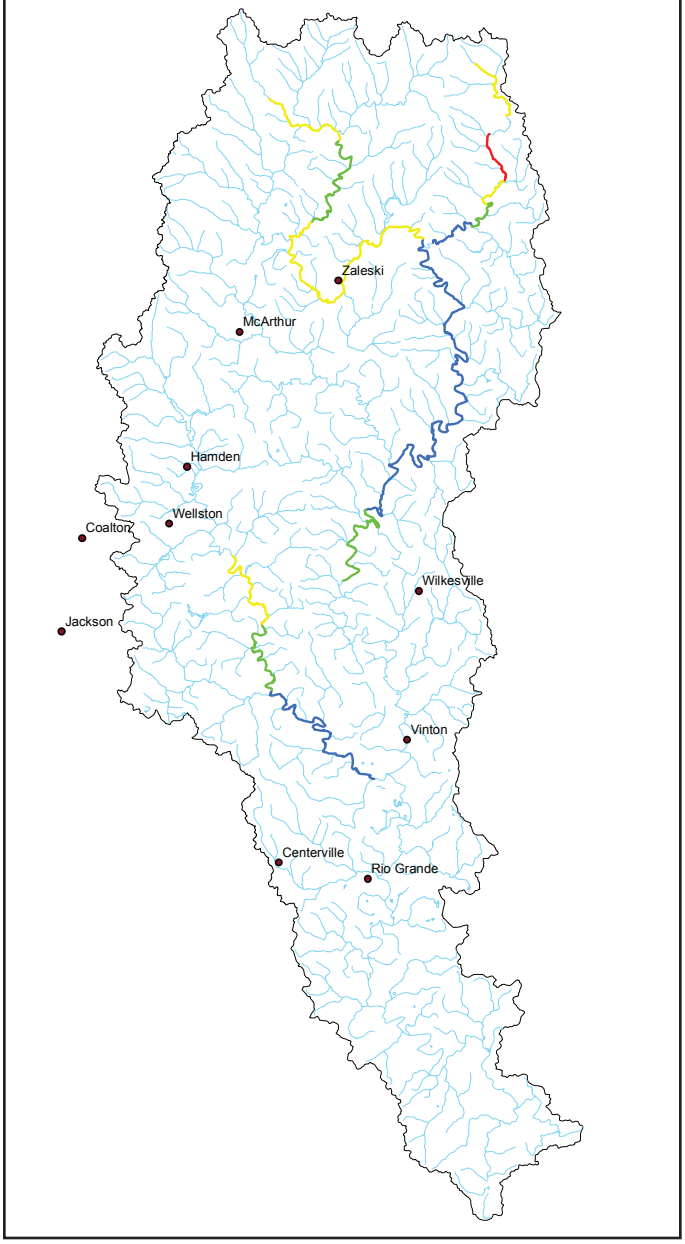


In Raccoon Creek pH values have improved throughout the watershed from baseline conditions (1994-2001) to 2008. Raccoon Creek mainstem, Hewett Fork and Little Raccoon Creek average pH values have increased from a range of 4.0-5.4 during baseline to 5.9-8.5 in 2008. In 2008, 9.2 river miles in Hewett Fork, 31.6 river miles in Little Raccoon Creek, and 50.4 miles along the mainstem of Raccoon Creek all met the pH standard (pH >6.5).On the mainstem of Raccoon Creek there were an aditional 24.7 miles attaining the pH standard (6.5) as compared to last year's data.

Raccoon Creek 2006 MAIS



Raccoon Creek 2008 MAIS



Macroinvertebrate Aggregated Index for Streams

- 0 - 7
- 8 - 11
- 12 - 15
- > 15

MAIS samples were collected throughout Raccoon Creek in 2008, these stations has been established as annual monitoring stations for macroinvertebrates. These sites will be used to track incremental changes in future years.

MAIS samples were collected throughout Raccoon Creek from 2005 through 2008. These stations have been established as annual monitoring stations for macroinvertebrates they will be used to track incremental changes in future years. After each station amasses five samples (five years of data) a regression analysis can be used to determine changes. One station on Hewett Fork has data from 2001-2008, HF090 (RM 8.3). The regression analysis for this site indicates 'no statistical change' over the seven year period. There was a slight score increase from 2005 to 2006, but scores have been variable in 2007 and 2008 (P value 0.17) (Johnson 2009, personal communication).

After 2009 when there are at least five sampling events to perform the more robust regression analysis, an "area of degradation" analysis can be used to assess degradation along a section of stream. In Hewett Fork in 2008, along river mile 13.4 to 0.9, the area of degradation was similar to that of 2006 (-35 compared to -34), apparently recovering after declining to -62 in 2007. The first three stations from RM 13.4 to 8.3 recovered to 2006 levels, and the last two stations (RM 4.0 to 0.9), more than 3 river miles, met the cutoff that approximates WWH attainment (MAIS score >12).

Missing data in 2005 and 2007 made direct comparisons more difficult, however, from 2005 to 2006, there was noticeable improvement (area of degradation reduced by half, -164 to -58).

From 2006 to 2007, there was again a marked improvement (area of degradation declined from -39 to +16). In 2008, there was a small drop in quality (from +16 to +4), but still a considerable improvement over 2005 and 2006 (Figure 2).

Figure 1. Area of degradation for MAIS scores in Hewett Fork from 2007 to 2008.

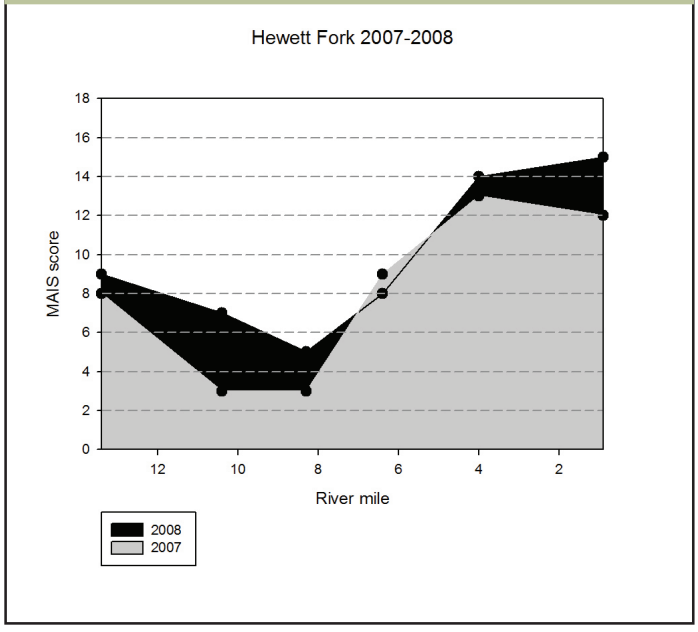
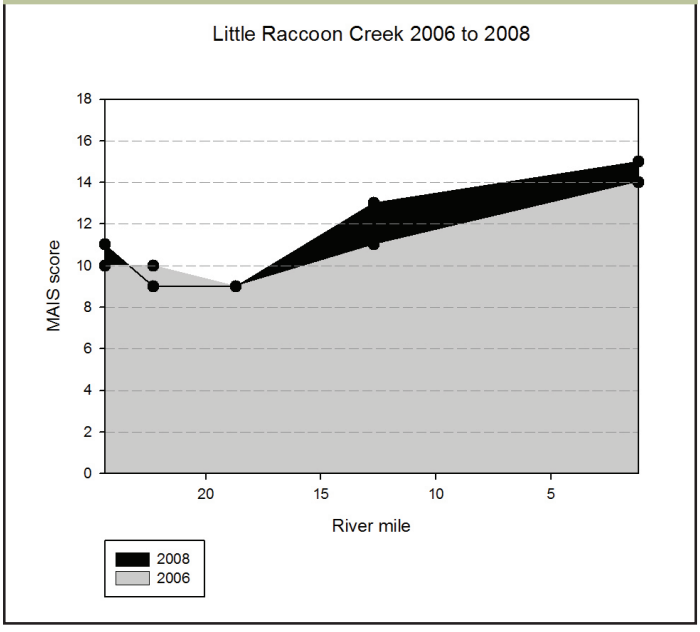


Figure 2. Area of degradation for MAIS scores in Little Raccoon Creek from 2006 to 2008.



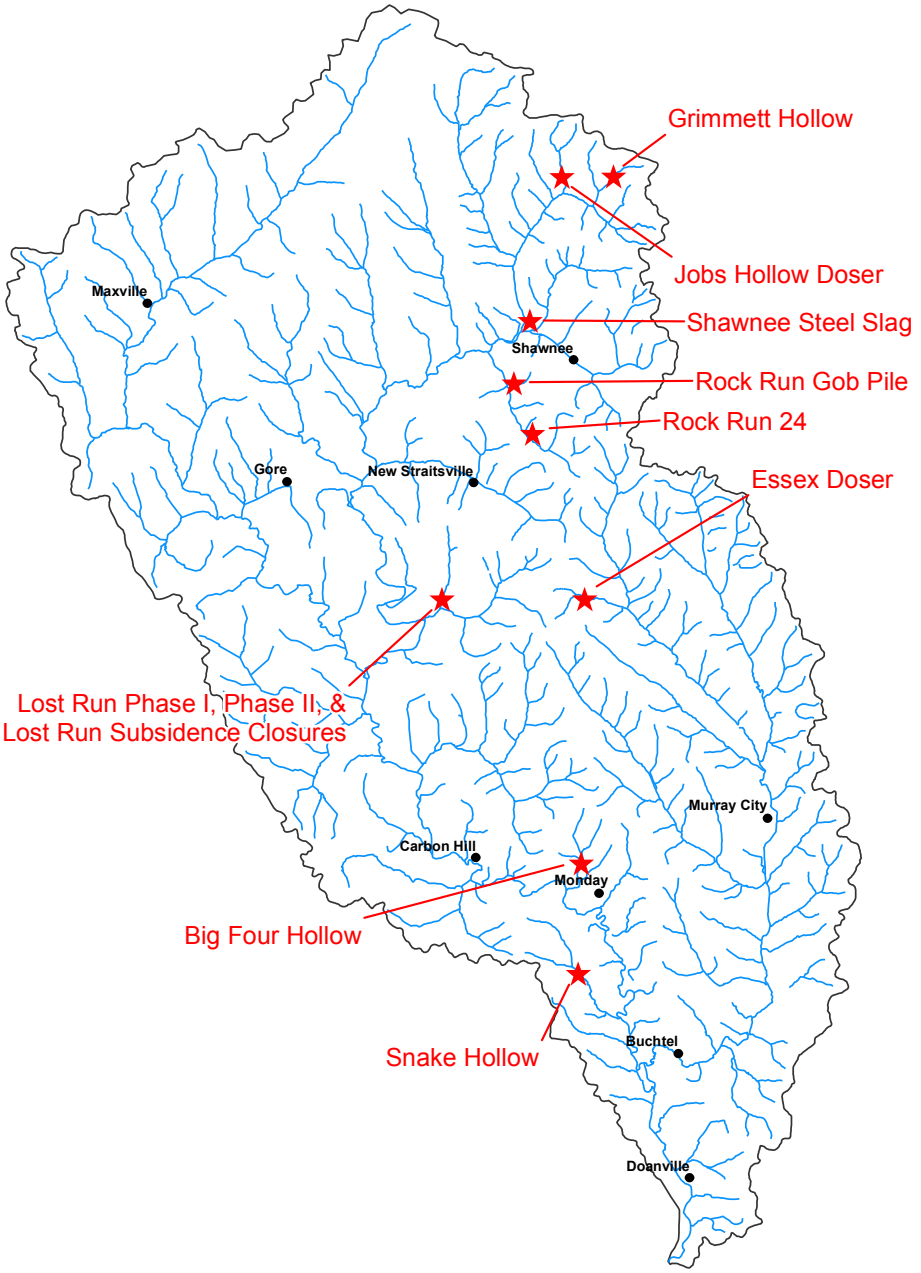
• Monday Creek, located in the Appalachian Region of southeastern Ohio, is a 27-mile long tributary of the Hocking River, the latter which flows directly into the Ohio River. The Monday Creek Watershed drains a 116 square-mile area, with streams winding through portions of Athens, Hocking, and Perry Counties.

• Our project is a collaborative partnership of officials and residents of the Monday Creek watershed, along with more than 20 other organizations and state and federal agencies. Our shared goal is to restore the watershed for the benefit of local communities. Large portions of Monday Creek and its tributaries are dead due to acid mine drainage (AMD) left behind from a century of coal mining.

• Since 1994, our partnership has worked together to identify water quality problems, conduct field research and site characterization, and prioritize and plan on-going restoration activities. The MCRP has completed the reclamation of the Rock Run gob pile in southern Perry County through an EPA Section 319 grant and is beginning another project in the headwaters of Jobs Hollow through 319.

• In 1997-1998, we identified issues to be addressed for the long-term improvement of the watershed, and to the benefit of local communities. These issues, along with goals, objectives, action strategies, and progress indicators are discussed in detail in the Monday Creek Comprehensive Management Plan.

• To learn more about the Monday Creek Restoration Project, visit our website at www.mondaycreek.org or call 740-394-2047



Monday Creek Restoration Project

333,935,000 gallons per year eliminated from entering into the deep mines as the result of conducting six stream capture closure projects in Monday creek

Reductions

Total acid load reduction = 2,861 lbs/day

Total metal load reduction = 381 lbs/day

Data derived using the Mean Annual Load Method (Stoertz, 2004).

(excludes Rock Run Gob Pile Project)

Costs

Design $304,056
(excluding Snake Hollow)

Construction $3,658,851

Total costs through 2008 = $3,962,906

Monday Creek Stream Capture Projects

Project status: Six subsidence closures projects were completed from 1995-2007

Project Name	Year project complete	Acres Captured	Agencies funding	Estimated gallons/yr of water diverted from entering the deep mine
Majestic Mine	1999	100	ODNR-DMRM	36,860,000
Salem Hollow	2000	60	ODNR-DMRM	22,116,000
Murray City	2004	5	ODNR-DMRM	1,843,000
Goose Run	1995	506	ODNR-DMRM	186,512,00
Snow Fork	1999	140	ODNR-DMRM	51,604,000
Lost Run	2007	100	USFS	35,000,000

Six stream captures located in the Monday Creek Watershed were closed and completed from 1995 to 2007. A total of 911 acres surface drainage area drained year round into the deep mines and as a result of closing these subsidence holes, 333,935,000 gallons per year were diverted from entering into the deep mine thus abating the generating of acid mine drainage.

Projects Completed Jan. 1 2008 – Dec. 31, 2008

Shawnee Steel Slag	**$219,791**
Lost Run Phase II	**$553,889**
Total	**$773,680**

Load Reductions

	Lost Run Phase II	Shawnee Steel Slag
Acid Load	143 lbs/day	NA
Metal Load	0 lbs/day	NA

Cumulative BMP's installed

	Treatment Installed	
Lost Run Phase II	Limestone J-trench	140 linear feet
	Steel slag leach bed	14,250 square feet
	Steel slag berm	197 linear feet
	Open limestone channel	1,300 linear feet
	Limestone leach bed	7,650 square feet
Shawnee Steel Slag	Steel slag bed	22,800 square feet
	Open limestone channel	190 linear feet
	Sand filter	1 pre-treatment

Completion

Sub-target 2
Total projects proposed in 1999 AMDAT = **13**
Total projects complete = **11 (plus 5 subsidence closures)**

Attainment Miles

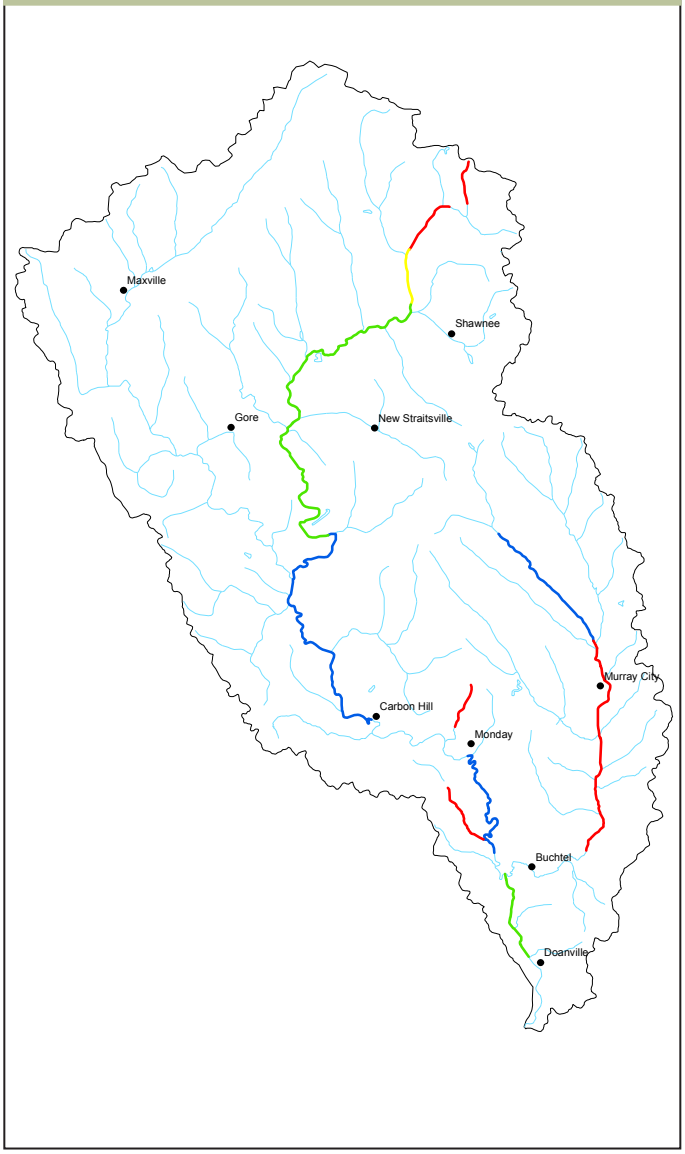
Total stream miles assessed impacted by mine drainage = **83 miles**

Target #1 indicates 30% attainment of impaired streams by 2010 = **25 miles**

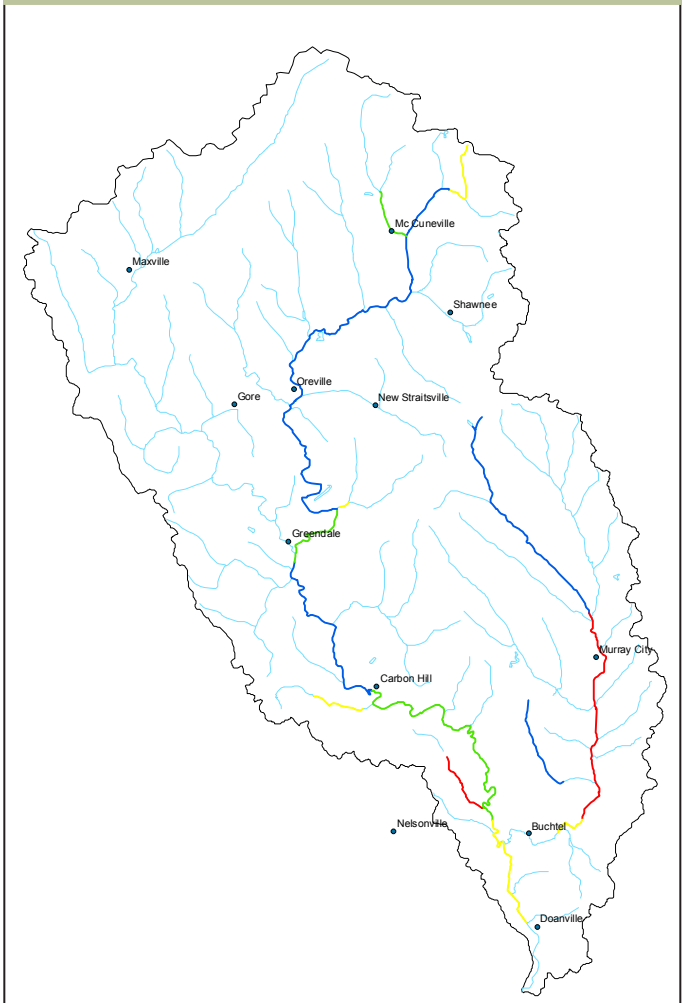
2006 progress = 0 miles meeting Full WWH attainment

(33 miles assessed in 2006)

Monday Creek baseline pH



Monday Creek 2008 pH

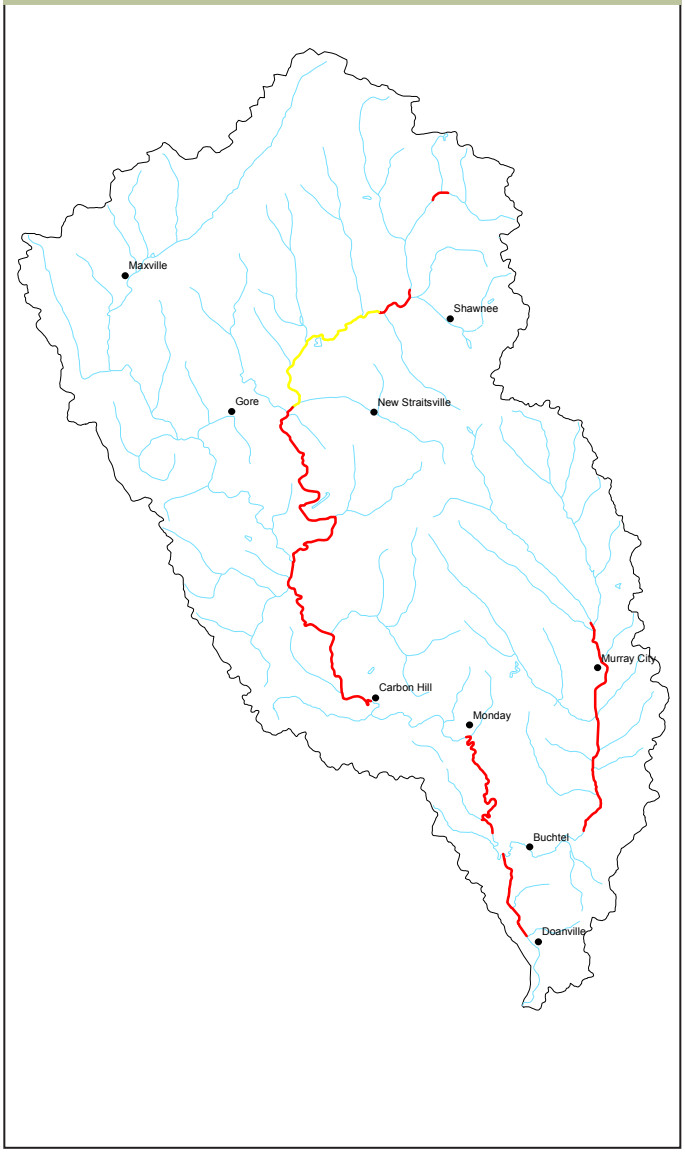


Lab pH

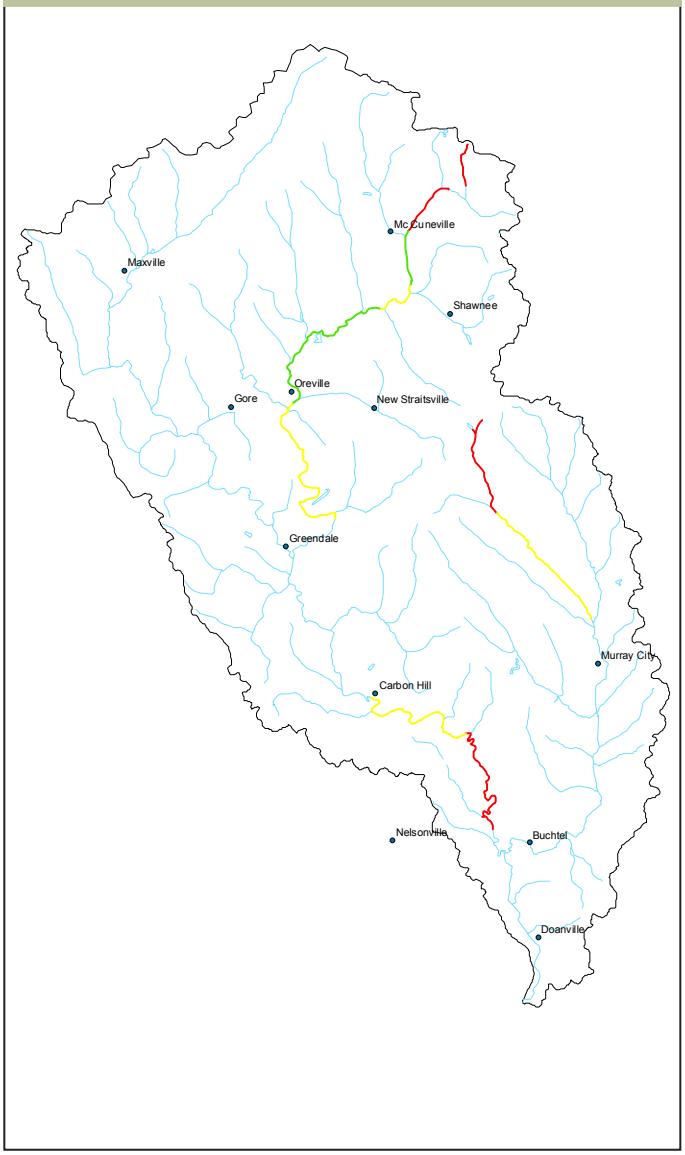
- < 4
- 4 - 5.4
- 5.5 - 6.4
- > 6.4

In Monday Creek pH values have improved throughout the watershed from baseline conditions (2001) to 2008. However during 2008, there was a decrease in pH values from previous years seen in the lower part of Monday Creek from site MC00240 (RM 7.2) up to MC00500 (RM 16.2). Only 6.6 miles of stream along the mainstem are meeting the water quality standard for pH (>6.5) from Jobs Hollow down to Lost Run. The three miles of the headwaters of Snow Fork, Essex Mine to Murray City continues to meet water quality standard for pH (>6.5).

Monday Creek baseline MAIS



Monday Creek 2008 MAIS



Macroinvertebrate Aggregated Index for Streams

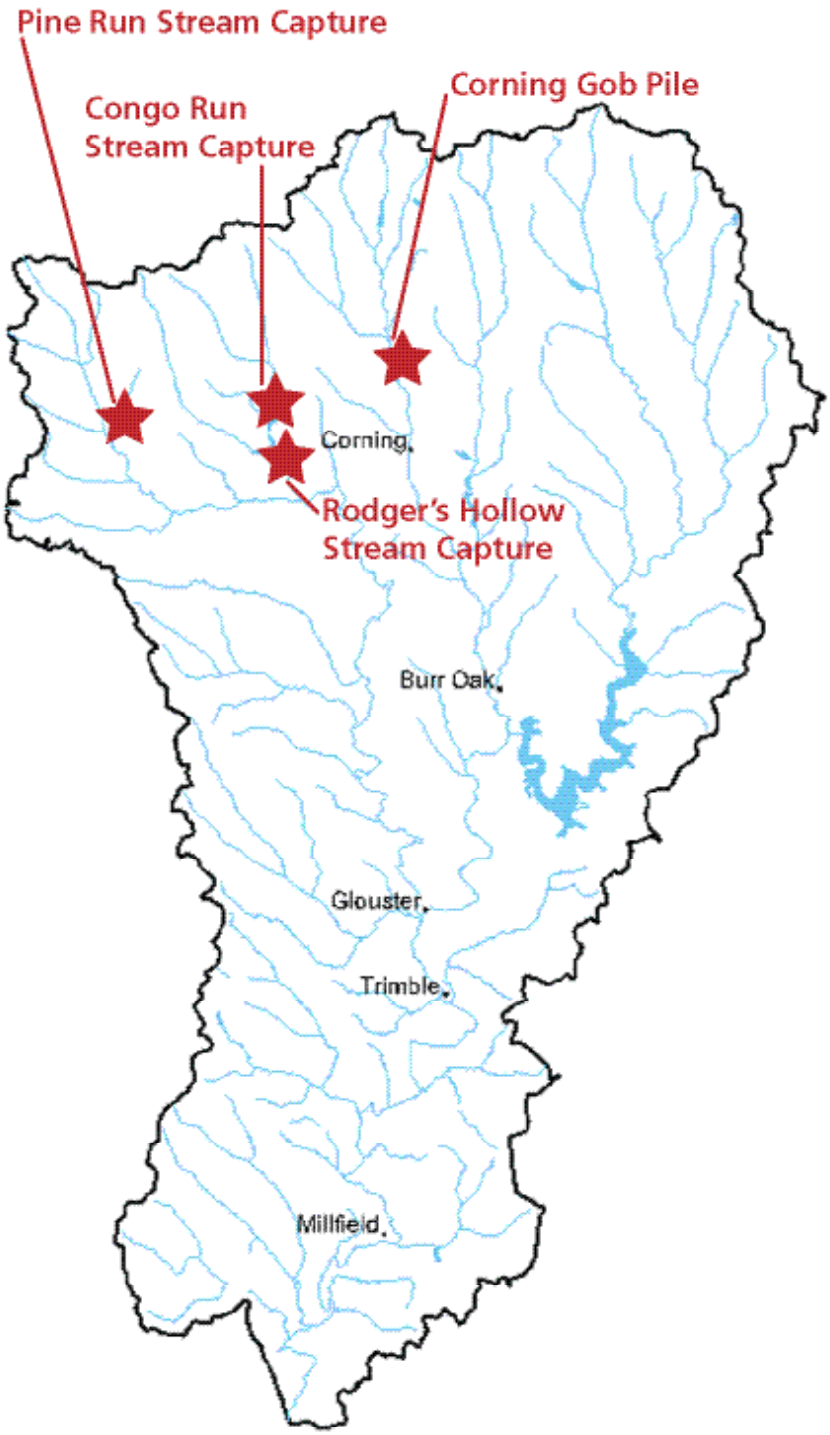
- 0 - 7
- 8 - 11
- 12 - 15
- > 15

MAIS samples were collected throughout Monday Creek at established annual monitoring stations from 2001 through 2008. Six stations along mainstem of Monday Creek have sufficient data to conduct a regression analysis (n>5). From this analysis there is evidence of long-term biological improvement. Of the six stations, five showed significant improvement (P = 0.04, 0.02, 0.01, 0.05 and 0.04). One site showed no improvement (JH00500). The three sites with the greatest improvement occurred at MC00300 (mainstem Carbon Hill, Bucks Inn), MC00510 (mainstem upstream of Lost Run), and MC00580 (Oreville).

• The Sunday Creek Watershed Group emerged from local residents' concerns for the health of the Sunday Creek. Currently, we are a project of Rural Action. The Sunday Creek Watershed group office is located on 69 High St. Glouster Ohio 45732. The phone number is 740-767-2225 and our web page is http://www.sunday-creek.org. Our most active partners are: Ohio Department of Natural Resources the divisions of Mineral Resource Management and Soil and Water Conservation; Ohio Environmental Protection Agency; Office of Surface Mining; Ohio University; ILGARD; Hocking College; Trimble and Miller School District; Rural Action's Environmental Learning Program and Sustainable Forestry; Local Village Councils; Local Township Trustees; Little Cities of Black Diamonds; Buckeye Trail Group; Moose Lodge; Wayne National Forest; Burr Oak State Park.

• Our mission statement, as adopted by the Sunday Creek Watershed Group in 2000; "The Sunday Creek Watershed Group is committed to restoring and preserving water quality through community interaction, conservation, and education; in pursuit of a healthy ecosystem capable of supporting bio-diversity and recreation."

• The Sunday Creek Watershed is located in the Appalachian foothills, in the unglaciated part of Ohio. It is mostly rural with many small villages throughout, and the majority of the land is privately owned. The Sunday creek watershed starts in the East Branch, north of Rendville and the West Branch at Shawnee. The creek follows SR 13 through Corning, Glouster, Millfield and it goes into the Hocking River right in Chauncey. The watershed covers 139 square miles crossing Athens (38.8%), Perry (42.84%), Morgan (18.35%), and Hocking (0.01%) Counties. According to the Ohio Department of Natural Resources, in 1994, land cover classification for Sunday Creek consisted of 78% wooded, 17% agricultural, 2.4% brush, 1% urban, 1% open water, 0.3% barren, and 0.2% non-forested wetland (Map 2: land use/land cover). The U.S. Forest Service manages approximately 15% of the total acreage.



• In the fall of 1999, Jim Hart began putting together a list of other local residents interested in water quality in the Sunday Creek watershed. A group of over 20 people attended the first meeting, which was held in the Trimble High School library. At the beginning, the group focused on organization, establishing a mission, and getting a sense of the community's concerns for the Sunday Creek. In 2000, the group partnered with Rural Action and got its first full time Americorp VISTA. That year we received an EPA 319 planning grant to develop a management plan. With that grant we completed a State Endorsed Management Plan and an Acid Mine Drainage Abatement Plan with additional funding from ODNR-MRM. In 2002, we received a six year ODNR Soil and Water Conservation Watershed Coordinator grant. In 2003 we began our first EPA 319 2002 implementation grant. Currently we are in the last year of our second (2004) EPA 319-implementation grant. We also received an Appalachian Clean Stream Initiative Grant from OSM. All of this funding has been made possible with our strong partnership and match funding from the ODNR division of Mineral Resource Management. We have finished our first acid mine drainage remediation project at Congo Run, a subsidence closure. The SCWG is currently coordinating major reclamation projects in the West Branch of Sunday Creek and Headwaters. We have also completed 17 upgrades of septic systems, planted thousands of trees, cleaned up over 200 tons of garbage, and educated thousands of students.

Reductions

Project Name	Year Completed	Acres Captured	Agencies funding	Estimated water diverted from entering the deep mine
Congo Run CR-15	2004	72	ODNR-DMRM, OSM	**24,000,000** gallons/yr
Pine Run	2007	138	ODNR-DMRM, OEPA	**50,867,000** gallons/yr
Rodgers Hollow	2007	1,600	ODNR-DMRM, OEPA	**589,290,000** gallons/yr

Three stream captures located in the Sunday Creek Watershed were closed and completed from 2004-2007. A total of 1,810 acres surface drainage area drained year round into the deep mines and as a result of closing these subsidence holes 664,157,000 gallons per year were diverted from entering into the deep mine thus abating the generating of acid mine drainage. Expected additional alkaline loading from these closures returning clean water to the recieving streams is 864 lbs/day. As result of the Rodgers Hollow Subsidence closure, the deep mine discharge in Drakes has seen a reduction in Acidity loads by 20 lbs/day.

Attainment Miles

Total stream miles assessed impacted by mine drainage = **59 miles**

Target #1 indicates 30% attainment of impaired streams by 2010 = **18 miles**

2006 progress = 0 miles
meeting Full WWH attainment
(20 miles assessed in 2006)

Completion

Sub-target 2
Total projects proposed in Sunday Creek Watershed AMDATS =**23**

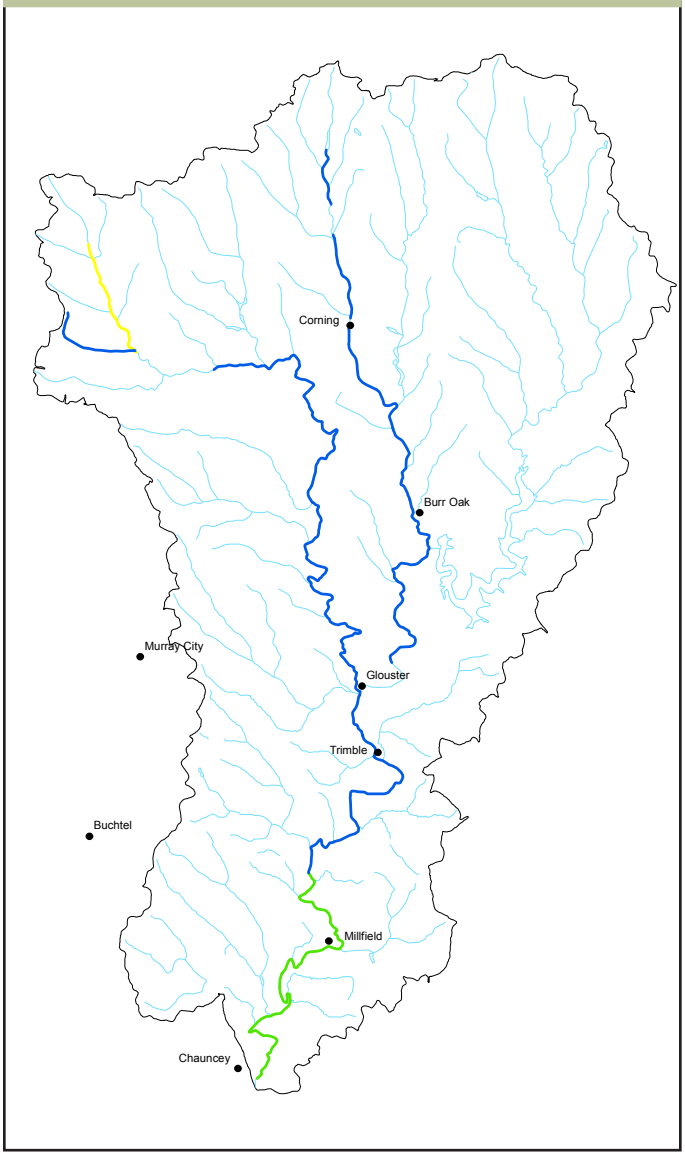
Total projects complete =
4 subsidence closure project

Costs

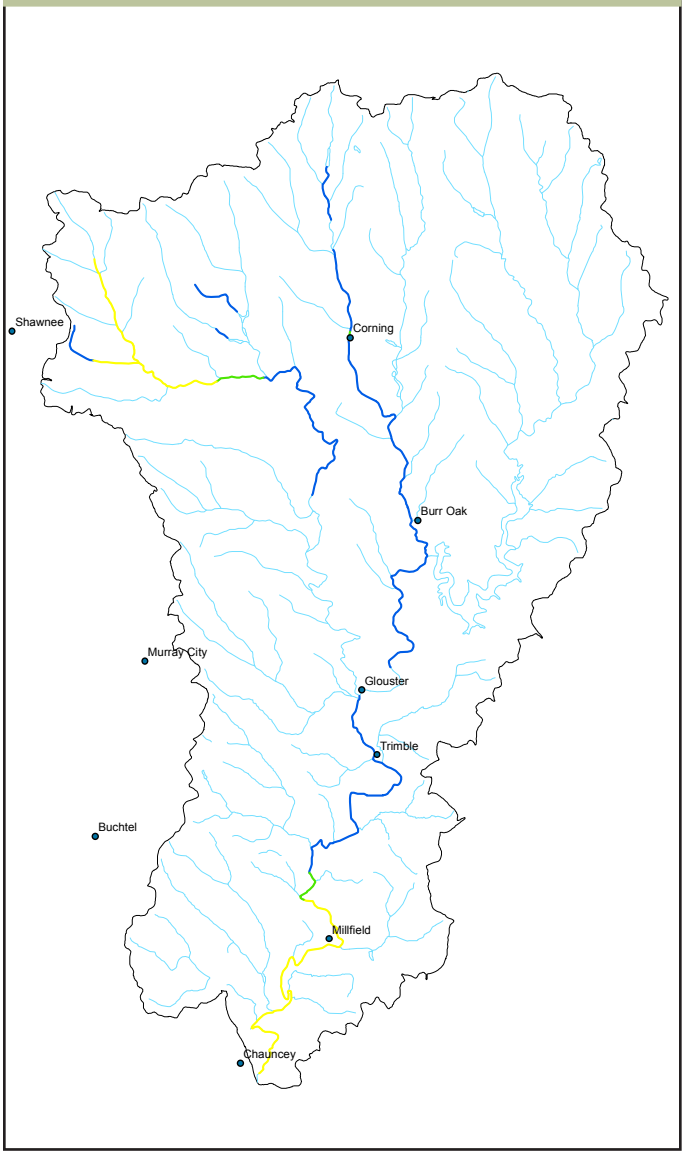
Design = $147,781
Construction = $504,399

Total costs through 2008 = $652,180
(excluding Congo Run CR-15 design)

Sunday Creek baseline pH



Sunday Creek 2008 pH

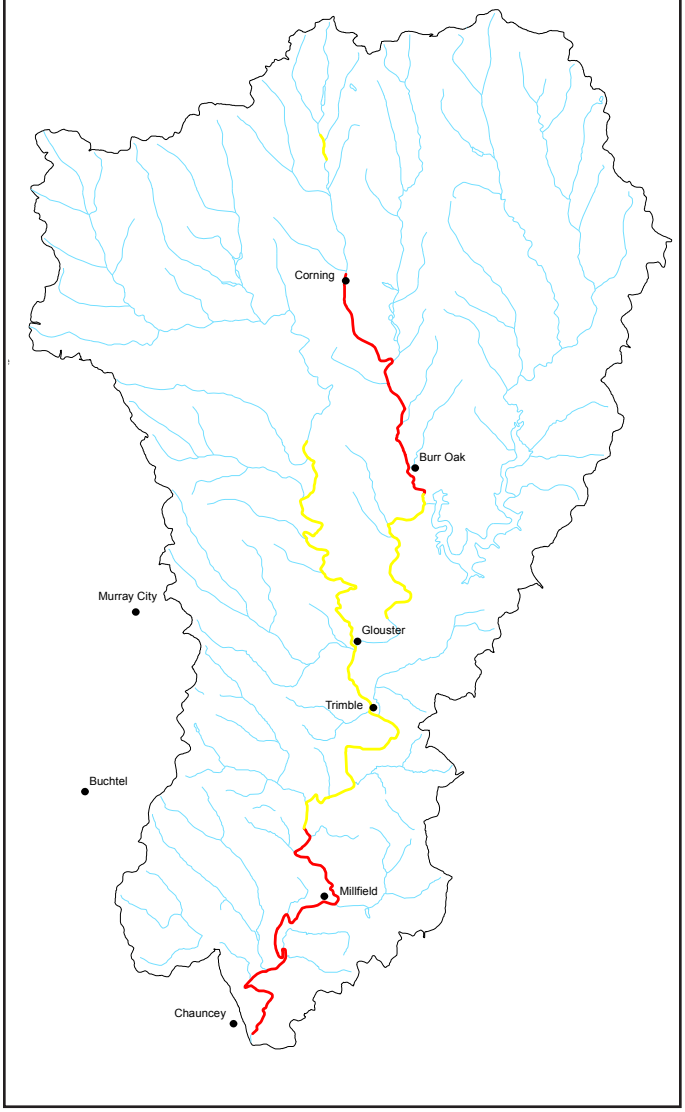


Lab pH

- < 4
- 4 - 5.4
- 5.5 - 6.4
- > 6.4

Water quality along the West Branch Sunday Creek has been degrading since baseline conditions in 2001. Values of average pH dropped from >6.4 to 4.0-5.4 range in 2005 to 2006 and remained constant in 2007. When the subsidence features increased in Rodger's Hollow, funneling more water into the mine that generated AMD and discharged it into West Branch of Sunday Creek, the water quality decreased. However, since the subsidence closure in Rodger's Hollow in late 2007, the 2008 data for the first time shows an increase in pH along this stream segment. The average pH in 2007 at site WB 003 was 4.83 and in 2008 it is 5.97.

Sunday Creek Baseline MAIS



Sunday Creek 2008 MAIS

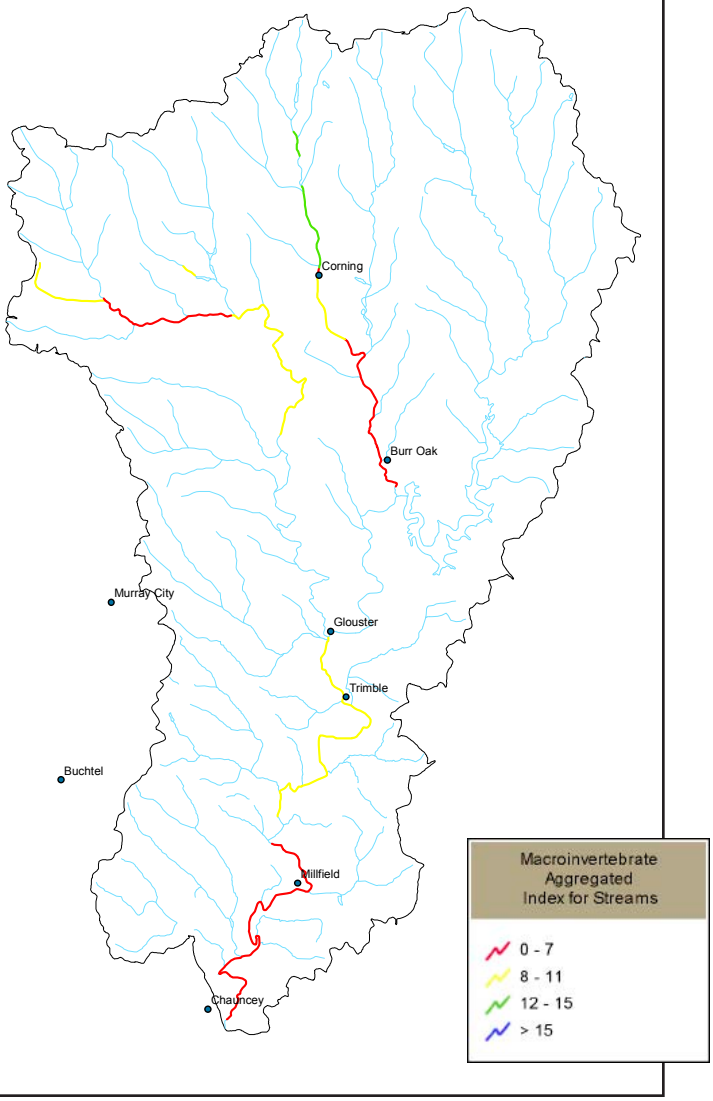
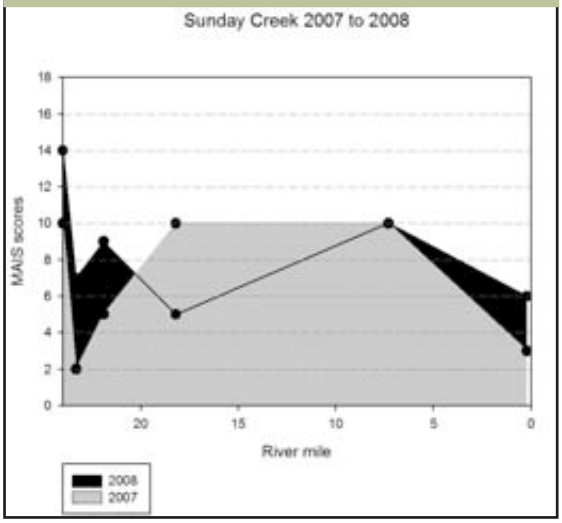
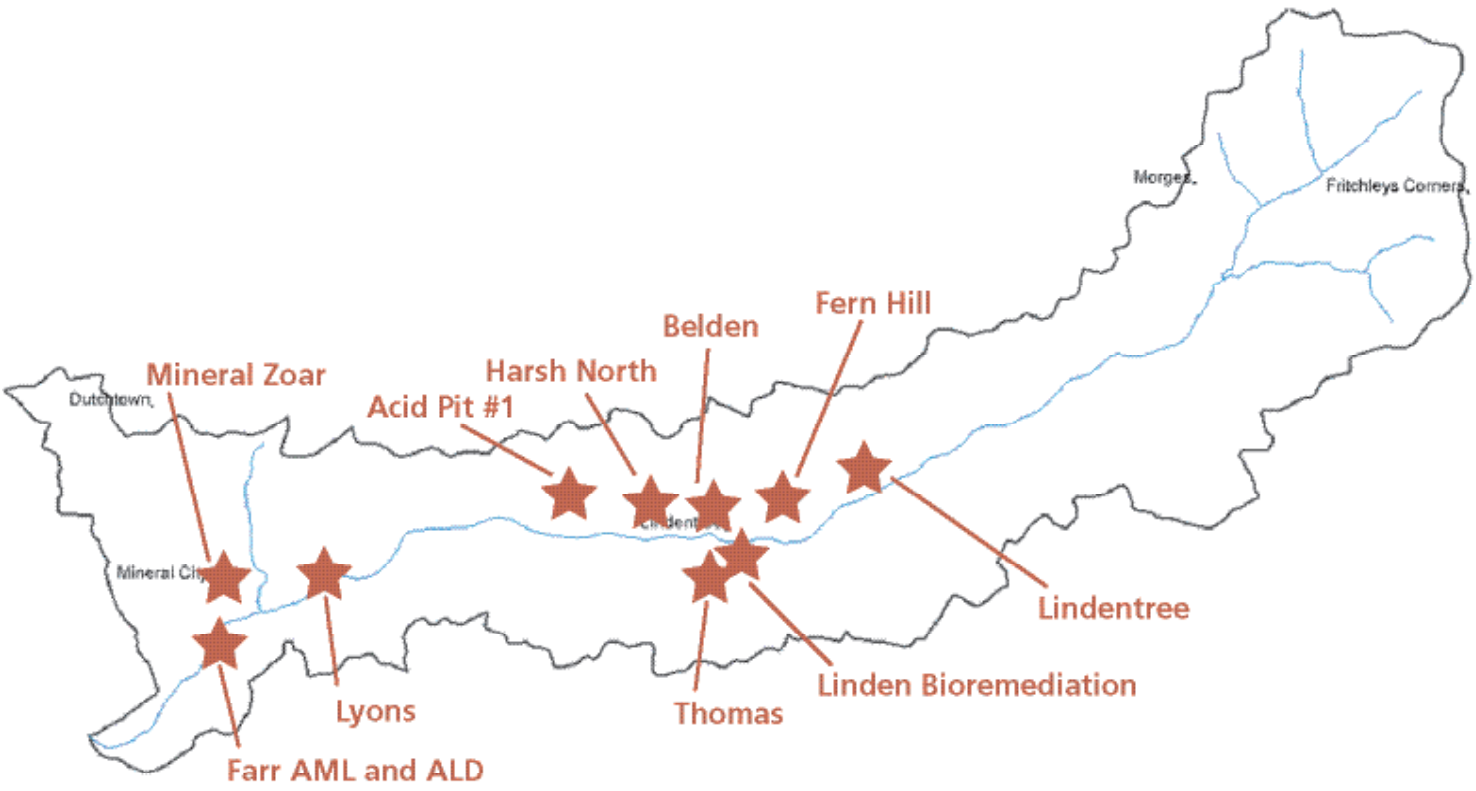


Figure 3. Area of degradation in Sunday Creek mainstem from 2007 to 2008.



MAIS samples were collected throughout Sunday Creek at established annual monitoring stations from 2001 through 2008. Four stations have sufficient data to conduct a regression analysis (n>5). One station (RM 21.9) that has shown a wide range of variation in biological quality showed marginally significant improvement (P = 0.08), but the remaining three stations show no statistical change between 2001 and 2008. This is consistent with the water quality data and the area of degradation analysis (Figure 3). Until restoration projects are complete in Corning, Truetown, and West Branch Headwaters, no change in macroinvertebrates or water quality is expected.

HUFF RUN WATERSHED



• Huff Run flows from the Morges community in Carroll County, into Tuscarawas County and has its confluence in the Conotton Creek just South of Mineral City, Ohio. Huff Run is 9.9 miles long with a 13.9 square mile watershed. Almost all land east of State Route 542 (about 2/3 of the watershed) has been mined for coal and some limestone and clay. Because much of the land mined was not reclaimed, the watershed is plagued with the resulting acid mine drainage. Other pollution issues in the watershed include illegal dumping, poor riparian buffers, raw sewage entering the stream, oil and gas impacts, and agricultural impacts.

• The Huff Run Watershed Restoration Partnership Inc. (HRWRP) was founded in 1996 by a group of concerned citizens. The HRWRP has partnered with ODNR/MRM, Rural Action, OEPA, Crossroads RC&D, OSM and others to fulfill their mission statement which is "To restore the Huff Run watershed by improving water quality and enhancing wildlife habitat, through community support and involvement."

• The Farr Anoxic Limestone Drain, the first passive treatment system in the watershed, was constructed in 2000. Also, HRWRP can boast of building the first bioremediation system in Ohio with their Linden Restoration Project. They also were awarded a US EPA Targeted Watershed Grant in 2005 for their Belden Successive Alkaline Producing System. At their 10 year anniversary, seven restoration projects have been completed with funding obtained for five more.

• To learn more about the HRWRP, visit their website at www.huffrun.org or call 330-859-1050 to reach their office.

Reductions

Total acid load reduction = 82 lbs/day at site HRR08

Total acid load reduction = 141 lbs/day at project effluent sites Linden, Lindentree, and Lyons, where acid load reduction could be calculated.

Attainment Miles

Total stream miles assessed impacted by mine drainage=9.90 miles

Target #1 indicates 30% attainment of impaired streams by 2010=**2.97 miles**

2006 progress = **0 miles** meeting Full WWH attainment, *however* **3.90 miles changed from Non-supportive to Partial Attainment**

(9.90 miles assessed in 2006)

Completion

Sub-target 2 - Total projects proposed Huff Run Watershed = **11 projects**

Total projects complete = **9 projects**

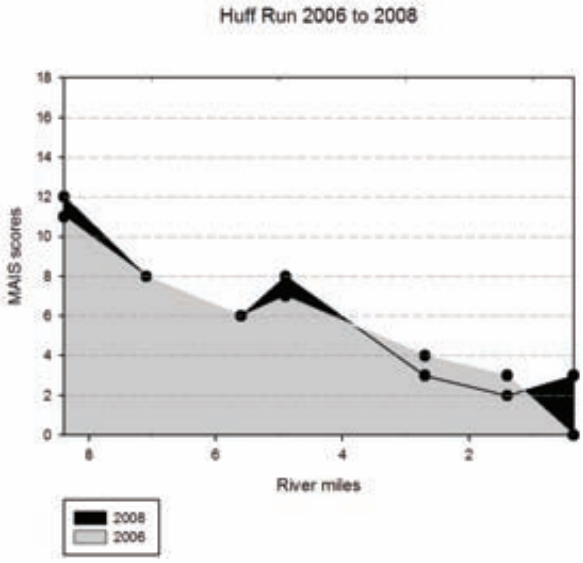
Costs

Design $388,460 (excluding Huff Run AML)

Construction $3,106,739 (excluding Huff Run AML)

Total cost through 2008=$3,495,199

Figure 4. Area of degradation along Huff Run mainstem in 2006 and 2008.



Timeline of the Huff Run Watershed Project Milestones & AMD Projects

This timeline demonstrates this history of the Huff Run Watershed Restoration Partnership and the work done to restore Huff Run. AMD projects have been administered through Crossroads RC&D, the Tuscarawas Soil and Water Conservation District and the present sponsor of Huff Run, Rural Action. Funding has been secured for projects through the Office of Surface Mining, Ohio EPA 319 Program, US EPA Targeted Watershed Grant Program and match from the Ohio Department of Natural Resources, Division of Mineral Resources Management.

1985 Study funded by ODNR/DR conducted by Benatec Associates to identify acid problems in Huff Run Watershed

1988 First abandoned mine land project, Jobes, completed in the watershed

1996 Huff Run Watershed Restoration Partnership founded

2000 Huff Run AMDAT completed

Huff Run Watershed Coordinator funded for six years

First acid mine drainage restoration project, Farr, completed in watershed

2001 First draft of Huff Run Watershed Plan completed

2002 Linden Bioremediation Project constructed

2003 Acid Pit Restoration Project completed

2004 Lindentree Restoration Project completed

2005 Rural Action and Huff Run awarded US EPA Targeted Watershed Grant

Rural Action adds VISTA volunteer to Huff Run staff

Second draft of Huff Run Watershed Plan authored, endorsed by the State of Ohio

Lyons Restoration Project constructed

2006 Harsha North Restoration project completed

2008 Belden Restoration Project constructed

Fern Hill (HR-42) Phase II Project constructed

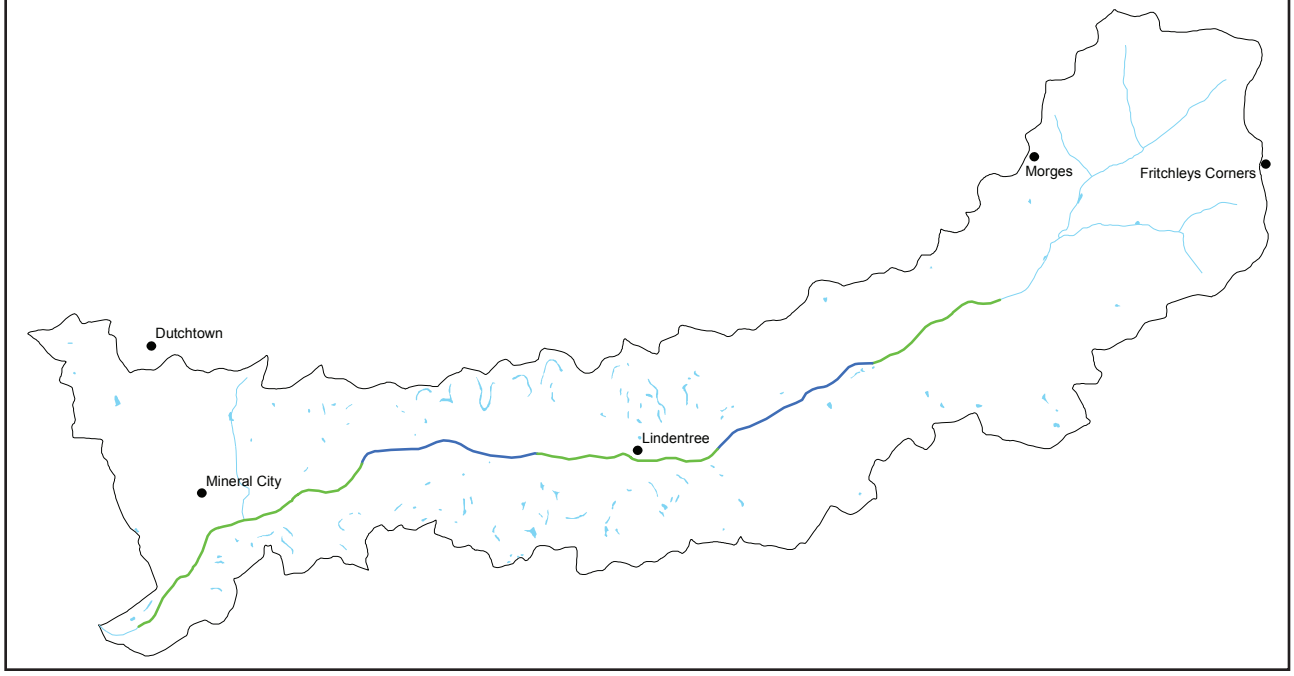
2009 Huff Run Watershed Coordinator funded for three years

Mineral Zoar Project completed

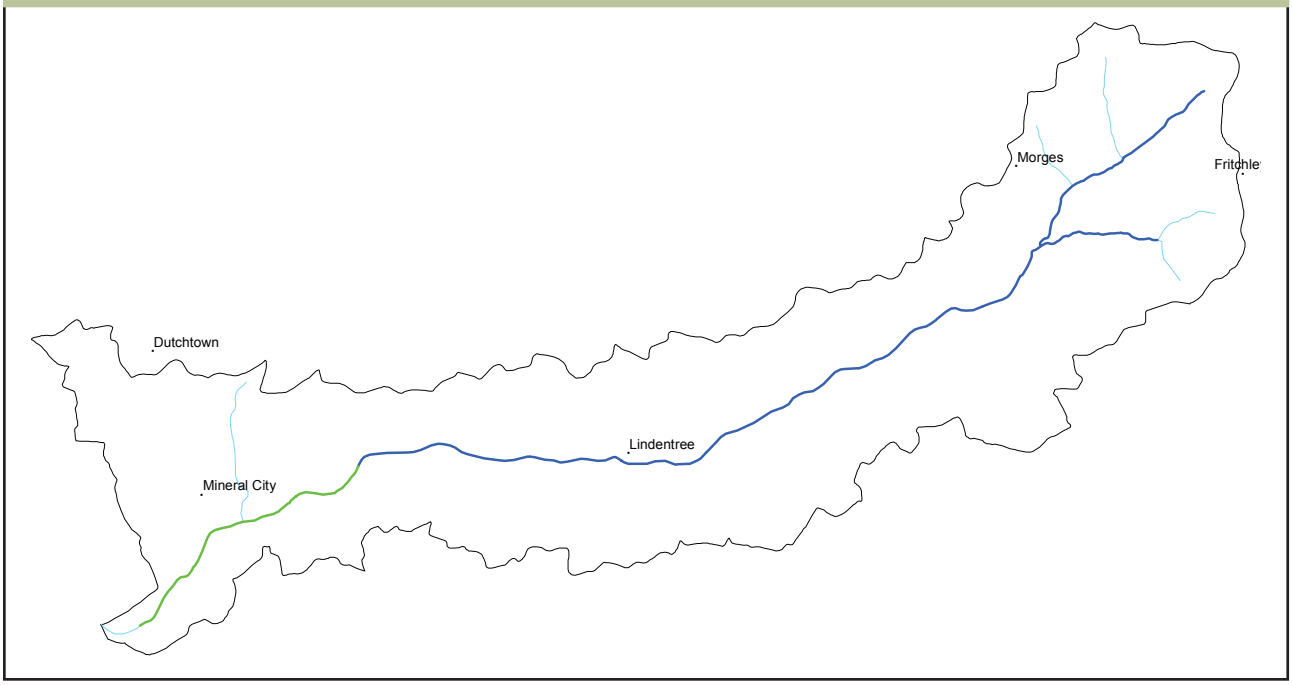
Thomas Project constructed

Rural Action adds AmeriCorps volunteer to Huff Run staff

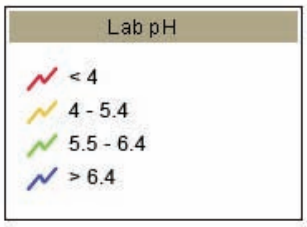
Huff Run baseline pH



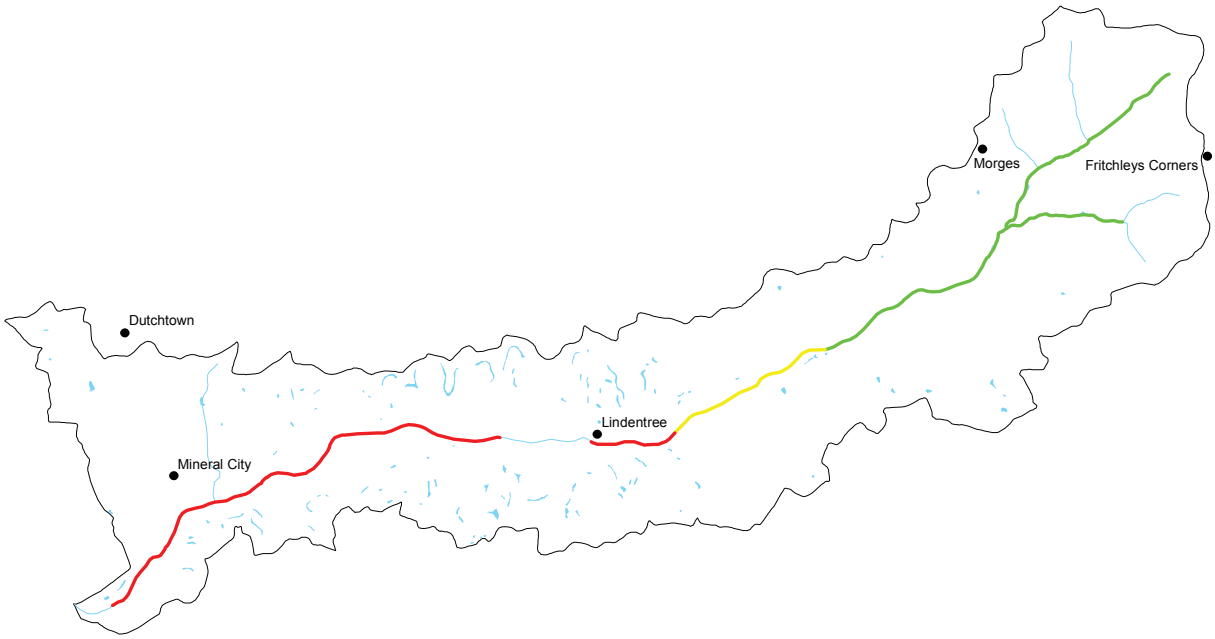
Huff Run 2008 pH



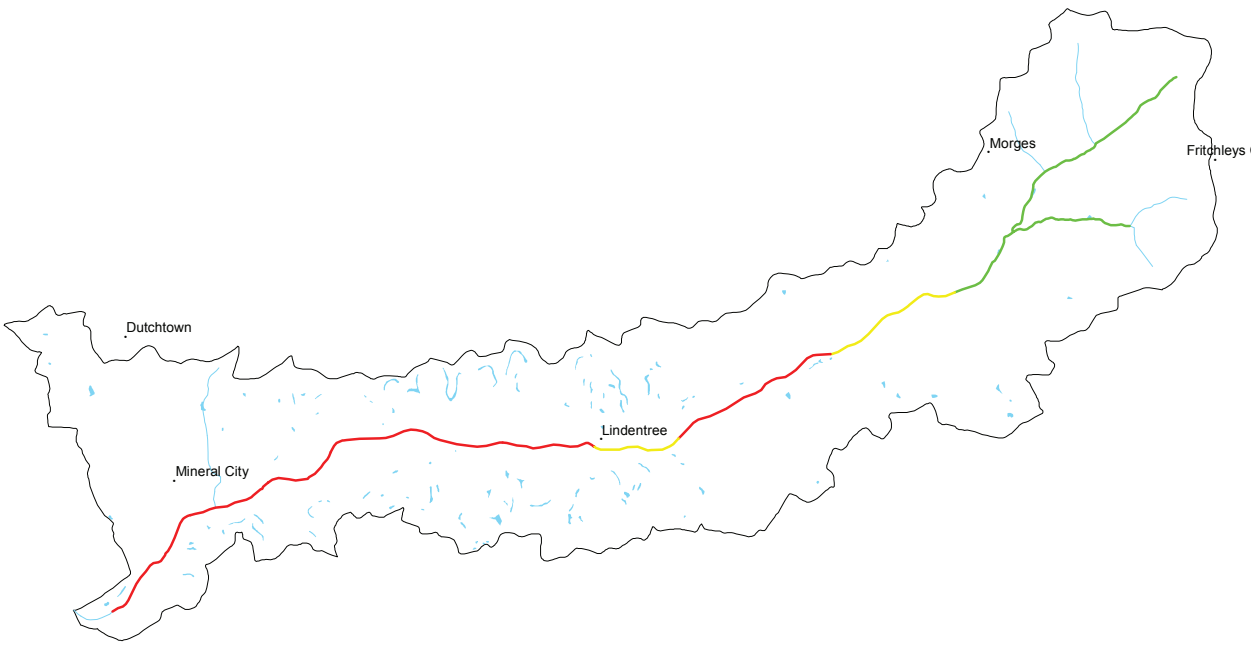
Huff Run pH values have improved from baseline conditions (1985-1998) to 2008. Three mainstem sections totaling 3.7 miles have improved pH values from the range 5.5–6.4 to now meeting water quality standards pH >6.5 since baseline. Huff run mainstem supports 8.3 miles in total that meet the pH standard (>6.5). Sites HRR05, HRR06, to HRR07 have increased in pH and decreased their net acidity values since 2007.



Huff Run 2005 MAIS



Huff Run 2008 MAIS



Huff Run aquatic life use has improved from baseline conditions (1985-1998) to 2005. Aquatic life use changed from WWH non-sportive to WWH partial attainment along 3.9 miles in Huff Run. In 2008 the MAIS score increased in the headwaters slightly (HR0, RM 8.4) and at HR11/HRR04 the site downstream of Lindentree Project, a pattern held over from 2007.

The area of degradation analysis for the seven mainstem sites along Huff Run in 2008 (-95, Figure 4), shows little change between 2005 (-84), 2006 (-95) and 2007 (-80).

Macroinvertebrate Aggregated Index for Streams

- 0 - 7
- 8 - 11
- 12 - 15
- > 15

Section III – AMD project reports

Raccoon Creek Watershed comprehensive acid mine drainage projects progress report for 2008.

Section III contains individual AMD project reports displaying photos of the project site, a description of the project, water quality data at the site and its impact to the receiving stream, and acid/metal loading reductions as a result of the project.

List of acid mine drainage reclamation projects reported in the 2008 NPS monitoring report:

1. Carbondale II Doser
2. Mulga Run
3. Middleton Run
4. State Route 124 Seeps
5. Flint Run
6. Lake Milton
7. Buckeye Furnace/Buffer Run
8. East Branch Phase I

Archive

9. Hope Clay – Status Completed*

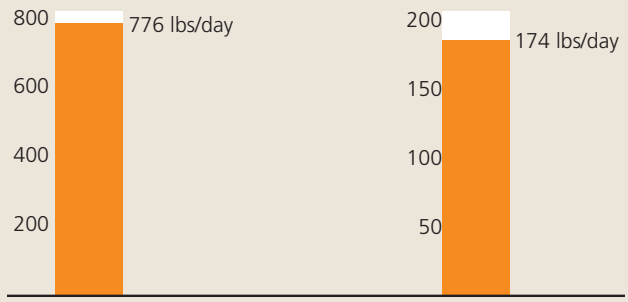
* "Status Completed" projects are no longer being monitored

Project Status: Complete 4/1/2004 ODNR Project Number: AT-Wl-05

Pre-construction

Carbondale East Seep, Photo by Brett Laverty

SITE: HF131

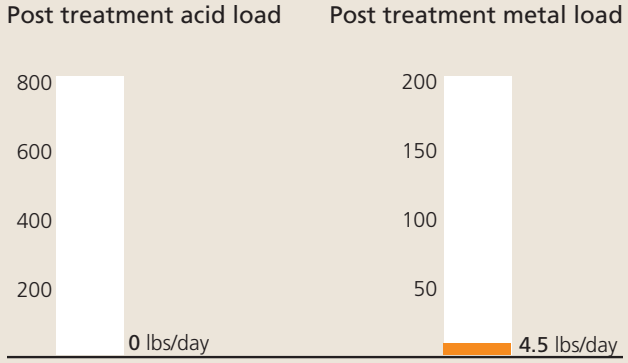


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Carbondale II Project Doser, Photo by JT Kneen

SITE: HF131



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Carbondale II Wetland is located in Section 30 of Waterloo Township in Athens County and lies within the 14-digit HUC unit #05090101030010. The site is seven acres and located in the subwatershed Hewett Fork of Raccoon Creek Watershed. The majority of AMD in Hewett Fork originates from abandoned underground coal mines near Carbondale. ODNR-DMRM installed a passive wetland treatment system to reduce the acid and metal load from two mine portals in this area in the mid 1990's. This wetland was effective at reducing metal and acid loads but was not efficient enough to produce improvements in Hewett Fork. The Carbondale Doser was implemented as Phase II at the site to remediate the entire acid load from the mine discharge in 2004. The design was completed by ATC Associates for $48,023. The treatment approach for this site was to install an Aqua-fix lime-dosing unit. The major considerations in this design were the metal precipitates discharge into Hewett Fork because of the limited space for storage ponds on site. The goal of the design was to reduce 100 percent of the acid load discharging from the Carbondale mine seeps. One problem encountered at this site was the dosing material performance. Initially lime kiln dust was used, but the material bridges in the dosing unit. The material was switched to calcium oxide, a more expensive material but greater neutralizing potential. Therefore the doser now has the ability to over-treat and neutralize acid mine drainage from downstream sources. Construction was complete April 1, 2004, by Law General Contracting for a cost of $389,637. The major responsibility of the construction company was to remove existing metal retention wetlands and install the doser and a concrete mixing channel. The funding source for the project design was ODNR-DMRM, and for construction the sources were ODNR-DMRM, OEPA, and OSM-ACSI. Figures 3 and 4 (shown on page 3) estimate approximately 776 lbs/day of acid were reduced from entering into Hewett Fork as a result of this AMD reclamation project. In addition to the acid load reduction there is an addition of approximately 166 lbs/day of alkalinity to Hewett Fork both as dissolved and solid unused calcium oxide. Dissolved metal load reduction occurring at this site was approximately 169 lbs/day. The metals precipitate as a result of the high pH water and become part of the substrate in the receiving stream.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the main-stem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

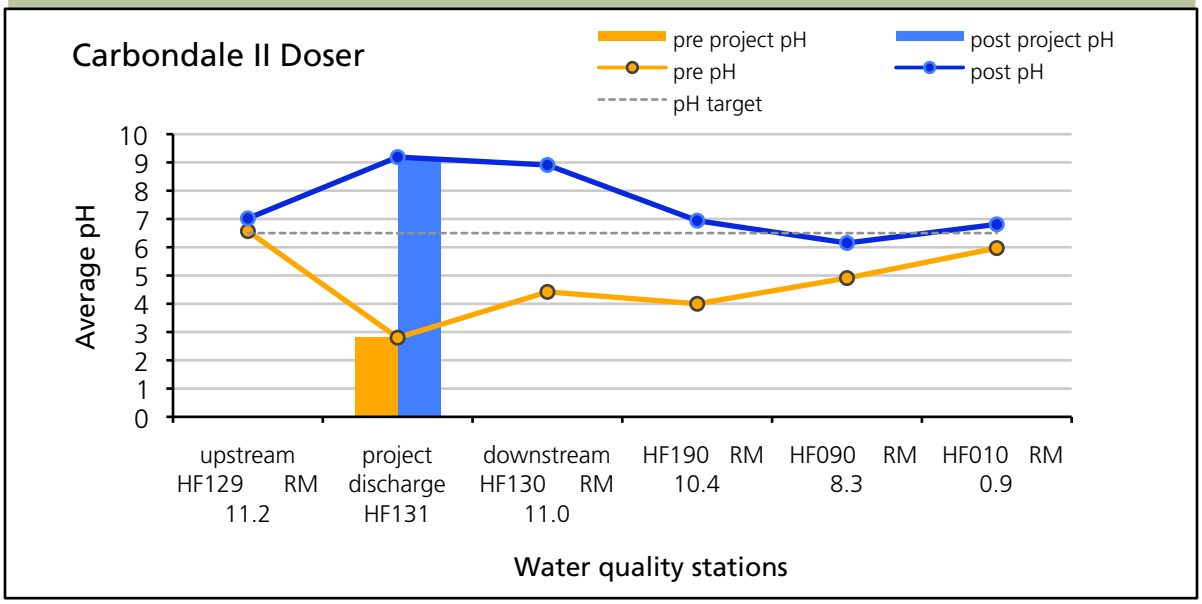
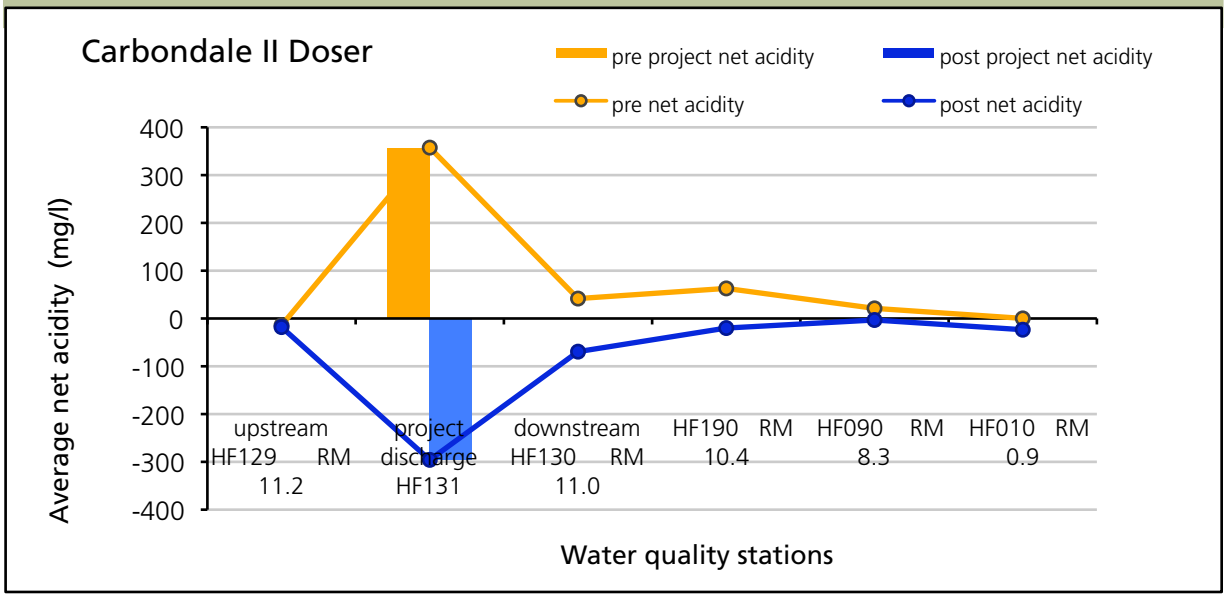


Figure 2. Pre and Post Acidity



As a result of the Carbondale II Wetland Doser project, the pH and net acidity has improved downstream of the reclamation site for 11 miles. Pre-construction data showed, pH in the range of 2.8 – 5.9 downstream of the project. However, after installation of the Carbondale II Wetland Doser, post-construction data shows pH in the range of 6.2 – 9.2 downstream of the project discharge. The net acidity concentrations decreased, showing net alkaline conditions continuing for 11 miles downstream to station HF010.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 6/21/1996 to 5/1/2003 for pre-construction and from 6/1/2004 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

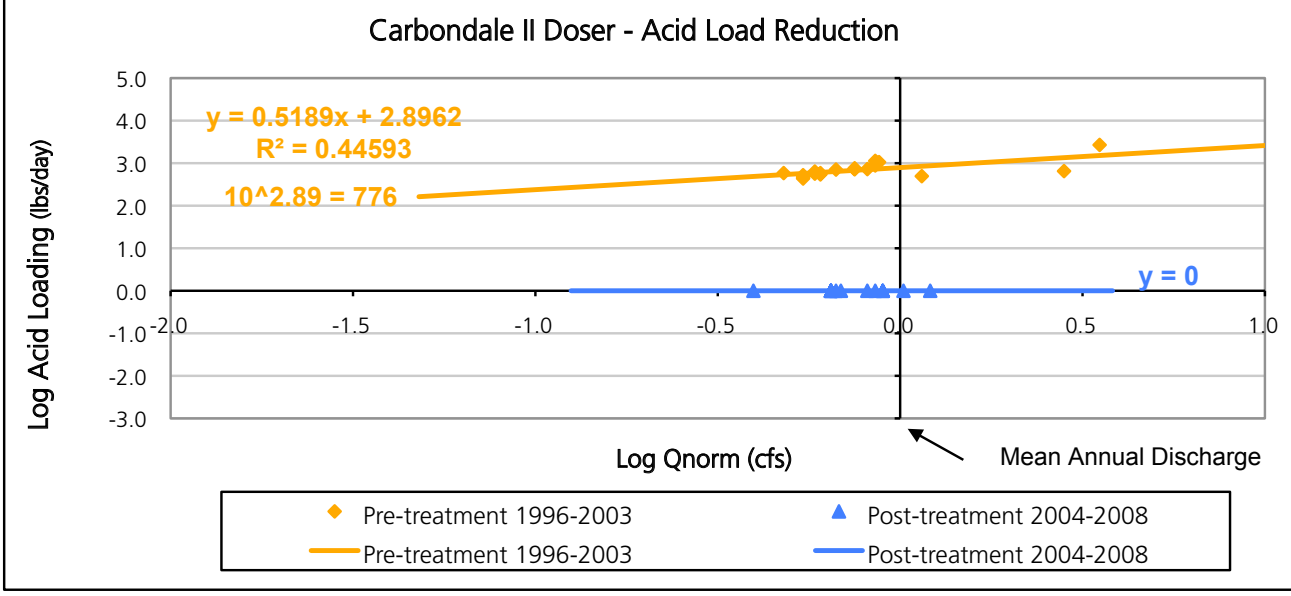
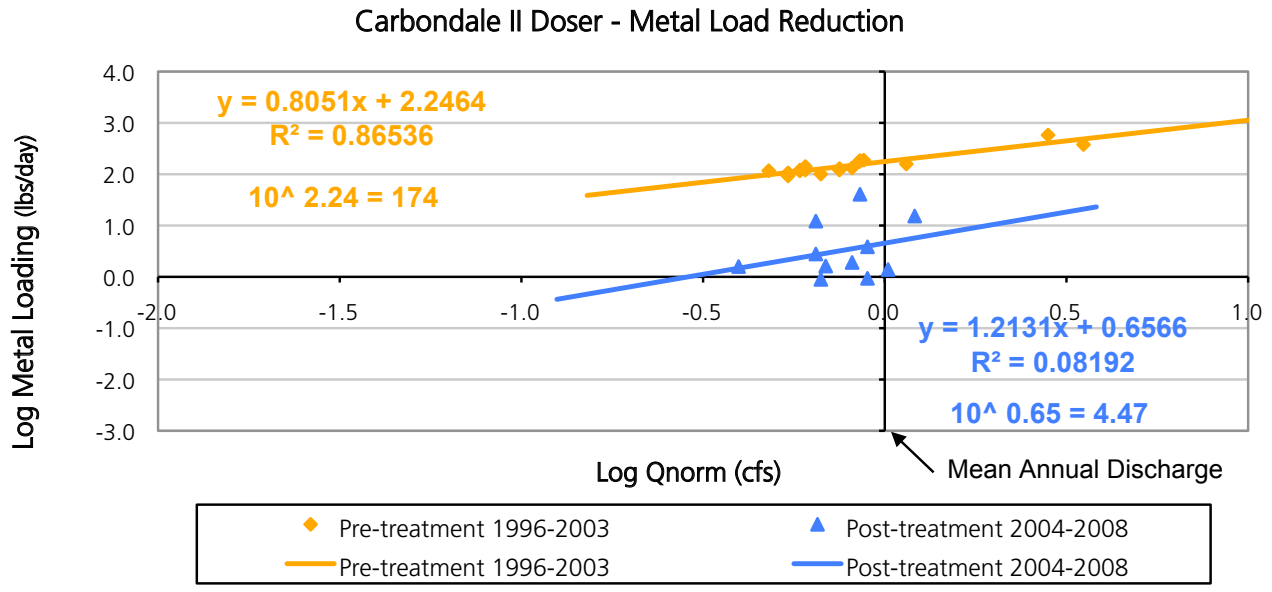


Figure 4. Metal Load Reduction



Average discharge measurements were used to calculate load reductions using the Mean Annual Load Method (Stoertz, 2004) instead of deriving the mean annual discharge from the drainage area because the discharge from the Carbondale II Wetland site is controlled primarily by deep mine drainage and not surface drainage.

Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

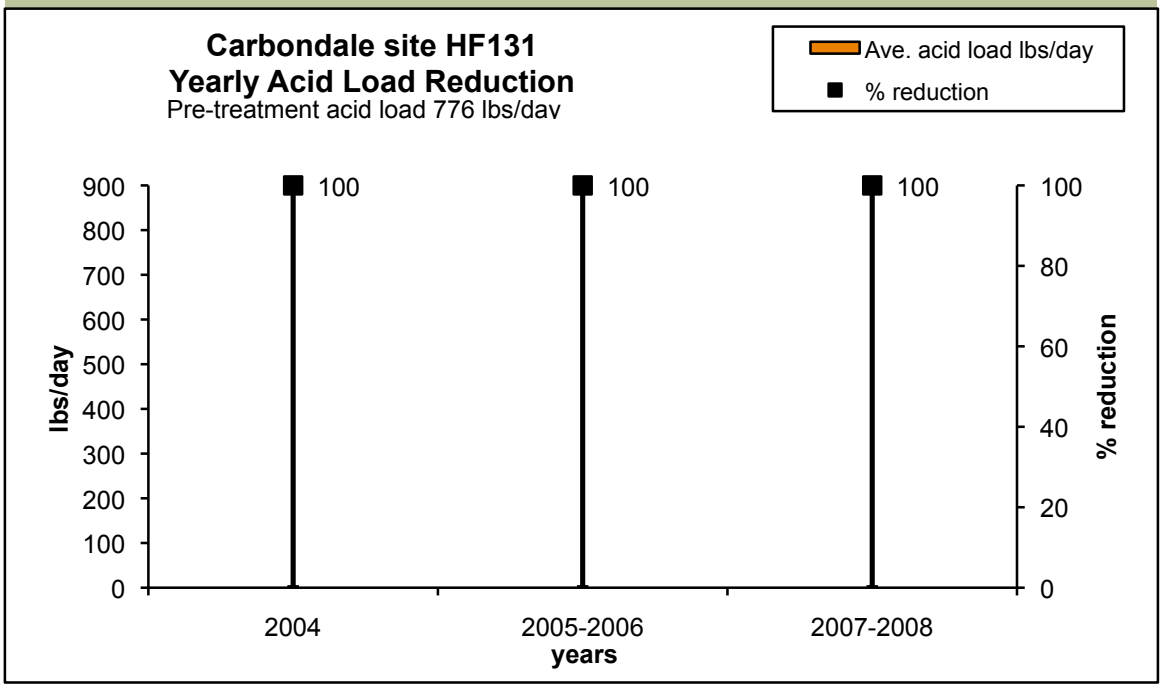
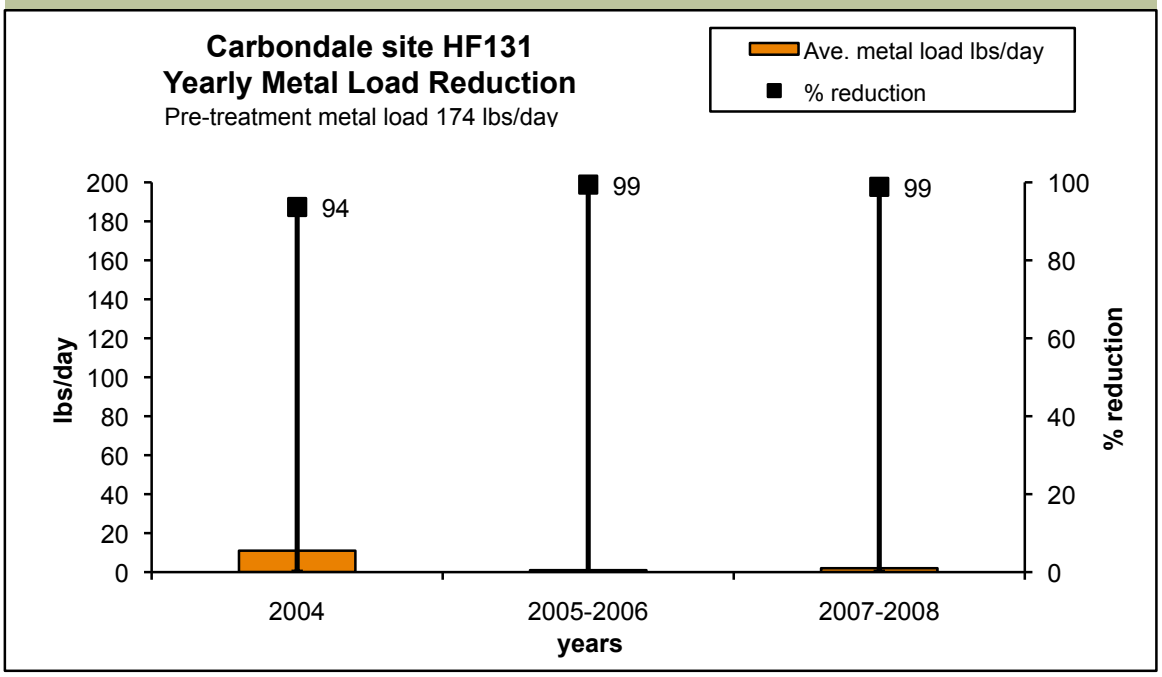


Figure 6. Yearly Metal Load Reduction

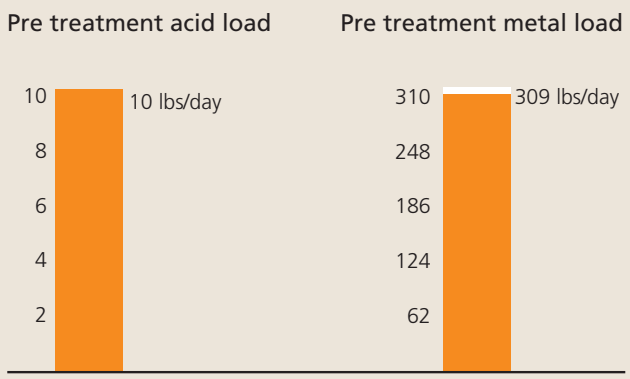


Project Status: Complete 8/30/2004 ODNR Project Number: JK-Ml-51

Pre-construction

Underground mine entrance, Photo by Brett Laverty

SITE: MR0010

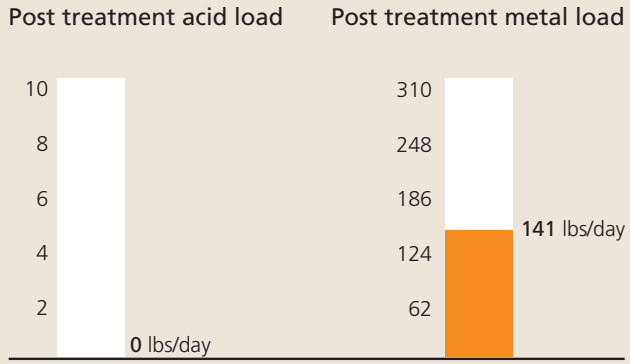


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Jaymar Steel Slag Leach Bed, Photo by Brett Laverty

SITE: MR0010



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Mulga Run Reclamation Project is located in Section 10 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The site is 6.8 acres and is located in the Little Raccoon Creek subwatershed. Mulga Run is considered the third largest contributor of acid mine drainage to this subwatershed according to the AMDAT in 2001. Due to drainage from abandoned deep mines and un-reclaimed coal refuse piles throughout, a basin wide treatment approach was used to reduce acid and metal loads to Little Raccoon Creek. The design was completed by ATC Associates for $247,127. The treatment approach for this site was to install two steel slag leach beds and conduct a wetland enhancement project. The major consideration for this design was to attempt to treat entire basin with steel slag leach beds and wetland instead of treating all acid mine drainage sites in the basin. Mulga Run discharge was sometimes net alkaline; however, the site was also capable of producing acid spikes (3000 lbs/day) throughout the year. The goal of the design was to reduce 100 percent of the acid spikes and create consistent net alkaline water discharging into Little Raccoon Creek. The project goal was met by 100 percent. A private residence height was increased to reduce the flood risk adjacent to the project site. Construction was complete August 30, 2004, by Stockmeister Enterprises for a cost of $440,783. The funding source, for this the project design were Ohio EPA and ODNR-DMRM and for construction the sources were ODNR-DMRM, OEPA and OSM-ACSI. Figure, 3 and 4 (shown on page 3) estimate approximately 10 lbs/day of acid and 168 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

Water Quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the main-stem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

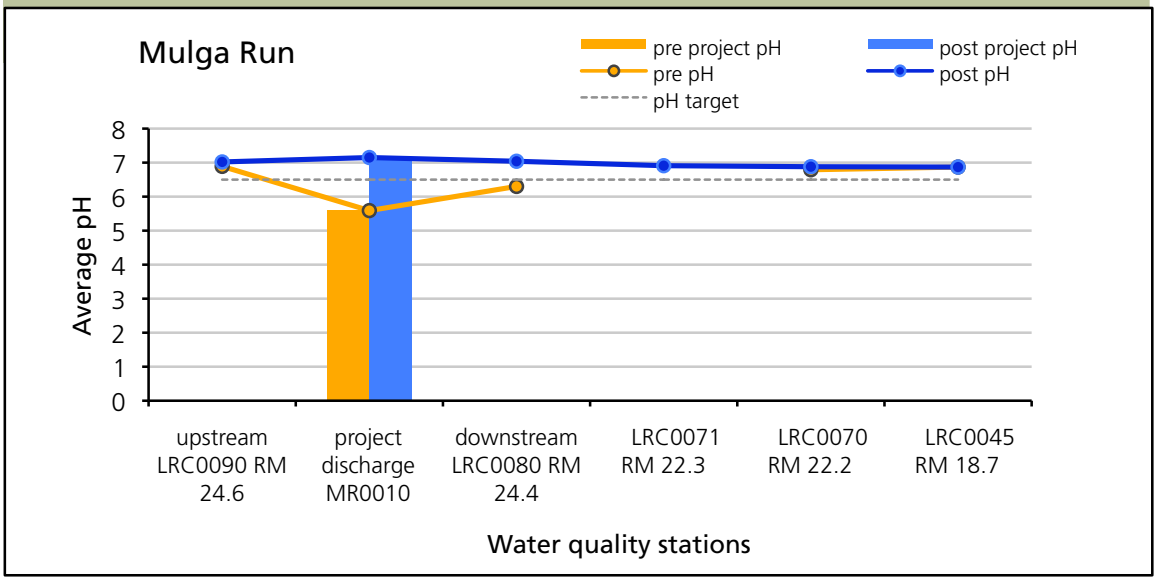
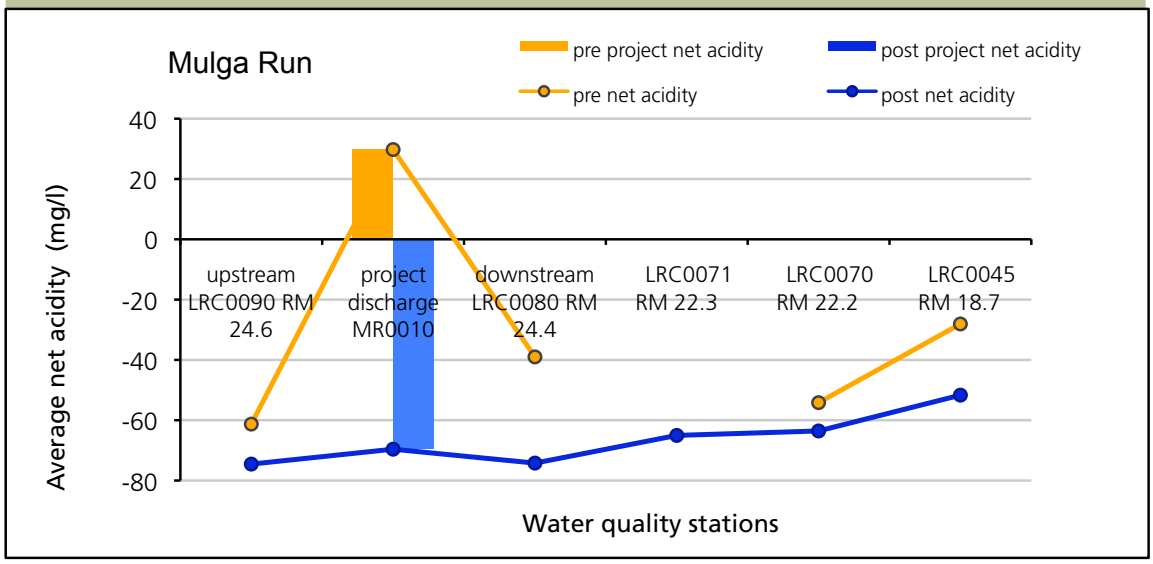


Figure 2. Pre and Post Acidity



As a result of the Mulga Run Reclamation project, the pH and net acidity has improved downstream of the reclamation site for 2.1 miles. Pre-construction data showed pH in the range of 5.5 – 6.9 downstream of the project. However, after installation of the Mulga Run Reclamation project, post-construction data shows pH in the range of 6.8 – 7.2 downstream of the project discharge. The net acidity concentrations decreased, showing net alkaline conditions continuing for 5.7 miles downstream to station LRC0045.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1/1/1998 to 8/1/2003 for pre-construction and from 9/1/2004 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

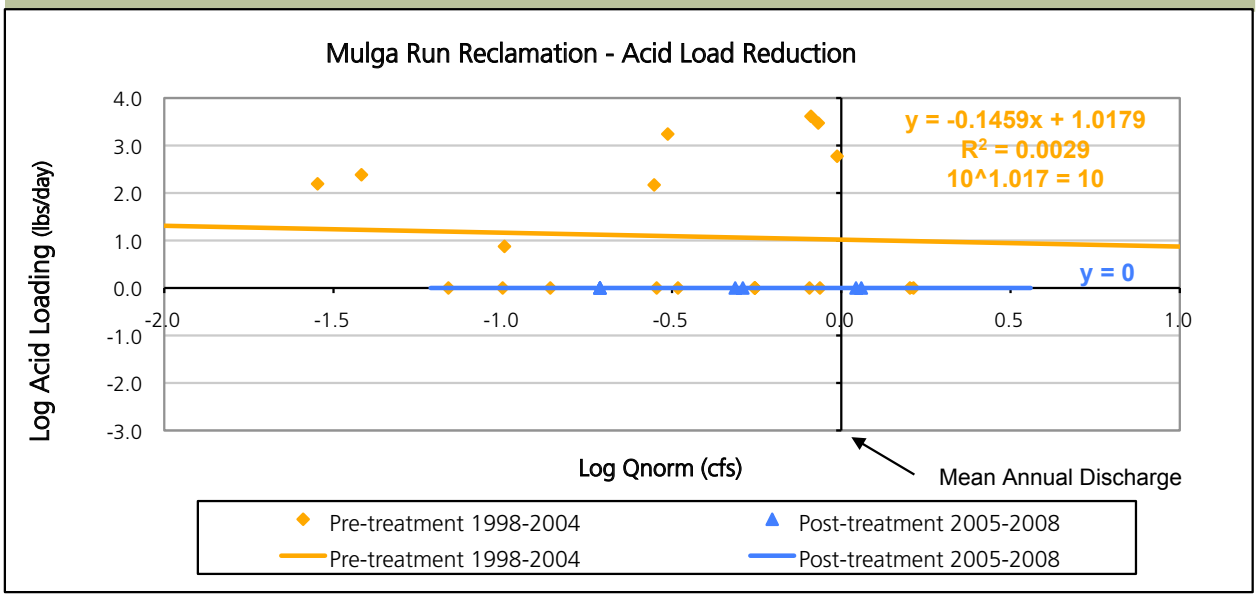
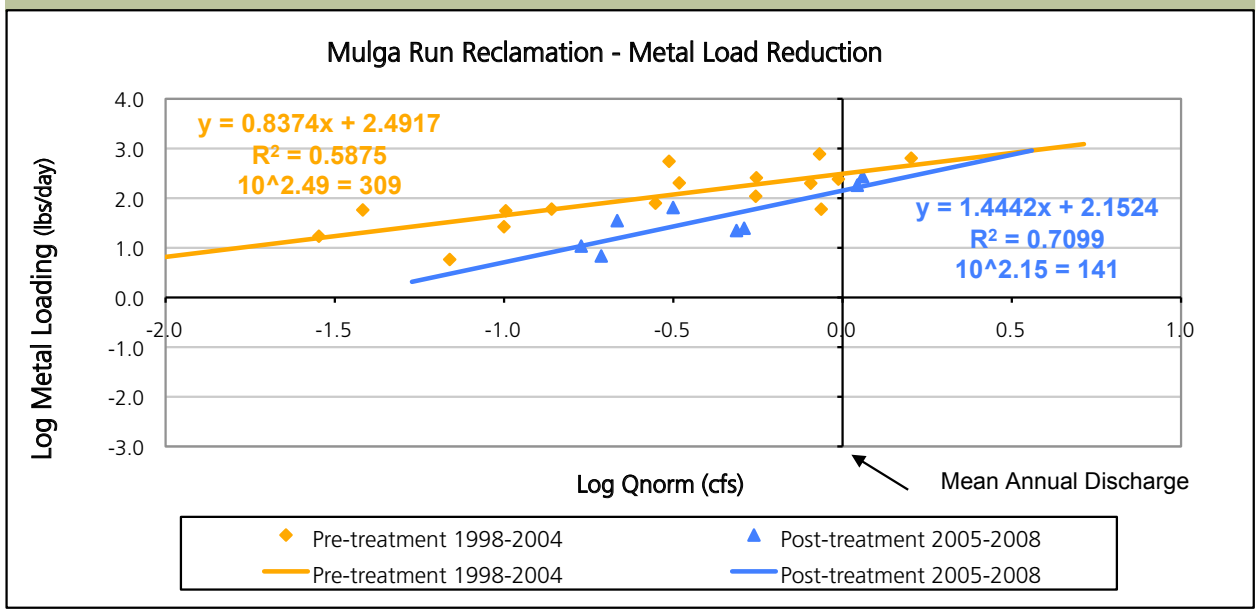


Figure 4. Metal Load Reduction



The trendline in Figure 3 for pre-treatment acid loading is not well-defined due to the sporadic chemical water quality conditions at the Mulga Run site. Sometimes net alkaline conditions were present, and sometimes acid spikes were produced (3000 lbs/day). The goal of this project was to decrease acidity and eliminate the acid spikes from entering into Little Raccoon Creek. Figure 3 shows these variations during the pre-treatment time period and shows 100 percent acid load reduction during post-treatment.

Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

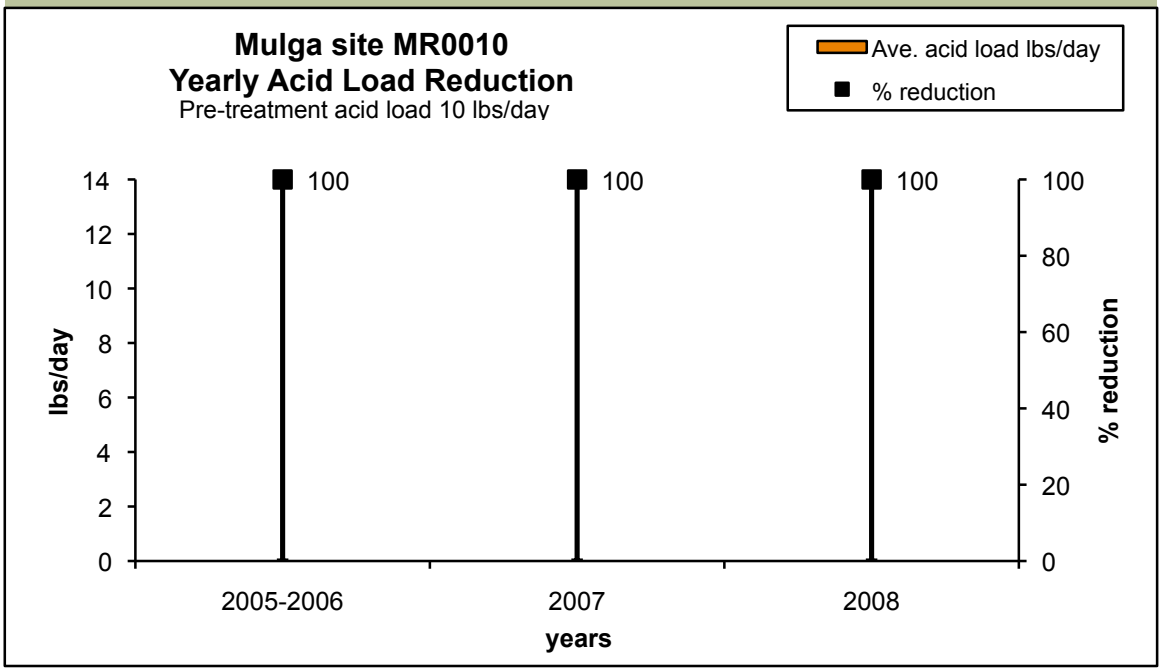
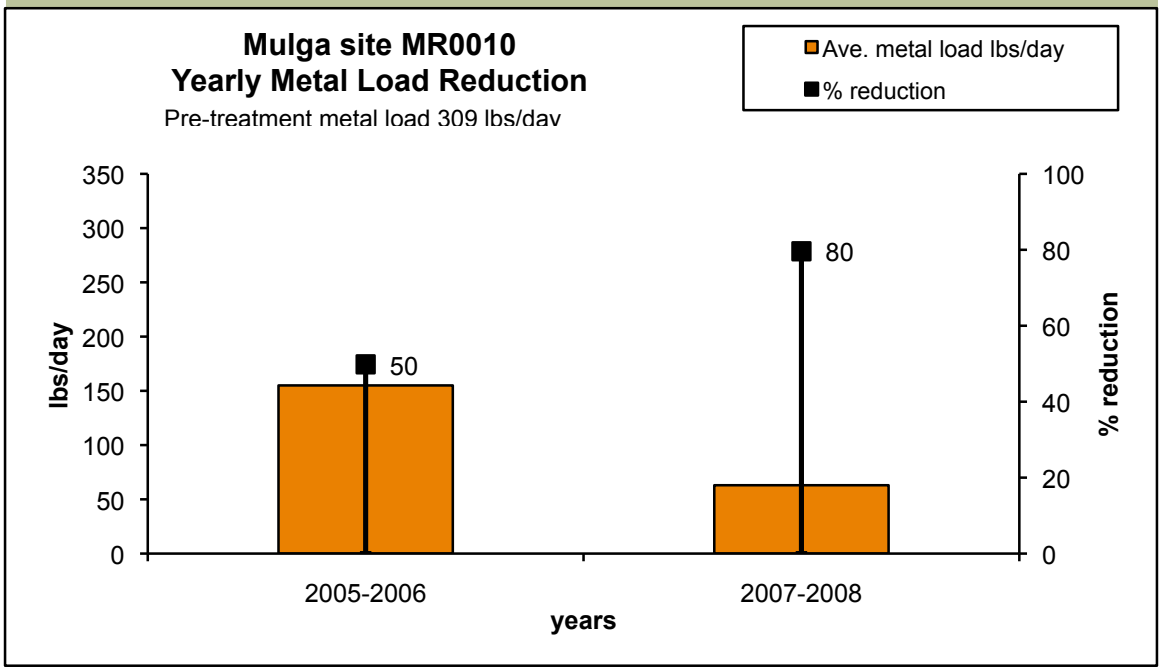


Figure 6. Yearly Metal Load Reduction

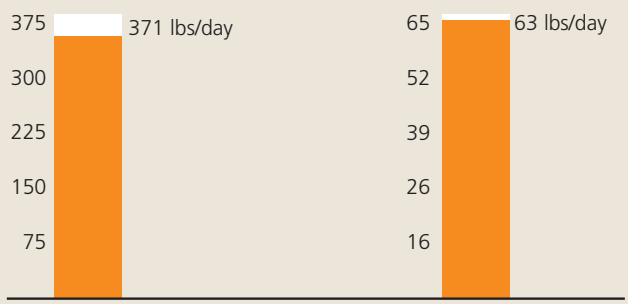


Project Status: Complete 11/15/2005 ODNR Project Number: JK-MI-55

Pre-construction

Exposed mine pit floor, Photo by Brett Laverty

SITE: MiR0021, MiR0032, MiR0090

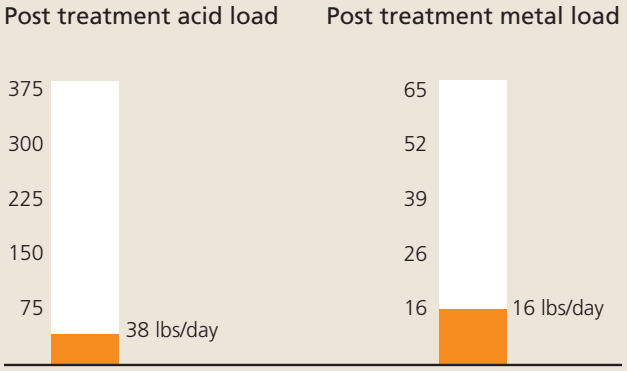


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Middleton Run limestone channels, Photo by Ian Hughes

SITE: MiR0021, MiR0032, MiR0090



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Salem Road/Middleton Run Project is located in Section 15 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The site totals 60 acres and is located in the Little Raccoon Creek subwatershed. This large area has been affected by deep mines, strip mine lands, and un-reclaimed mine spoil that was part of the Broken Aro mine. Abandoned surface mines affect about 63% of this watershed while abandoned subsurface mines affect about 5 %. The main valley on the sites was exposed pit floor with high amounts of clay and acidic spoil. Additionally, acidic lakes were present as well as a discharging undgerground mine. This project has three different drainages, all tributaries to Middleton Run. The design was completed by GAI Consultants Inc. and Bergmann Associates for $193,283. The treatment approach for this site was to install 3 separate treatment components consiting of: open limestone channels, steel slag channels, reclamation, J-trenches, and a limestone leach bed (see diagram on page 3 of this report). The major consideration for this design was to eliminate all water storage, create contours for positive drainage, cover toxic materials, and generate alkalinity. The goal of the design was to reduce 100 percent of the acidity loading discharging into Little Raccoon Creek. Data monitored at the mouth of Middleton Run (MiR0010) for 2006-2008 have shown that 554 lbs/day of acid and 50 lbs/day of metal loads have been reduced from entering Little Raccoon Creek. Construction was complete November 15, 2005, by Stockmeister Enterprises Inc. for a cost of $687,913. The funding source, for the project design and construction were ODNR-DMRM and Ohio EPA. Figures 4 and 5 (shown on page 5 and 6 of this report) estimate approximately 333 lbs/day of acid and 47 lbs/day of metals were reduced from entering into Middleton Run Creek as a result of these three AMD reclamation project. Each of the three treatment components are evaluated further on page 4 of this report. However, in 2008 monitoring showed site MiR0021 as the only treatment functioning and providing alkalinity for Middleton Run. The other two treatment sites (MiR0032 and MiR0092) have failed due to clogging. No discharge data was collected at these two sites, therefore only MiR0021 changes are reflected in this report.

Water Quality Report

Water quality data was collected at three project discharges as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

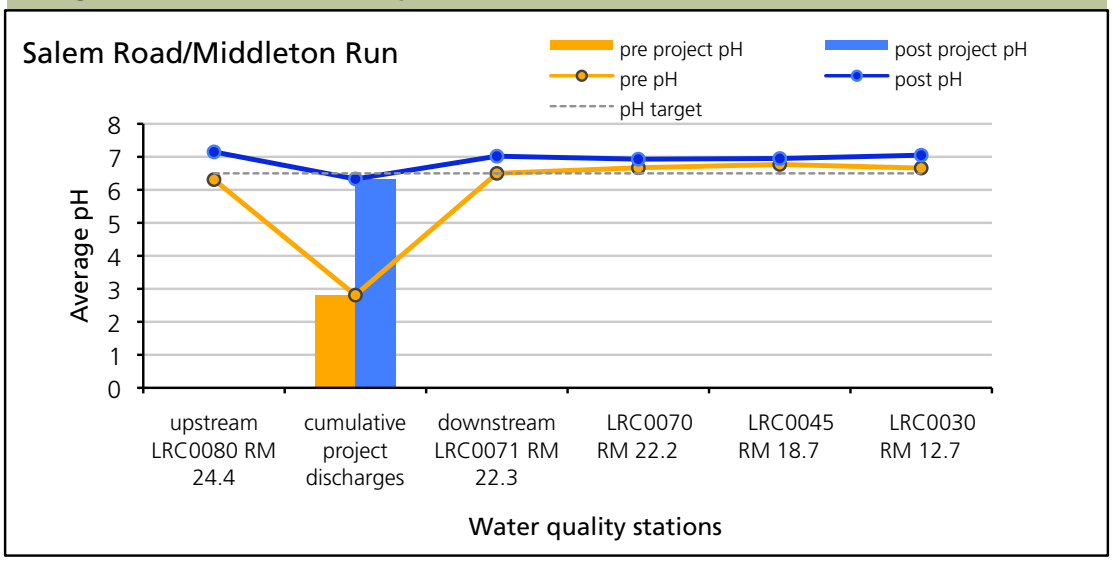
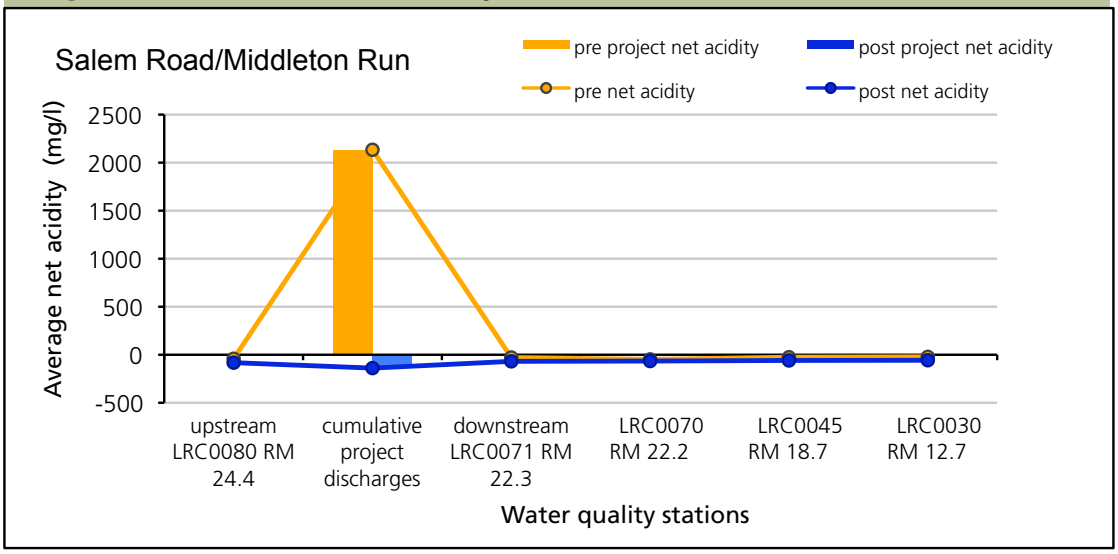


Figure 2. Pre and Post Acidity



As a result of the (Salem Road/Middleton Run) project, the pH and net acidity has improved downstream of the reclamation site for 11 miles. Pre-construction data showed pH in the range of 2.8 – 6.7 at the project cumulative discharges and downstream of the project. However, after installation of the Salem Road/Middleton Run reclamation project, post-construction data shows pH in the range of 6.3–7.1 downstream of the project discharge. The net acidity concentrations decreased by 100 percent at the three project discharges cumulatively creating net alkaline conditions continuing for 9.7 miles downstream to station LRC0030.

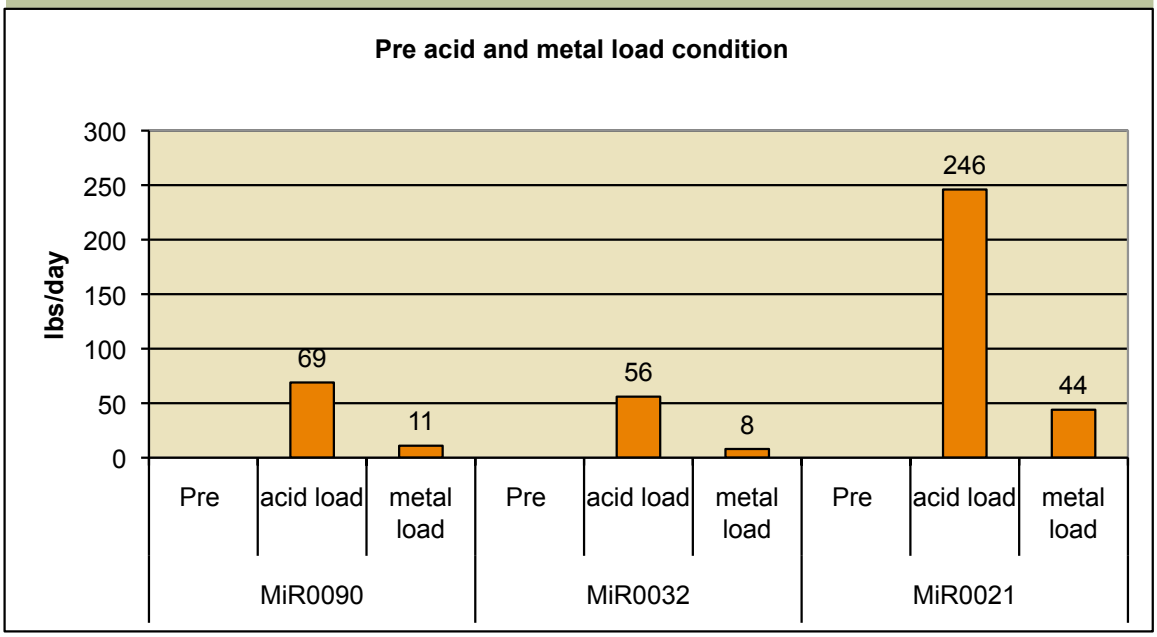
An analysis of the acid and metal load reductions of the three separate treatment components are shown below.

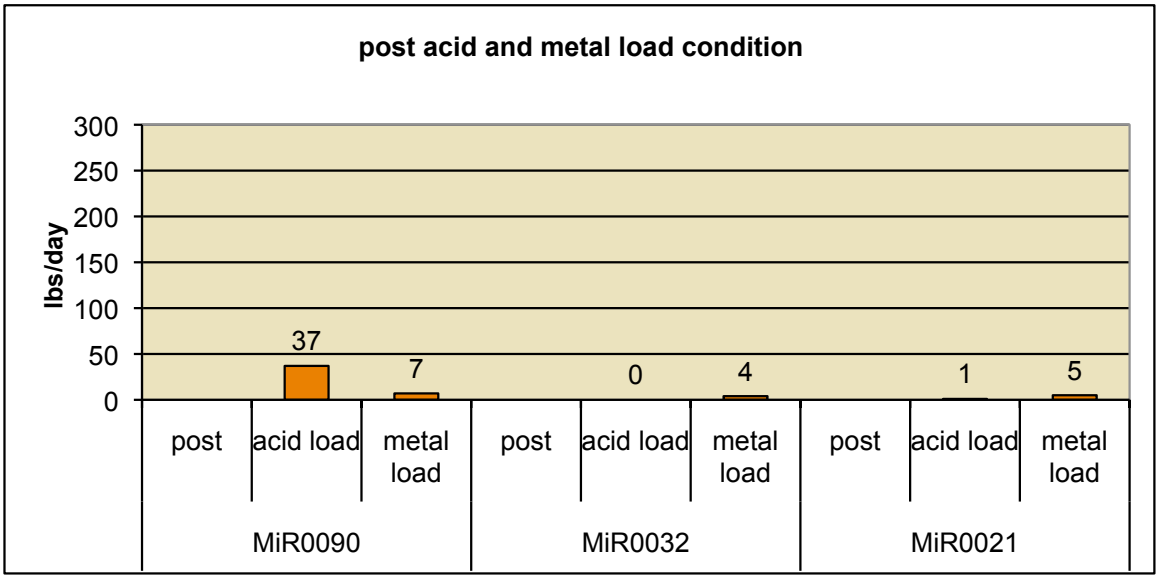
Sample site ID	Description of the sampling station
MiR0090	Tributary draining limestone leach bead treatment, site is at crossing with Salem Road
MiR0090	Tributary draining limestone leach bed treatment, site is at crossing with Salem Road
MiR0032	Sample site located directly below the dam at MiR0031. Two limestone J-trenches with steel slag cores.
MiR0021	The site represents discharge across the former mine pit floor. Sample site is at the Salem Road culvert (Fresh water pond draining into a limestone and steel slag channel.)

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3, 4, and 5. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1997 to 2005 for pre-construction and from 2006 to 2007 for post-construction at site MiR0040 and MiR0032. At site MiR0021 post-construction is from 2006 to 2008.

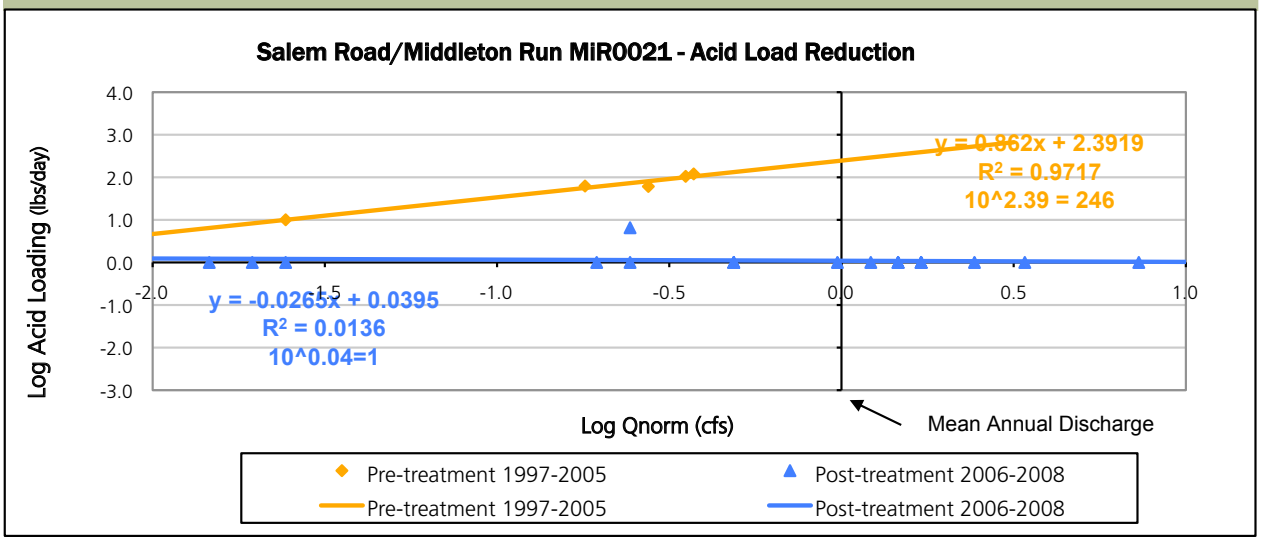
Figure 3. Acid Load Reduction Three project discharges at the Salem Road Project Site

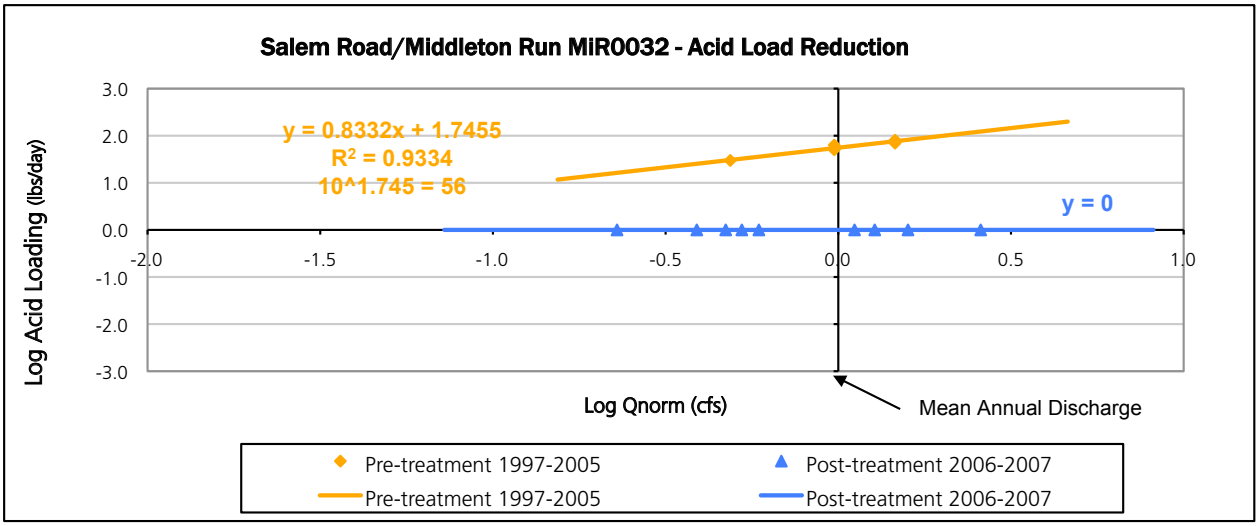




Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Figure 4. Acid Load Reduction





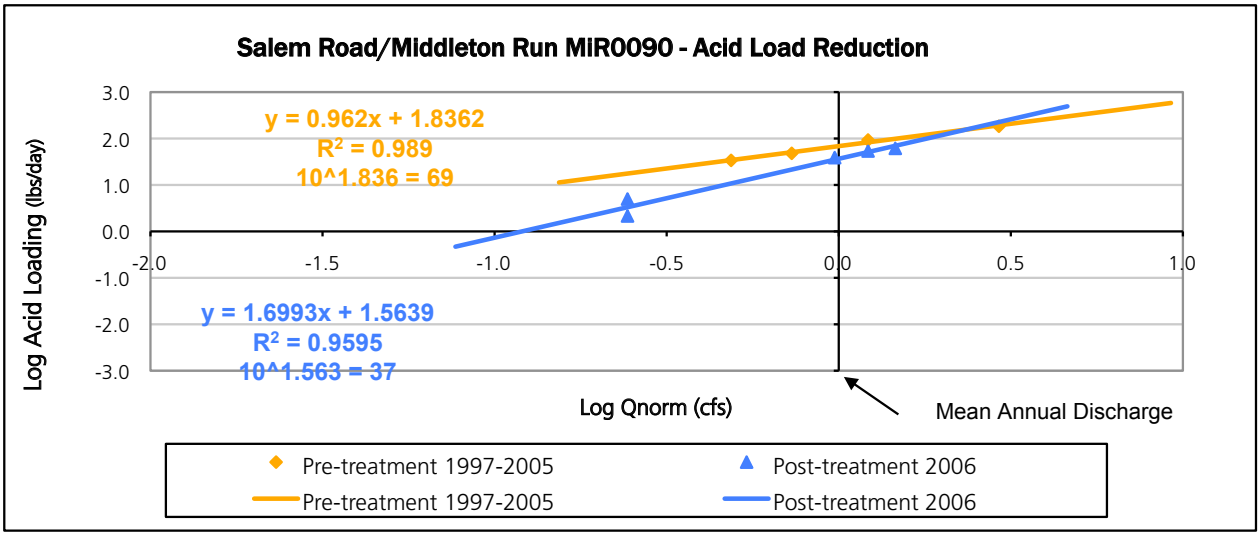
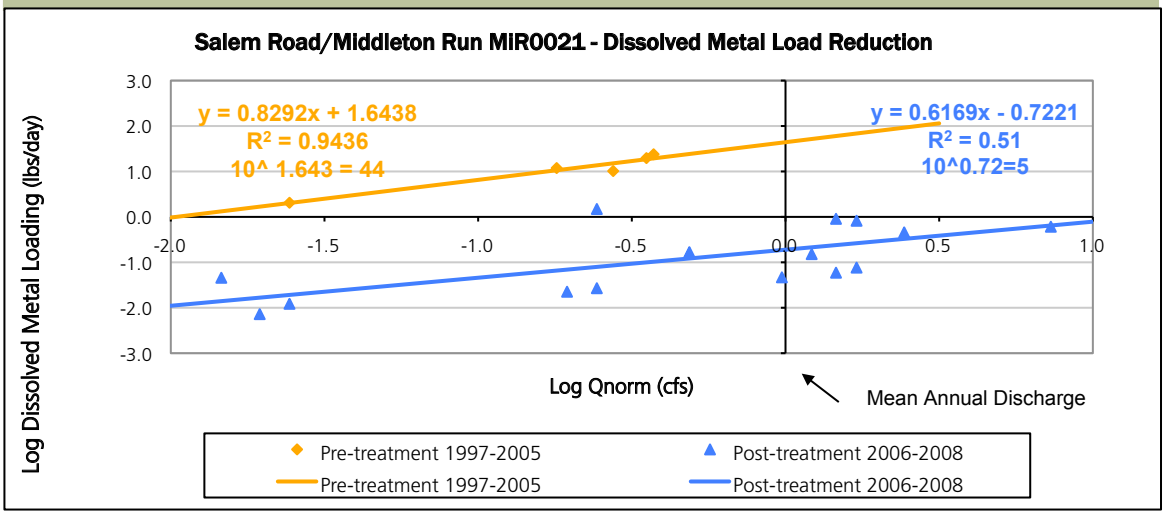
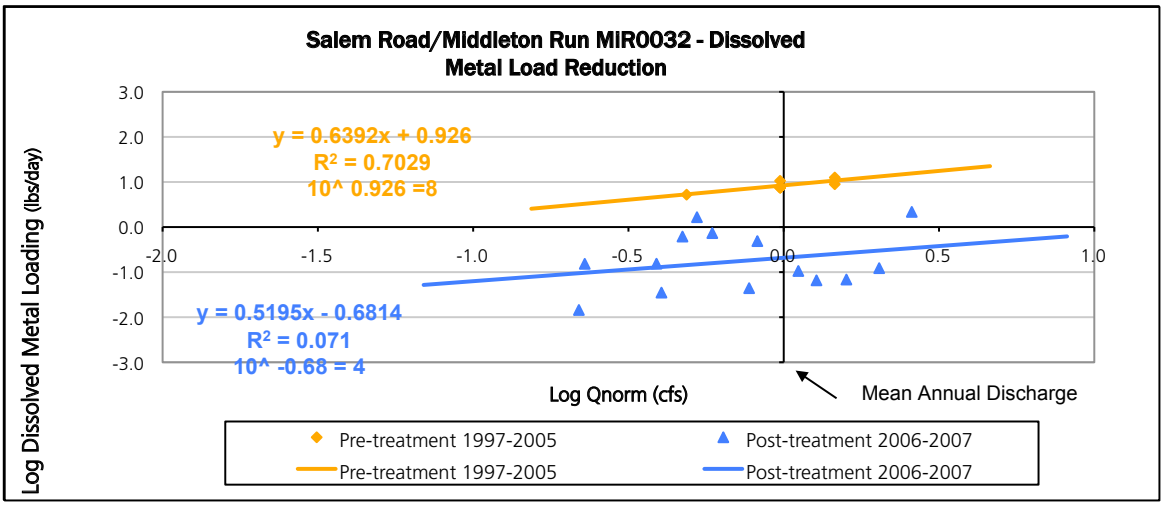
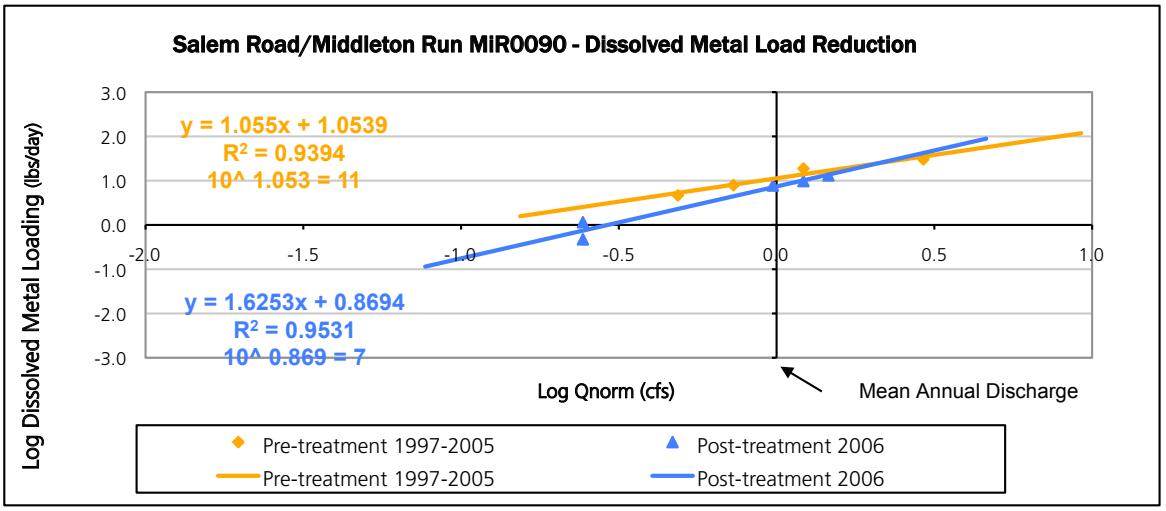


Figure 5. Dissolved Metal Load Reduction





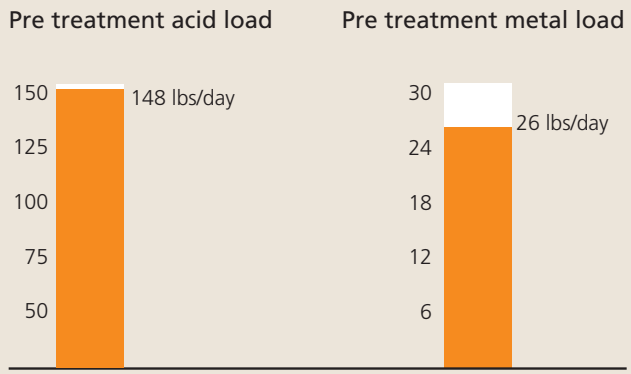


Project Status: Complete 6/18/2001 ODNR Project Number: JK-Ml-47

Pre-construction

Between pond and seep, Photo by Brent Miller

SITE: OTF0010

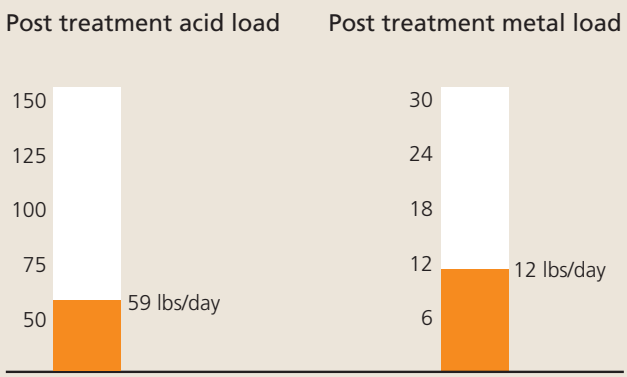


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Sr 124 hillside limestone channel, Photo by Chip Rice

SITE: OTF0010



Data derived using the Mean Annual Load Method (Stoertz, 2004).

State Route (SR) 124 Seeps Project is located in Section 15 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The site is 7 acres and is located in the Little Raccoon Creek subwatershed. This area consisted of an abandoned surface coal mine with an acidic surface pit. This un-reclaimed mine, resulted in seeps which drained directly into Little Raccoon Creek adjacent to SR 124. The site was reclaimed, pit was drained and regraded, and an open limestone channel was installed to collect drainage before discharging off site. The design was completed by ATC Associates Inc. for $80,000. The treatment approach for this site was to install several open limestone channels and conduct basic reclamation. The major consideration for this design was to establish positive drainage, remove several highwall impoundments, cover toxic materials, establish vegetations, and add alkalinity through the limestone channels. The goal of the design was to remove acidity from entering into Little Raccoon Creek. The project goal was met by 100 percent. Construction was complete June 18, 2001, by Oldtown Coal Company for a cost of $315,490. The major responsibility of the construction company was to complete all reclamation activities described in the project design. The funding source, for the project design and construction were ODNR-DMRM and Ohio EPA. Figures 3 and 4 (shown on page 3) estimate approximately 89 lbs/day of acid and 14 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre- and post- construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

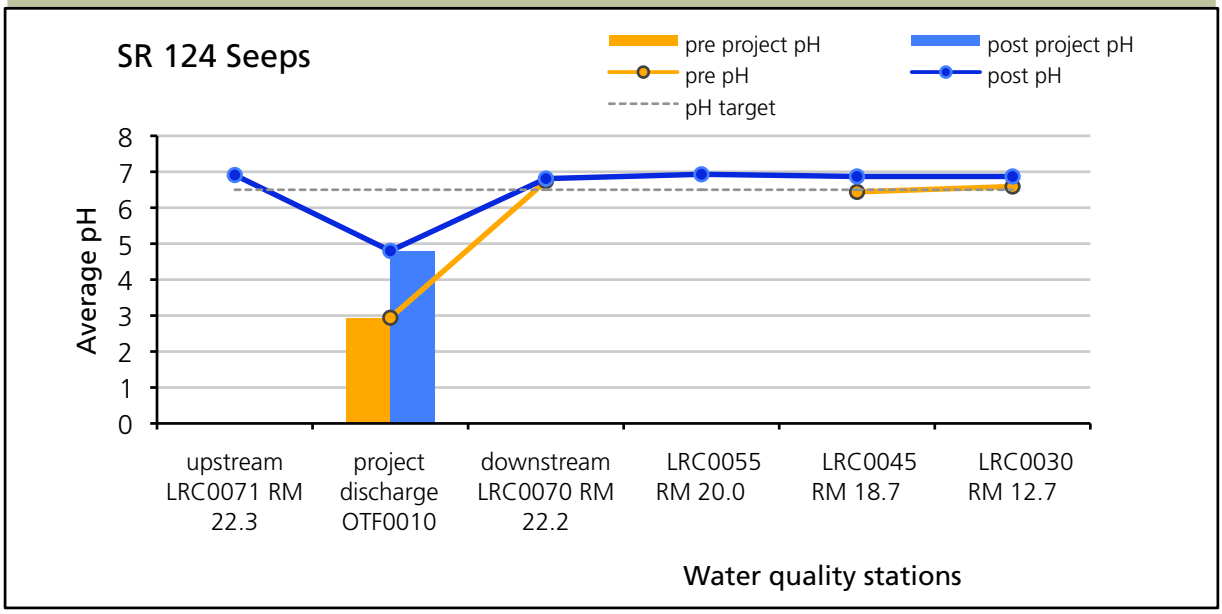
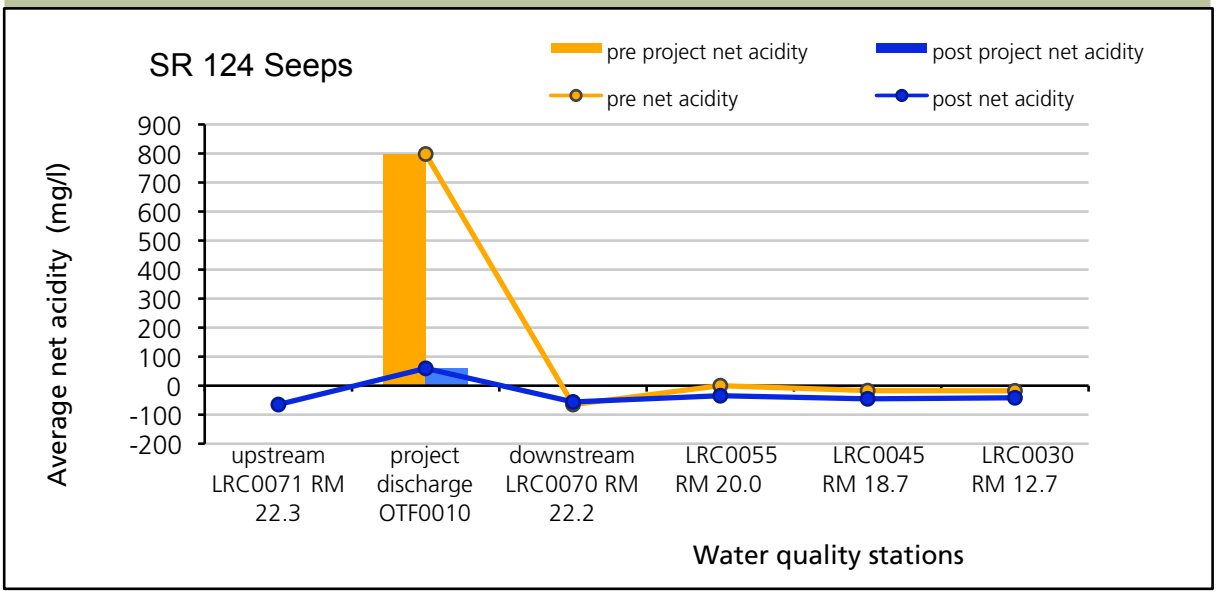


Figure 2. Pre and Post Acidity



As a result of the SR 124 Seeps project, the pH and net acidity has improved downstream of the reclamation site for 9.5 miles. Pre-construction data showed pH in the range of 2.9 – 6.7 downstream of the project. However, after installation of the SR 124 Seeps project, post-construction data shows pH in the range of 4.8 – 6.9 downstream of the project discharge. The net acidity concentrations decreased 93 percent at the discharge showing net alkaline conditions continuing for 9.5 miles downstream to station LRC0030.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 2/1/1997 to 11/27/2000 for pre-construction and from 6/19/2001 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

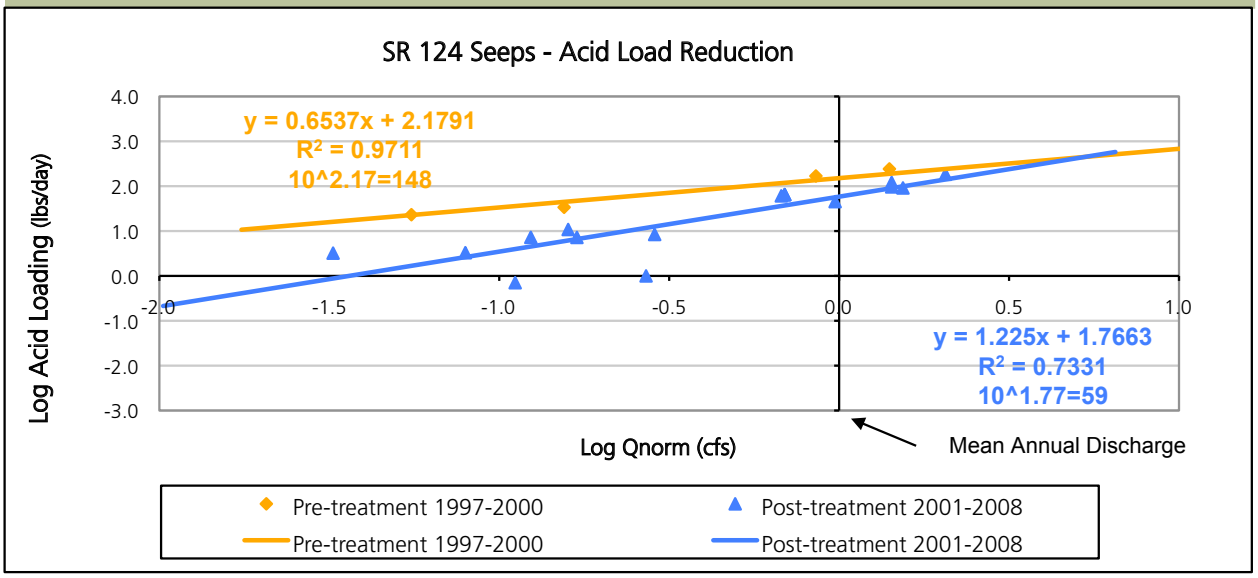
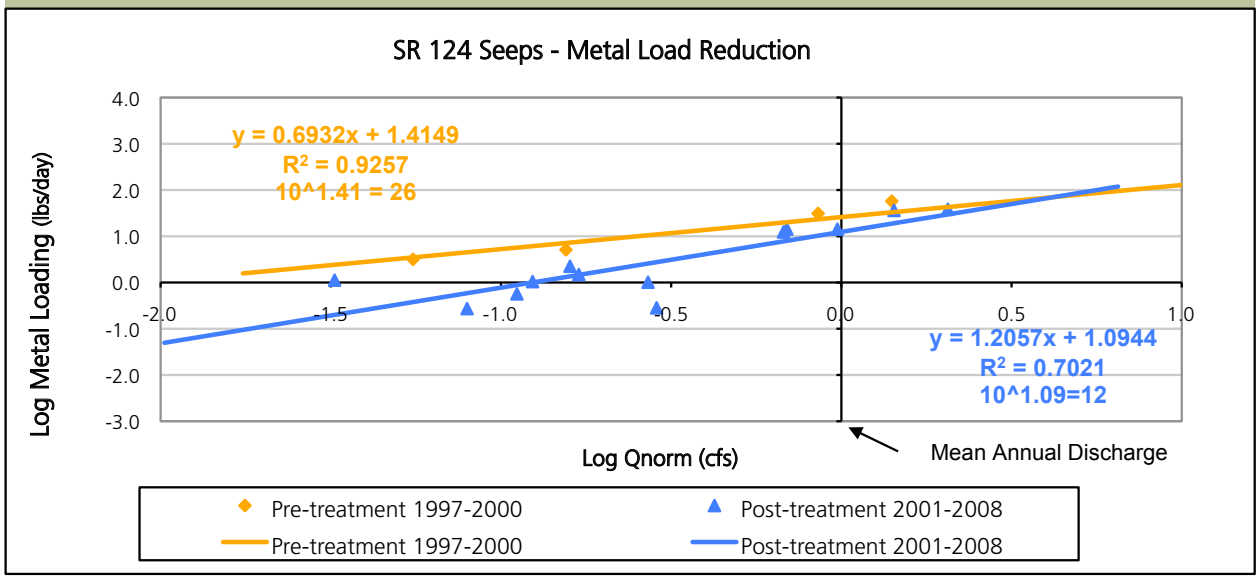


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Water Quality – load reductions

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 3. Yearly Acid Load Reduction

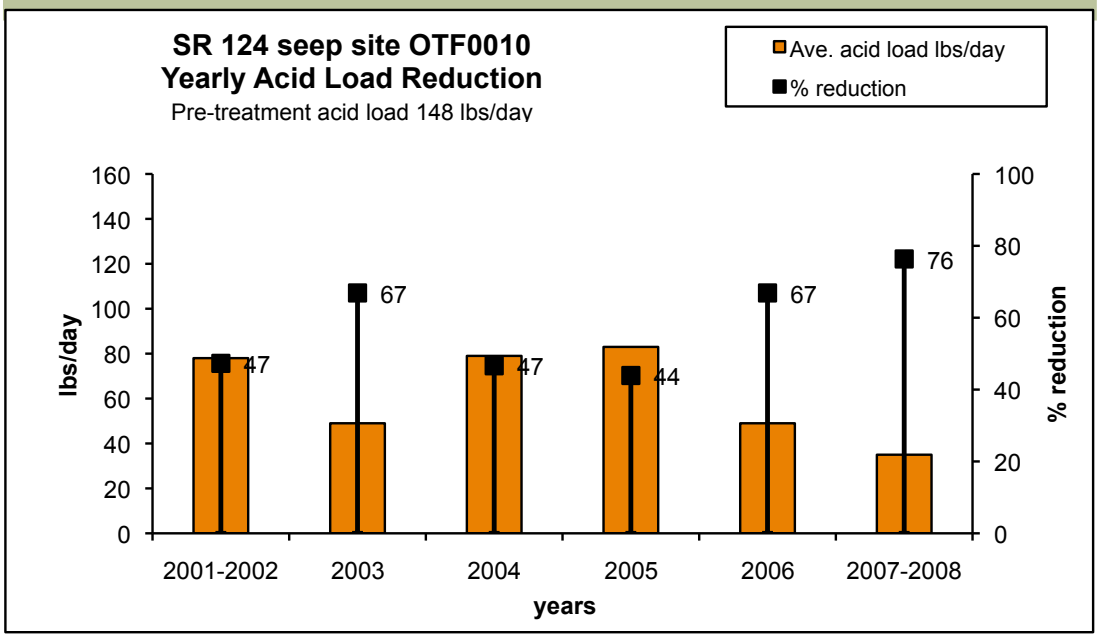
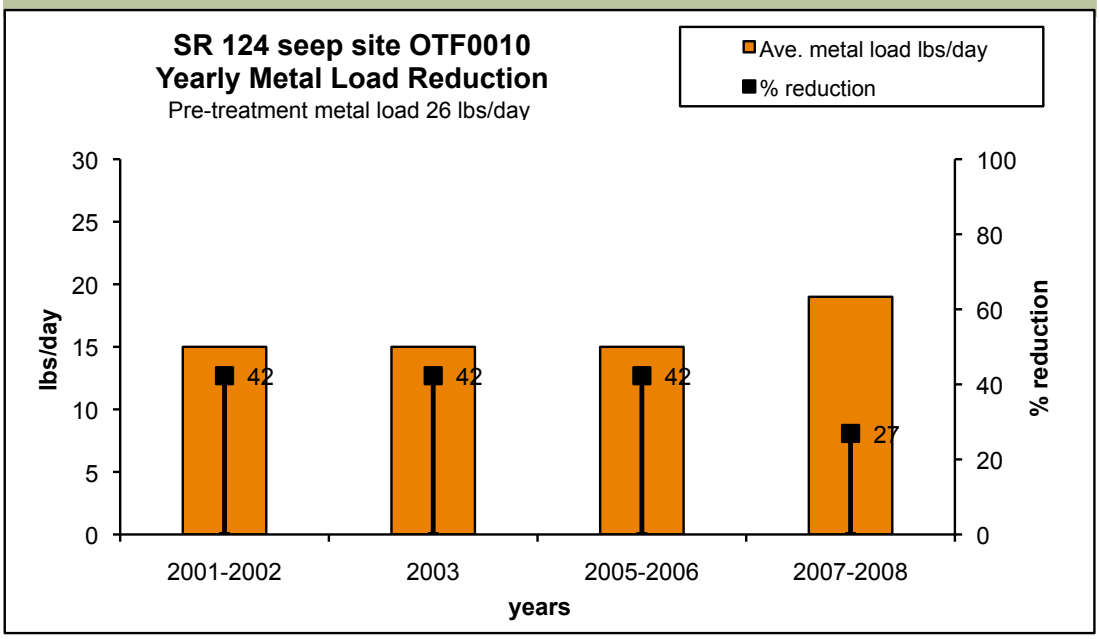


Figure 6. Yearly Metal Load Reduction

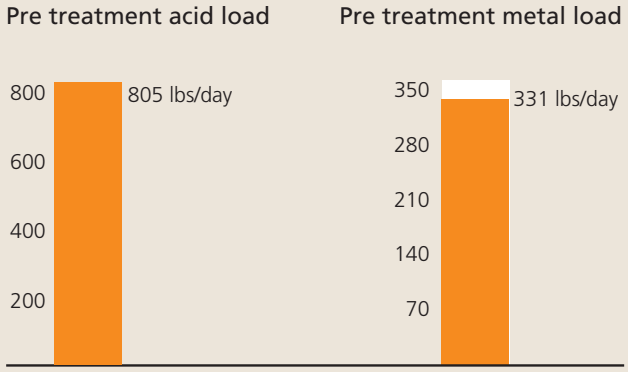


Project Status: Complete 8/1/2006 ODNR Project Number: Jk-Ml-34

Pre-construction

Flint Run East site discharge, Photo by Ben McCament

SITE: FR0126

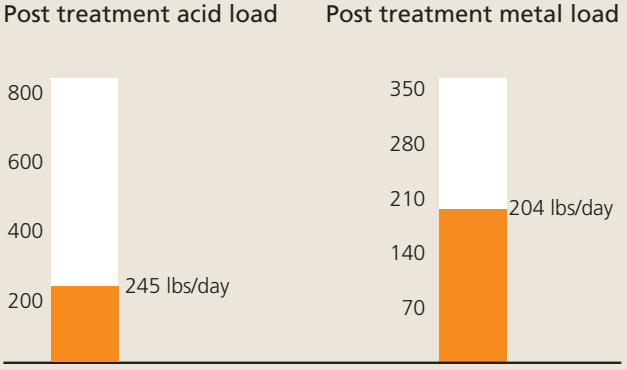


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Air photo of Flint Run site near completion, Photo by Ben McCament

SITE: FR0126



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Treatment Installed	Quantity & Units
Earthwork	56 acres
Erosion Control	13,000 linear feet
Dewatering Existing Impoundments	12,827,200 gallons of water
Sediment Pond	87,400 square feet
Steel Slag Leach Bed	32,500 square feet
Fresh Water Storage Pond	84,800 square feet
Limestone Leach Bed	10,400 square feet
Wetland, passive	4,800 square feet
Succesive Alkaline Producing Systems (SAPS)	32,500 square feet
Open Limestone Channel	13,650 linear feet

Flint Run East is located in Section 28 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The project site is 56 acres and is located in Little Raccoon Creek next to Lake Milton. Flint Run East project is Phase I of the Flint Run Reclamation Project, Lake Milton is Phase II. The project discharge was measured at the tributary draining the Flint Run East treatment site. The Flint Run sub watershed is affected by abandoned strip mine drainage and associated unreclaimed coal refuse piles mostly from the Broken Aro mine which is in the headwaters of Flint Run. This area was the coal washing and loading facility for the Broken Aro mine. The site is very complex hydrologically, the site consists of large buried slurry impoundments and surface mining pits around the rim of the main valley. Mead-Westvaco reclaimed the main slurry pond area with paper mill sludge in the mid 1980's. AMD seeps originate in many locations associated with the slurry impoundments and the surface mine pits. The design was completed by RD Zande for a cost of $241,702. The treatment approach for this site was to dewater the strip pits and install passive acid mine drainage treatment systems. The major consideration during the design process was to reduce groundwater infiltration into the valley coal refuse pile. The goal has been met 100%. Construction was complete Aug. 1, 2006, by Berridge Reclamation for a cost of $1,456,106. The funding sources for this project were ODNR-DMRM for the design and ODNR-DMRM, EPA-319 and OSM ACSI for construction. Figure 3 to 4 (shown on page 3) estimate approximately 560 lbs/day of acid and 127 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

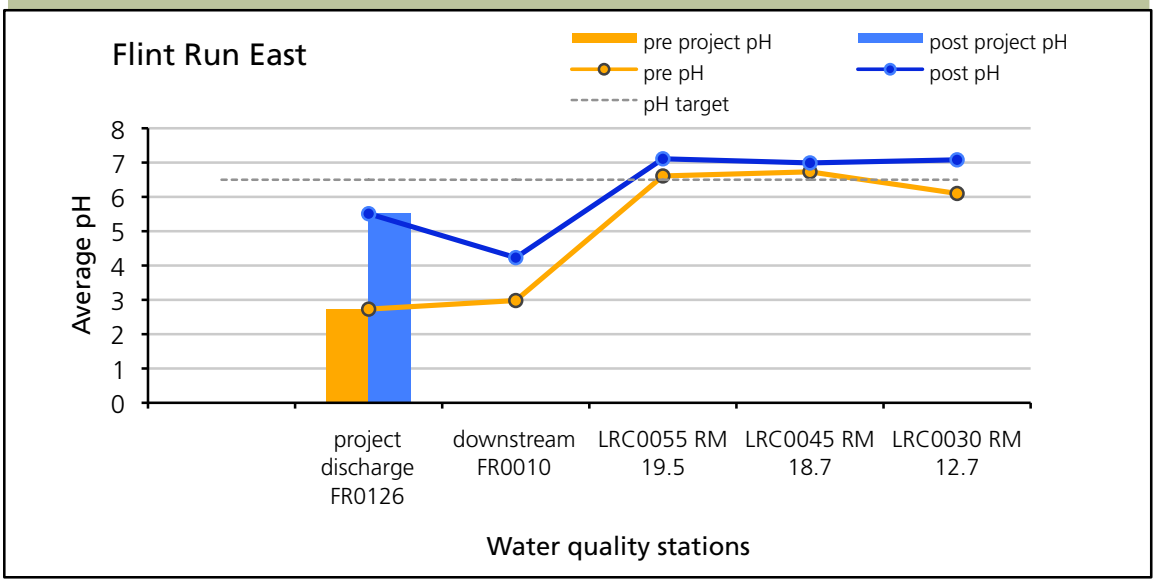
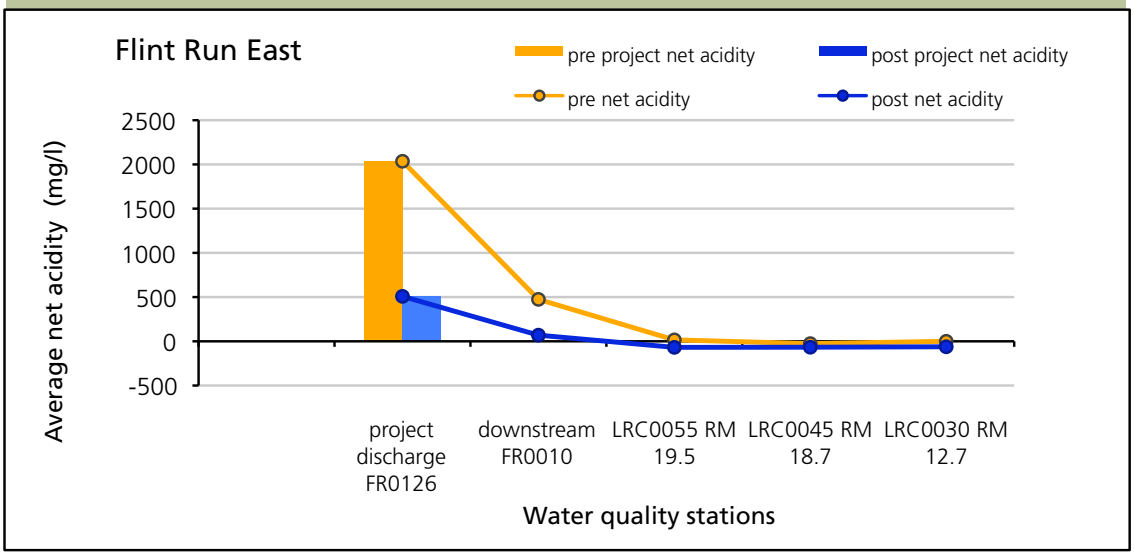


Figure 2. Pre and Post Acidity



Initial results from the Flint Run East Project indicate, pH and net acidity have improved downstream of the reclamation site for 7.0 miles. Pre-construction data showed pH in the range of 2.7 – 6.7 at the project discharge and downstream. However, after installation of the Flint Run East Project, post-construction data shows pH in the range of 4.2 – 7.1 at the discharge, and downstream. The net acidity concentrations decreased 85 percent at the project discharge showing net alkaline conditions for 7.0 miles downstream to station LRC0030. This 85 percent acidity decrease is down 3 percent from last years report (88%).

Water Quality- load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1/1/1975 to 5/31/2006 for pre-construction and from 6/1/2006 to 12/31/2008 for post-construction, with the exception for the acid load reduction graph (figure 3). Acid load reductions were calculatd for 2007 to 2008 only, this excluded the 2006 date where initital acid load reduction were high and have since decreased. The 2007 to 2008 data portray current conditions more accurately.

Figure 3. Acid Load Reduction

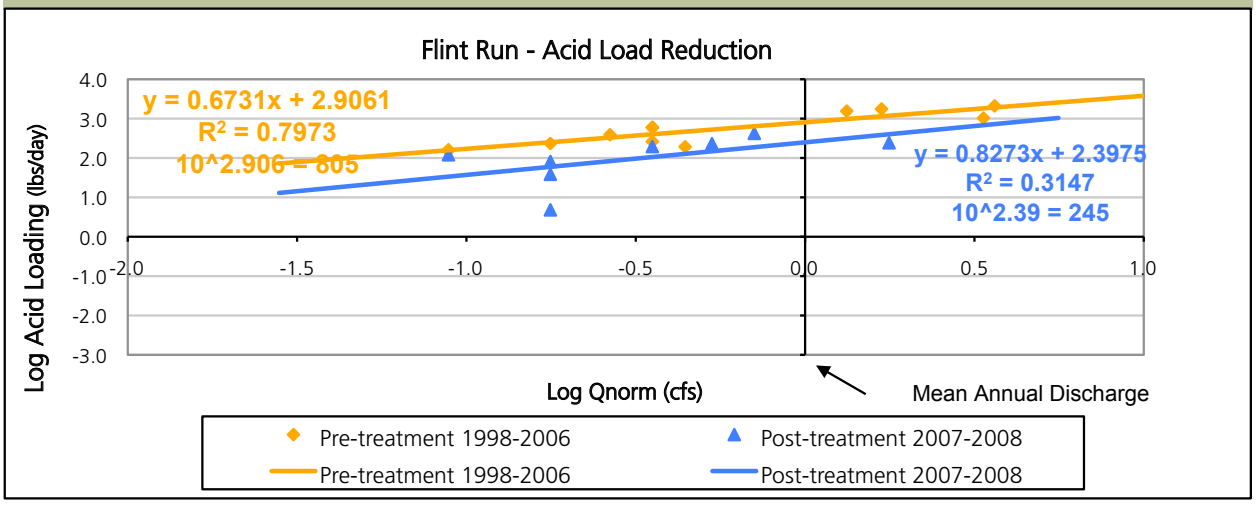
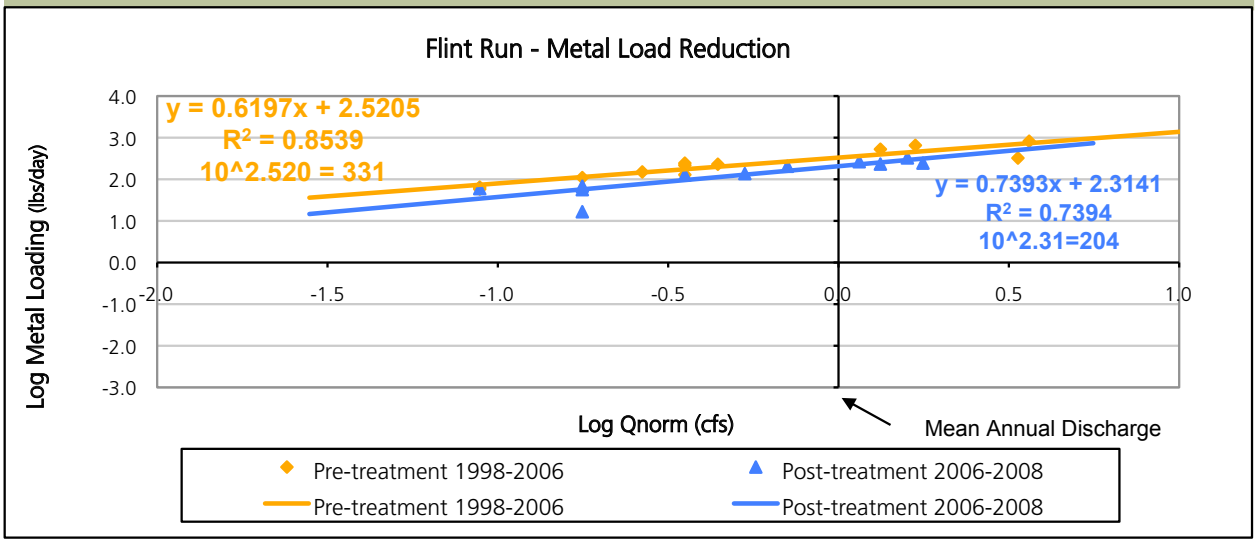


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Water Quality – load reductions

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

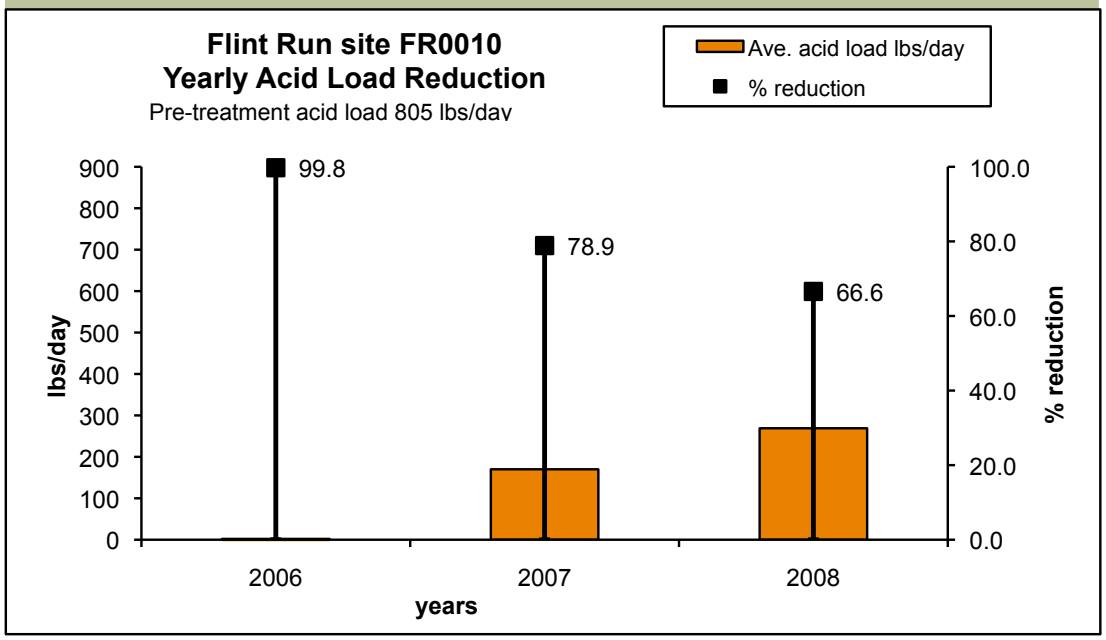
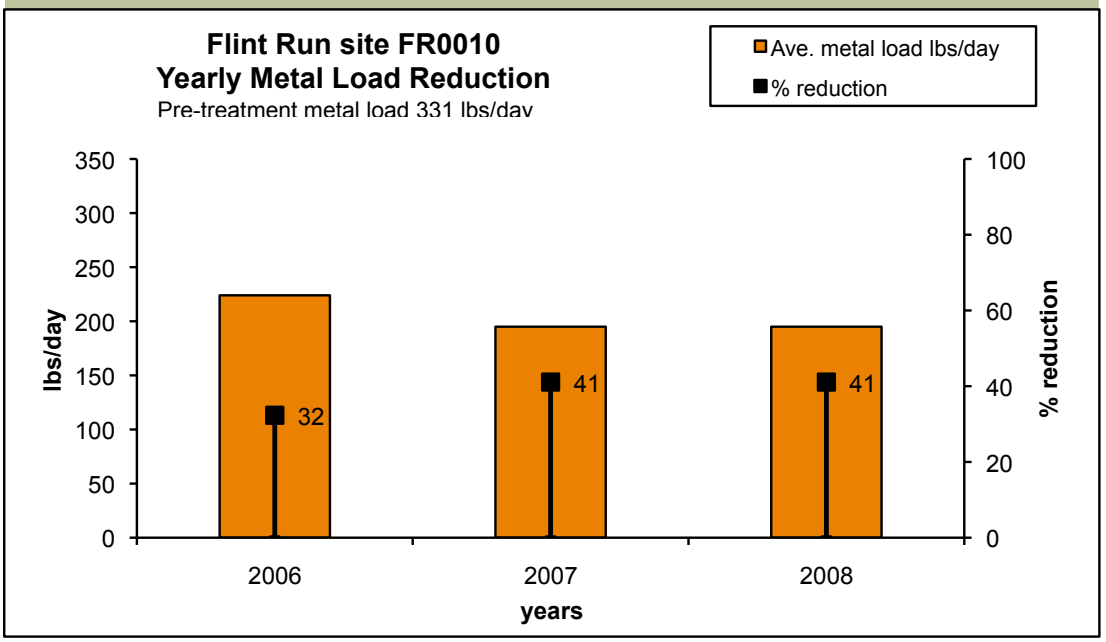
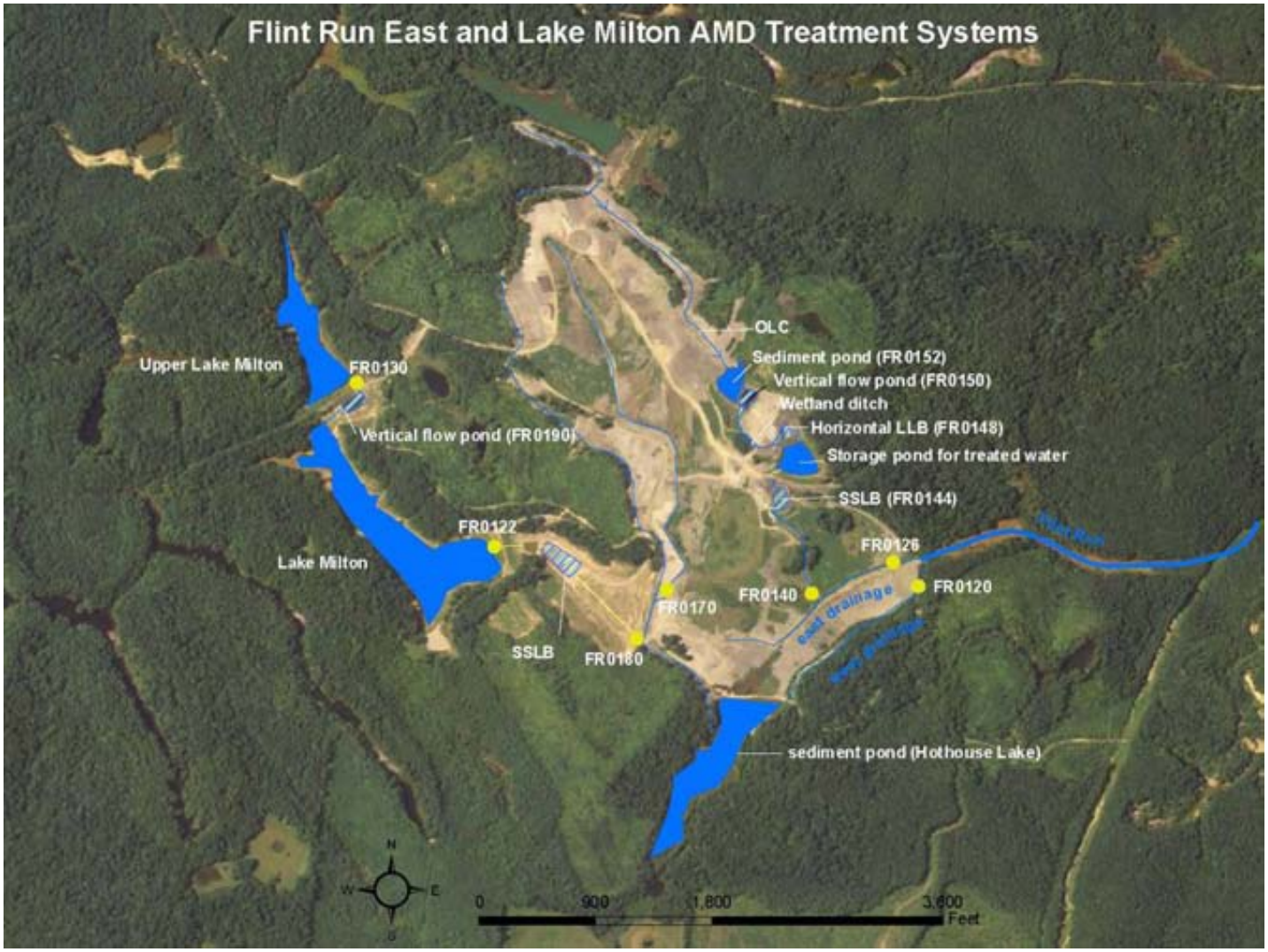


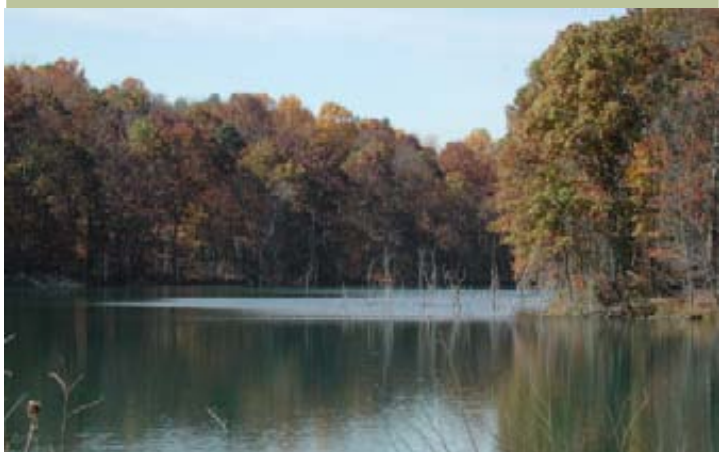
Figure 6. Yearly Metal Load Reduction




Flint Run East and Lake Milton AMD Treatment Systems
Upper Lake Milton
FR0130
Vertical flow pond (FR0190)
OLC
Sediment pond (FR0152)
Vertical flow pond (FR0150)
Wetland ditch
Horizontal LLB (FR0148)
Storage pond for treated water
SSLB (FR0144)
FR0122
Lake Milton
FR0126
FR0140
FR0120
FR0170
SSLB
FR0180
sediment pond (Hothouse Lake)
N
W
E
S
0
900
1,800
3,600
Feet

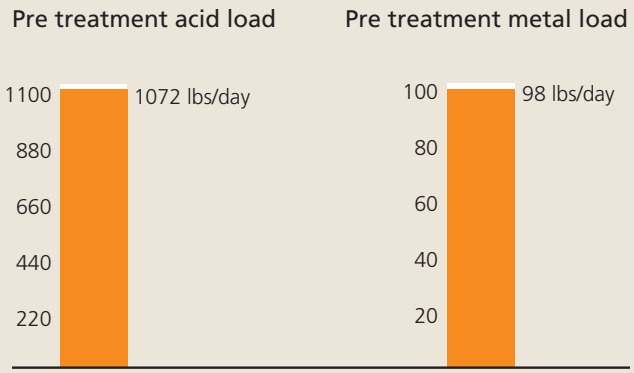
Project Status: Complete 9/5/2006 ODNR Project Number: Jk-Ml-113

Pre-construction



Lake Milton - 25 acre acidic lake, Photo by Ben McCament

SITE: FR0120

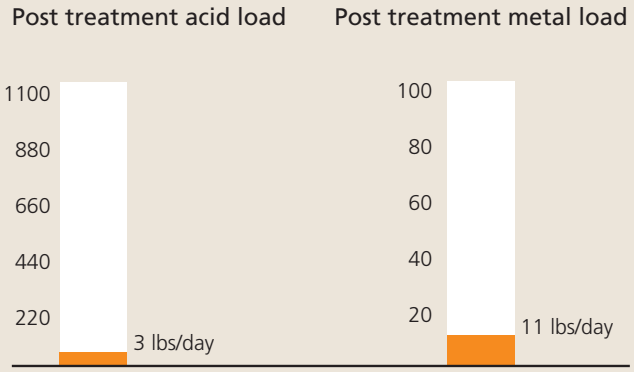


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Steel slag bed downstream Lake Milton, Photo by Ian Hughes

SITE: FR0120



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Treatment Installed	Quantity & Units
Water Treatment in Lake Milton	50 *million gallons*
Open Limestone Channel	2,300 *linear feet*
Steel Slag Leach Bed	74,000 *square feet*
Succesive Alkaline Producing Systems (SAPS)	16,000 *square feet*
Repair Dam with Slurry Wall	75,000 *square feet*

Lake Milton is located in Section 28 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The project site is 155 acres and is located in Little Raccoon Creek next to the Flint Run East Project. The Lake Milton Project is Phase II of the Flint Run Reclamation Project. The project discharge was measured at the outlet from Hothouse Lake. Lake Milton is part of a manmade drainage system that was used during mining operations for coal washing by the Broken Aro mine. Lake Milton is adjacent to the Flint Run East site and is a 15 acre lake with a small watershed area. AMD originates in spoil areas near Upper Lake Milton (separated by railroad embankment) before flowing into Lake Milton. Additional AMD is generated after Lake Milton discharges into coal slurry waste in the valley downstream of the lake dam. Lake Milton drains into Hothouse Lake before entering into Flint Run. The design was completed by Bergmann Associates and GAI Consultants Inc. for a cost of $416,000. The treatment approach for this site was to repair the Lake Milton, dam and to install a Successive Alkaline Producing System (SAPS) and a steel slag leach bed. The major consideration during the design process was the crucial need to treat the acid mine drainage in Upper Lake Milton to drain to Lake Milton before running into the steel slag bed downstream of Lake Milton. The goal of the design is to reduce 600 lbs/day of acid loading. Problems occured with the valves in 2007, therefore this project only worked intermittently until Sept. 2007. Construction was complete September 5, 2006 by Stockmeister Enterprises Inc. for a cost of $961,536. The funding sources for this project were ODNR-MRM, EPA-319 and OSM ACSI for both the design and construction. Figures 3 to 4 (shown on page 3) estimate approximately 1069 lbs/day of acid and 87 lbs/day of metals were reduced from entering into Little Raccoon Creek.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre-construction. The graphs below show pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream downstream of the project discharge.

Figure 1. Pre and Post pH

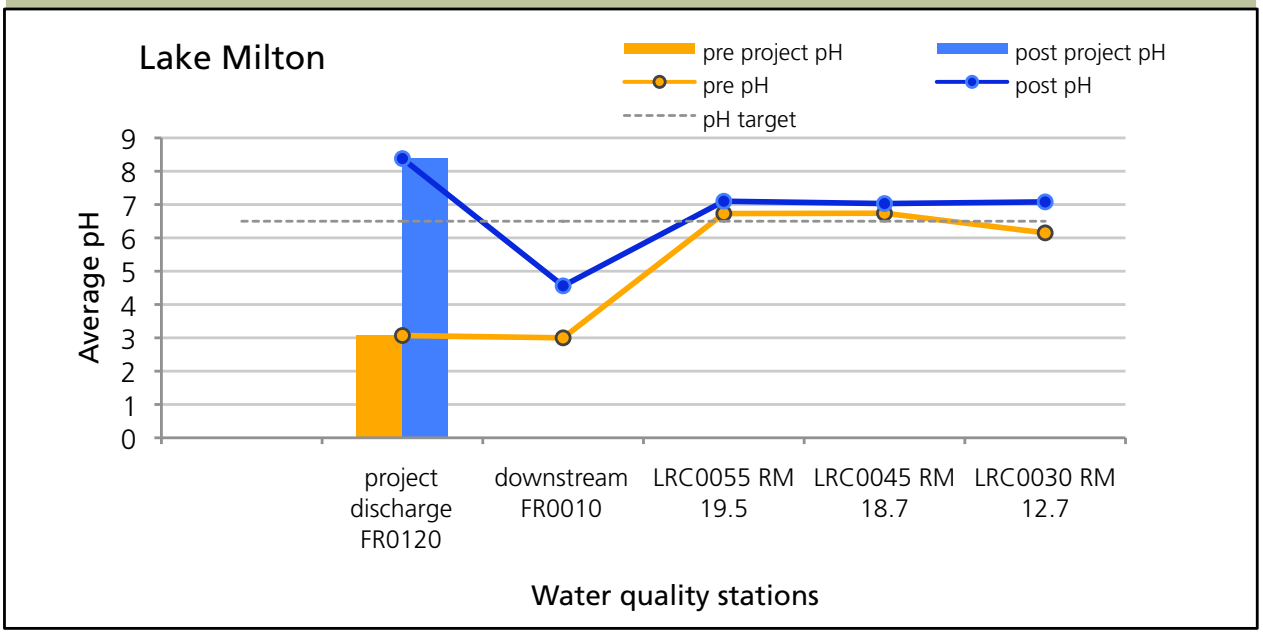
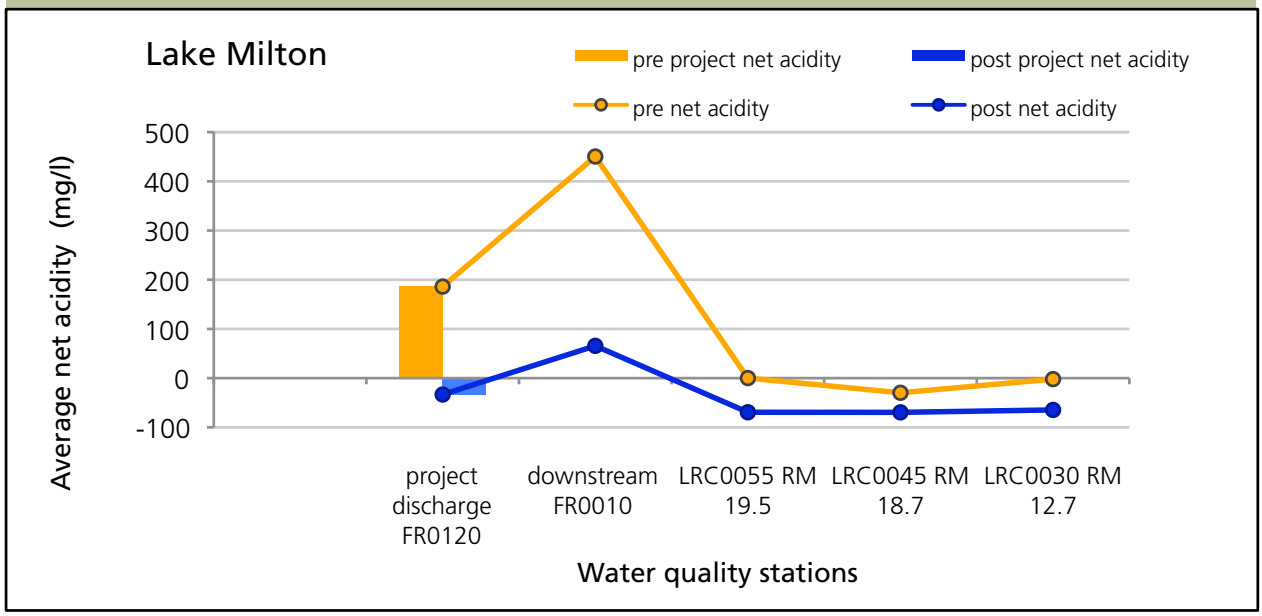


Figure 2. Pre and Post Acidity



As a result of the Lake Milton project the pH and net acidity has improved downstream of the reclamation site for 7.0 miles. Pre-construction data shows pH in the range of 3.0–6.7 downstream of the project. However, after installation of the Lake Milton Project, post-construction data shows pH in the range of 4.7-8.4 downstream of the project discharge. The net acidity concentrations decreased, showing net alkaline concentration for 7.0 miles downstream to station LRC0030.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 7/28/1998 to 8/9/2005 for pre-construction and from 10/16/2006 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

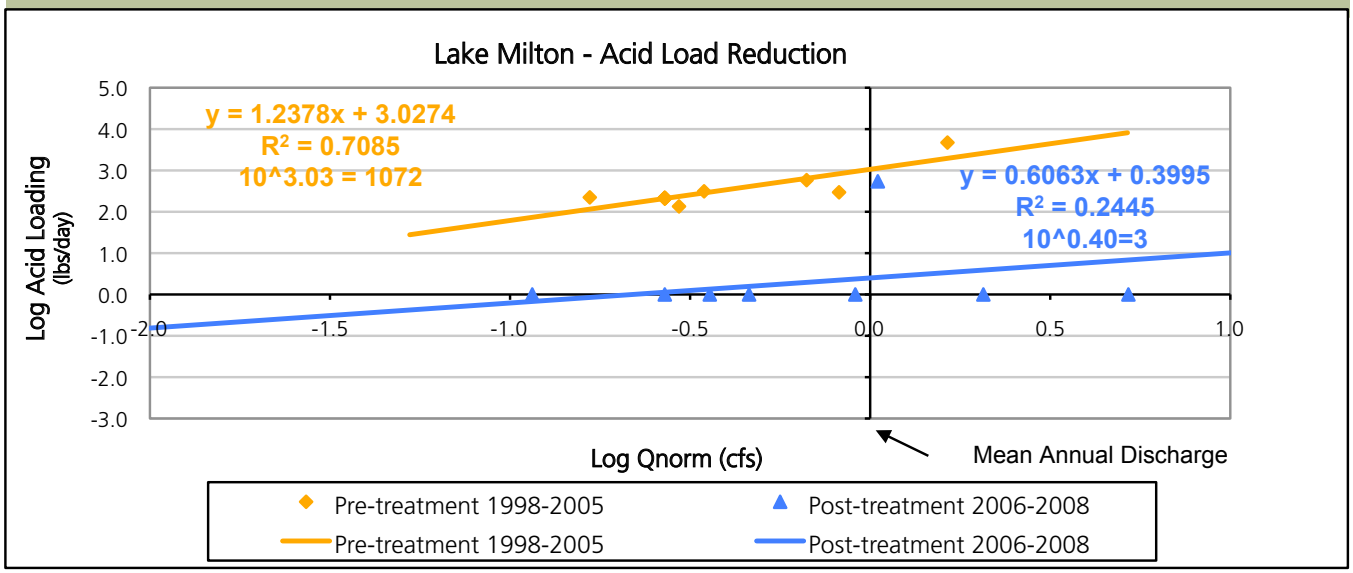
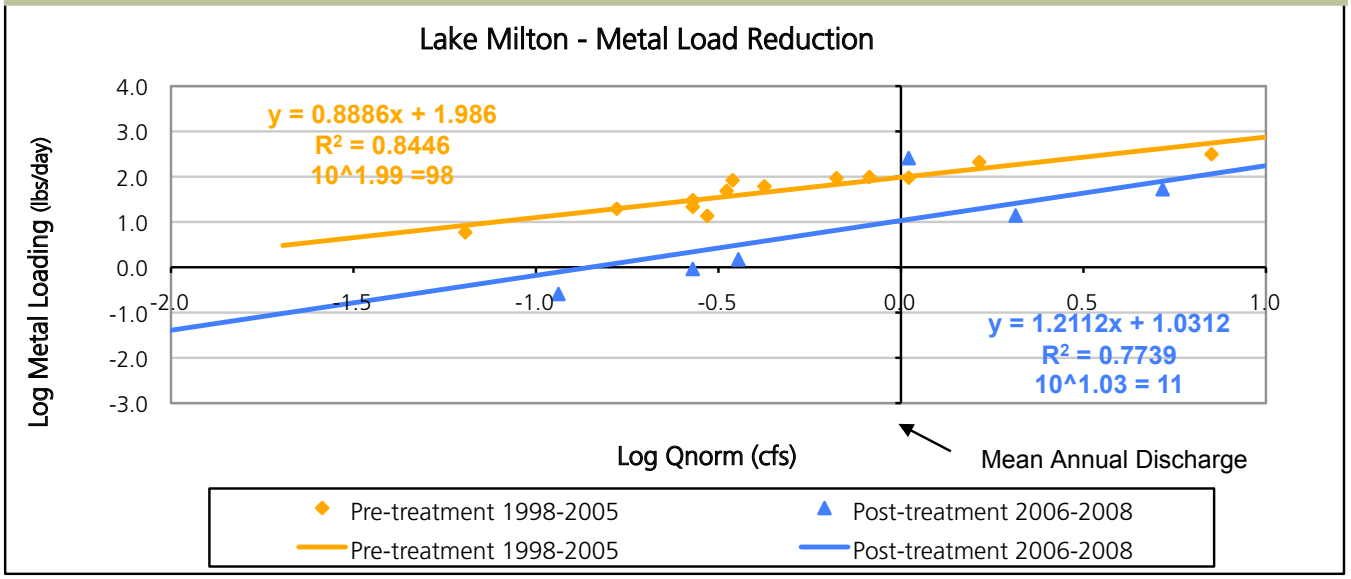


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

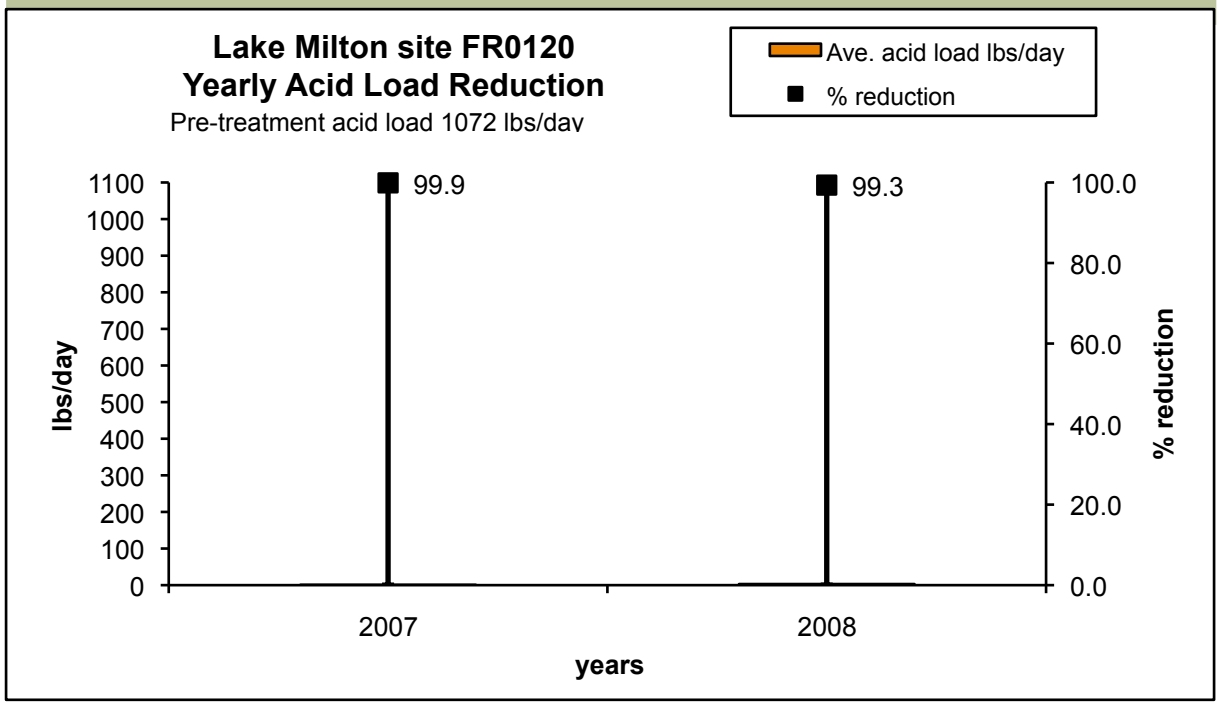
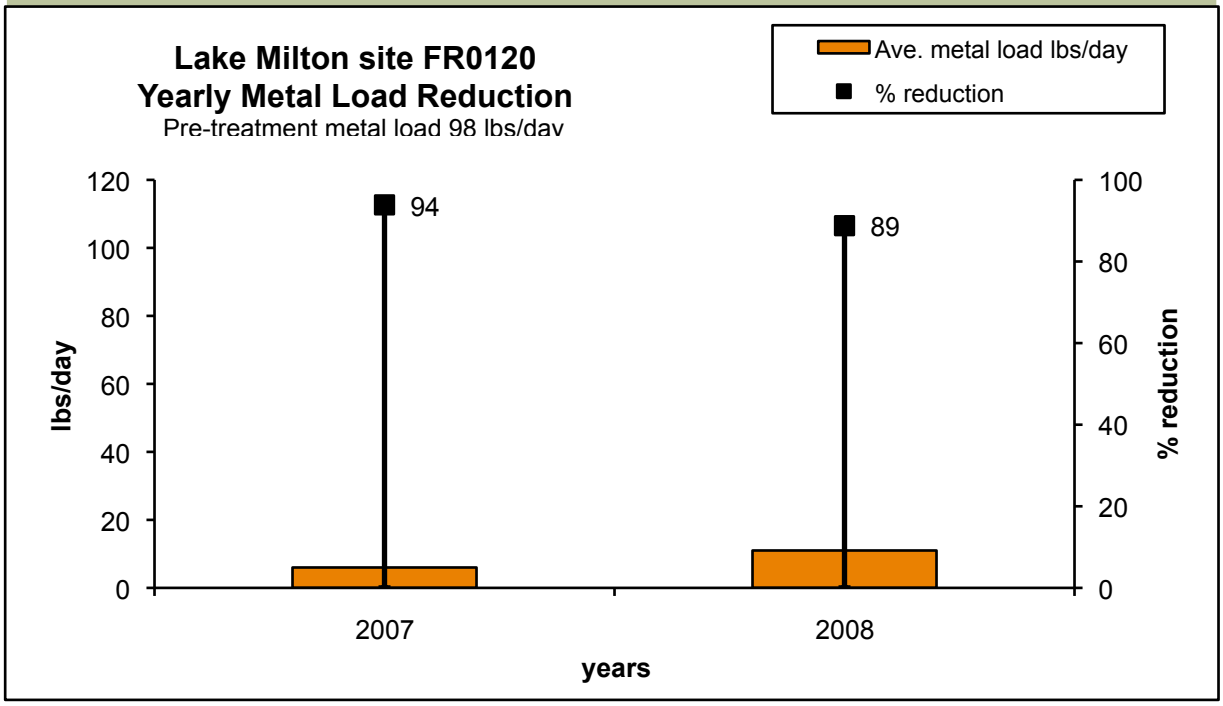


Figure 6. Yearly Metal Load Reduction

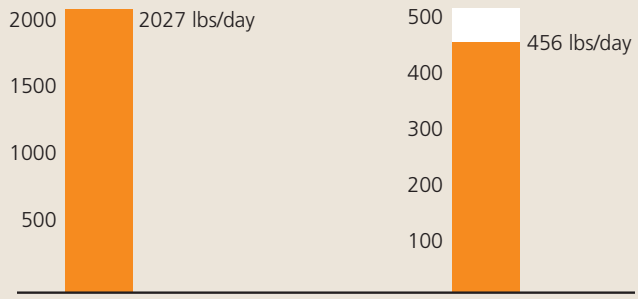


Project Status: Complete 6/20/1999 ODNR Project Number: JK-Ml-18

Pre-construction

Mine waste in valley, Photo by Raccoon Creek Partnership

SITE: BR0010

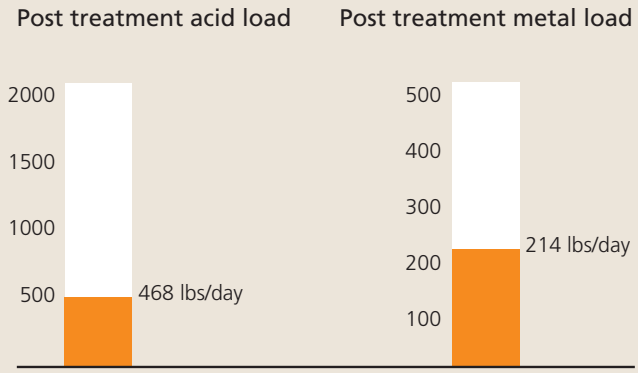


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Successive Alkaline Producing System (SAPS), Photo by Ben McCament

SITE: BR0010



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Buckeye Furnace and Buffer Run Project is located in Section 25 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The site is 65 acres and is located in the Little Raccoon Creek subwatershed. Deep mining of the area resulted in continuous AMD discharge from underground mines to Buffer Run, a tributary to Little Raccoon Creek. This area was also strip mined and used for a wash plant facility for a deep mine operation, resulting is several unreclaimed coal refuse areas and slurry ponds draining to Buffer Run. The design was completed by BBC&M Engineering Inc. for $125,000. The treatment approach for this site was to eliminate strip pits, reclaim the gob pile, and install a Successive Alkaline Producing System (SAPS) a passive treatment system. The major considerations for this project was mostly source control and but also constructing a passive treatment system. The goal of the design was to reduce 75 percent of the acidity discharging into Little Raccoon Creek. The acidity load has been reduced by 76 percent. Construction was complete June 20, 1998, by Earth Tech Inc. for a cost of $1,090,530. The funding source for the project design was ODNR-DMRM, and for construction the sources were ODNR-DMRM, OEPA and OSM. Figures 3 and 4 (shown on page 3) estimate approximately 1559 lbs/day of acid and 242 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the main-stem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

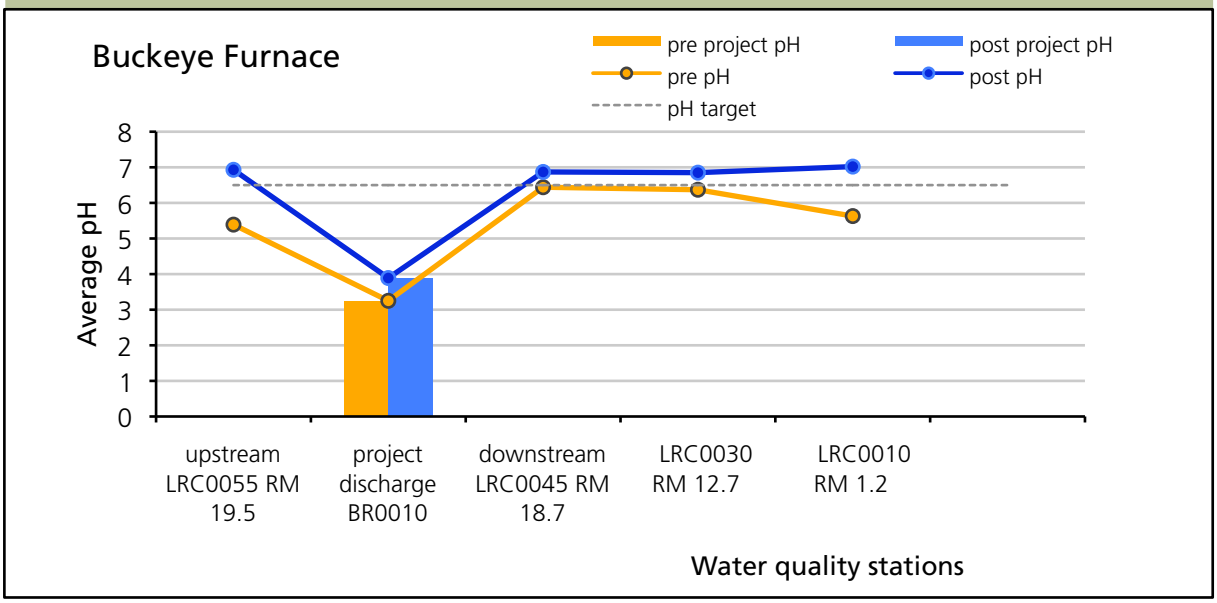
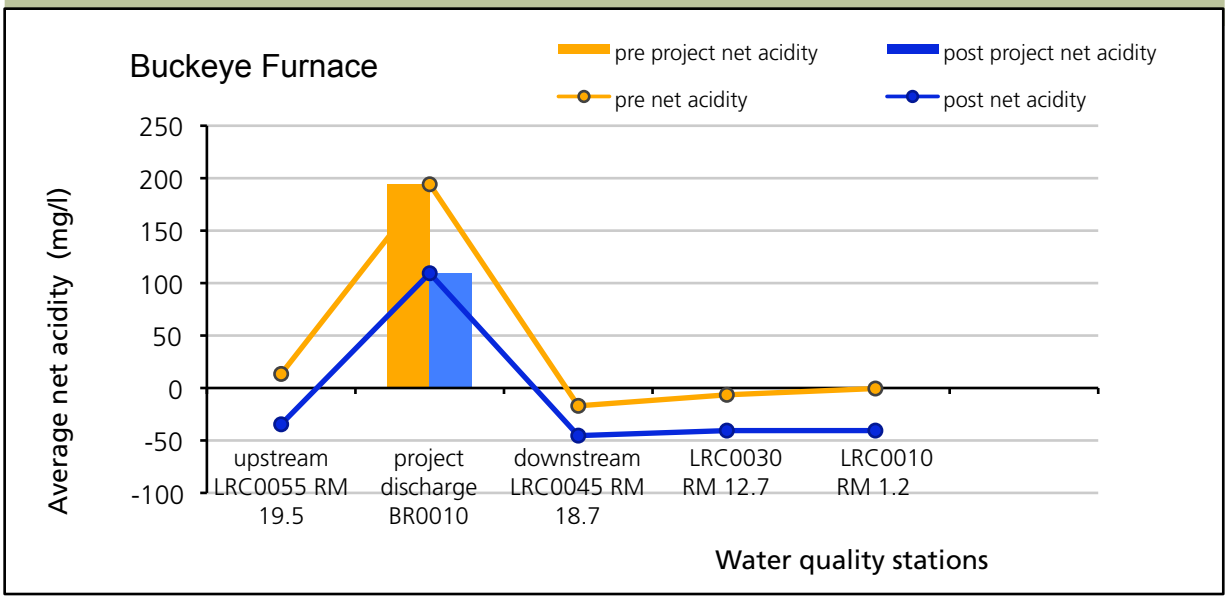


Figure 2. Pre and Post Acidity



As a result of the Buckeye Furnace and Buffer Run project, the pH and net acidity has improved downstream of the reclamation site for 18 miles. Pre-construction data shows pH in the range of 3.2 – 6.4 downstream of the project. However, after installation of the Buckeye Furnace and Buffer Run reclamation project, post-construction data shows pH in the range of 3.9 – 7.0 downstream of the project discharge. The net acidity concentrations decreased by 44 percent, showing net alkaline conditions continuing for 18 miles downstream to the mouth of Little Raccoon Creek station LRC0010. This percent acidity decrease is up two percent from last years report (42%).

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1/1/1996 to 3/25/1998 for pre-construction and from 6/23/1999 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

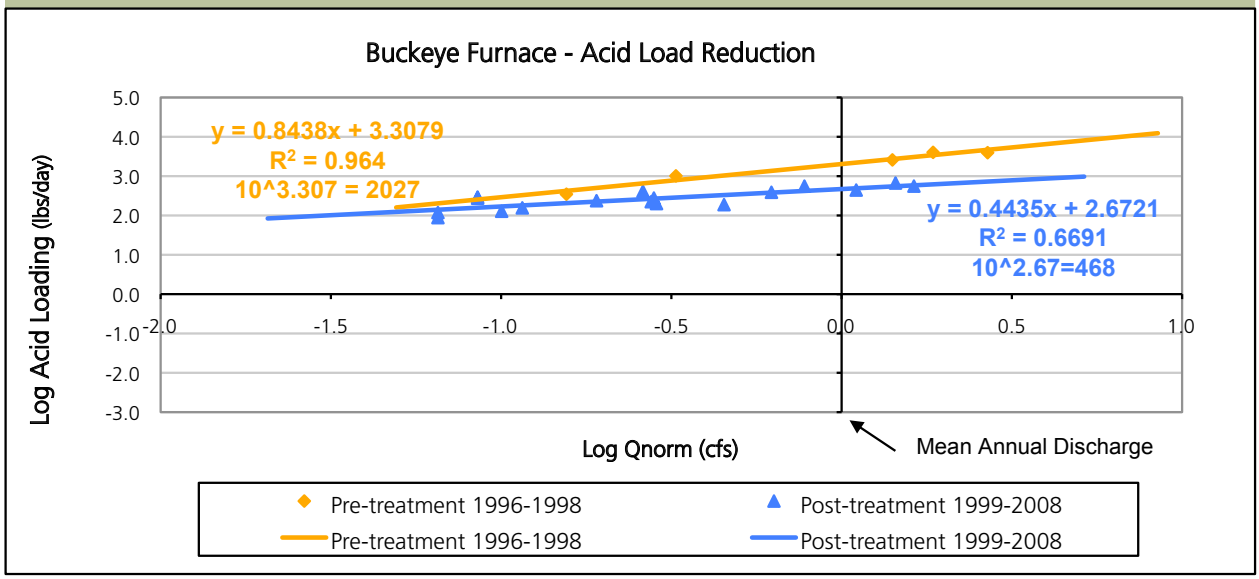
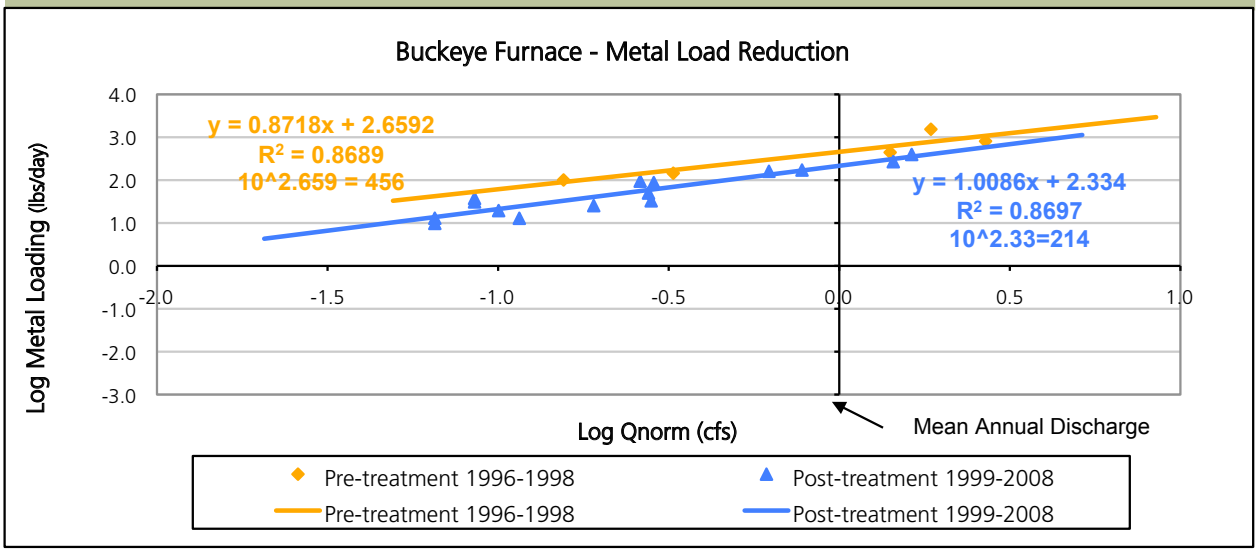


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

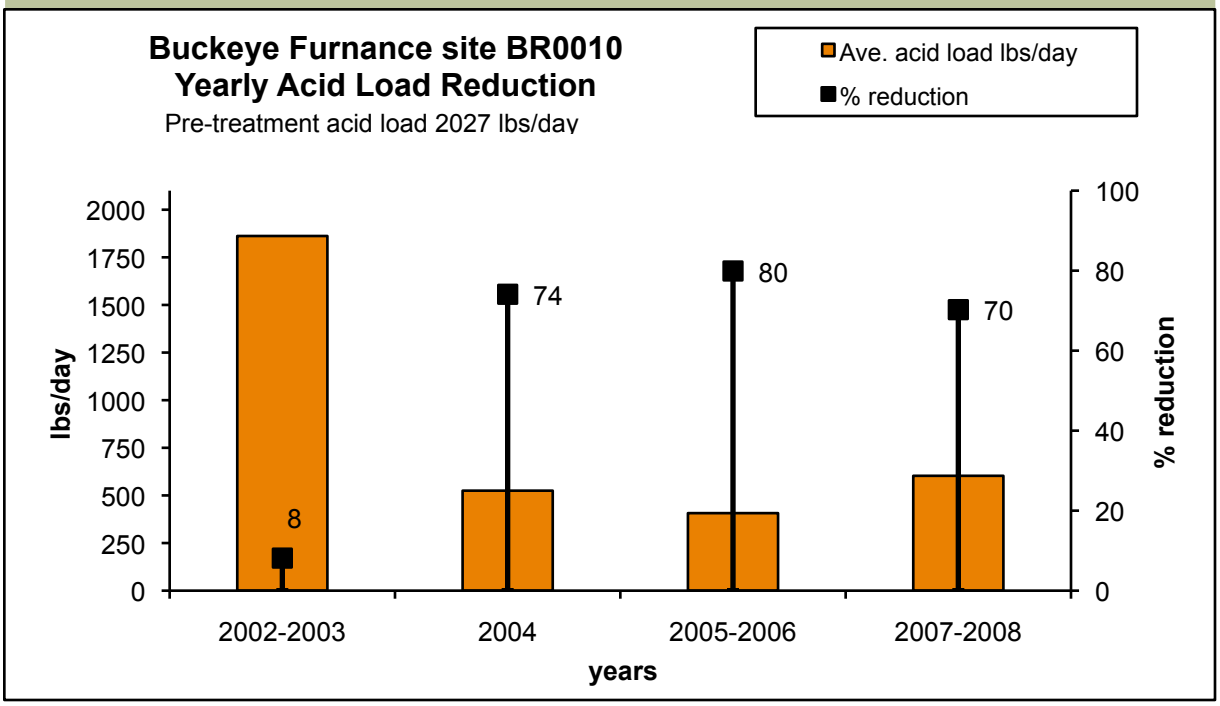
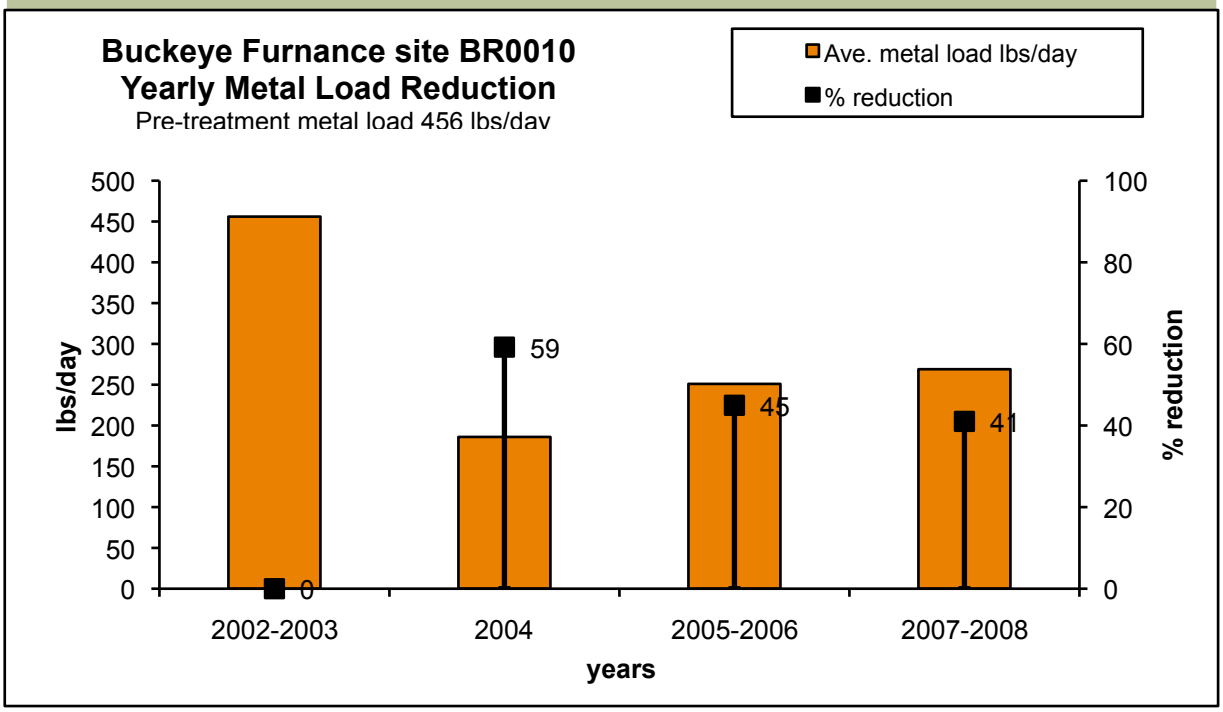


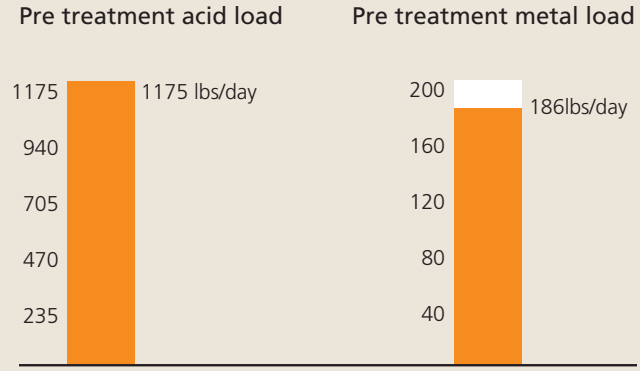
Figure 6. Yearly Metal Load Reduction



Project status: Complete 12/31/2007 ODNR project number:HC-ST-13

Pre-construction

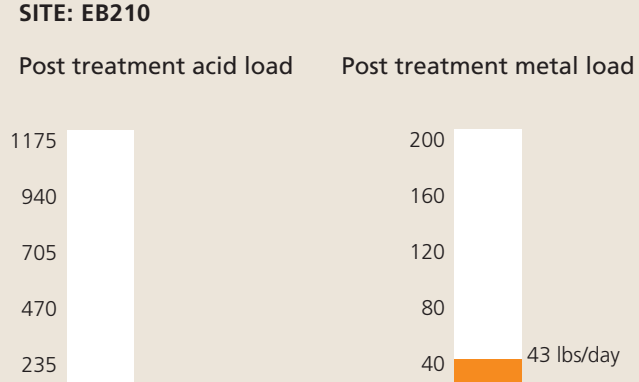
East Branch EB200 Nov. 2003, Photo by Brett Laverty



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Site #3 steel slag leech bed full of water 2-7-08, Photo by Amy Mackey



Data derived using the Mean Annual Load Method (Stoertz, 2004).

East Branch Phase I Reclamation Project is located in Section 14 and 15 of Starr Township in Hocking County and lies within the 14 digit HUC unit #05090101020010. There are six separate sites spread out over three headwater drainages of the East Branch of Raccoon Creek, project footprint of the six sites is approximately 27 acres. East Branch is the largest contributor of acid mine drainage to the headwaters of Raccoon Creek. Large areas of strip mined land, some has been reclaimed under the 1972 Act, coupled with few deep mine discharges resulting in seeps, contribute to the AMD which affects East Branch and its tributaries. The AMD is diffuse throughout the area due to the extensiveness of surface mining and has required a basin wide approach that focuses on reducing acid and metal load to Raccoon Creek. The design was completed by ATC Associates Inc. for $65,438. The treatment approach for this site was to install six steel slag leach beds (16,251 sq. ft), 1,100 linear feet of open limestone channels, reclaim 4.8 acres of gob piles, and install two passive settling ponds with limestone berms (42,000 square feet). The goal of the design was to reduce acid at the mouth of the East Branch (EB010). Construction was complete December 31, 2008 by Tucson Inc. for a cost of $911,287. The funding source for this the project design was Ohio EPA 319 grant and for construction the sources were ODNR-DMRM and Ohio EPA 319. Figure 3 and 4 (shown on page 3 of this report) estimate approximately 1174 lbs/day of acid and 143 lbs/day of metals were reduced from entering into East Branch and Raccoon Creek as a result of this AMD reclamation project.

Note: EB210 site does not take into account 1 SLB site #8 (EB160)

Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre-construction and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

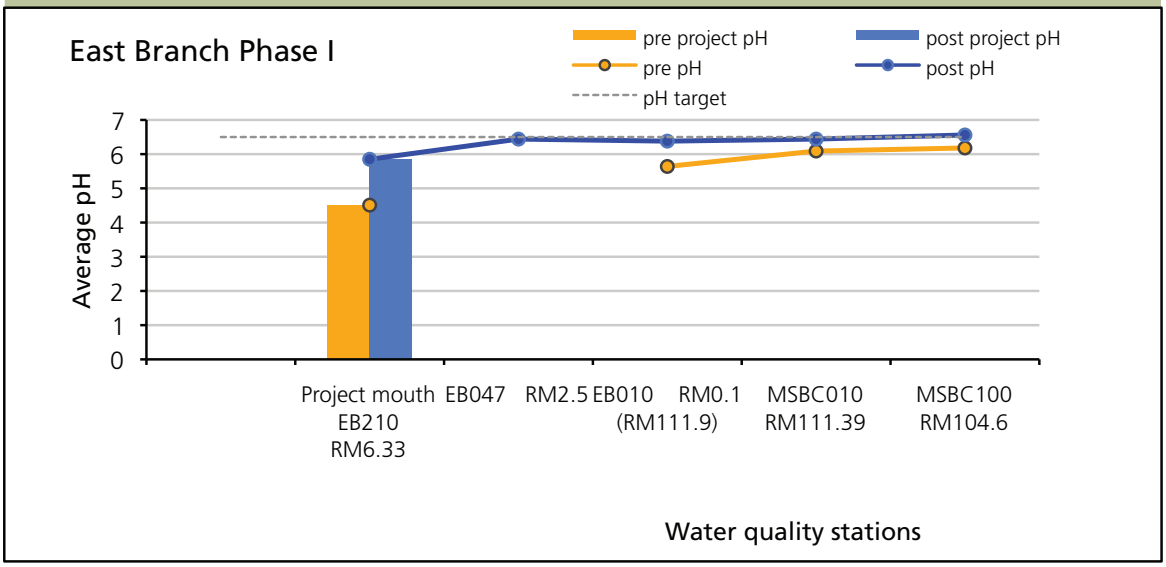
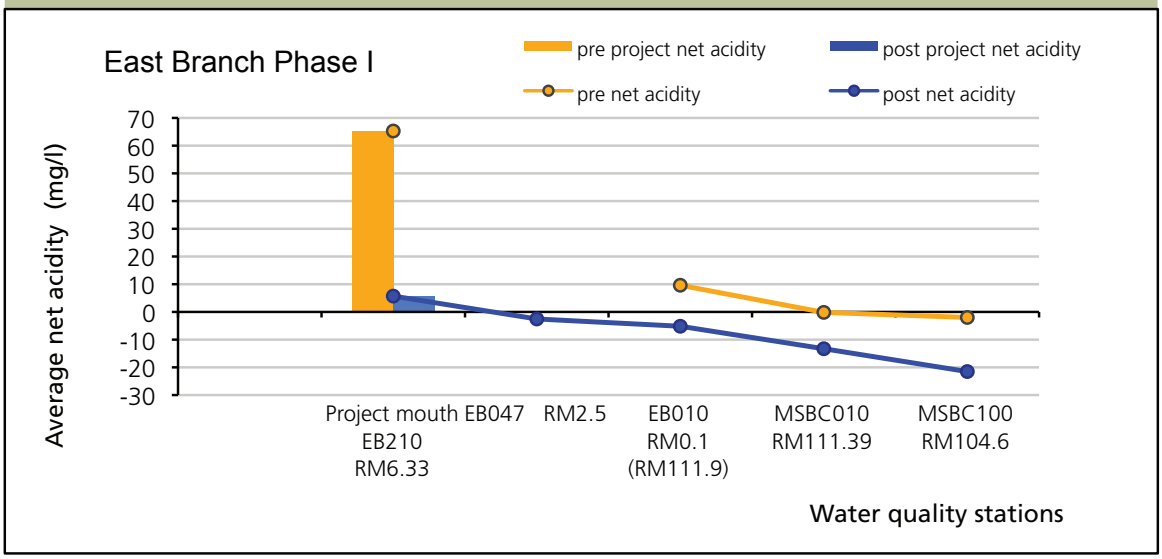


Figure 2. Pre and Post Acidity



East Branch Phase I Reclamation project pre-construction monitoring show pH and net acidity at East Branch river mile 6.33, downstream to the mouth of East Branch, and along the mainstem of Raccoon Creek, shown above. Pre-construction data shows pH in the range of 4.5–6.2 at river mile 6.33 of East Branch and downstream of the project on Raccoon Creek. Post-construction data at EB210 downstream to Raccoon Creek show pH in the range of 5.9–6.7. The net acidity concentrating decreased by 91 percent, showing net alkaline conditious continuing for 9.8 miles downstream to the mouth of East Branch (2.5) and farther into Raccoon Creek mainstream (7.3).

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 6/1/1996 to 11/1/2004 for pre-construction and from 2/18/2008 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

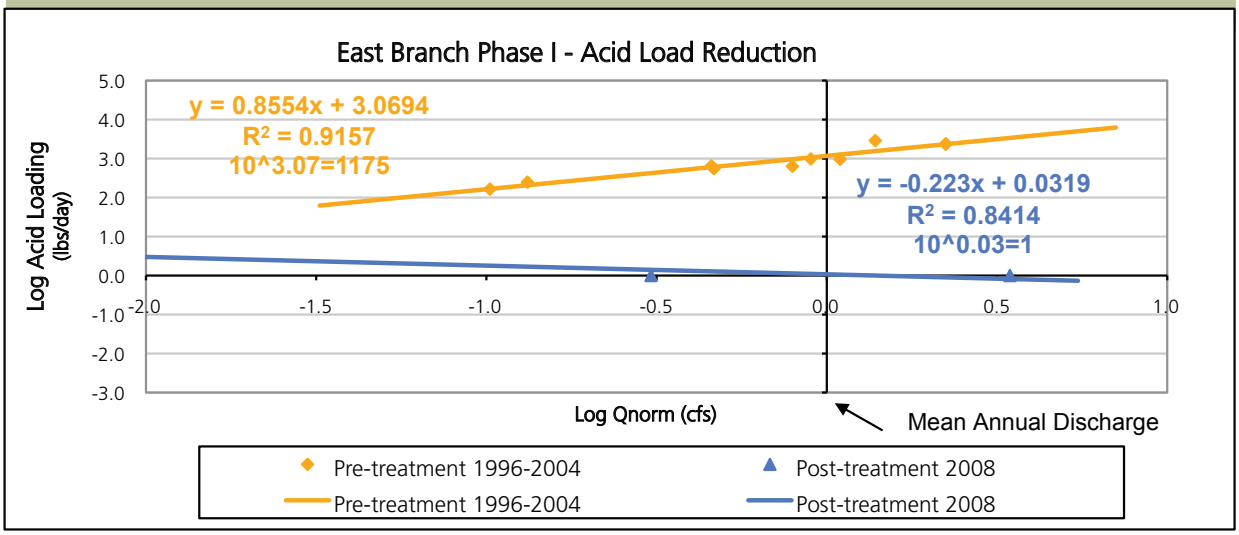
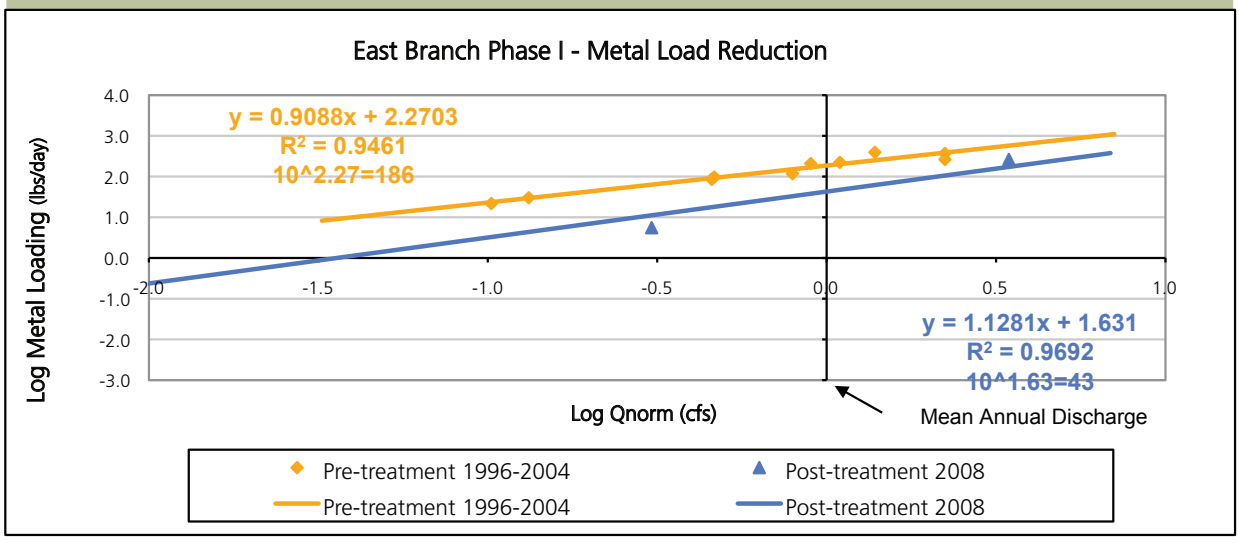
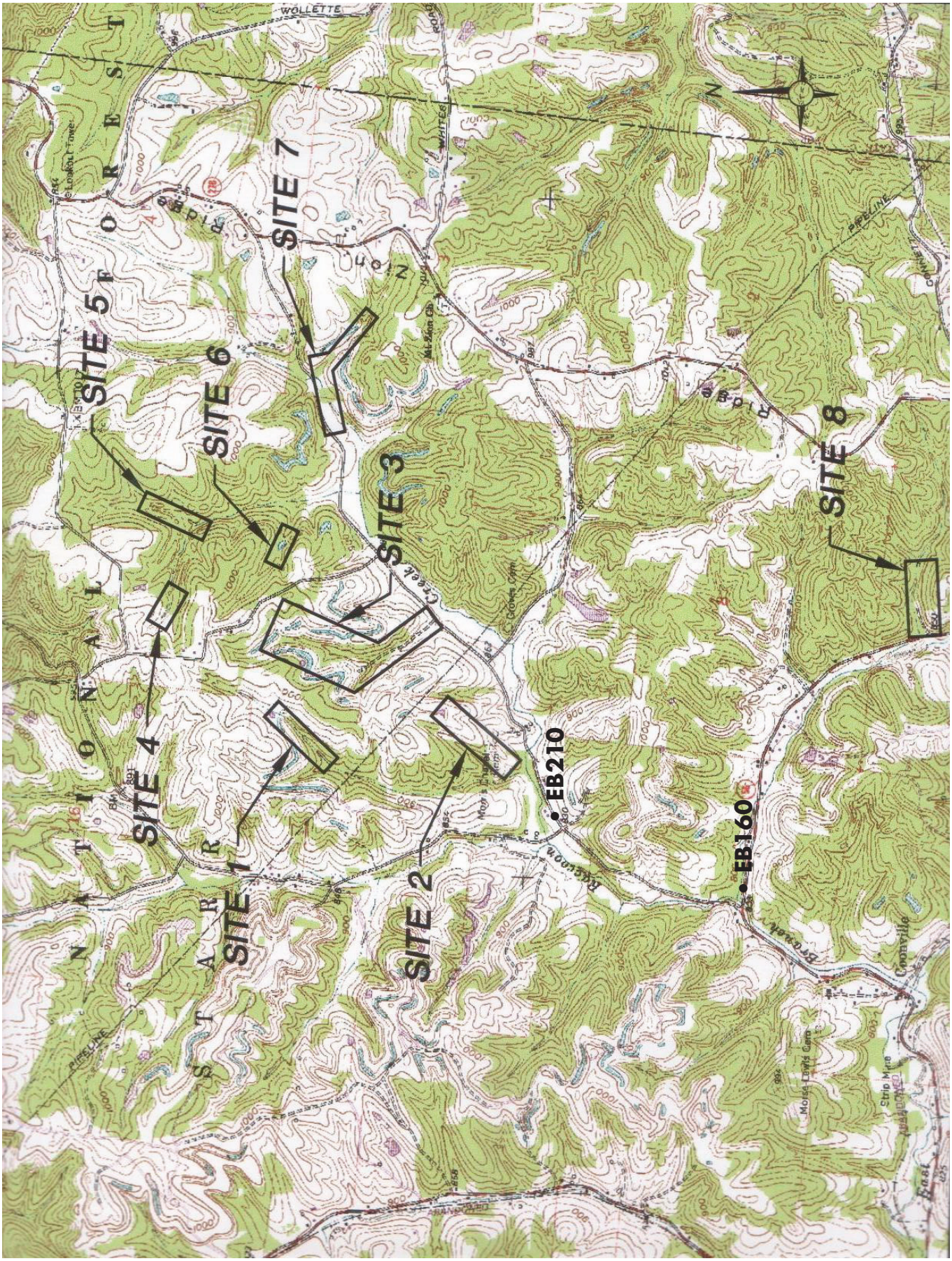


Figure 4. Metal Load Reduction



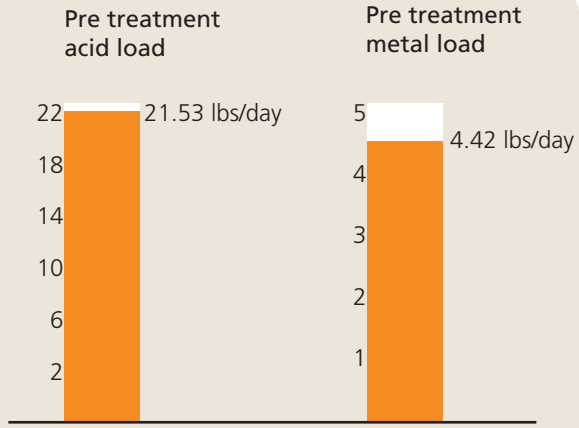
Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.


WOLLETTE
SITE 5
SITE 6
SITE 7
SITE 3
SITE 8
SITE 4
SITE 1
SITE 2
EB2i0
EB160
N

Project Status: Archive Completed 6/1/2005 *Monitoring Complete March 2006* ODNR Project Number:

Pre-construction

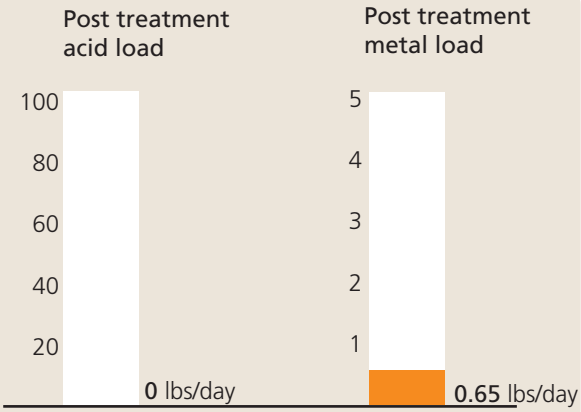
Unreclaimed gob pile
Photo by Raccoon Creek Watershed Partnership



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Regraded and resoiled gob pile
Photo by Ben McCament



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Hope Clay is located in Section 23 of Brown Township in Vinton County and lies within the 14-digit HUC unit #05090101020060. The project discharge was measured at the Hope Clay Project tributary. The design was completed by ODNR-DMRM for $5,000. The treatment approach for this site was to install an open limestone channel (OLC) and to conduct basic reclamation. The major consideration for this site was erosion control. The goal of the design was 100 percent acidity reduction and erosion control. The project goal was met by 100 percent.

The construction was complete June 1, 2005, by Hocking College Environmental Program for a cost of $67,000. The major responsibility of the Hocking College Environmental Program was to conduct site reclamation. The funding sources for this project were ODNR-DMRM and OSM ACSI for construction. Approximately 21.53 lbs/day of acid and 3.77 lbs/day of metals were prevented from entering into Raccoon Creek as a result of this AMD reclamation project.

Water Quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

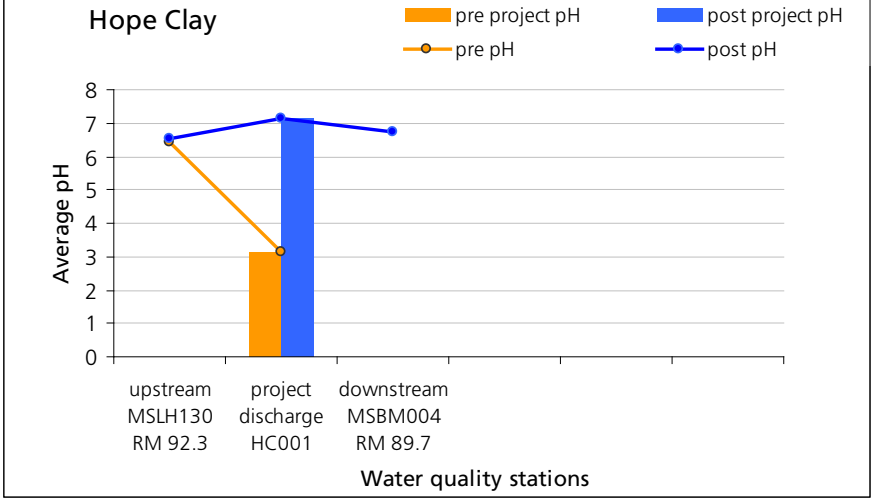
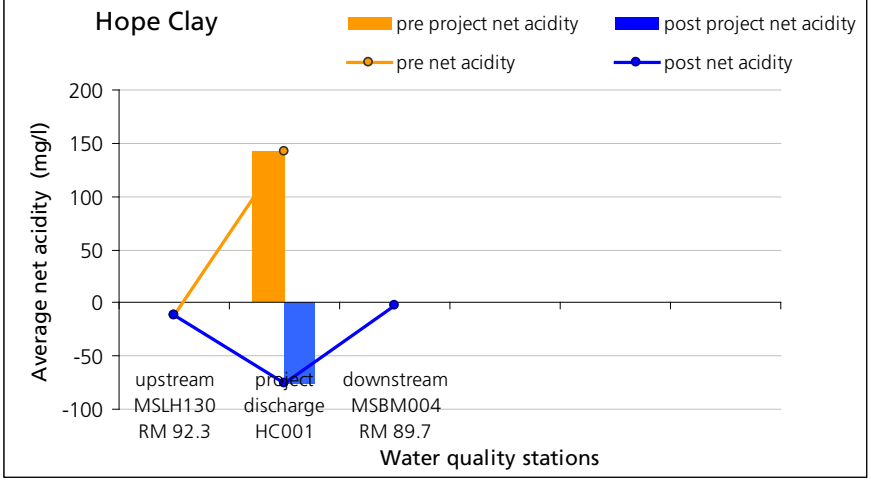


Figure 2. Pre and Post Acidity



As a result of the Hope Clay Project, pH and net acidity have improved downstream of the reclamation site for less than one mile. Pre-construction data showed pH at 3.3 at the project discharge. However, after installation of the Hope Clay Project, post-construction data shows pH in the range of 6.7 – 7.1 at the discharge and downstream. The net acidity concentrations decreased 100 percent at the project discharge showing net alkaline conditions downstream to station MSBM004.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1/1/1990 to 5/31/2005 for pre-construction and from 6/1/2005 to 12/31/2006 for post-construction.

Figure 3. Acid Load Reduction

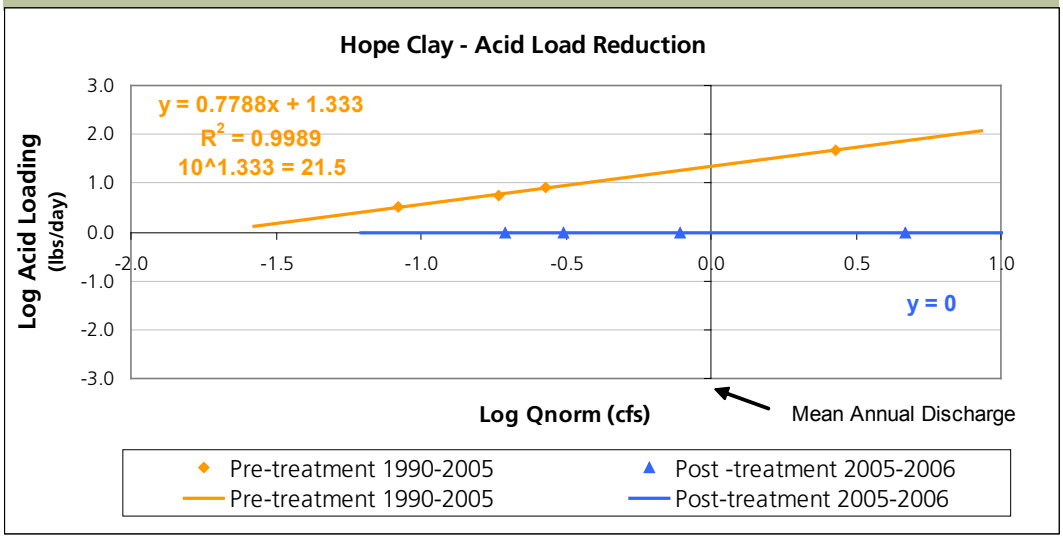
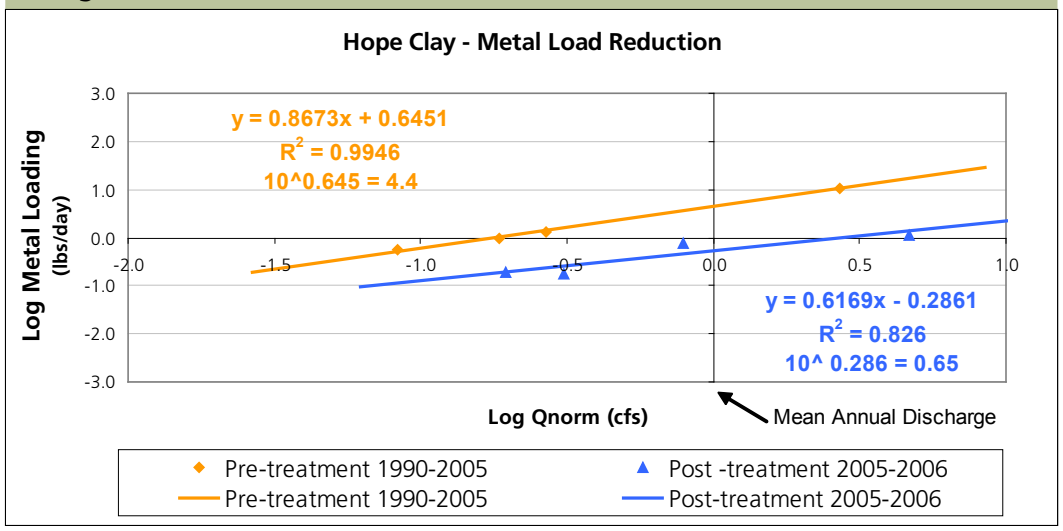


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Section III – AMD project reports

Monday Creek Watershed comprehensive acid mine drainage projects progress report for 2008.

Section III contains individual AMD project reports displaying photos of the project site, a description of the project, water quality data at the site and its impact to the receiving stream, and acid/metal loading reductions as a result of the project.

List of acid mine drainage reclamation projects reported on in the 2008 NPS monitoring report:

1. Grimmett Hollow
2. Jobs Hollow Doser
3. Rock Run Gob Pile
4. Rock Run 24
5. Big Four Hollow
6. Essex Doser
7. Snake Hollow
8. Lost Run Phase I
9. Lost Run Phase II
10. Shawnee Steel Slag Archive
11. Lost Run Subsidence Closures

Project Status: Complete 12/31/2003 ODNR Project Number: PR-SI-14

Pre-construction

Grimmett Hollow, Photo by Monday Creek Restoration Project

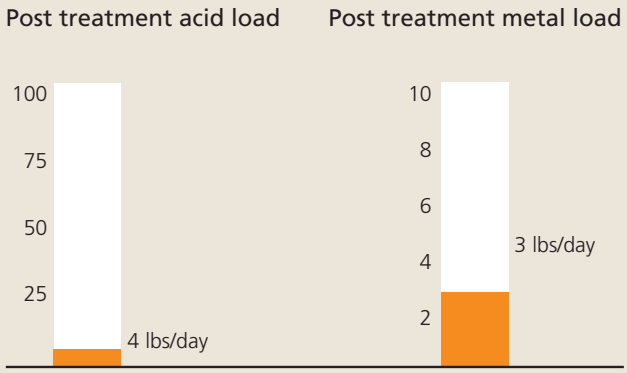
SITE: JH09020

Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Grimmett Hollow, Photo by Monday Creek Restoration Project

SITE: JH09020



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Grimmett Hollow is located in Section 4 of Salt Lick Township in Perry County and lies within the 14-digit HUC unit #05030204060010. The project site is five acres and located on Grimmett's Property in the headwaters of Jobs Hollow, the project discharge is measured at the bridge on CR223. This area was affected by abandoned strip mining, deep mining, and a remnant gob pile. The valley contained a wetland that received water from both strip pits and deep mines in the area. The gob pile was situated in the stream channel downstream of the wetland. The design was completed by Red Wing Engineering for $19,000. The treatment approach for this site was to enhance an existing 1.3-acre wetland with two rock dams (300 linear feet), incorporated with alkaline material (LKD) as well as install (500 linear feet) open limestone channels (OLC) at seep locations and regrade, soil and vegetate a gob pile (0.15 acres).

A stream was routed away from the gob pile via the open limestone channel. The goal of the design was to decrease acidity by 13.6 tons per year. The project goal was met by 100 percent. Major considerations encountered during the design process were the diffuseness of the AMD sources from above drainage underground mines, numerous seep discharges in the basin, gob pile and spoil deposited in wetland, and a stream flowing through the gob pile. Construction was complete Dec. 31, 2003 by Perry Reclaiming Inc. for a cost of $160,000. The funding sources for this project were ODNR-MRM and EPA-319 for both design and construction. Figure 3 and 4 (shown on page 3) estimate approximately 94 lbs/day of acid and 7 lbs/day of metals were prevented from entering into Jobs Hollow and Monday Creek as a result of this AMD reclamation project.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

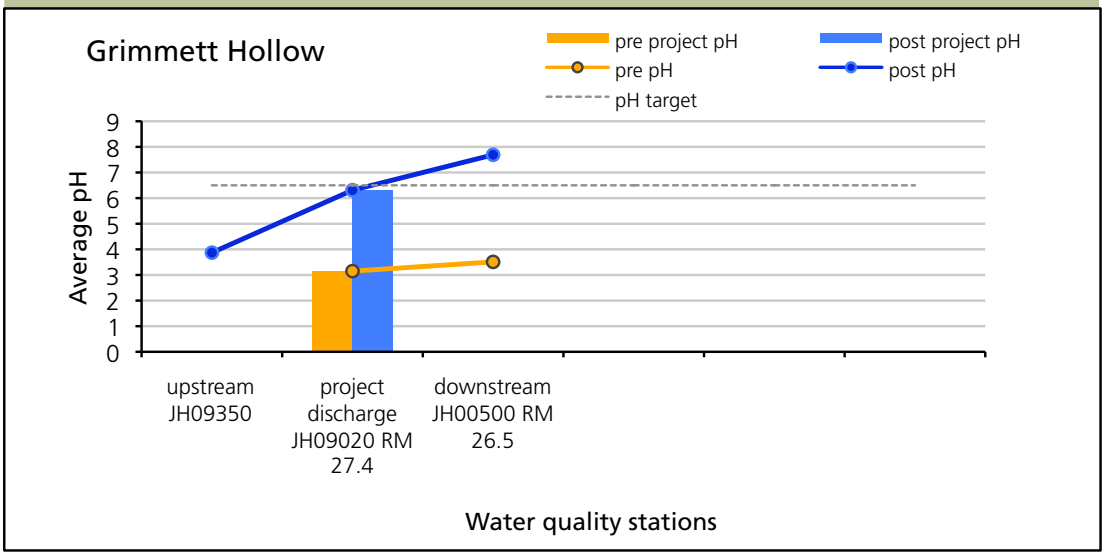
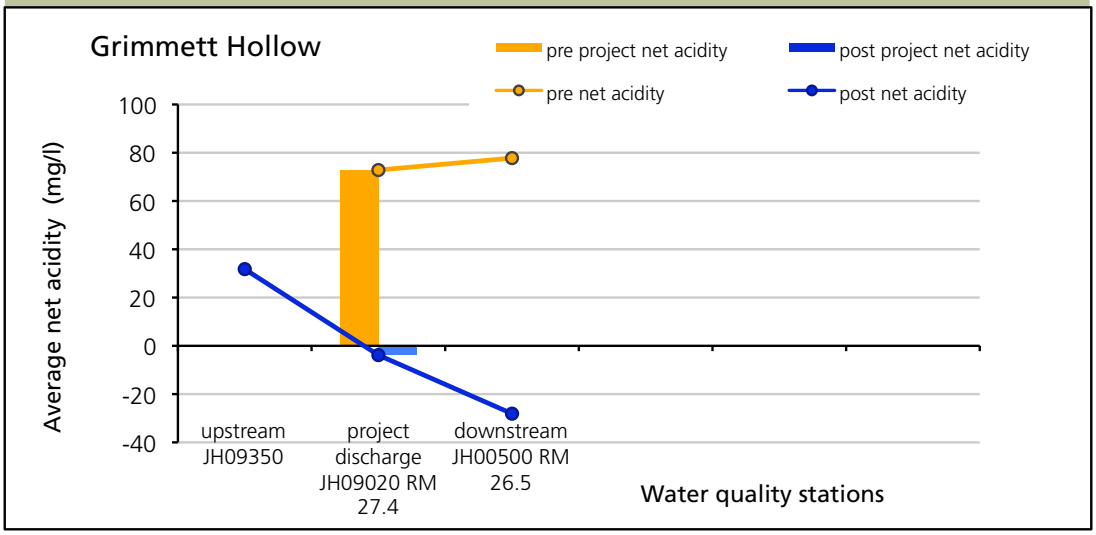


Figure 2. Pre and Post Acidity



As a result of the Grimmett Hollow Project, pH and net acidity have improved downstream of the reclamation site for 0.75 miles at which the Jobs Doser discharges into the stream. Pre-construction data showed pH in the range of 3.1 – 3.5 at the project discharge and down-stream. However, after installation of the Grimmett Hollow Project, post-construction data shows average pH in the range of 6.3 – 7.7 at the discharge and downstream. The net acidity concentrations decreased 100 percent at the project discharge showing net alkaline conditions for 0.75 miles downstream to station JH00500.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 10/1/1997 to 7/31/2003 for pre-construction and from 1/1/2004 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

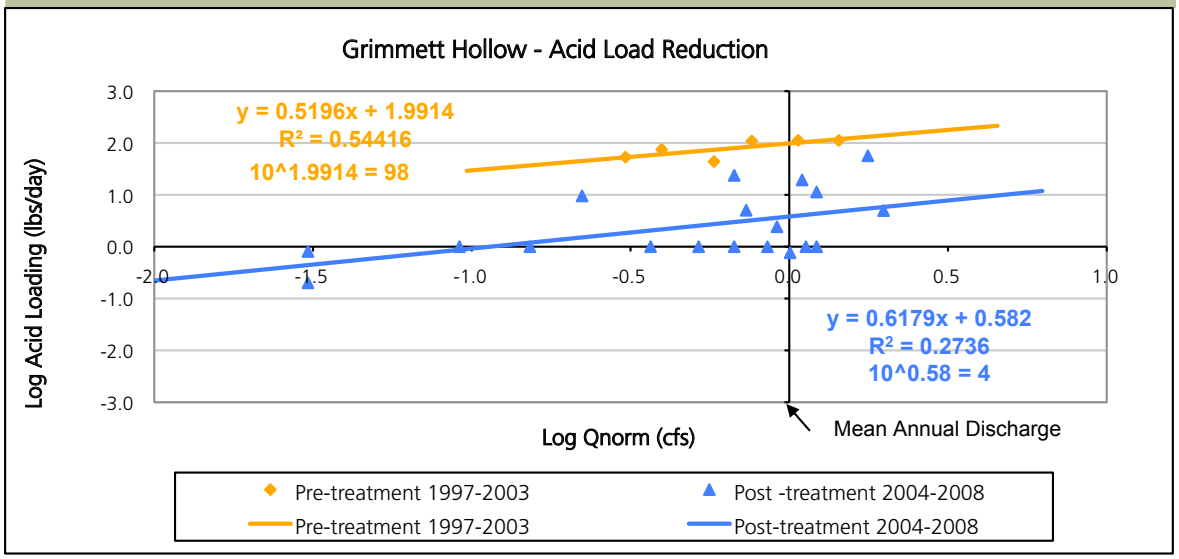
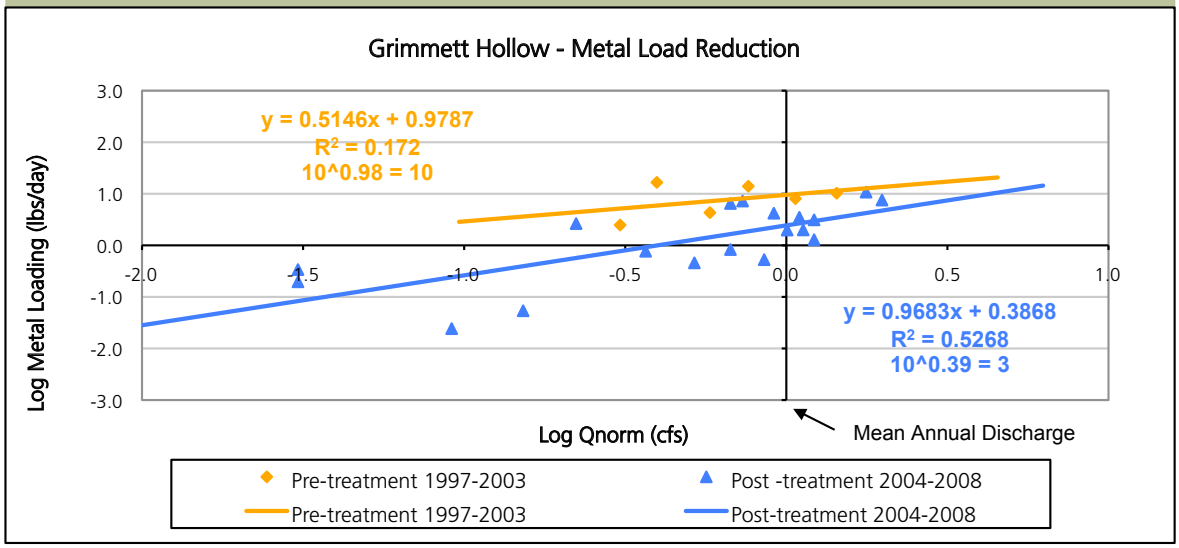


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

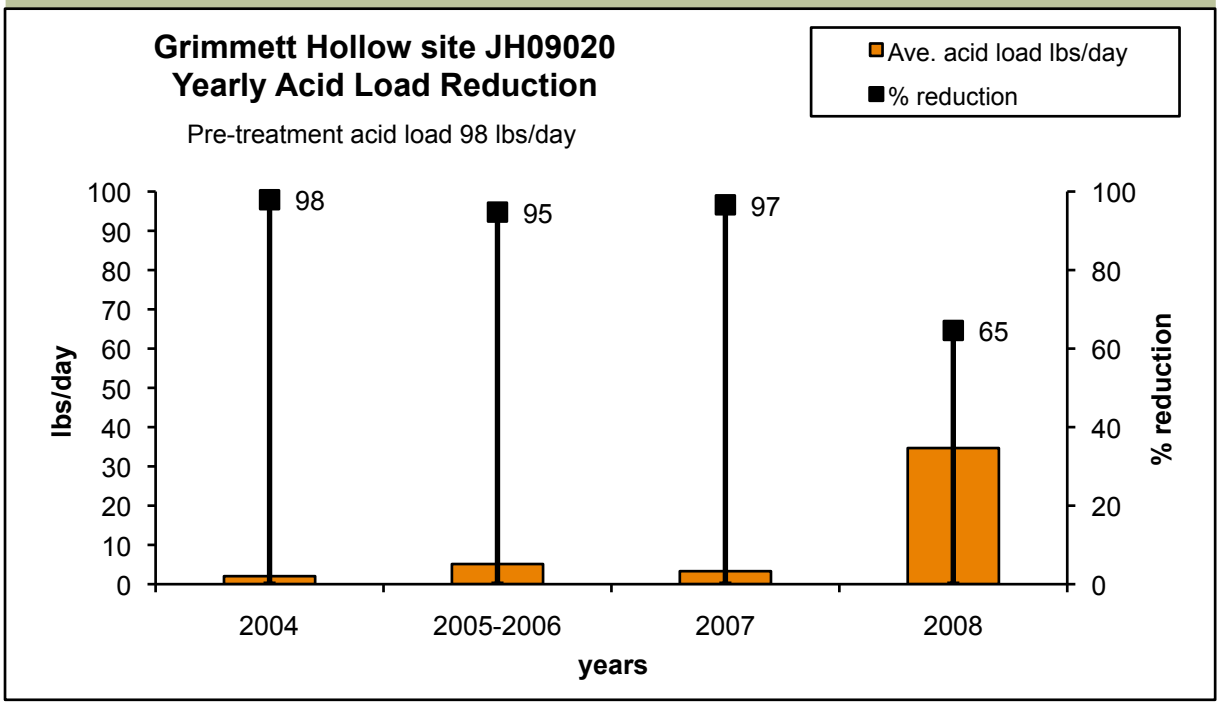
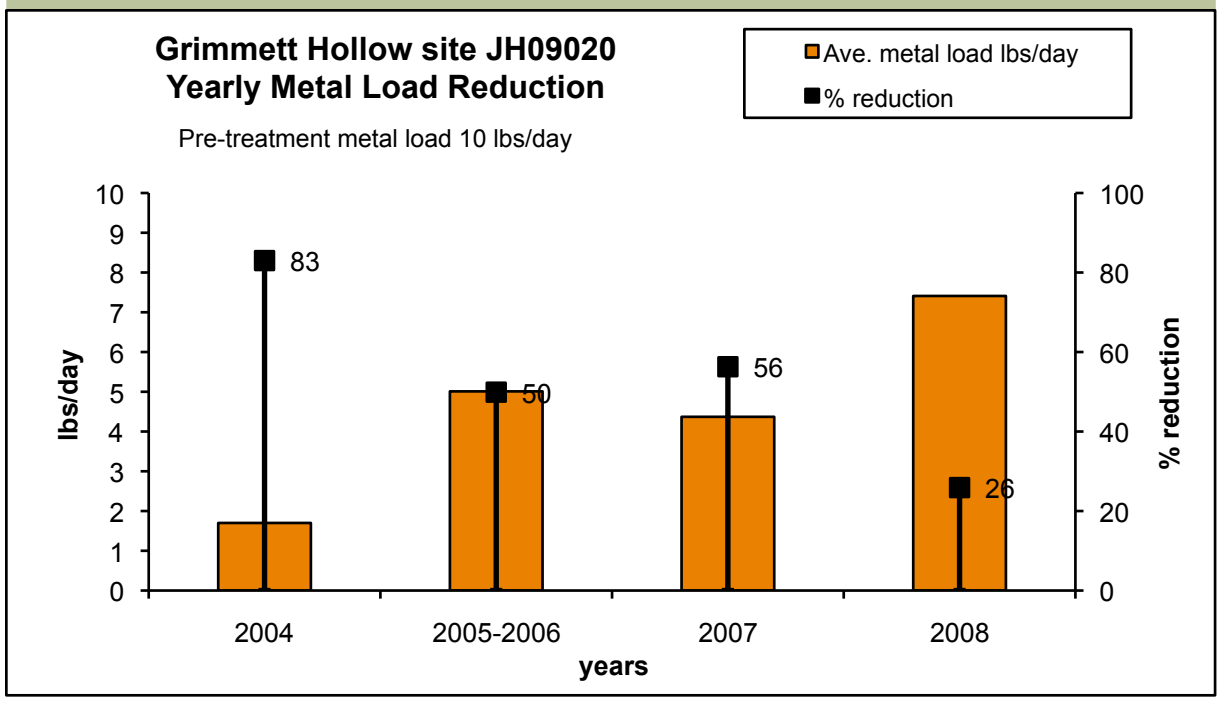


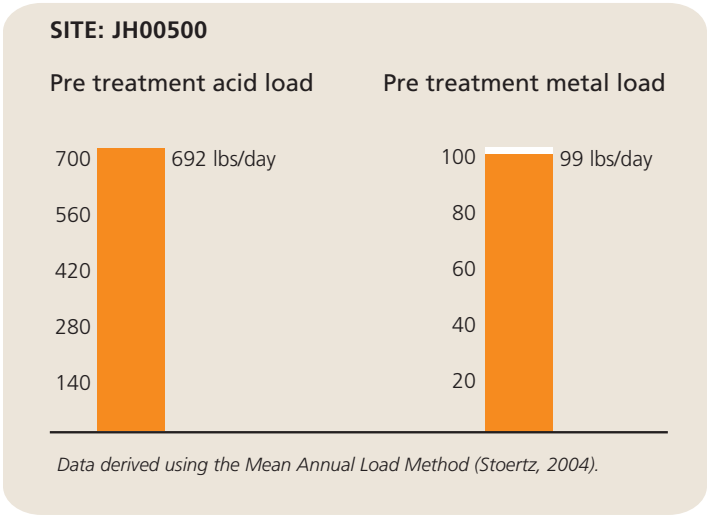
Figure 6. Yearly Metal Load Reduction



Project Status: Complete: 7/20/04 ODNR Project Number: PR-SI-13

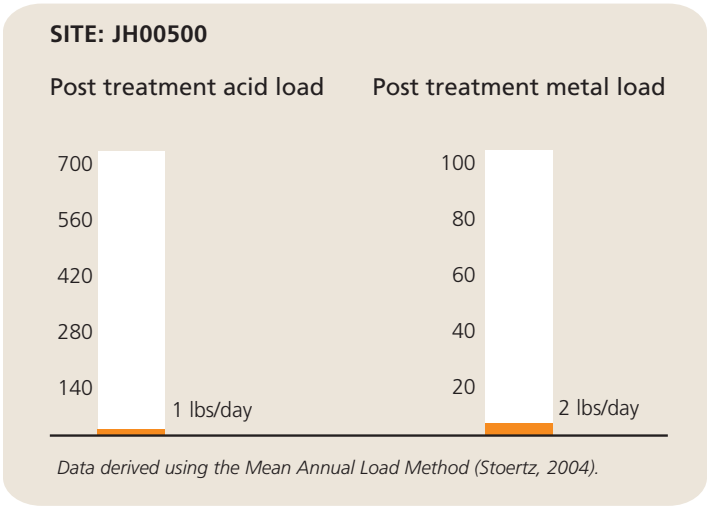
Pre-construction

Jobs Hollow, Photo by Monday Creek Restoration Project



Post-construction

Jobs Hollow Doser, Photo by Monday Creek Restoration Project



Jobs Hollow Doser is located in Section 5 of Salt Lick Township in Perry County and lies within the 14-digit HUC unit #05030204060010. The site is located in the headwaters of Monday Creek Watershed downstream of Jobs Hollow at the bridge on Portie Flamingo Road (CR 12). This basin contains approximately 13 small tributaries, most of which are affected by acid mine drainage. The major contributors of acidity are from diffuse deep mine seeps and numerous gob piles. Due to the diffuse and abundant AMD sources and their inaccessibility, a doser was the most practical and efficient method for treatment. The design was completed by ATC Associates for $66,916.50. The treatment approach for this site was to install a lime doser. The goal of the design was to decrease acid load from the headwaters of Monday Creek by 54 percent. The project goal was met 100 percent. One major consideration encountered during the design process was that the dosing unit is located adjacent to an intermittent tributary of Monday Creek. Therefore a retention pool was created to create a constant supply of water to the doser. Construction was complete July, 20, 2004 by Tuson Inc. for a cost of 319,066.50. Funding sources for this project were ODNR-MRM, OSM-ACSI and OEPA-319 for design and ODNR-DMRM and OSM-ACSI for construction. Figure 3 and 4, estimate approximately 691 lbs/day of acid was reduced from entering into Monday Creek as a result of this AMD reclamation project (shown on page 3). Dissolved metal load reduction occurring at this site was approximately 97lbs/day. The metals precipitate as a result of the high pH water and become part of the substrate.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre- and post- construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

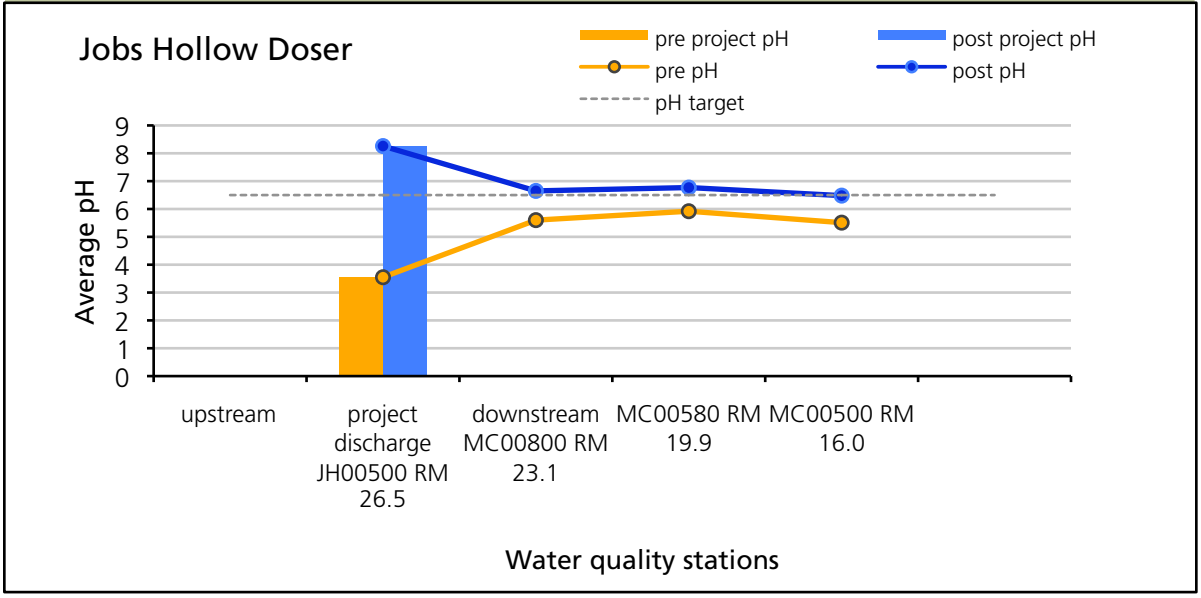
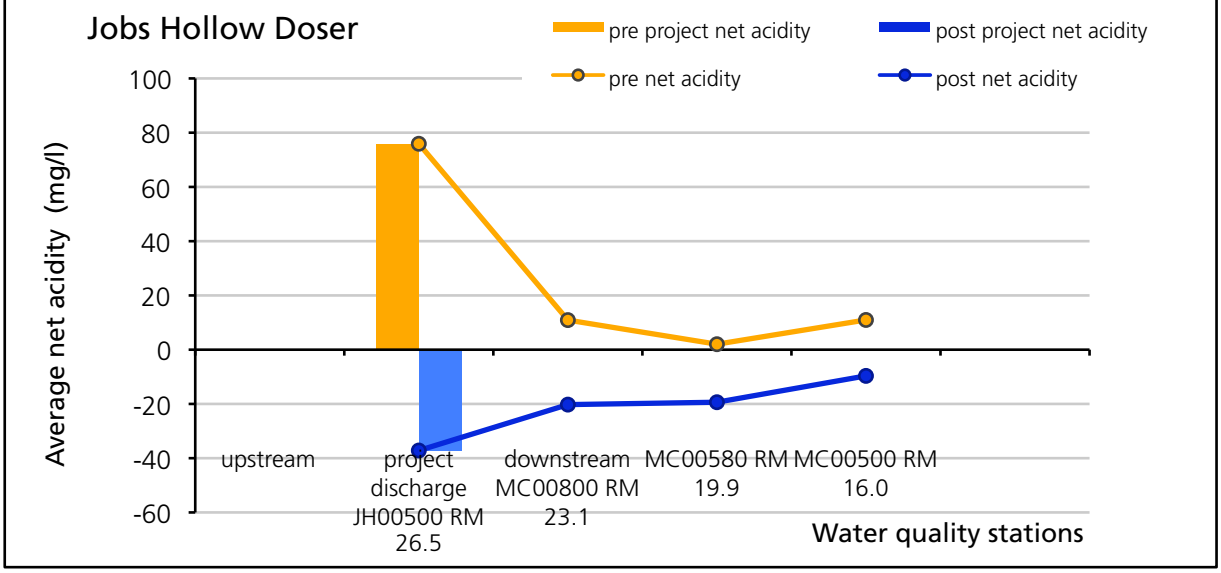


Figure 2. Pre and Post Acidity



As a result of the Jobs Hollow Doser project, the pH and net acidity have improved downstream of the reclamation site for 10 miles. Pre-construction data showed pH in the range of 3.5 – 5.9 downstream of the project. However, after installation of the Jobs Hollow Doser, post-construction data shows pH in the range of 6.6 – 8.2 downstream of the project discharge. The net acidity concentrations decreased100 percent showing net alkaline conditions continuing for 10 miles downstream.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 10/1/1997 to 5/1/2004 for pre-construction and from 6/1/2005 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

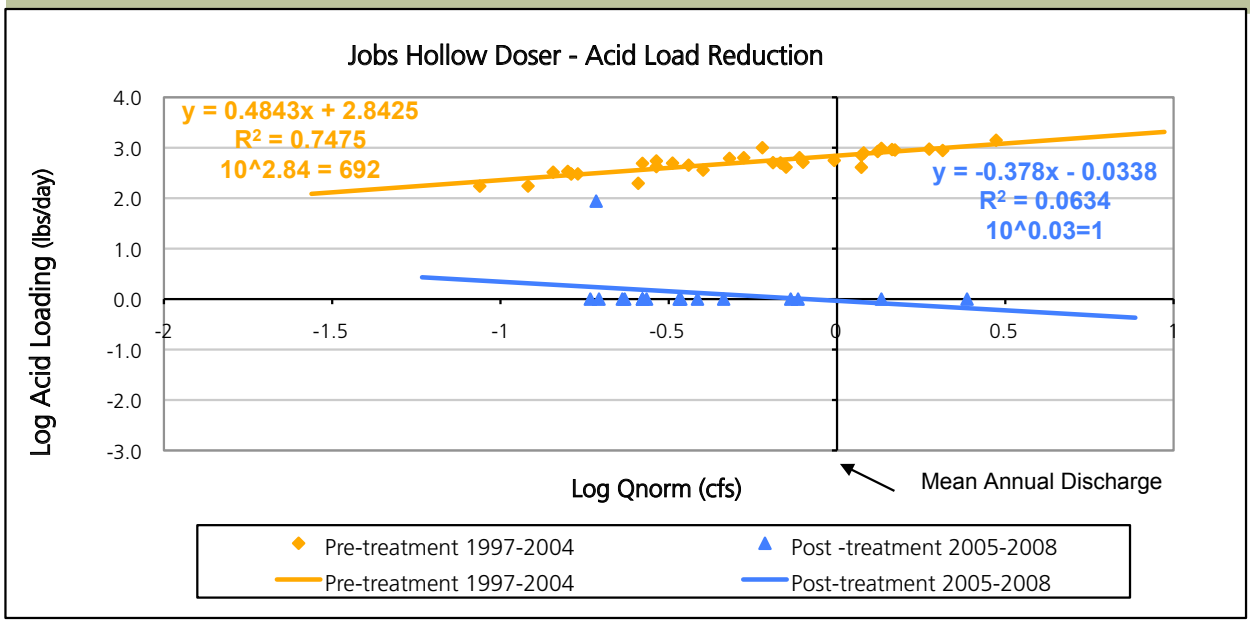
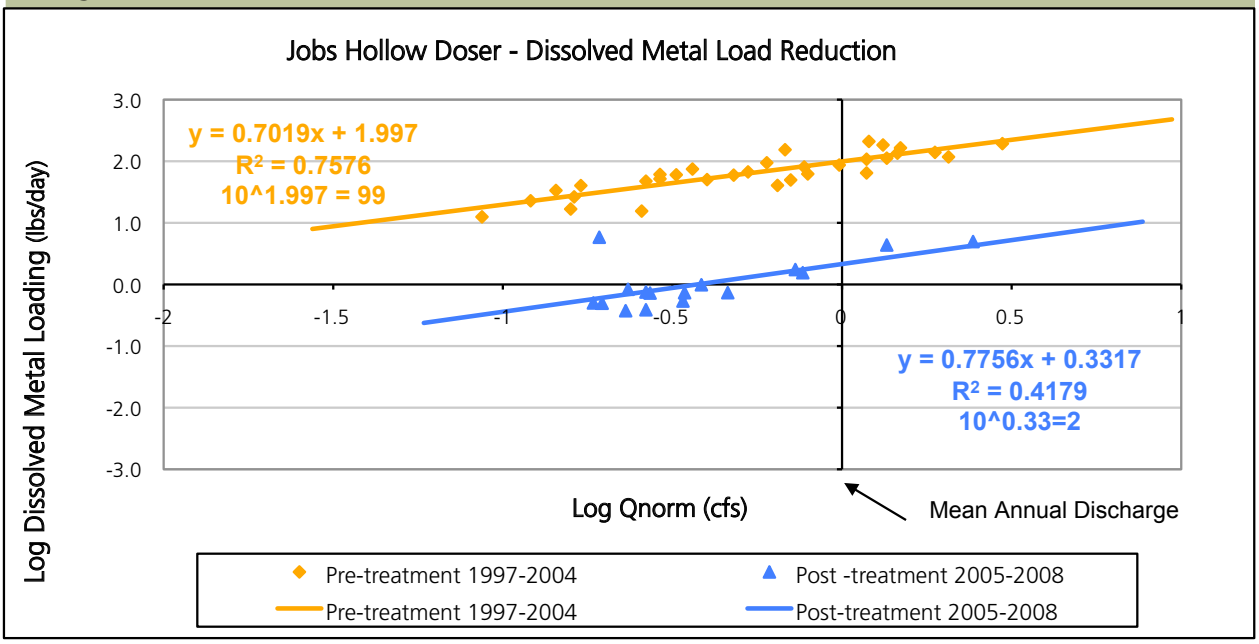


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

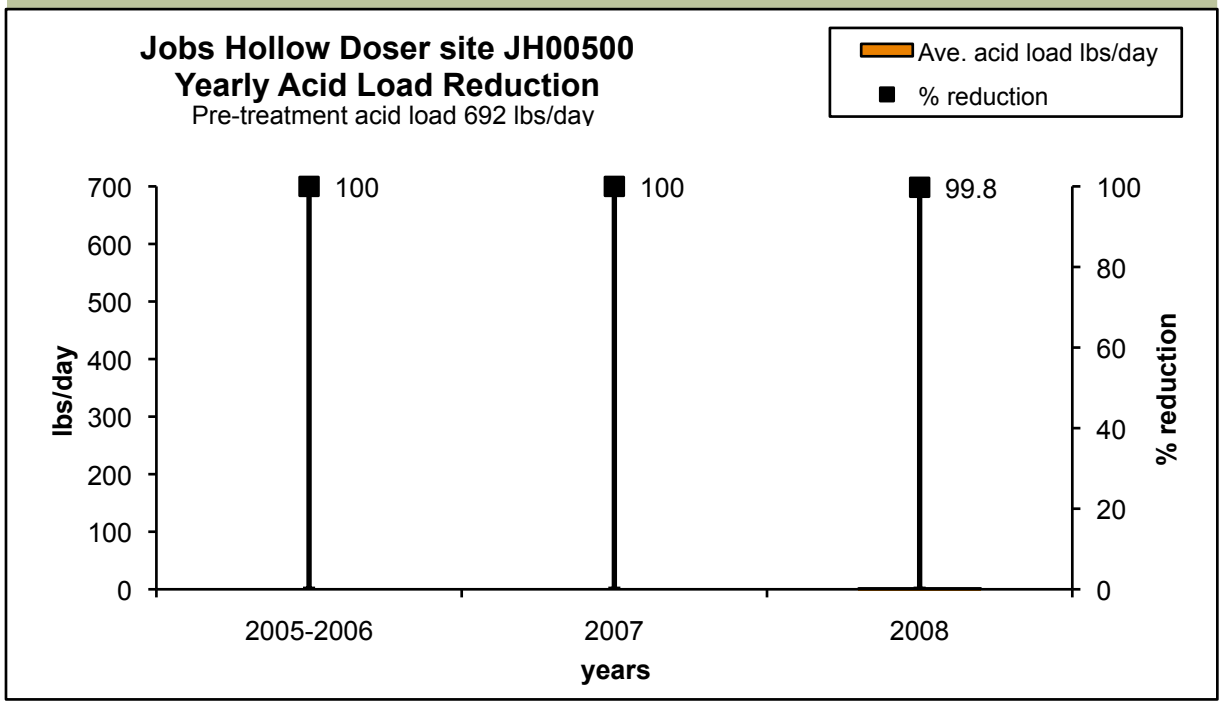
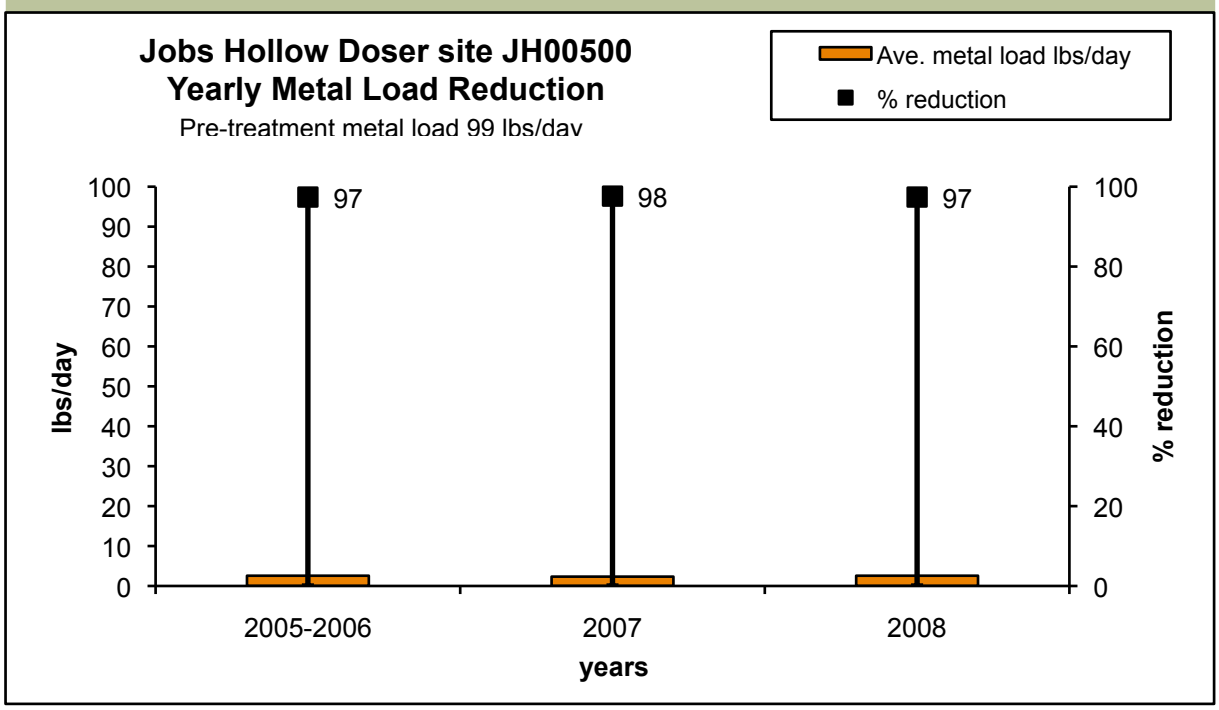


Figure 6. Yearly Metal Load Reduction



Project Status: Complete 9/1/1999 ODNR Project Number: PR-Co-08

Pre-construction

Rock Run Gob Pile
Photo by Monday Creek Restoration Project

Post-construction

Rock Run Gob Pile
Photo by Monday Creek Restoration Project

Rock Run Gob Pile which was actually a slurry impoundment is located in Section 20 of Coal Township in Perry County and lies within the 14 digit HUC unit #05030204060010. The Rock Run Gob Pile is stretched over 17 acres and was located on the north side of the Rock Run tributary. The design was completed by ODNR-DMRM and Damariscotta for $15,000. The treatment approach for this site was to cover the 17 acre gob pile using standard reclamation methods, covering the gob with a layer of flue gas desulfurization, and installing a 3,200 Sq. ft. Successive Alkalinity Producing System (SAPS) was used to treat the acid mine drainage emitting from a deep mine at the back of the property. The goal of the design was to reclaim the gob pile and reduce metals and acid loadings from the mine drainage. The project goal was met by reducing acidity to net alkaline conditions at station RR02100 and increasing the pH. Major considerations encountered during the design process was the mine drainage exiting the SAPS (approximately 10% of the water exiting the site) couldn't be separated from the gob pile reclaim. The valley was too small to accommodate and separate the run off from the SAPS treatment cells so a OLC was lined to carry the drainage off site after treatment. Construction was complete 9/1/1999 by Stimmel Brothers Construction for a cost of $274,500. The funding sources for this project were for both the design and construction: ODNR-DMRM, EPA-319, and OSM-ACSI. Load reductions are not calculated due to lack of pre-construction data, see figure 3 & 4.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

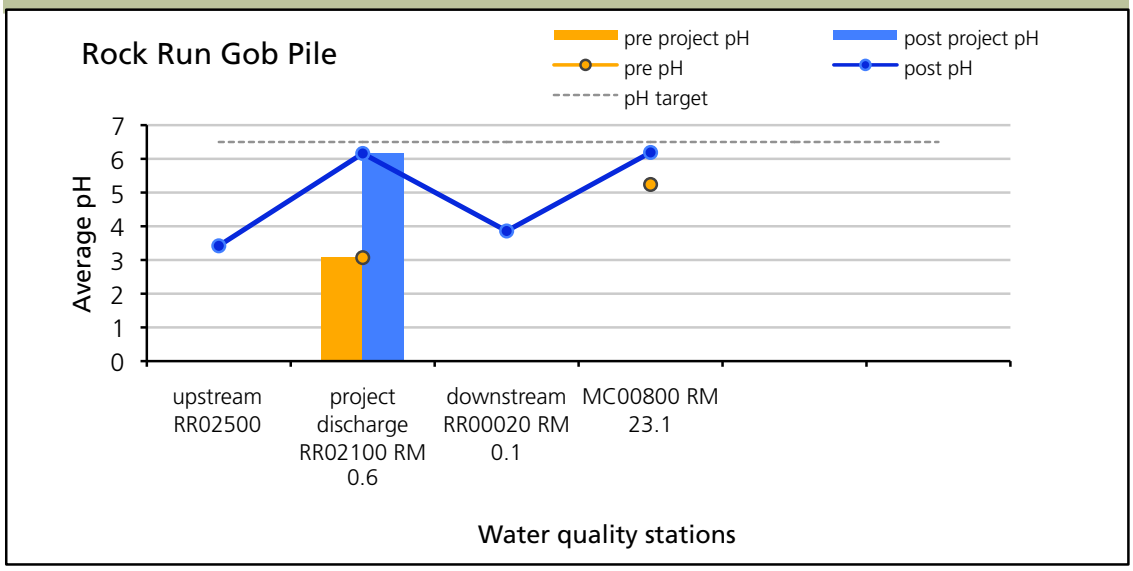
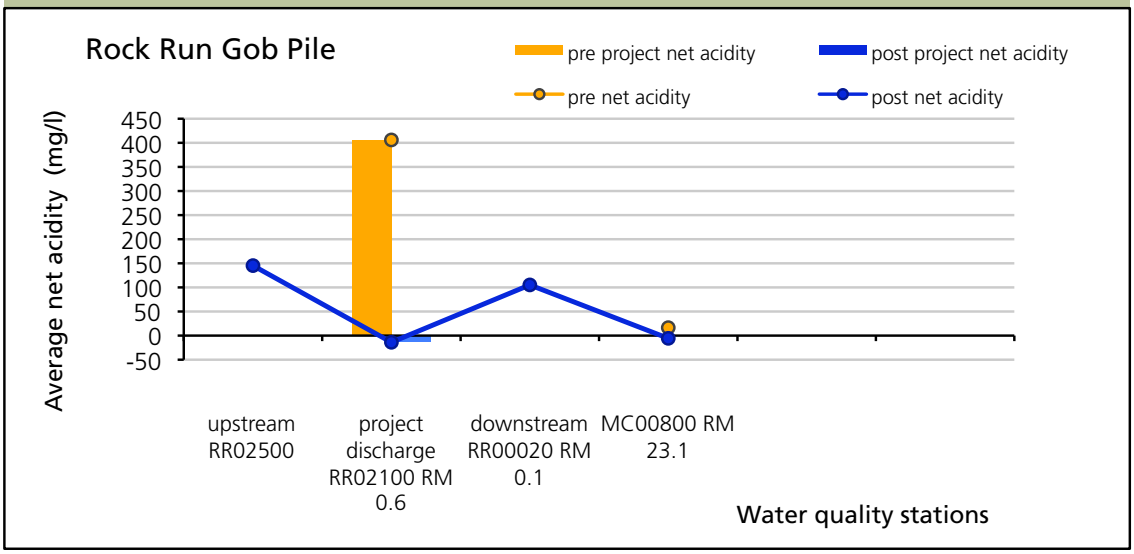


Figure 2. Pre and Post Acidity



As a result of the Rock Run Gob Pile Project, pH and net acidity have improved further downstream at site MC00800 approximately 0.75 miles. At the first station downstream of Rock Run Gob Pile, water quality didn't show improvement due to other sources of acid mine drainage entering into the Rock Run tributary. Pre-construction data shows pH in the range of 3.1 – 5.2 at the project discharge and downstream. However after reclamation of the Rock Run Gob Pile Project, post-construction data shows pH in the range of 3.9– 6.2 at the discharge and downstream. The net acidity concentration decreased resulting in net alkaline water at the project discharge.

Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre-, and post-construction at the project discharge, 8/31/1998 for pre-construction and from 10/1/1999 to 12/31/2007 for post-construction. Only one sample was recorded during the pre-construction time period. No new data was collected in 2008. Site ID: RR02100

Figure 3. Acid Load Reduction

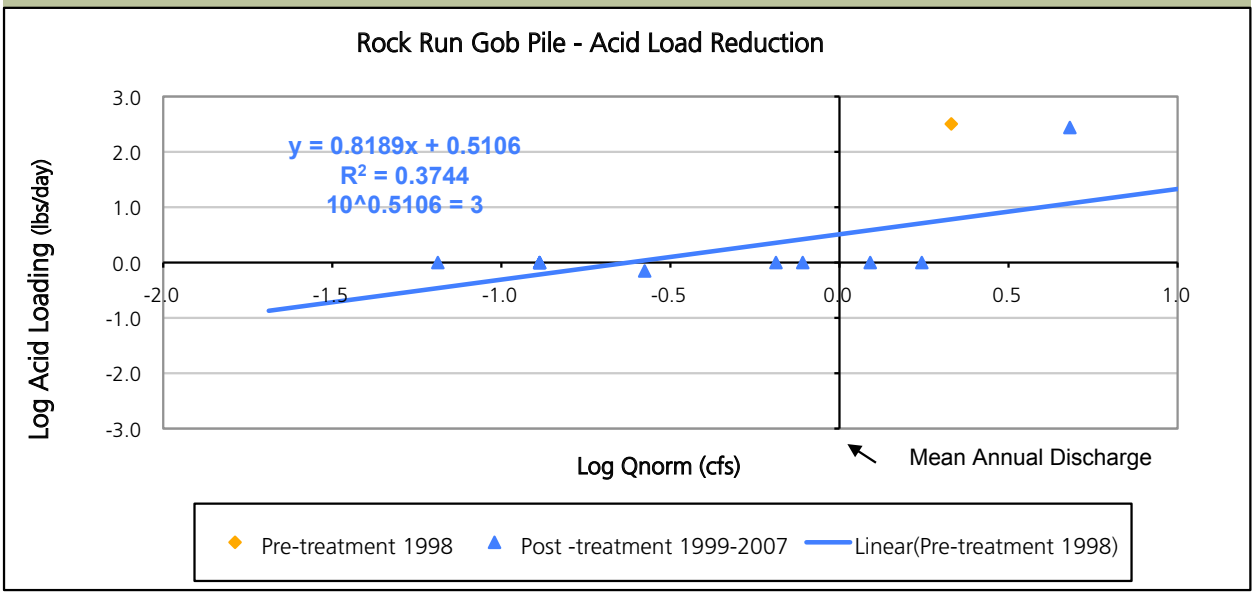
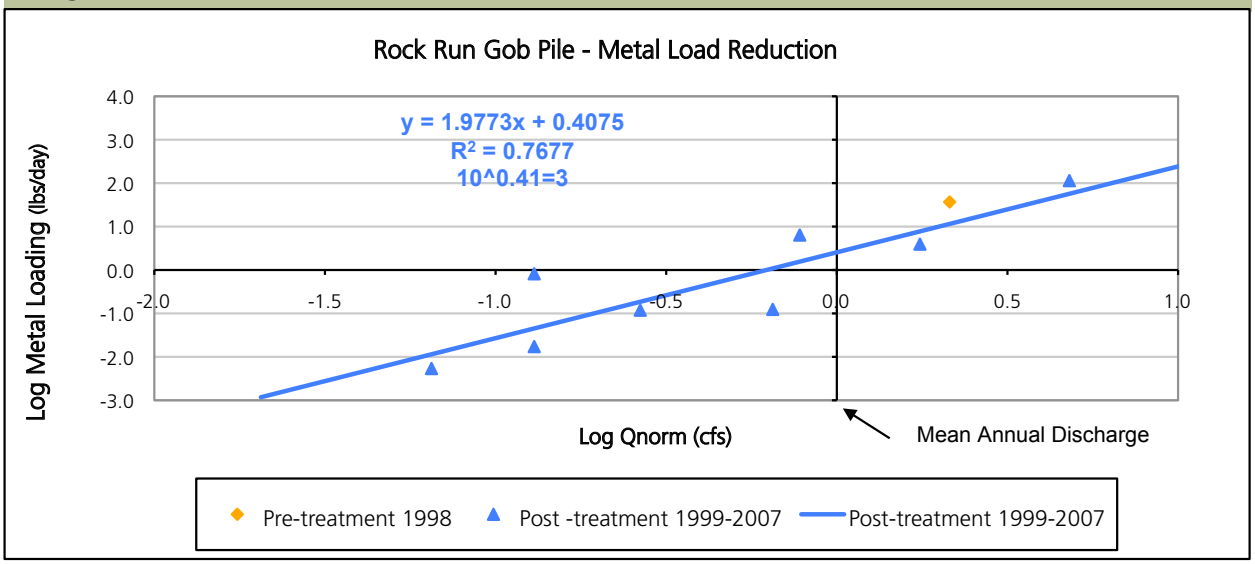


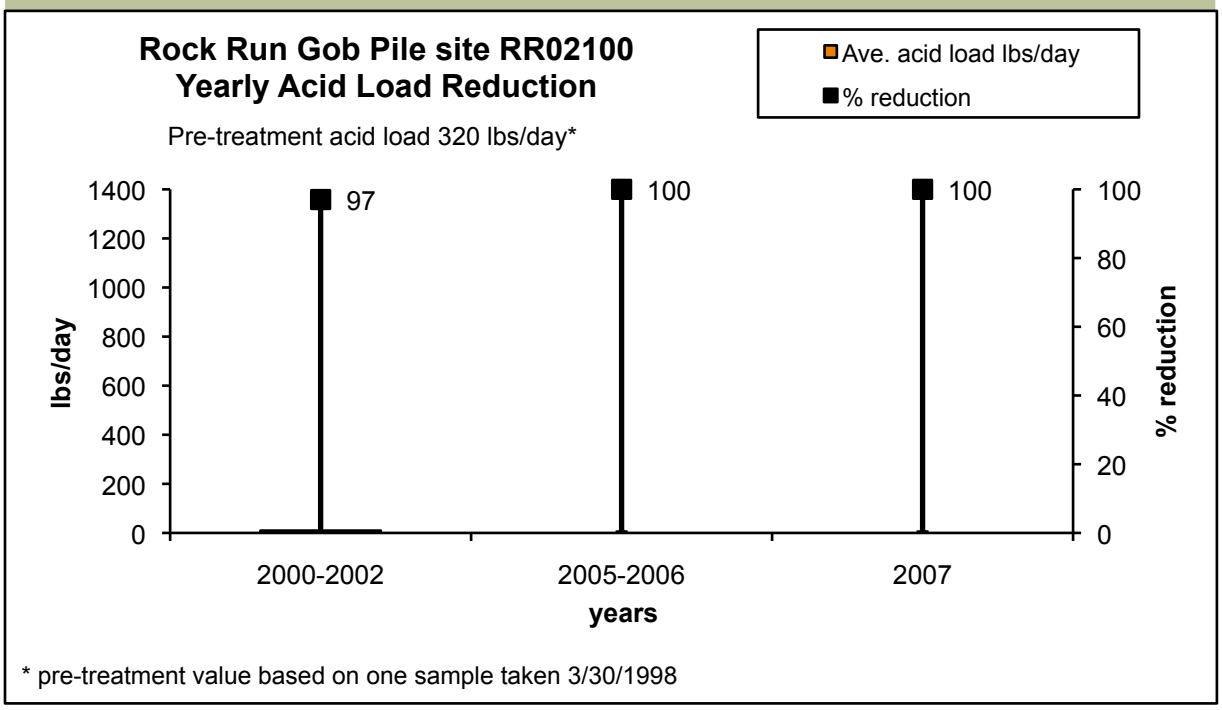
Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

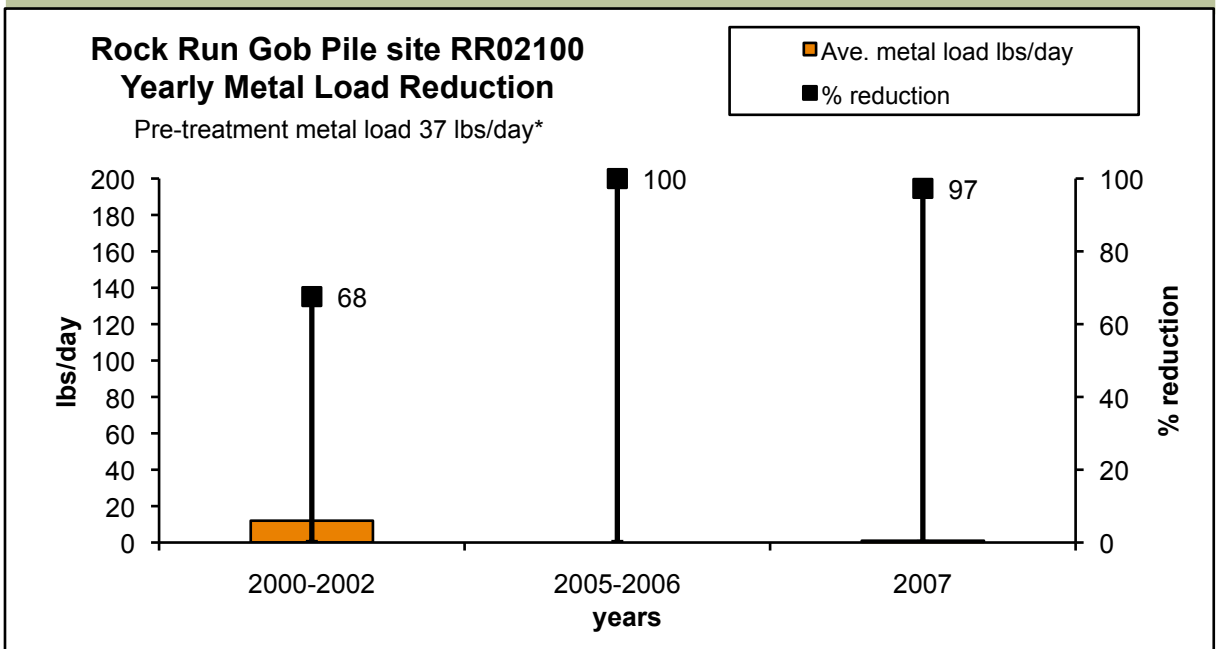
Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction



* pre-treatment value based on one sample taken 3/30/1998

Figure 6. Yearly Metal Load Reduction



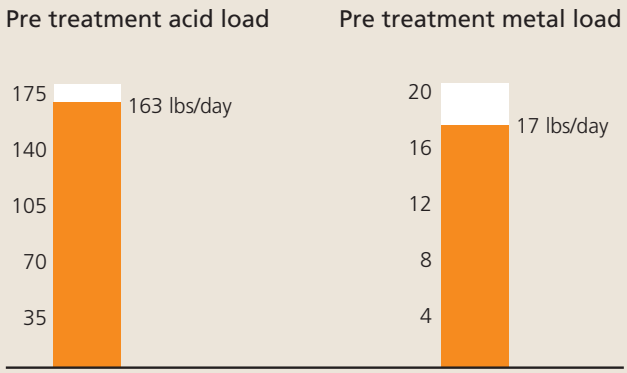
* pre-treatment value based on one sample taken 3/30/1998

Project Status: Complete 9/30/2001 ODNR Project Number: PR-SI-

Pre-construction

Rock Run 24, Photo by Monday Creek Restoration Project

SITE: Pre RR00820, Post RR00780

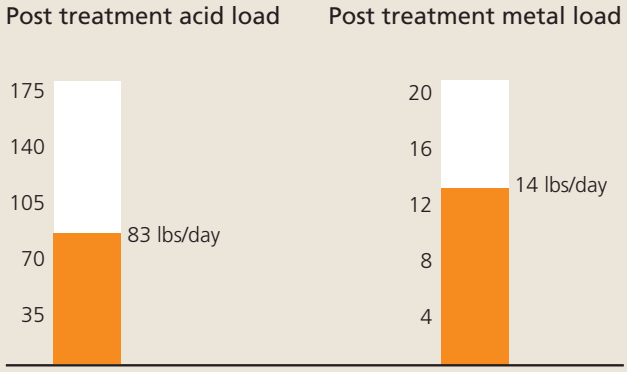


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Rock Run 24, Photo by Monday Creek Restoration Project

SITE: Pre RR00820, Post RR00780



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Rock Run 24 is located in Section 20 of Coal Township in Perry County and lies within the 14-digit HUC unit #05030204060010. The site is located on the north side of the headwaters of Rock Run tributary. An abandoned deep mine seep originated in a side hollow and then discharged into Rock Run. The design was completed by Red Wing Engineering for $25,840. The treatment approach for this site was to install 800 linear feet of open limestone channel (OLC). The goal of the design was to reduce acidity concentration by 36 percent. The project goal was met 100 percent at station MC00800, 1.5 miles downstream. However, at the project discharge RR00780, acidity concentrations only decreased by 29 percent. Major considerations encountered during the design process were landowners concerns and less than 10 percent slope for OLC. The original design was changed from a Reverse Alkaline Producing System (RAPS) to an OLC due to private landowner and U.S. Forest Service liability issues (i.e. flooding). Construction was complete Sept. 17, 2001, by Burr Oak Excavating for a cost of $71,281. The funding sources for this project were ODNR-DMRM and OSM-ACSI for both the design and construction. Figure 3 and 4 (shown on page 3) estimate approximately 80 lbs/day of acid and 3 lbs/day of metals were prevented from entering into Rock Run tributary and Monday Creek as a result of this AMD reclamation project.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

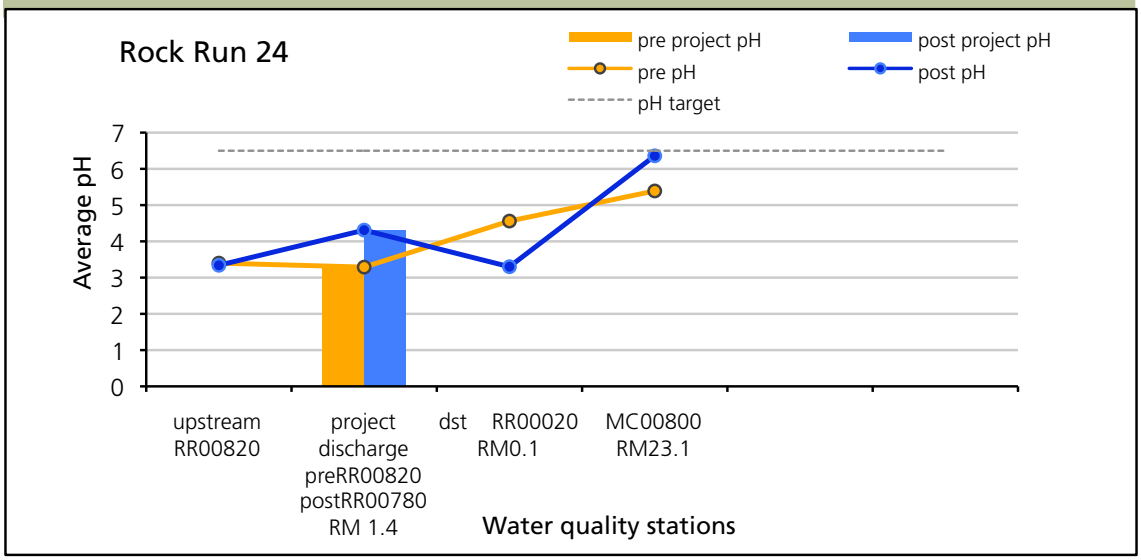
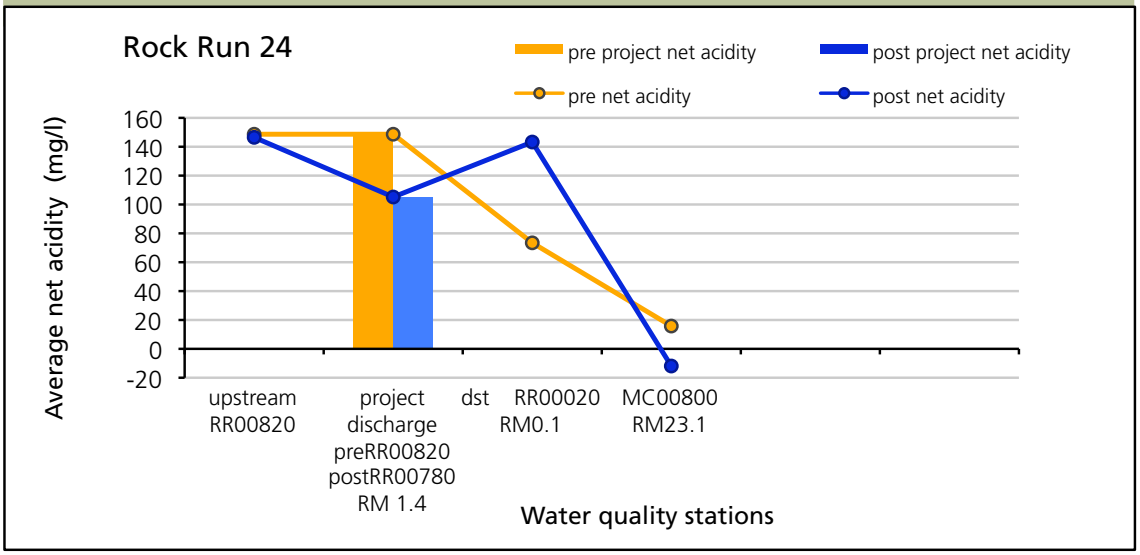


Figure 2. Pre and Post Acidity



As a result of the Rock Run 24 Project, pH and net acidity have improved further downstream at site MC00800 approximatley 0.75 miles. At the first station downstream of Rock Run 24, water quality didn't show improvement due to other sources of acid mine drainage entering into the Rock Run tributary. Pre-construction data showed pH in the range of 3.3 – 5.4 at the project discharge and downstream. However after installation of the Rock Run 24 Project, post-construction data shows pH in the range of 4.3 – 6.4 at the discharge and downstream. The net acidity concentration decreased 29 percent at the project discharge, which resulted in a 100 percent decrease to net alkaline conditions at the downstream LTM 1 station MC00800.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 10/1/1997 to 9/17/2001 for pre-construction and from 10/1/2001 to 12/31/2007 for post-construction. No new data collected in 2008.

Figure 3. Acid Load Reduction

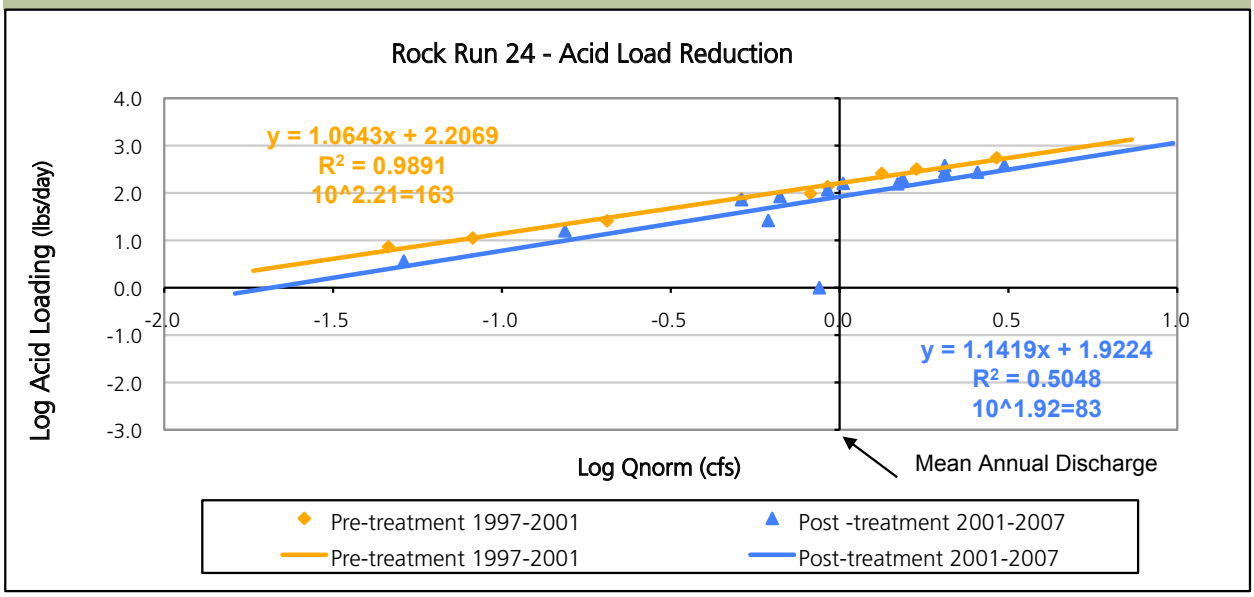
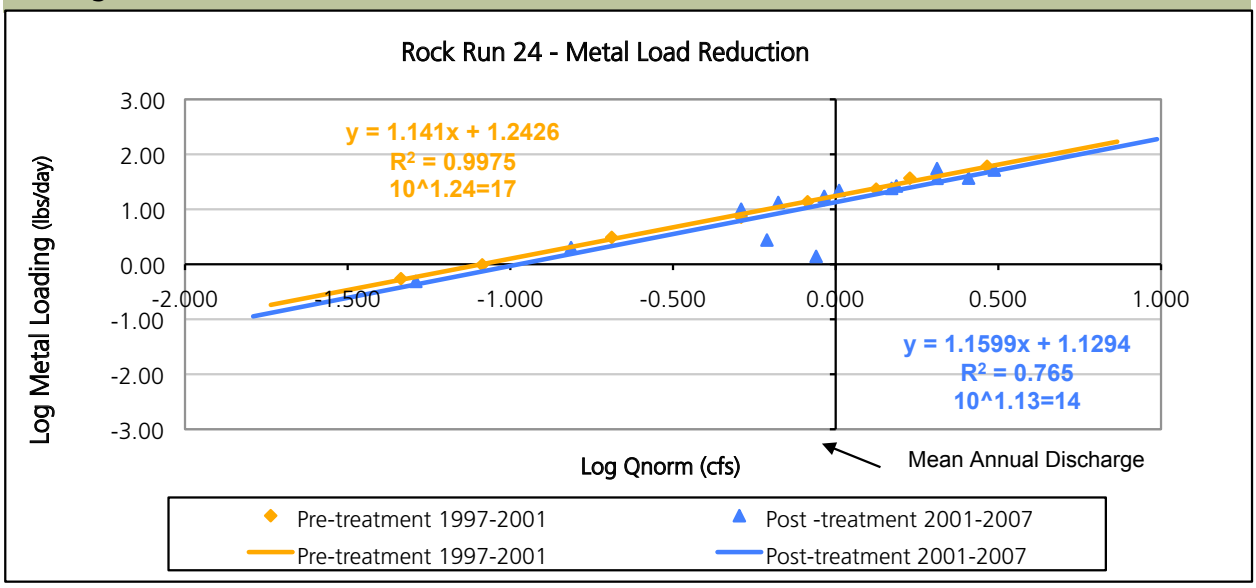


Figure 4. Metal Load Reduction



Approximately 80 lbs/day of acid and 3 lbs/day of metals were prevented from entering into Rock Run tributary and Monday Creek as a result of this AMD reclamation project. Average pre-contstruction discharge measurements were used to calculate load reductions using the Mean Annual Load Method (Stoertz, 2004) instead of deriving the mean annual discharge from the drainage area because the discharge from the Rock Run 24 site is controlled primarily by deep mine drainage and not surface drainage.

Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

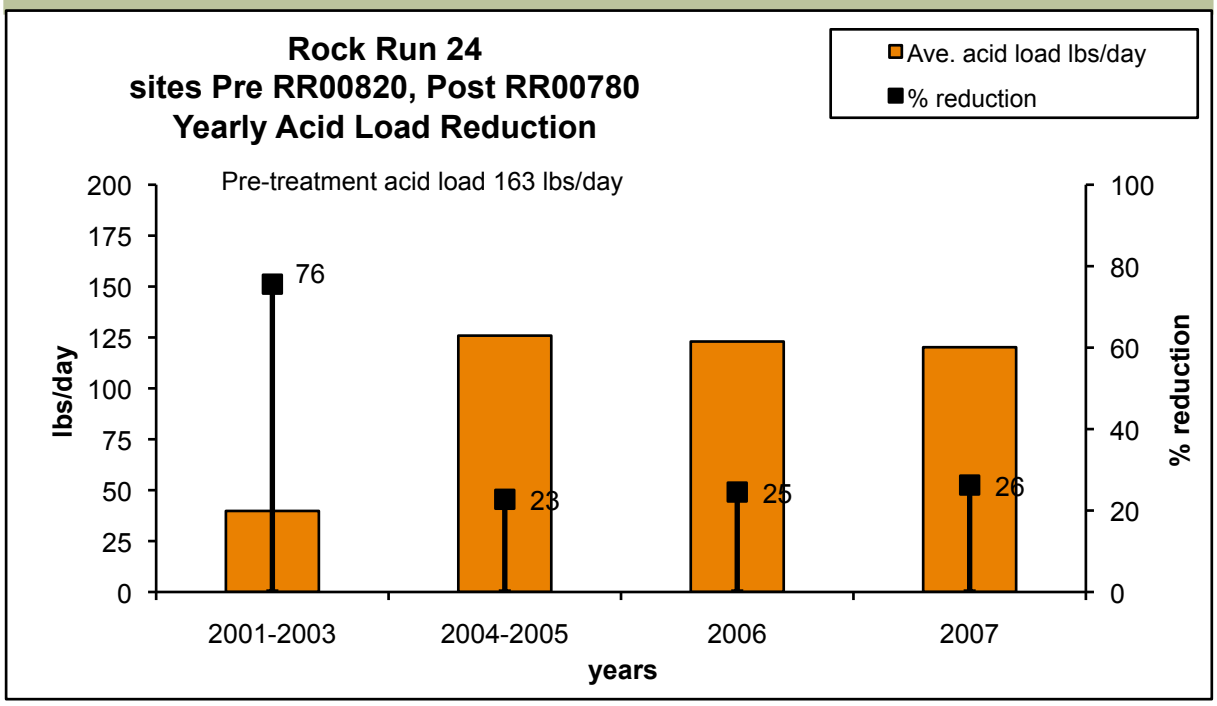
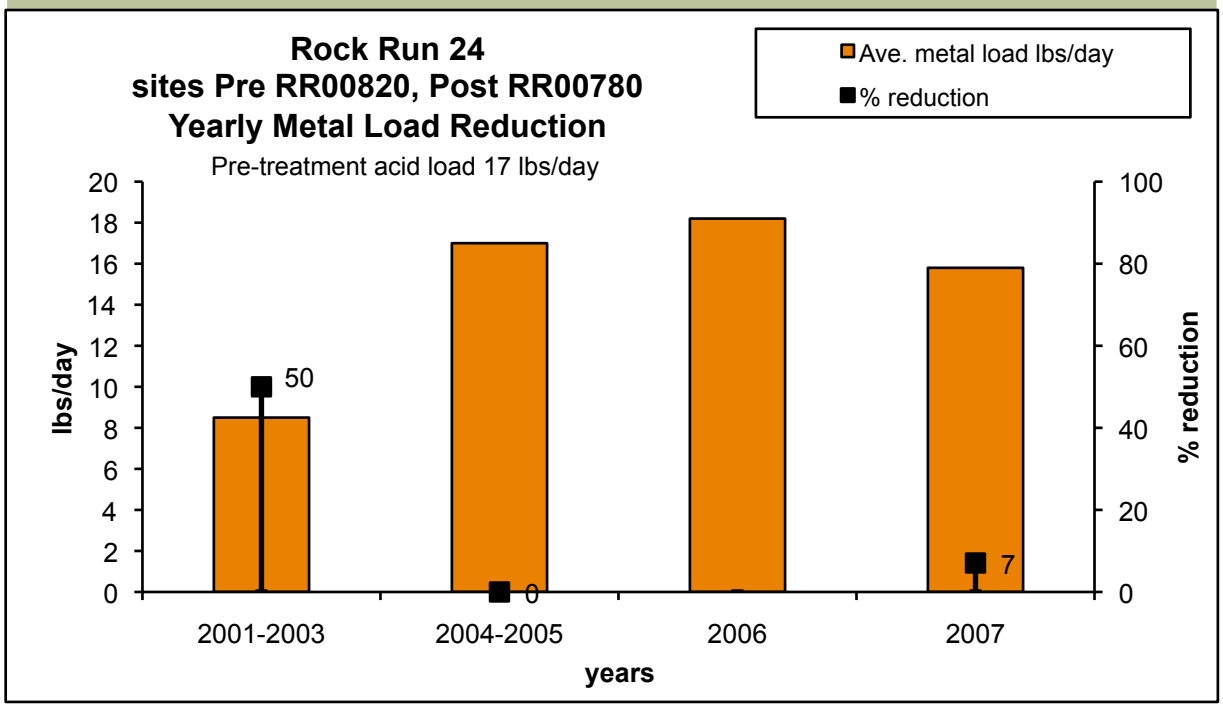
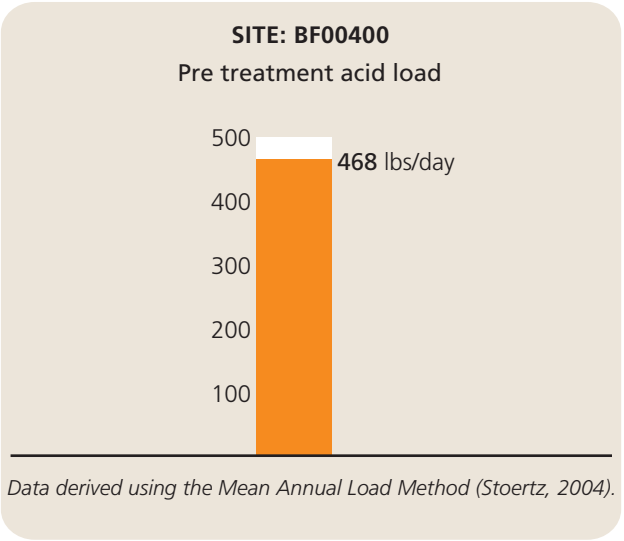


Figure 6. Yearly Metal Load Reduction



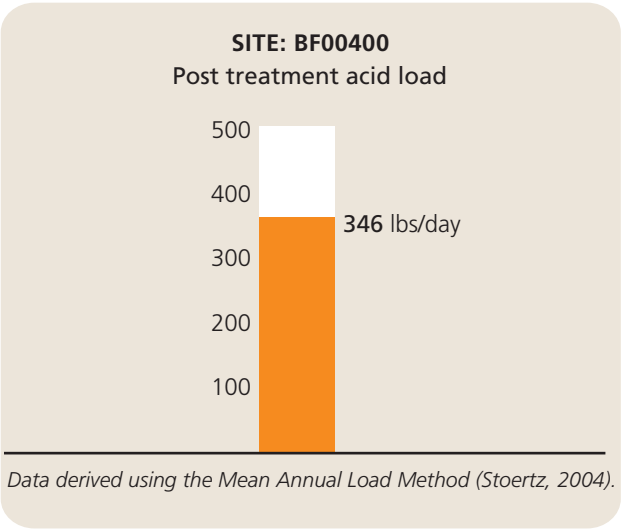
Project Status: Complete 10/29/2004 ODNR Project Number: HC-Wr-20

Pre-construction



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Big Four Hollow
Photo by Monday Creek Restoration Project

Big Four Hollow is located in Section 14 of Ward Township in Hocking County and lies within the 14-digit HUC unit #05030204060030. The project site covers 285 acres of a 410 acre sub-watershed (Big Four Hollow) draining to Monday Creek. Big Four Hollow is underlain by deep mines and has been surface mined around the hills where the coal crop was accessible causing many AMD seeps to discharge in the basin. The design was completed by USFS and TN & A for $19,000. The treatment approach for this site was to install two limestone leach beds (3000 sq. ft) and approximately 1,400 linear feet of limestone channel (OLC). The goal of the project was to decrease acidity concentrations by 82% at station BF00400. However only 27% of the acidity concentration has been decreased at site BF00400. Construction was complete Sept. 17, 2001, by Pangea for a cost of $320,000. The funding sources for this project were USFS for the design and MCRP, ODNR-DMRM and USFS for construction. Figure 3 and 4 (shown on page 3) estimate approximately 121 lbs/day of acid and 0 lbs/day of metals were prevented from entering into Monday Creek as a result of this AMD reclamation project. This project was designed to reduce acidity, not metals.

Water Quality Report

Water smples were collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

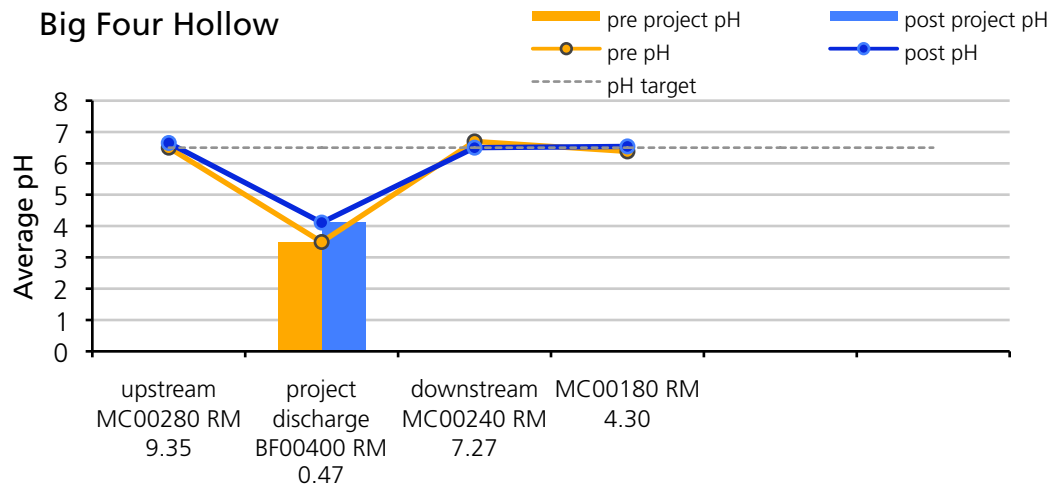
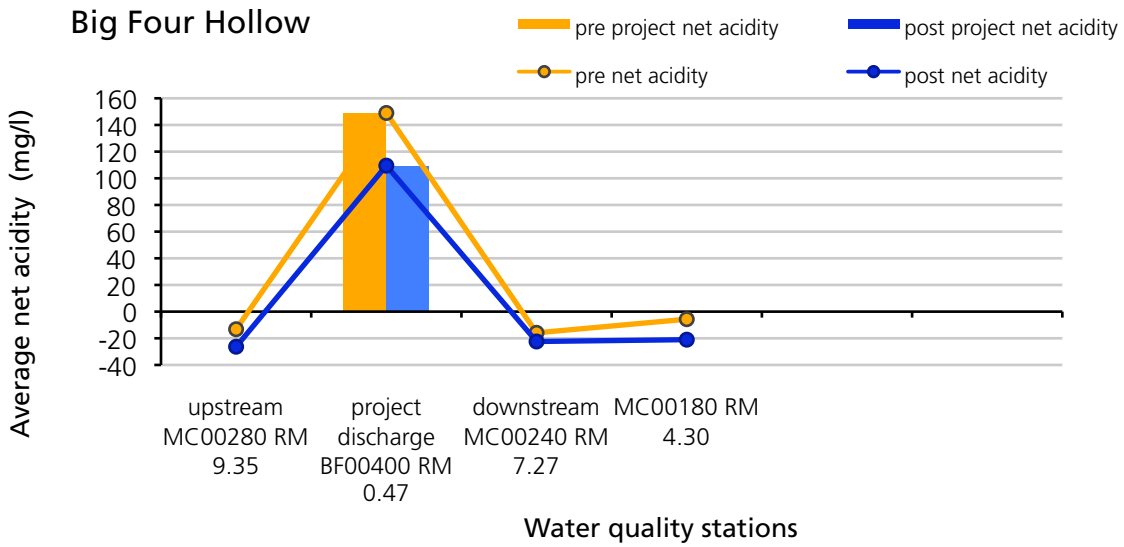


Figure 2. Pre and Post Acidity



As a result of the Big Four Hollow Project, pH and net acidity have improved downstream for approximately 0.75 miles. Pre-construction data showed pH in the range of 3.5 – 6.7 at the project discharge and downstream. However, after installation of the Big Four Hollow Project, post-construction data shows pH in the range of 4.1 – 6.5 at the discharge and downstream. The net acidity concentration decreased 27 percent at the project discharge.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 9/1/1997 to 7/30/2004 for pre-construction and from 11/1/2004 to 12/31/2007 for post-construction. No new data collected in 2008.

Figure 3. Acid Load Reduction

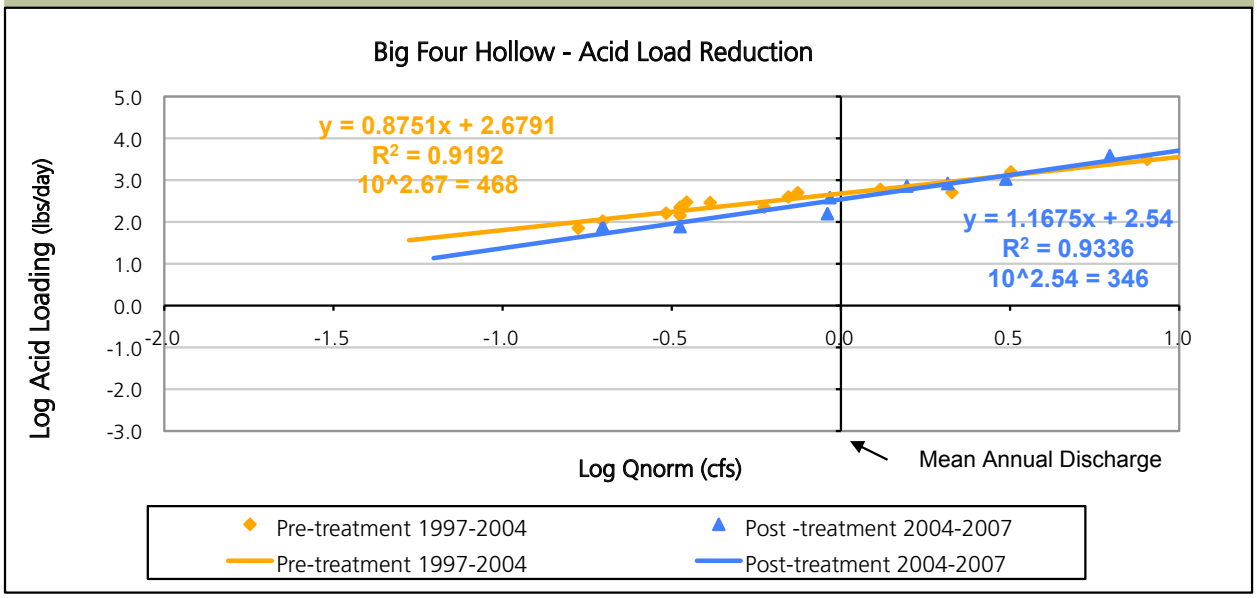
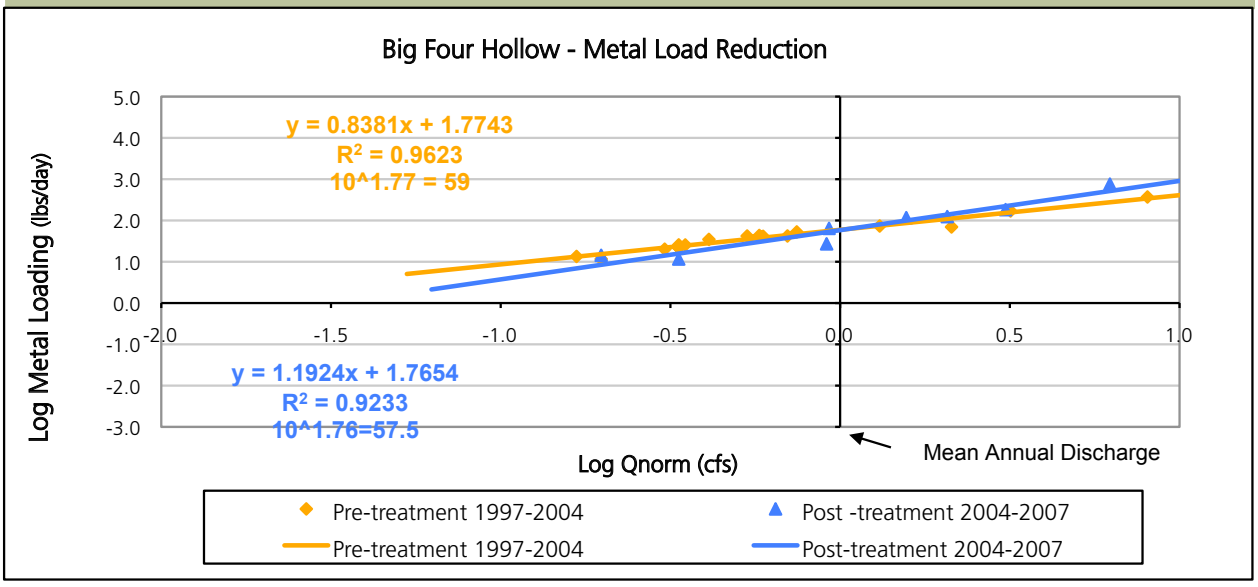


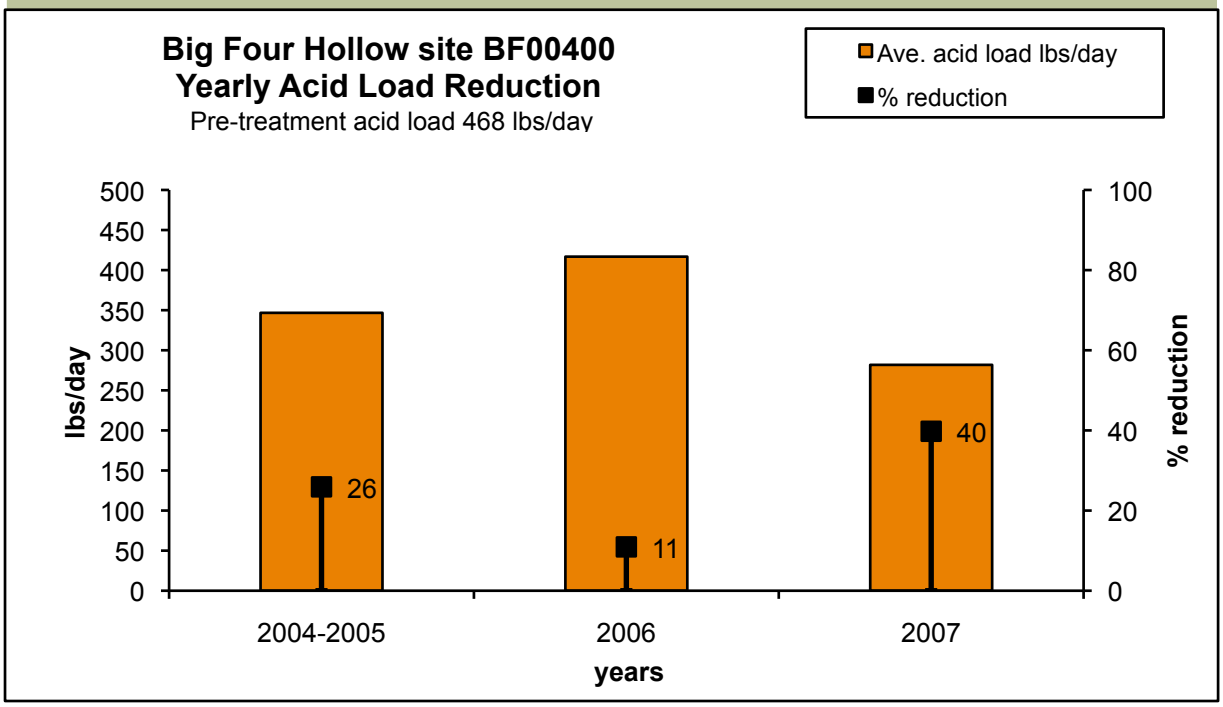
Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction



ESSEX DOSER

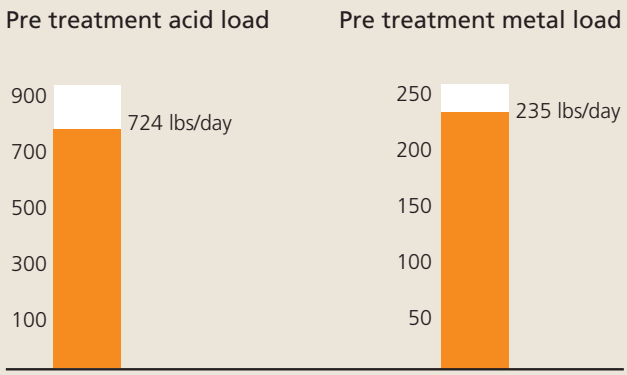
Project Status: Complete 3/31/2006

ODNR Project Number: HC-Wr-03

Pre-construction

Essex Doser, Photo by Monday Creek Restoration Project

SITE: SY00706

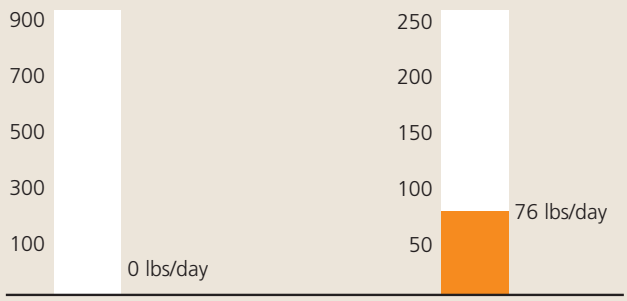


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Essex Doser, Photo by Monday Creek Restoration Project

SITE: SY00706



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Essex Doser is located in Section 18 of Ward Township in Hocking County and lies within the 14 digit HUC unit #05030204060040. The site is located along Sycamore Hollow, State Route 216. Abandoned underground deep mines and subsidence captures surround the area and discharge AMD into Sycamore Run through an open mine portal adjacent to State Route 216. Sycamore Hollow is a tributary to Snow Fork. The design was completed by ATC Associates for a cost of $32,320. The treatment was to install a lime doser. A problem encountered during design was that the funding for this project was originally intended to address Murray City Seeps. However the village of Murray City would not sign a right-of-entry form, so the project was moved to Essex Mine, further upstream of Murray City. The goal of the design was to neutralize acidity discharging from Essex Mine. The project goal, as indicated from initial post-construction sampling, has been met 100 percent. A major consideration encountered during the design was the close proximity of the doser to State Route 216. Construction was complete March 31, 2006, by AWT Services Inc. for a cost of $287,400. The funding sources for this project were ODNR-DMRM and EPA-319 for both the design and construction. Figure 3 & 4 (shown on page 3) estimate approximately 724 lbs/day of acid was reduced from entering into Sycamore Hollow and Snow Fork as a result of this AMD reduction project. In addition to the acid loading reduction measured at this site, there was approximately 871 lbs/day of alkaline addition to the headwaters of Sycamore Hollow. Total metal load reduction occurring at this site was approximately 159 lbs/day. The metals precipitate as a result of the high pH water and became part of the substrate. The doser was turned off during 2008 and is planned to be moved when the Army Corps of Engineers projects begin in 2010.

Water Quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post- construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

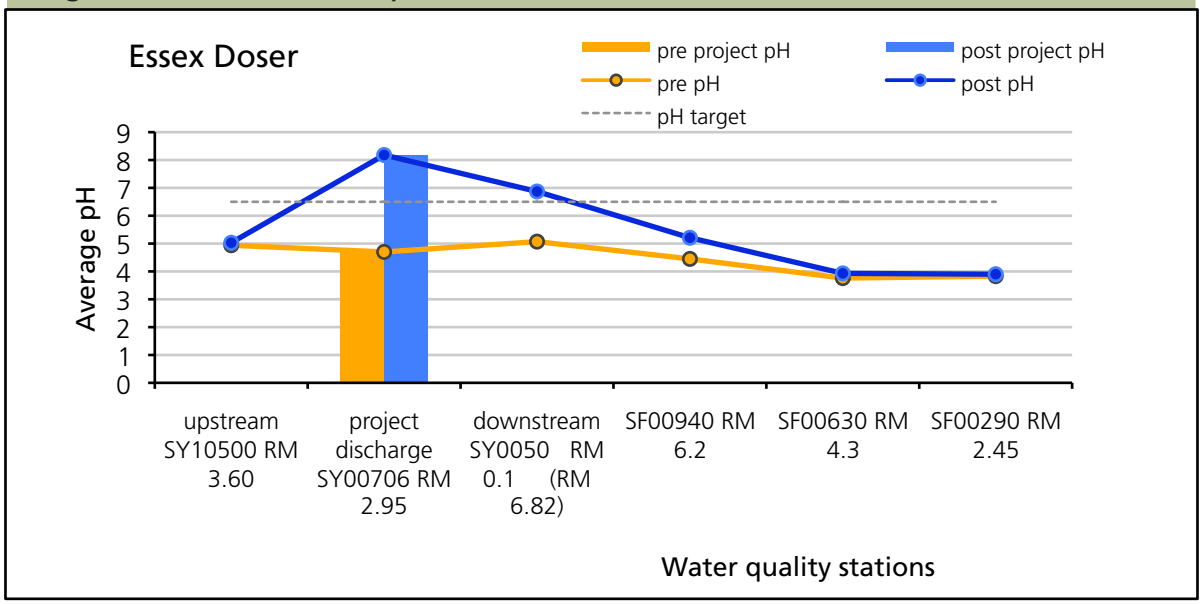
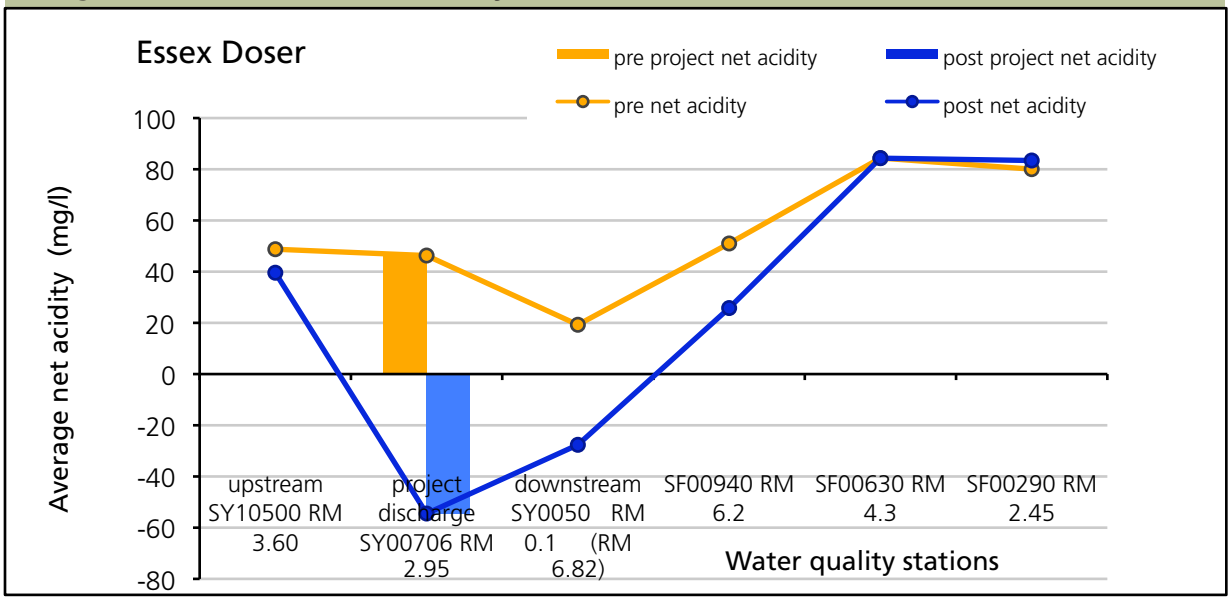


Figure 2. Pre and Post Acidity



As a result of the Essex Doser Project, pH and net acidity have improved downstream approximately 6.0 miles. Pre-construction data showed pH in the range of 3.7 – 5.1 at the project discharge and downstream. After installation of the Essex Doser Project, initial post-construction data shows pH values are in the range of 3.9 – 8.2 at the discharge and downstream. The net acidity concentration decreased 100 percent at the project discharge, resulting in net alkaline conditions on the mainstem of Sycamore Hollow for 2.95 miles.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre-, and post-construction at the project discharge from 7/10/2001 to 10/31/2005 for pre-construction and from 04/06/2006 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

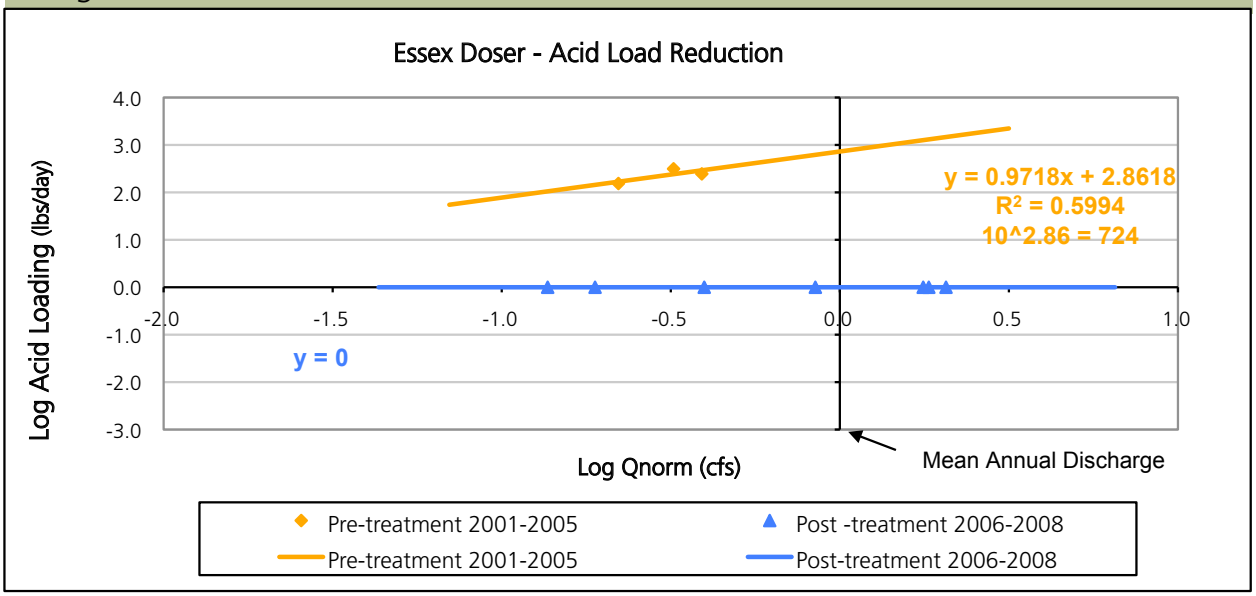
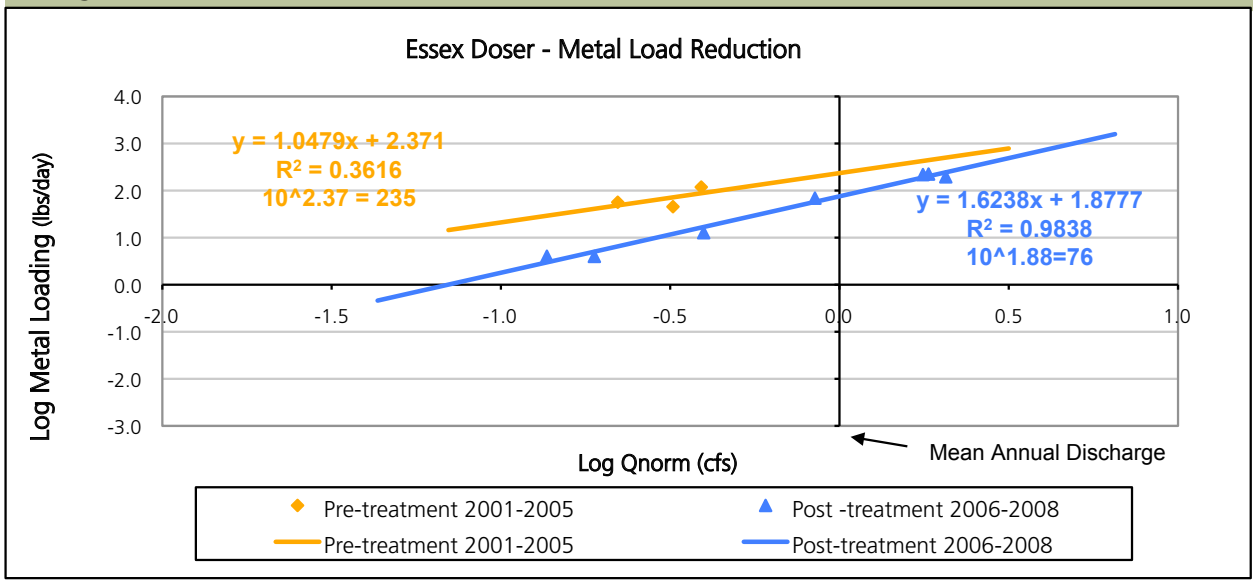


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

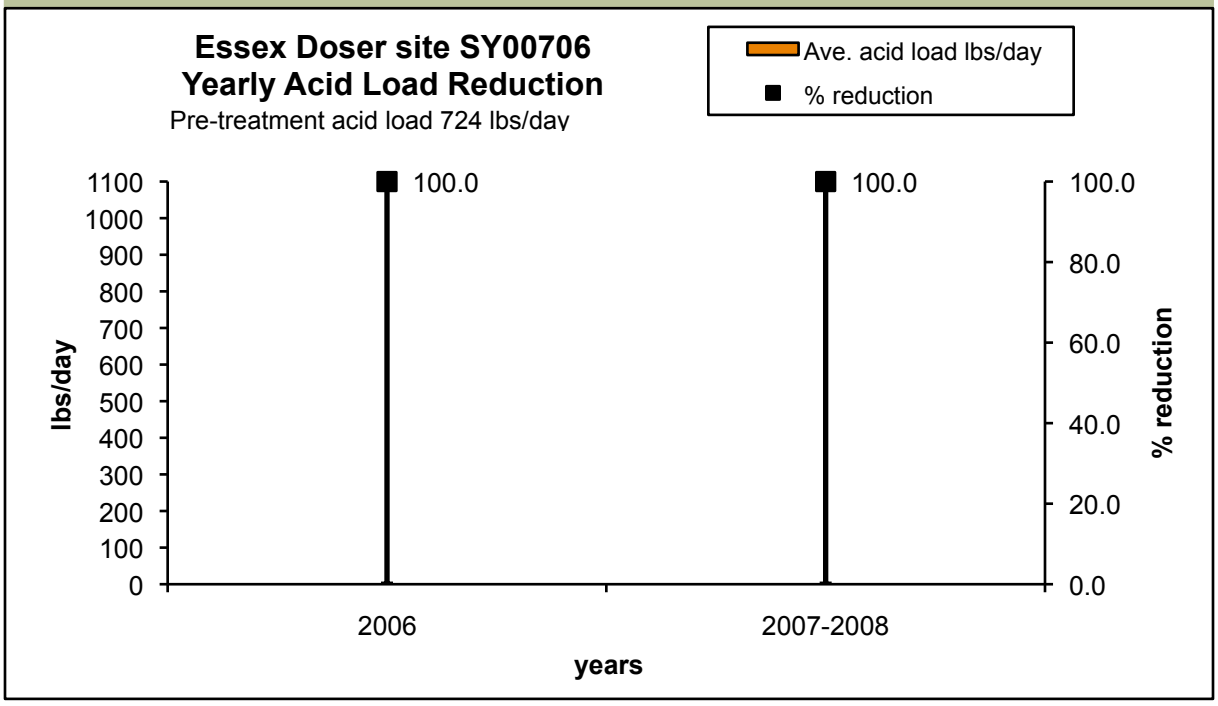
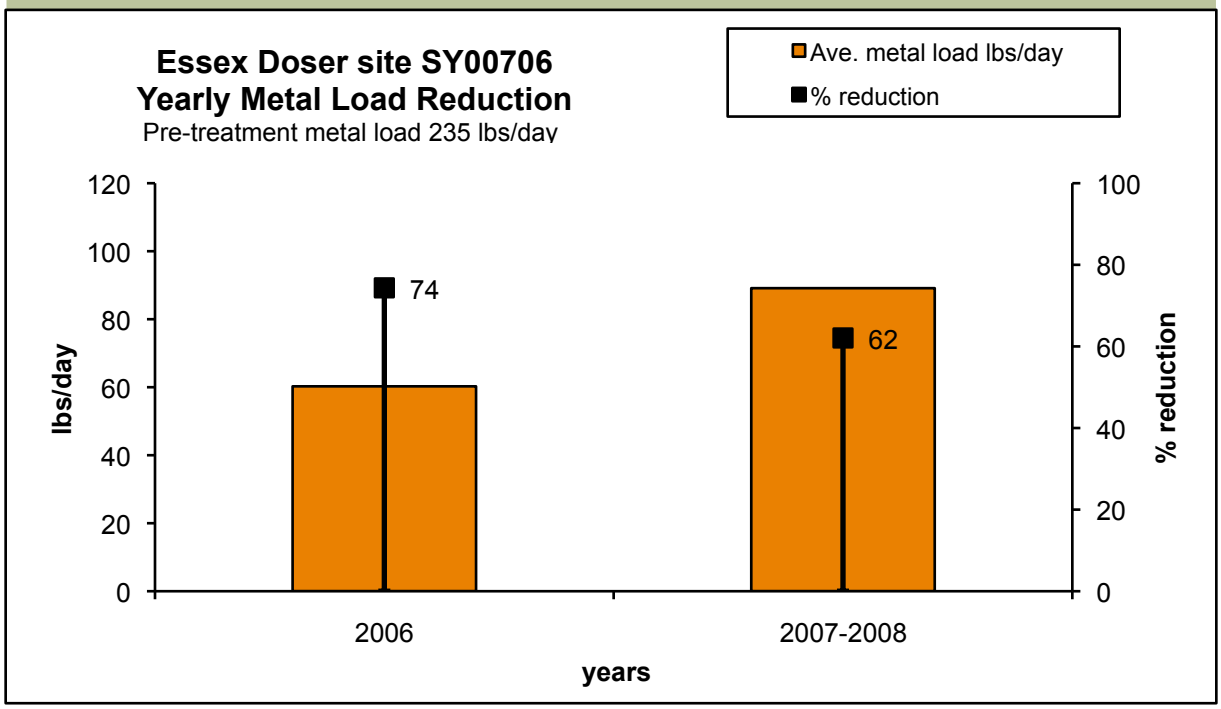


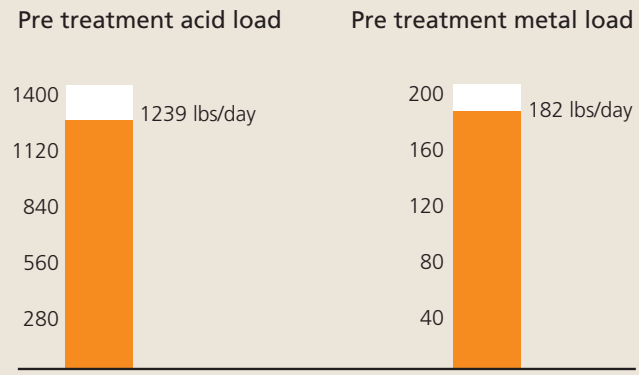
Figure 6. Yearly Metal Load Reduction



Project Status: Complete 12/31/2004 ODNR Project Number: HC-Wr-19

Pre-construction

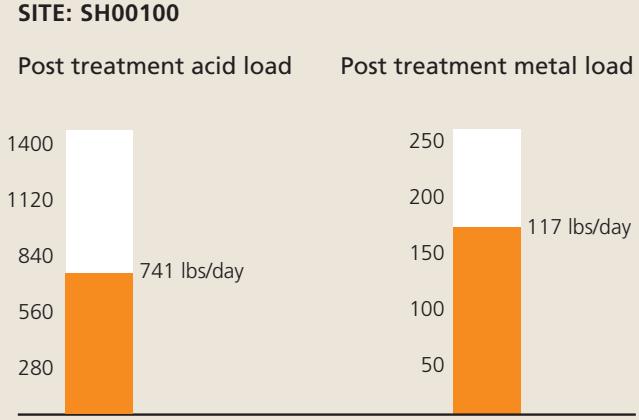
Snake Hollow, Photo by Monday Creek Restoration Project



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Snake Hollow, Photo by Monday Creek Restoration Project



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Snake Hollow is located in Section 18 of York Township in Athens County and lies within the 14-digit HUC unit #05030204060030. The site encompasses the entire Snake Hollow subwatershed, approximately 500 acres in size. Snake Hollow is a tributary to Monday Creek. Numerous deep mine discharge sites are located on the hillsides around the headwaters and along the stream. The area was stripped at the outcroppings along the ridges where the coal portals from the deep mining had originally been. The design was completed by the U.S. Forest Service (Wayne National Forest). The treatment approach for this site was to construct approximately two miles of limestone channels (OLC) and two slag leach beds, close nine subsidence holes and two portals and enhance the existing one acre wetland with limestone rock dams. The goal of the design was to reduce acid and metals concentrations discharging into Monday Creek. Figures 3 and 4 (shown on page 3) estimate approximately 498 lbs/day of acid and 65 lbs/day of metals were prevented from entering into Monday Creek as a result of this AMD reclamation project which was the goal of the project. A major consideration encountered during the design was the documented capture of the Indiana Bat. During the design process, access road costs doubled. Construction was complete Dec. 31, 2004, by Environmental Quality Management for a cost of $740,000. The funding sources were ODNR-DMRM and USFS for both design and construction.

Water Quality Report

Water samples were collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

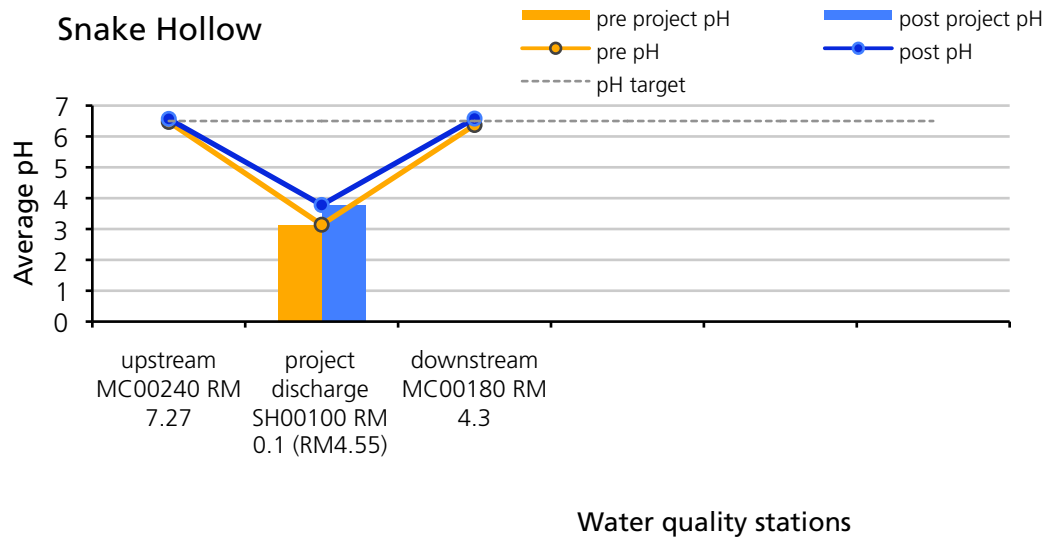
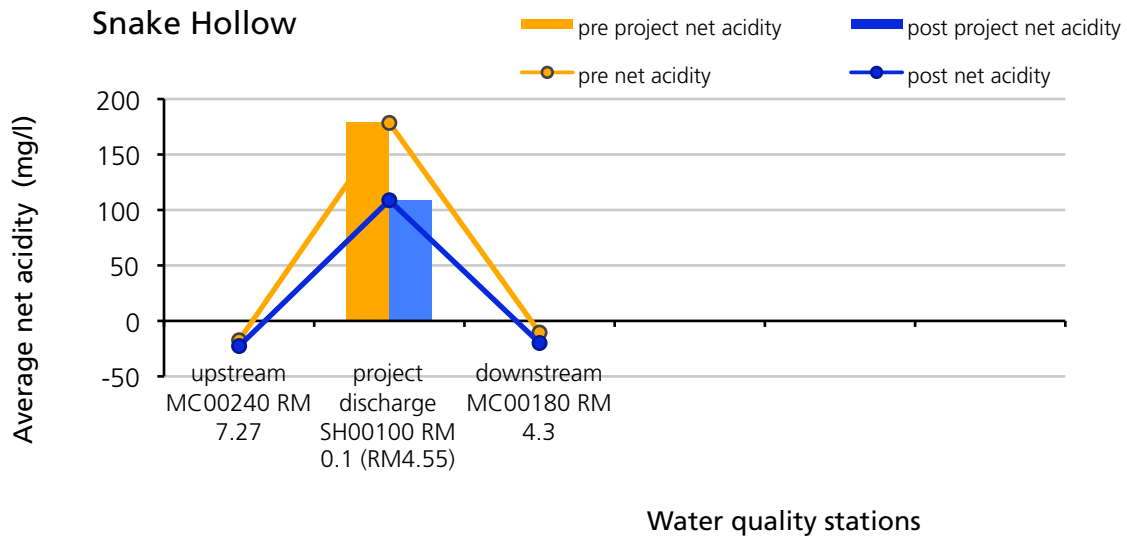


Figure 2. Pre and Post Acidity



As a result of the Snake Hollow Project, pH and net acidity have improved downstream at site MC00180 approximately 0.25 miles. Pre-construction data showed pH in the range of 3.1 – 6.4 at the project discharge and downstream. After installation of the Snake Hollow Project, post-construction data shows pH in the range of 3.8 – 6.6 at the discharge and downstream. The net acidity concentration decreased 39 percent at the project discharge, which resulted in net alkaline conditions (-20 mg/l) on the mainstem of Monday Creek at the downstream station MC00180.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre-, and post-construction at the project discharge from 2/26/1998 to 9/11/2001 for pre-construction and from 1/3/2005 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

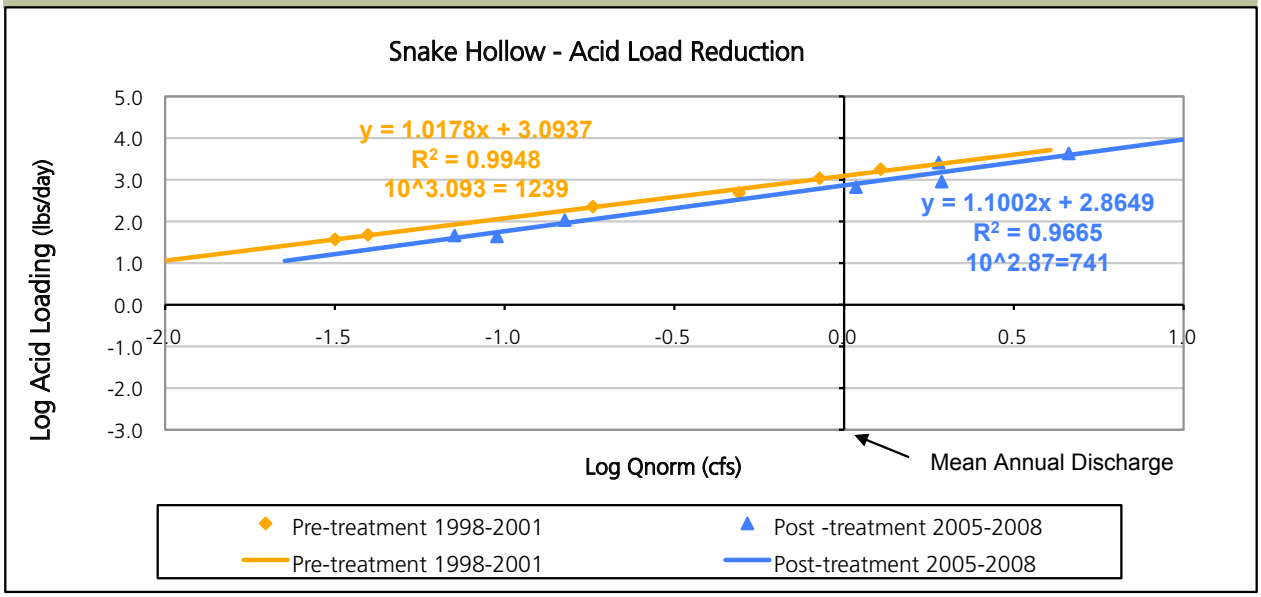
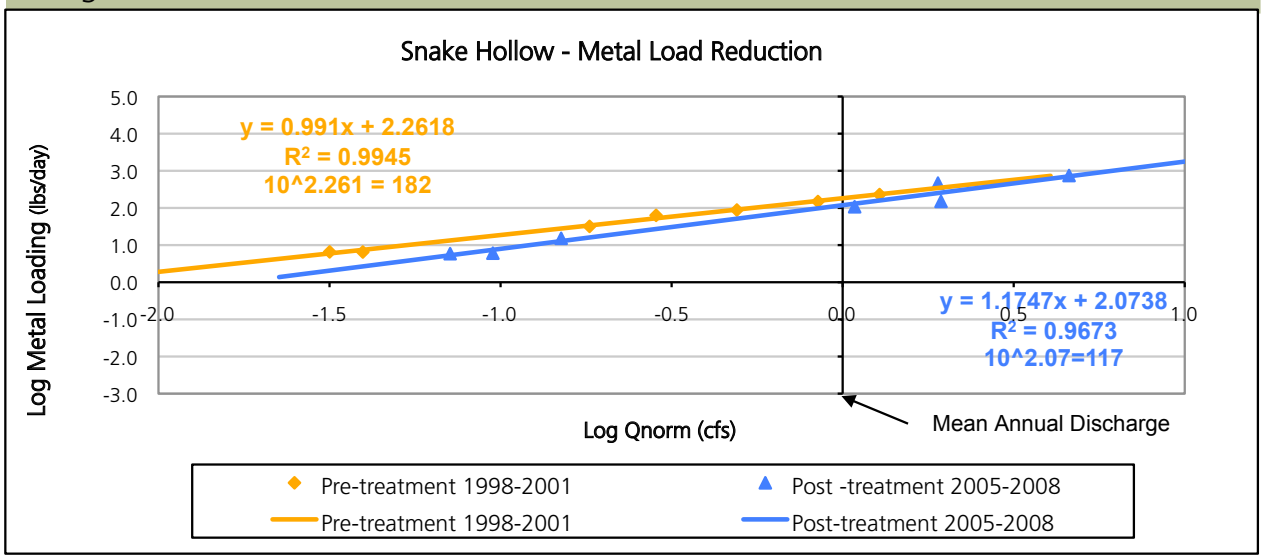


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

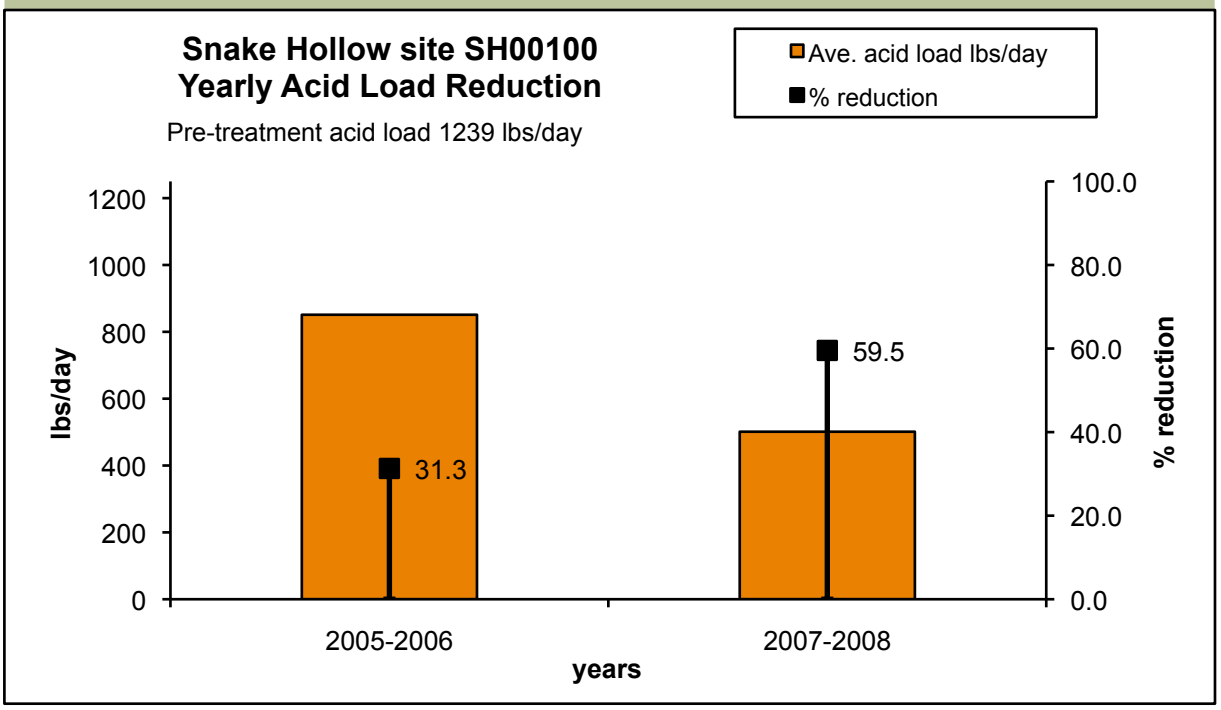
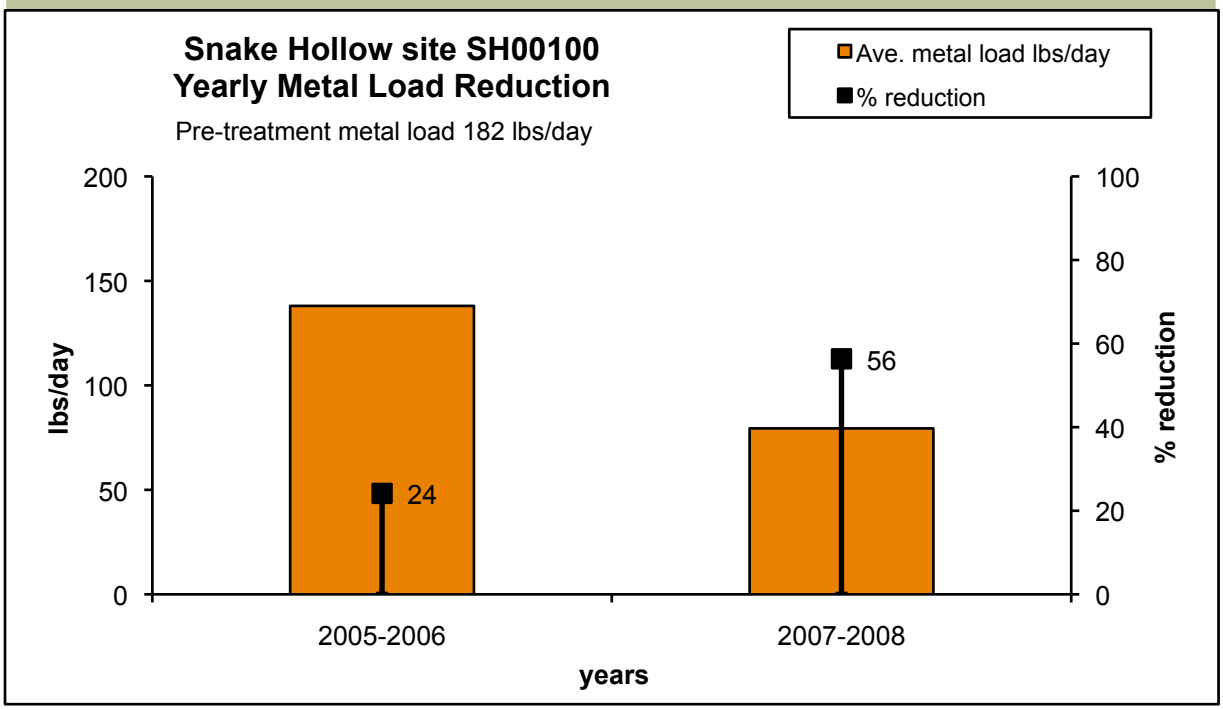


Figure 6. Yearly Metal Load Reduction

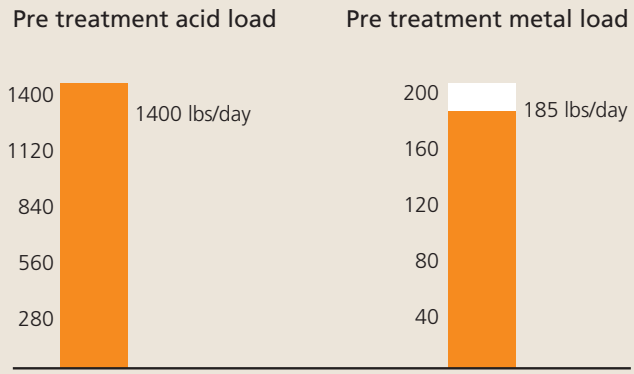


Project Status: Complete: 10/31/2006 ODNR Project Number: HC-Wr-30

Pre-construction

Lost Run Seep (1W2 Seep)
Photo by Fuller, Mossbarger, Scott, May Engineers, Inc. (FMSM)

SITE: LR01020

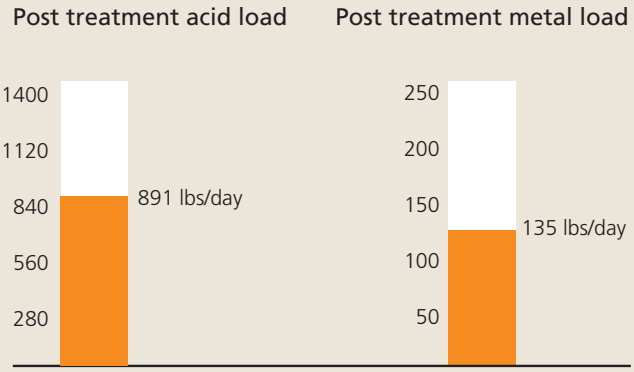


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Lost Run Open Limestone Channel (1W5)
Photo by Monday Creek Restoration Project

SITE: LR01020



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Lost Run Phase I is located in Section 36 of Ward Township in Hocking County and lies within the 14 digit HUC unit #05030204060010. The site is located at the mouth of the first tributary to the west in the Lost Run subwatershed. Project area is less than five acres. Lost Run is a tributary to Monday Creek at river mile 16.08. The Lost Run area was providing recharge to underground mine complexes. The majority of AMD discharging in the lower portion of Lost Run occurred beneath the abandoned high walls, or near the perimeter of surface mine reclamation areas at the coal crop line. Seeps also occur in areas where overburden was deposited. The design was completed by Ohio Department of Natural Resources – Division of Mineral Resources Management ($35,000). The treatment consisted of constructing a 13,700 square foot limestone leach bed and installing 3,540 linear feet of limestone channels to treat acid mine drainage from five locations. The goal of the design was to reduce acid and metal concentrations discharging into Monday Creek. Construction was complete 10/31/2006 by Tucson Inc. for a cost of $475,000. Problems with the limestone leach bed were encountered summer of 2007. The system was modified and repaired August 2007. Figure 3 and 4 (shown on page 3 of this report) estimate that 509 lbs/day of acid and 50 lbs/day of metals were prevented from entering Monday Creek as a result of Phase I AMD reclamation project in Lost Run. The funding sources for this project were ODNR-DMRM for the design and for construction was MCRP, ODNR-DMRM and Ohio EPA 319.

Water Quality Report

Water samples were collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

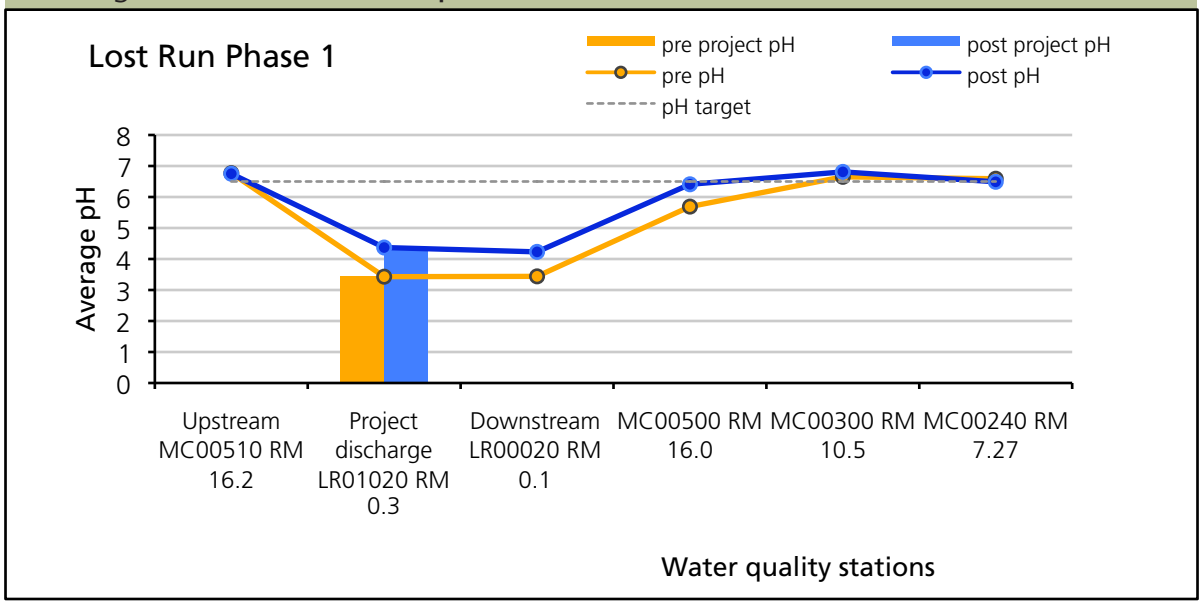
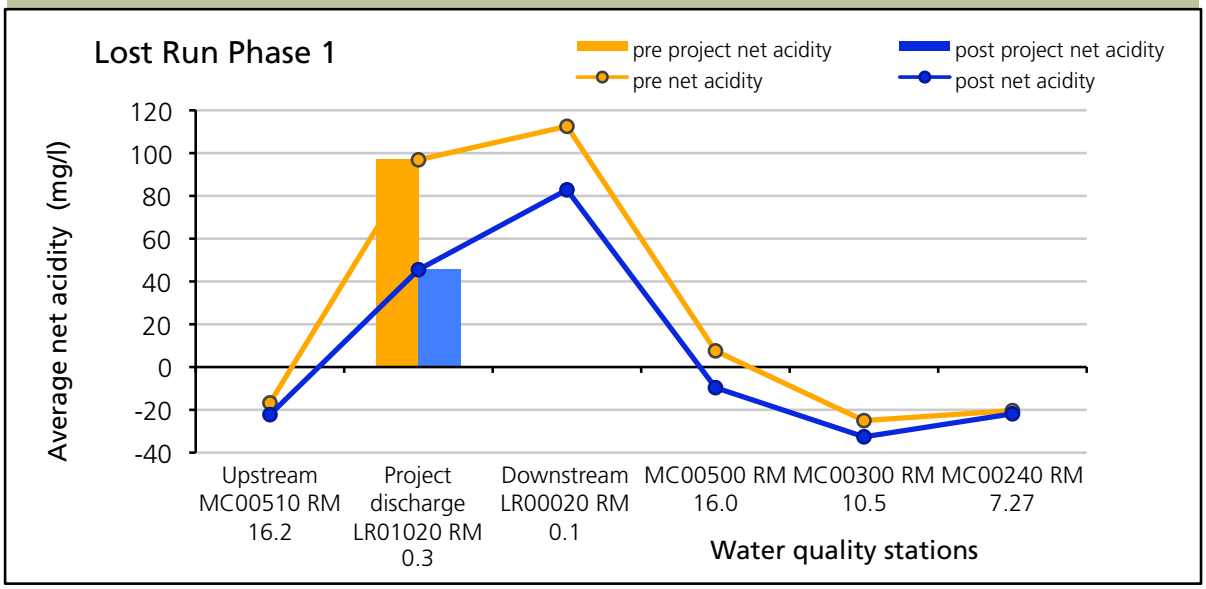


Figure 2. Pre and Post Acidity



As a result of the Lost Run Phase I Project, pH and net acidity have improved downstream approximately 6.0 miles. Pre-construction data shows pH in the range of 3.4 – 6.6 at the project discharge and downstream. After installation of the Lost Run Phase I Project, post-construction data shows pH in the range of 4.4 – 6.8 at the discharge and downstream. The net acidity concentration decreased 53% at the project discharge.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre-, and post-construction at the project discharge from 5/9/2001 to 6/19/2006 for pre-construction and from 3/6/2007 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

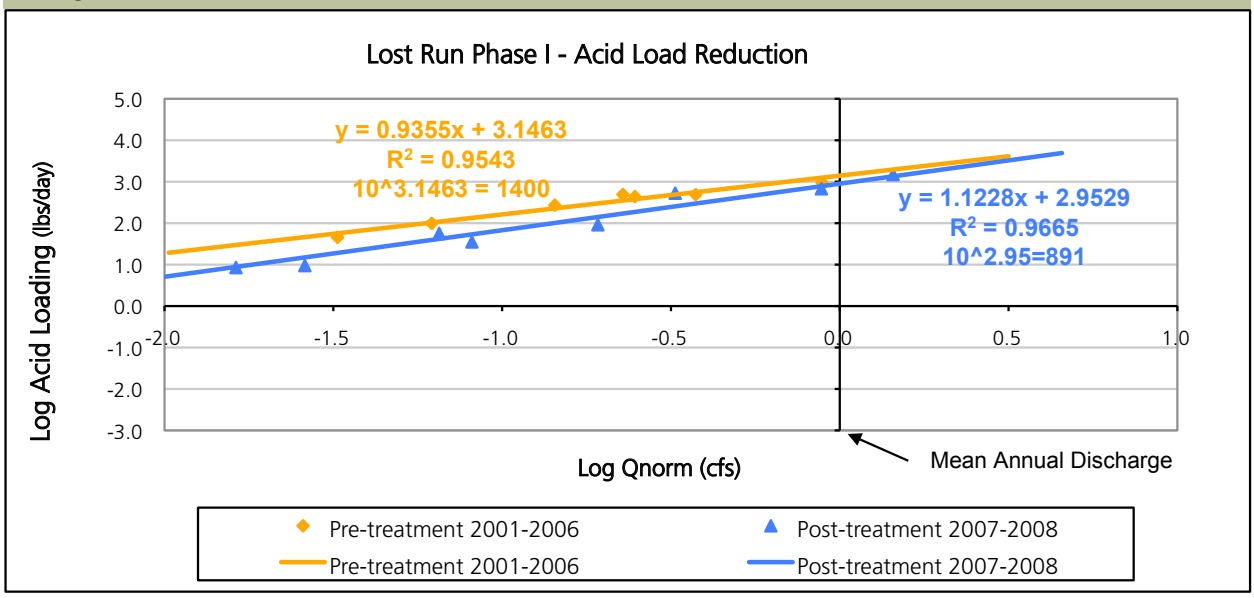
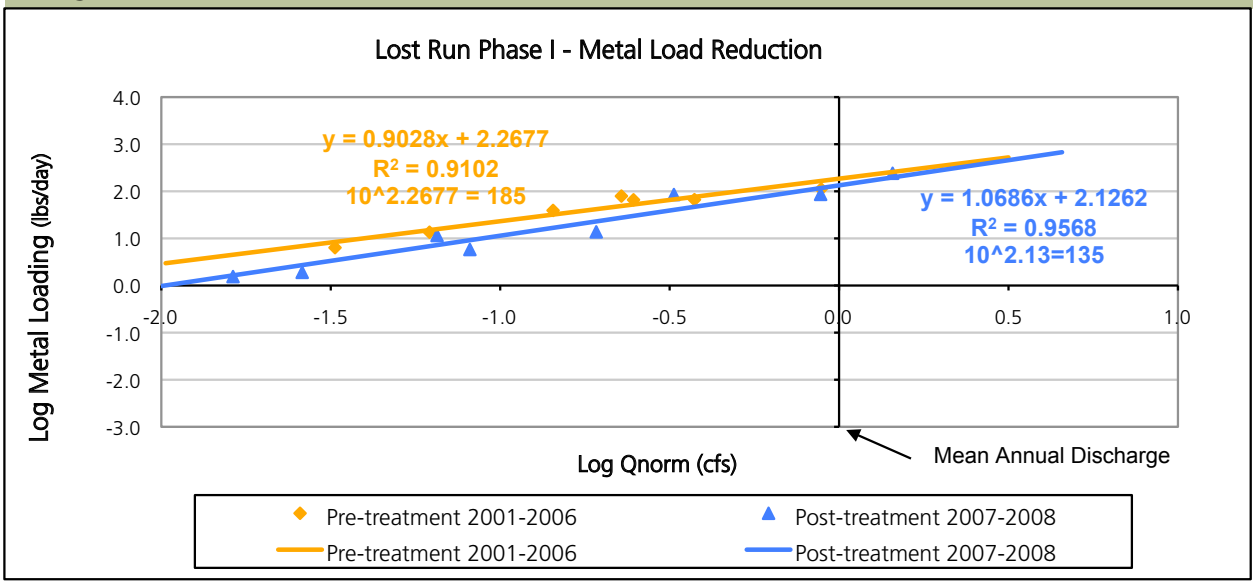


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

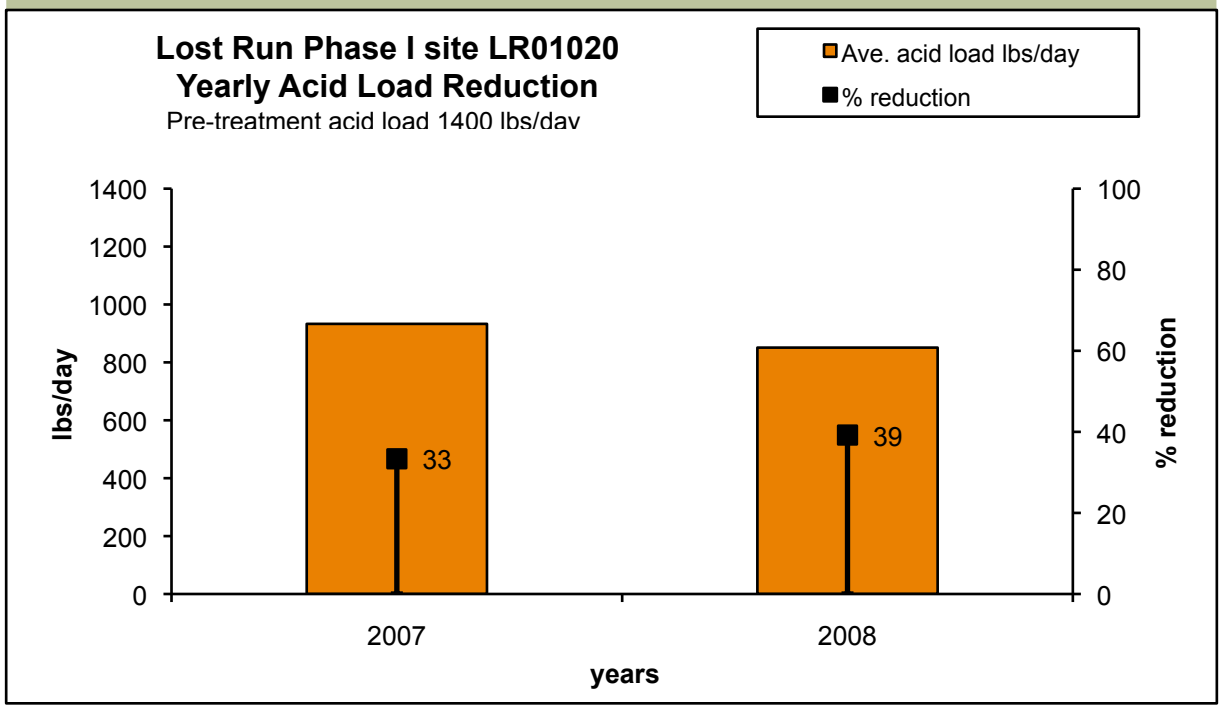
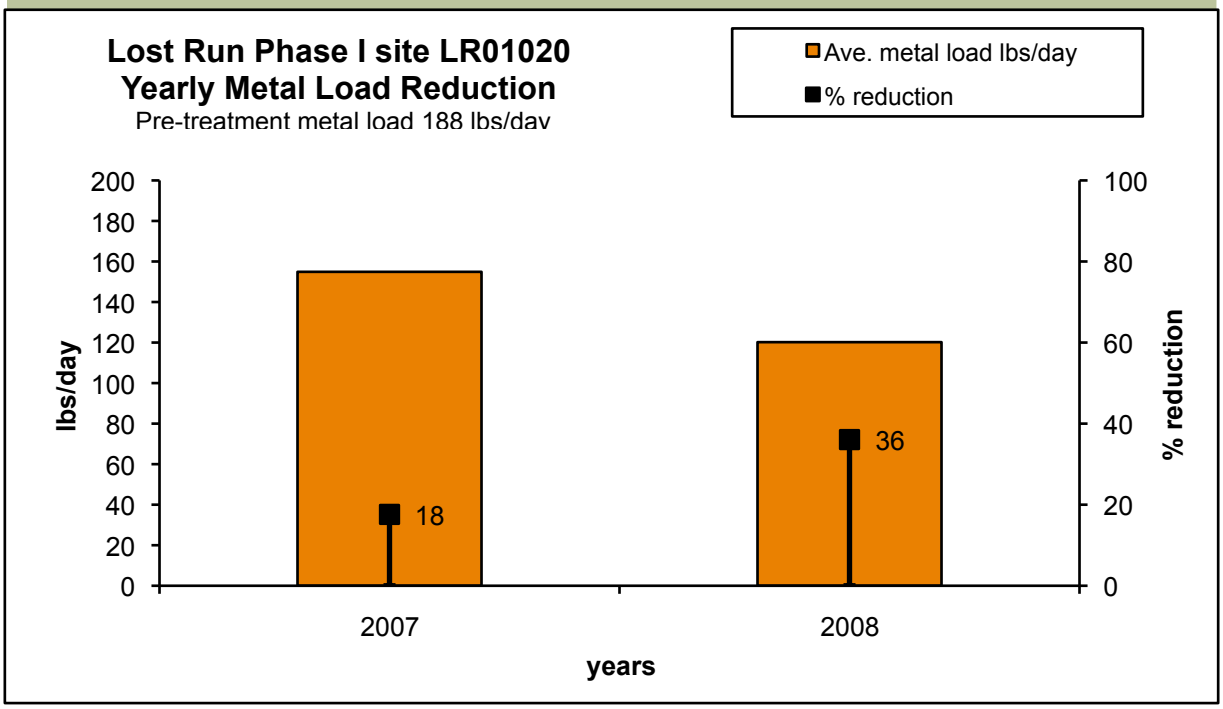


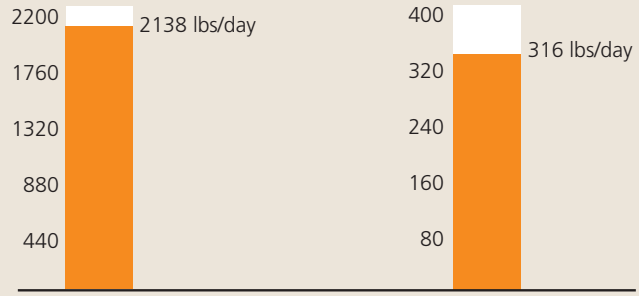
Figure 6. Yearly Metal Load Reduction



Project Status: Complete: 7/1/2007 ODNR Project Number: HC-Wr-34

Pre-construction

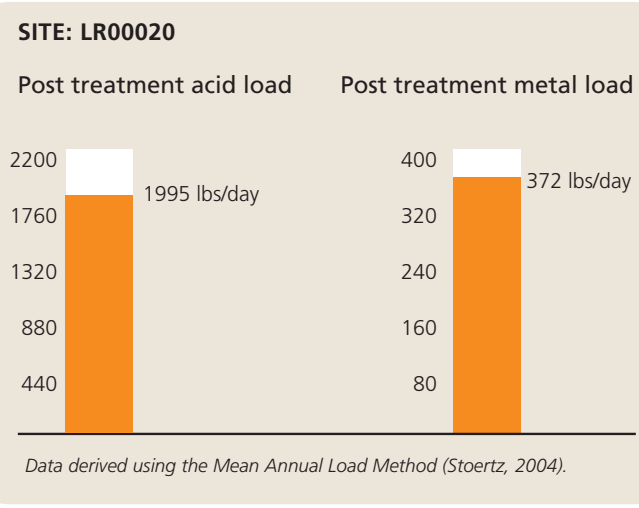
Lost Run Seeps, Photo by Nate Schlater



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Lost Run limestone leach bed site (4W)
Photo by Monday Creek Restoration Project



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Lost Run Phase II is located in Section 30 of Ward Township in Hocking County and lies within the 14 digit HUC unit #05030204060010. Upstream AMD is generated from subsidence features, spoil blocks in side drainages of intermittent streams, fractured high walls, and slumped drift mine entries. Phase II of the Lost Run reclamation project consists of numerous alkaline addition systems spread throughout the headwaters of the Lost Run basin to buffer numerous AMD sources throughout the basin. Post construction monitoring is being collected at site LR00040. However, no pre-construction data was collected at this site. Therefore, reclamation results for this report are evaluated at the mouth of Lost Run (site LR00020). This site also represents water quality from Lost Run Phase I. For this report both Phase I and II of Lost Run are evaluated at the mouth of Lost Run at site LR00020. The design was completed by ODNR – DMRM ($63,979). The treatment consisted of constructing a 7,650 square foot limestone leach bed, installing 1,300 linear feet of limestone channels, 140 linear feet of Limestone J-trenches, 14,250 square ft. of steel slag leach bed and 197 linear feet of a steel slag berm to add alkalinity to buffer acidity generated in Lost Run. The goal of the design was to reduce acid and metal concentrations discharging into Monday Creek. Construction was complete 6/20/2007 by Stimmel Construction for a cost of $489,910. One of the planned steel slag berms could not be constructed due to private landowner denying permission. The funding sources for this project were for the design was ODNR-DMRM and for construction was MCRP, ODNR-DMRM and Ohio EPA 319. Figure 3 and 4 (shown on page 3 of this report) estimate approximately 143 lbs/day of acid and 0 lbs/day of metals were prevented from entering into Monday Creek as a result of Phase I and II of the Lost Run AMD reclamation project.

Water Quality Report

Water samples were collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

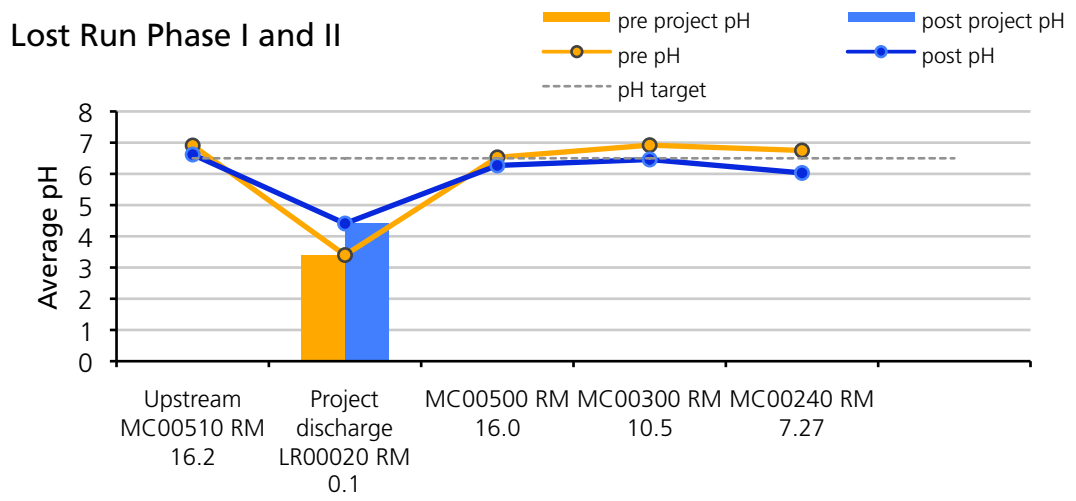
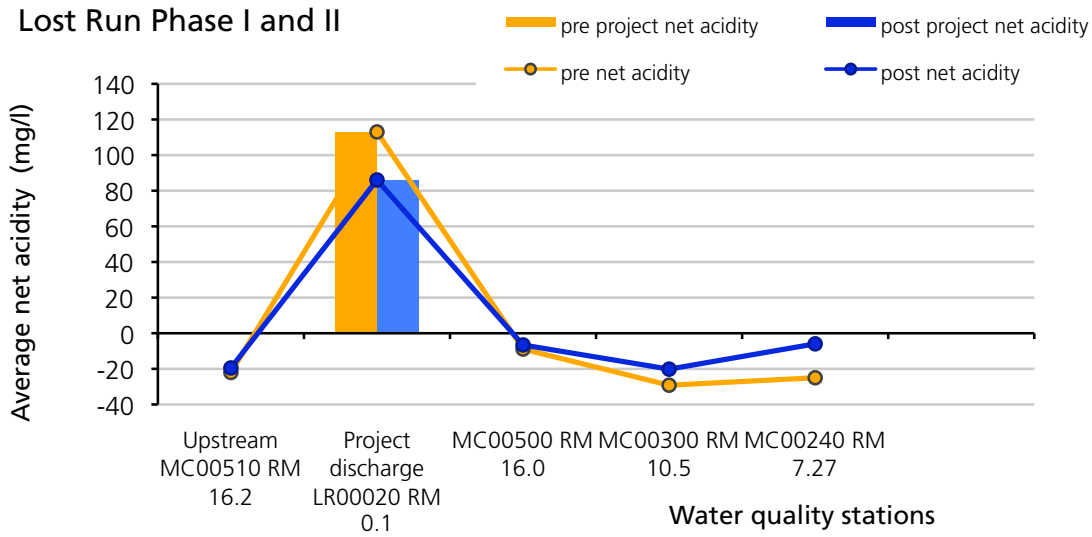


Figure 2. Pre and Post Acidity



As a result of the Lost Run Phase I and II Project, pH and net acidity have improved at the mouth of Lost Run. Pre-construction data shows pH at 3.4 at the mouth of Lost Run. After installation of the Lost Run Phase I and II Project, initial post-construction data shows pH at 4.4 at the mouth of Lost Run. The net acidity concentration decreased 24% at the mouth of Lost Run.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre-, and post-construction at the project discharge from 3/21/2005 to 6/20/2007 for pre-construction and from 1/1/2008 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

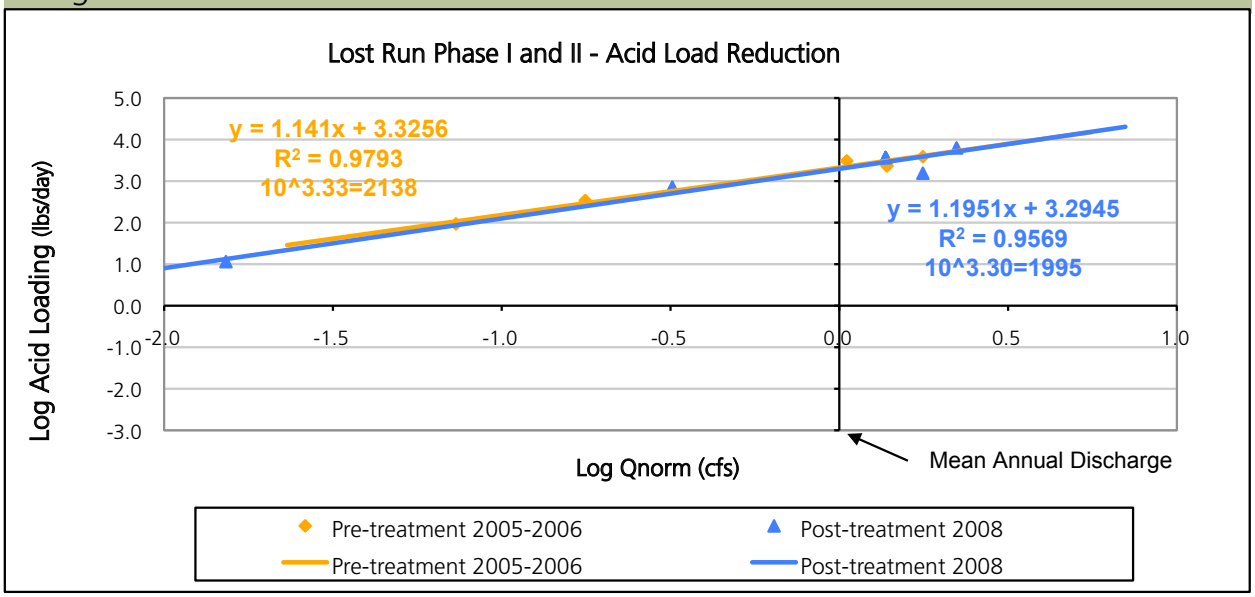
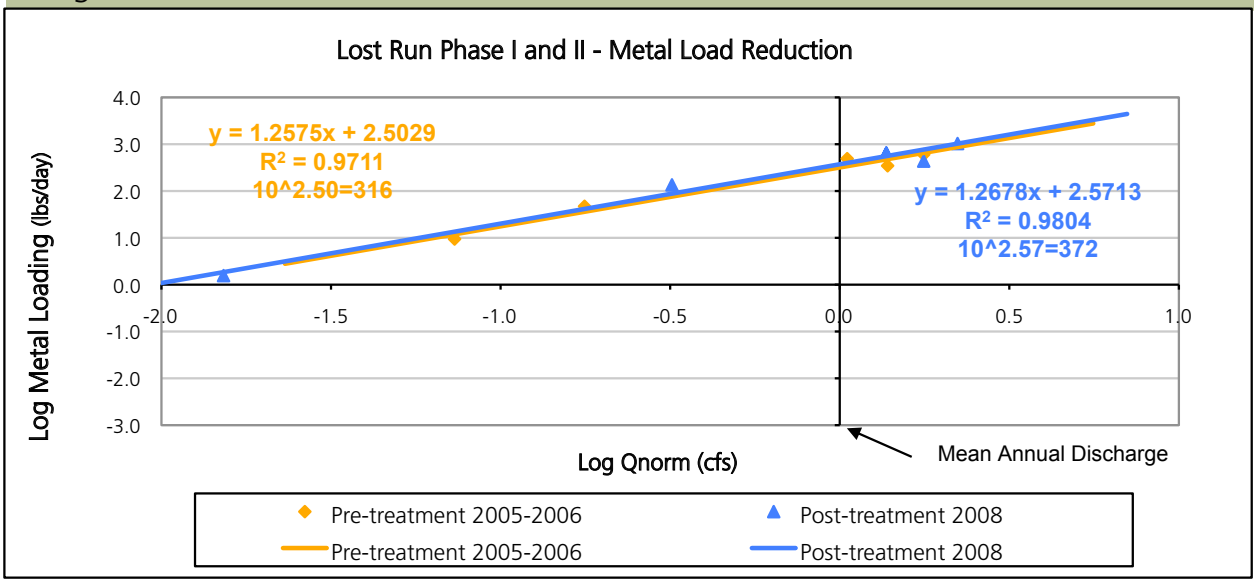


Figure 4. Metal Load Reduction

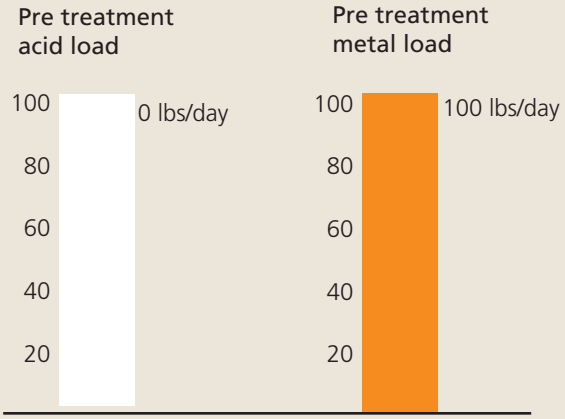


Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Project Status: Complete 9/23/2008 ODNR Project Number: PR-SL-19

Pre-construction

Shawnee Waste Water Plant
Photo by Monday Creek Restoration Project



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Shawnee Steel Slag Bed is located in Section 17 of Salt Lick Township in Perry County and lies within the 14 digit HUC unit #05030204060020. Shawnee Steel Slag Bed reclamation project consists of constructing a steel slag leach bed at the effluent from the Shawnee waste water treatment plant to add alkalinity to Monday Creek. The design was completed by Ohio Department of Natural Resources Division of Mineral Resources Management ($20,000). The treatment consists of one 22,800 square foot steel slag bed, 190 linear feet of open limestone channel, and a sand filter to collect suspended solids and algae before entering the steel slag bed. The goal of the design is to boost net alkalinity on the mainstem to meet an alkalinity target of 30 mg/l and maintain a pH in the 6-9 range for approximately four miles downstream. Construction was complete 9/23/2008 by Tucson, Inc, for a cost of $199,791. The funding sources for this project was ODNR-DMRM for the design and Ohio EPA 319, ODNR-DMRM, and MCRP for construction.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

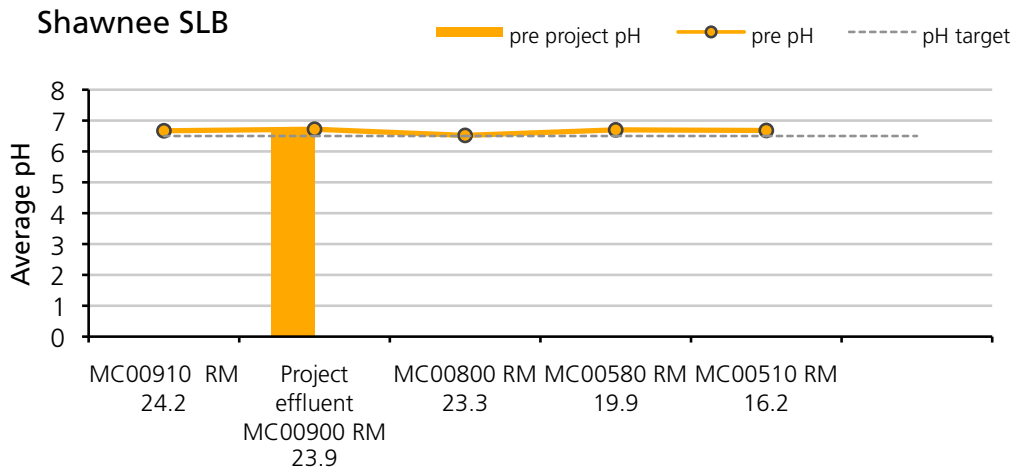
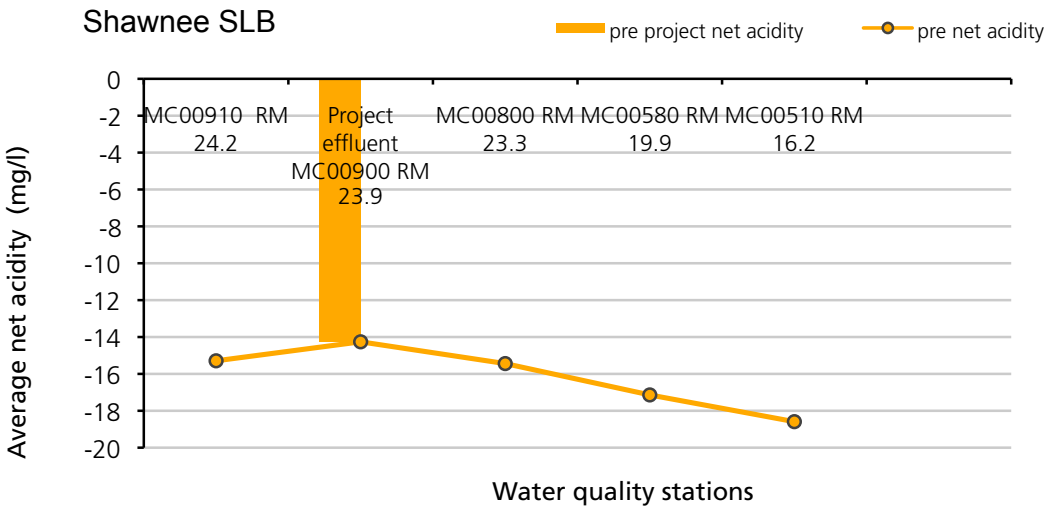


Figure 2. Pre and Post Acidity



Data from the Shawnee Steel Slag Bed Reclamation project pre-construction monitoring show pH and net acidity at project discharge and along the mainstem of Monday Creek, shown above. Pre-construction data shows pH in the range of 6.5 to 6.7 and net alkaline conditions in the range of -14 to -19 at the effluent and downstream of the project on Monday Creek. Post-construction data will be evaluated and reported in the 2009 annual report.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum, and discharge were measured pre-construction at the project effluent from 2/04/2008 to 9/23/2008 for pre-construction. Post-construction data will be evaluated in the 2009 NPS report.

Figure 3. **Metal Load Reduction**

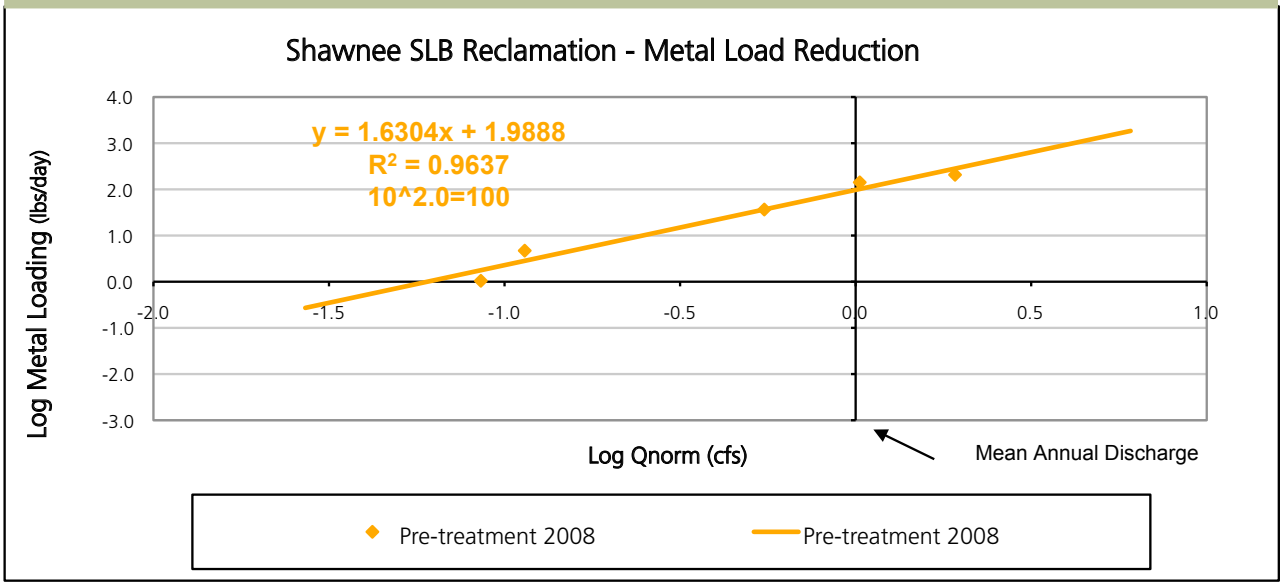
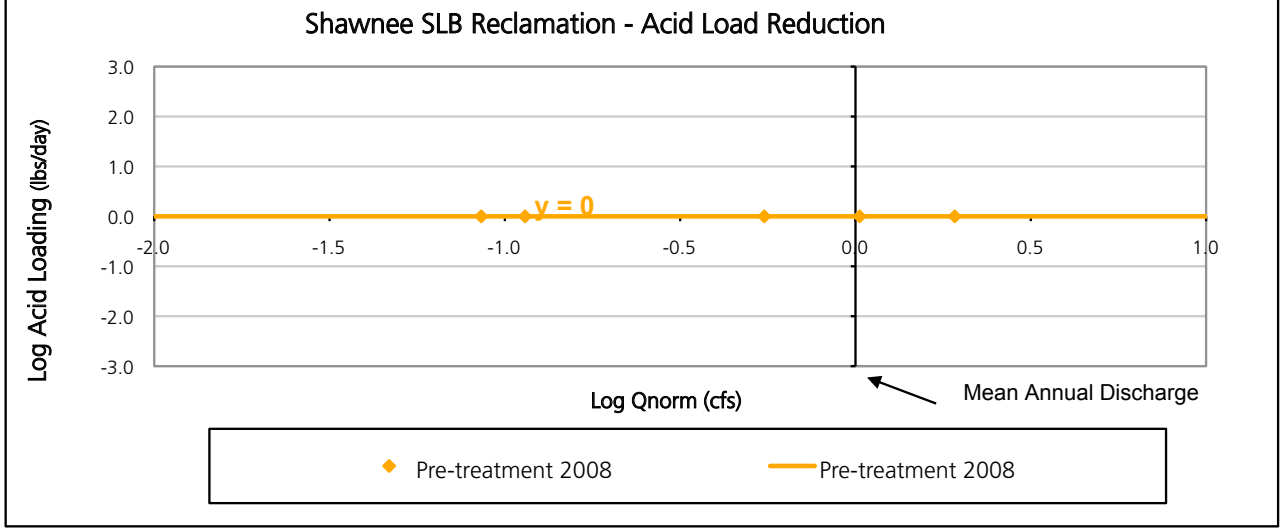


Figure 4. **Acid Load Reduction**



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

In-progress

Lost Run Subsidence (site CDE) in-progress closure
Photo by: Mike Grebeck

In-progress

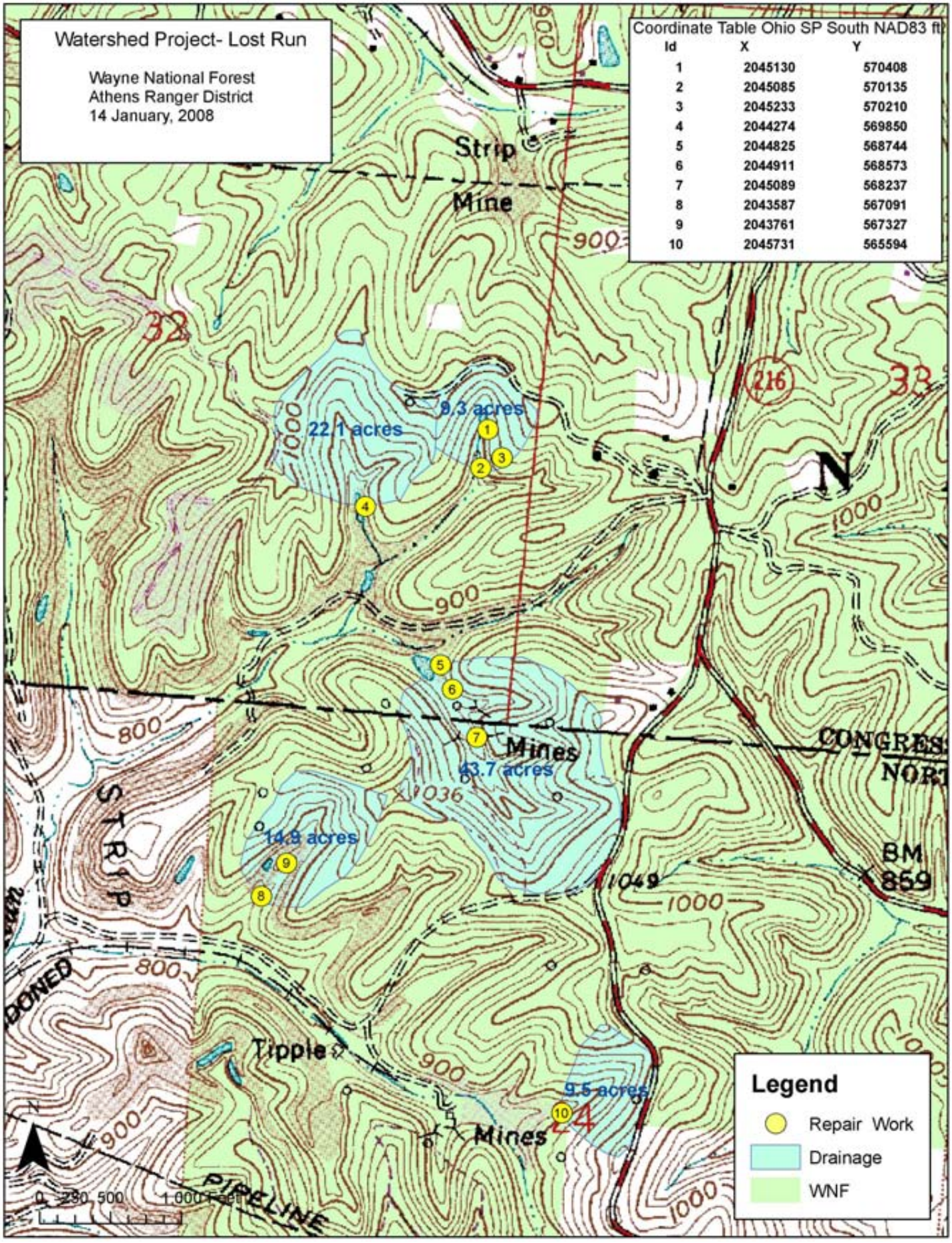
Lost Run subsidence (site CDE) closed. OLC in progress.
Photo by: Mike Grebeck

Post-Construction Estimated Effects

Amount of water returned to the stream and diverted from entering the deep mine and generating acid mine drainage

Gallons/yr = 35,000,000

Lost Run Subsidence and Portal Closures are located in Section 33 of Coal Township in Perry County and lies within the 14 digit HUC unit #05030204060010. The site footprint is approximately 250 acres and is located in the Lost Run subwatershed a tributary to Monday Creek. The Wayne National Forest partnered with the Monday Creek Restoration Project and the ODNR-DMRM to close ten subsidence and portal features in this subwatershed. The design was completed by USFS engineers for approximately $7,000. The treatment approach was to seal the mine entries to keep water on the surface and for safety purposes. The goal of the design was to keep water out of the underground mine complexes, eliminating the generation of acid mine drainage. Approximately 100 acres of drainage area were restored from captures and 3,280 linear feet of limestone channels were installed. During the design process two additional holes opened up, engineers changed the design to allow for additional work. By closing these ten features, 100- acre drainage area was restored, allowing clean surface water to return to Lost run and decrease 35,000,000 gallons/yr of water from entering the deep mine and becoming acid mine drainage at deep mines discharges in Lost Run and Sycamore Hollow. The project goal was met by 100 percent. Construction was complete November 1, 2007 by D. J. Group for a cost of $321,900. The major responsibility of the construction company was to perform tasks outlined in the plans and specifications to close all subsidence and portals. The funding sources for this project were for both the design and construction was the USFS.


Watershed Project- Lost Run
Wayne National Forest
Athens Ranger District
14 January, 2008
Coordinate Table Ohio SP South NAD83 ft
Id X Y
1 2045130 570408
2 2045085 570135
3 2045233 570210
4 2044274 569850
5 2044825 568744
6 2044911 568573
7 2045089 568237
8 2043587 567091
9 2043761 567327
10 2045731 565594
Strip Mine
22.1 acres
9.3 acres
43.7 acres
14.9 acres
9.5 acres
Mines
Tipple
PIPELINE
Legend
Repair Work
Drainage
WNF
0 250 500 1,000 Feet

Section III – AMD project reports

Sunday Creek Watershed comprehensive acid mine drainage projects progress report for 2008.

Section III contains individual AMD project reports displaying photos of the project site, a description of the project, water quality data at the site and its impact to the receiving stream, and acid/metal loading reductions as a result of the project.

List of acid mine drainage reclamation projects reported on in the 2008 NPS monitoring report:

1. Rodger's Hollow Stream Capture
2. Pine Run Stream Capture
3. Corning Gob Floodplain

Archive

4. Congo Run Stream Capture (CR-15) – Status Complete*

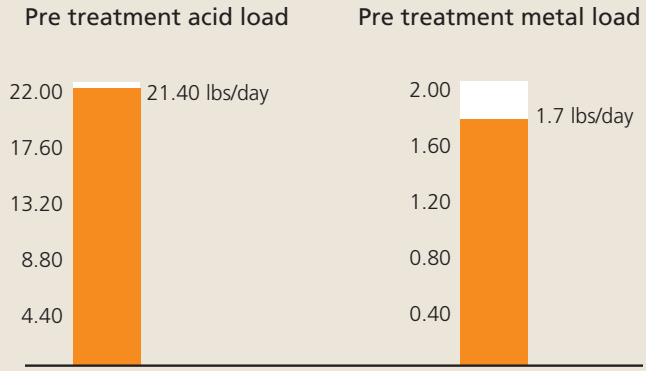
* "Status Completed" projects are no longer being monitored

Project Status: Funded - completed 12/14/2007 ODNR project number:PR-Mn-16

Pre-construction

One of Rodger's Hollow primary stream captures during wet conditions, Photo by Sunday Creek Watershed Group

SITE: WB49

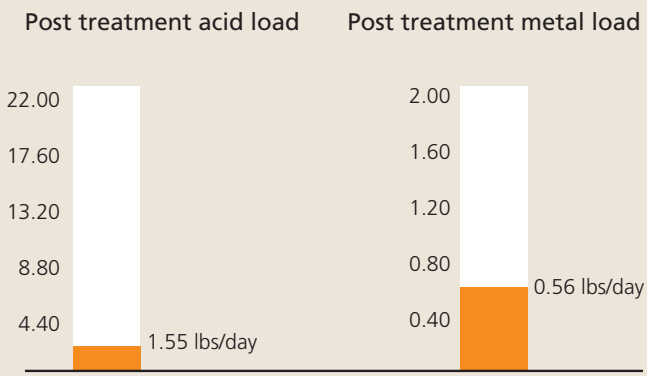


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Completed natural channel stream, Photo by Kaabe Shaw

SITE: WB49



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Rodger's Hollow Stream Capture is located in Section 17 of Monroe Township in Perry County and lies within the 14 digit HUC unit #05030204070030. The site is located in Congo Run subwatershed north of Drakes. There are two primary and four secondary stream captures. The design was completed by Fuller, Mossbarger, Scott, May Engineers, Inc. for a cost of $109,725. The treatment approach was to close primary and secondary stream captures and divert the channel, using natural stream design concepts (900 linear feet), away from the existing location which is an unstable abandoned coal pit along a highwall as well as add 879 linear feet of open limestone channels. Currently 1,600 acres (2.5 square miles) of surface water drains into the deep mine complex creating acid mine drainage at down-dip seep discharges in Drakes (WB 49 and 49/36). The goal of the design is to return 100 percent of stream water back into Congo Run thus adding alkalinity to Rodger's Hollow/Congo Run and reducing acid mine discharges in Drakes. Construction was completed December 14, 2007 by Tucson Inc. for $266,826. The funding source for the project design was ODNR-DMRM and construction was OEPA 319. Figures 4 and 5 (shown on page 3 of this report) estimate approximately 19.85 lbs/day of acid and 1.18 lbs/day of metals were reduced from entering West Branch of Sunday Creek from Drakes seep WB 49 as a result of the subsidence closures in the up-dip adjacent Rodgers Hollow. Reduction of acid and metals from the Drakes wetlands (site 36 and 49/36) has not been documented due to changes in flow route. However, WB 49 is seen as the primary source of AMD in Drakes and has seen a 75% reduction in flow following the subsidence closures. In addition Congo Run the receiving stream from the Rodgers Hollow project as expected has seen, on average, an increase in pH from 6.71 to 6.91, a decrease in net acidity from -39.01 to -43.73 mg/l and an increase in flow from 0.77 to 2.33 cfs.

Post-Construction Estimated Effects

Expected amount of water to return to the stream and be diverted from entering the deep mine generating acid mine drainage is: **Gallons/yr = 589,290,000**

Post-Construction Estimated Effects

Expected amount of alkalinity loading added to the streams providing buffering capacity to the watershed: **Alkalinity load = 758 lbs/day**

Water quality report

Water quality data was collected at the suspected AMD discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of West Branch in Drakes. This stream was been monitored because of its possible connected to the Rodgers Hollow deep mine where the subsidence closures were constructed.

Figure 1. Pre and Post pH

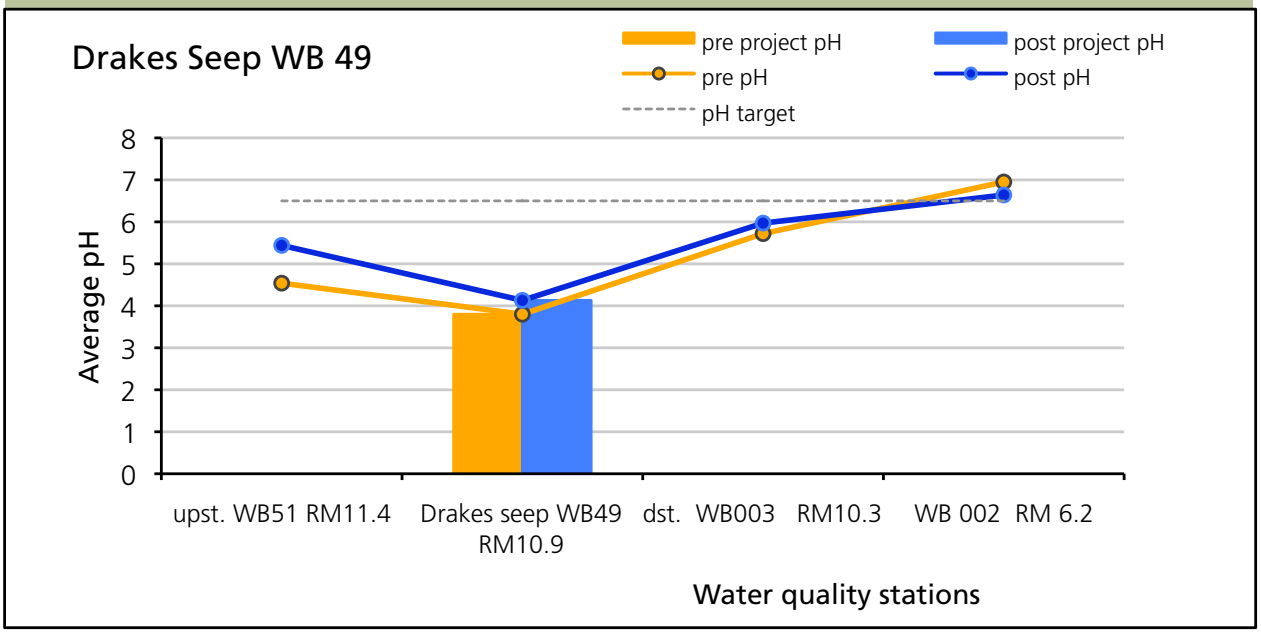
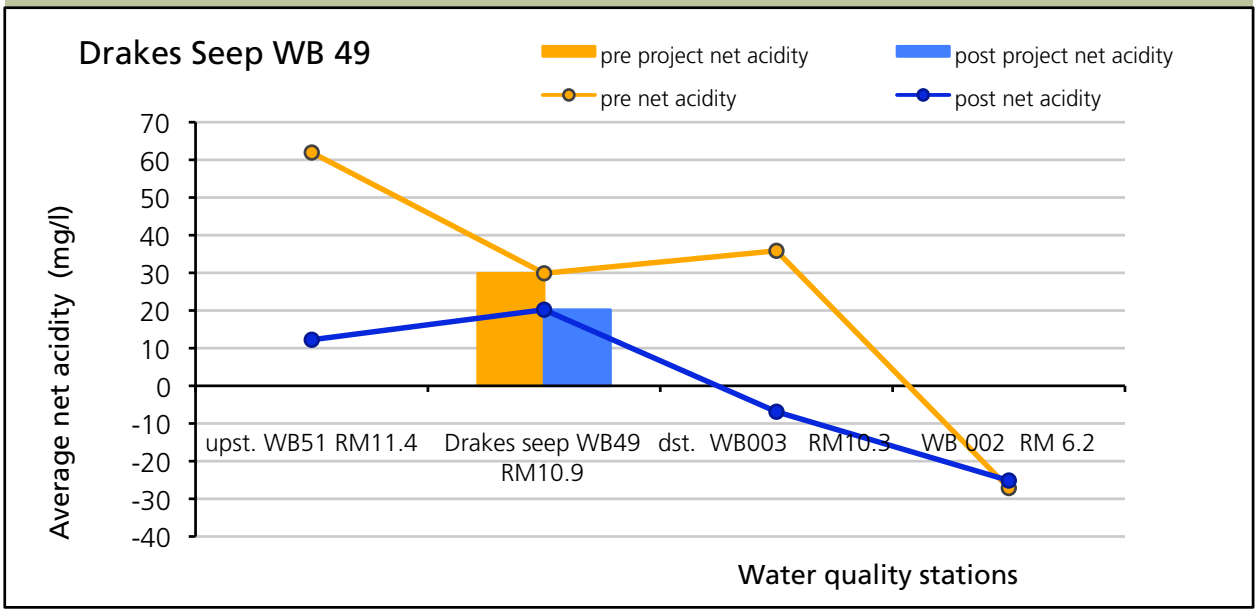


Figure 2. Pre and Post Acidity



Data analysis

Rodgers Hollow subsidence closure project monitoring along the West Branch of Sunday Creek in Drakes show pH and net acidity upstream, at the Drakes Seep WB 49, and along the mainstem of West Branch downstream of the seep discharge. Pre-construction data show pH in the range of 3.8 to 6.95, at the AMD discharge and downstream. Post-construction data show pH in the range of 4.13 to 6.64. Net acidity has decrease at the Drakes Seep by 32 % and flow has decreased by 75%.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- construction at the project discharge from 4/24/2001 to 1/29/2007 for pre-construction and 1/15/2008 to 12/31/2008 for post-construction.

Fig.3 Acid Load reduction

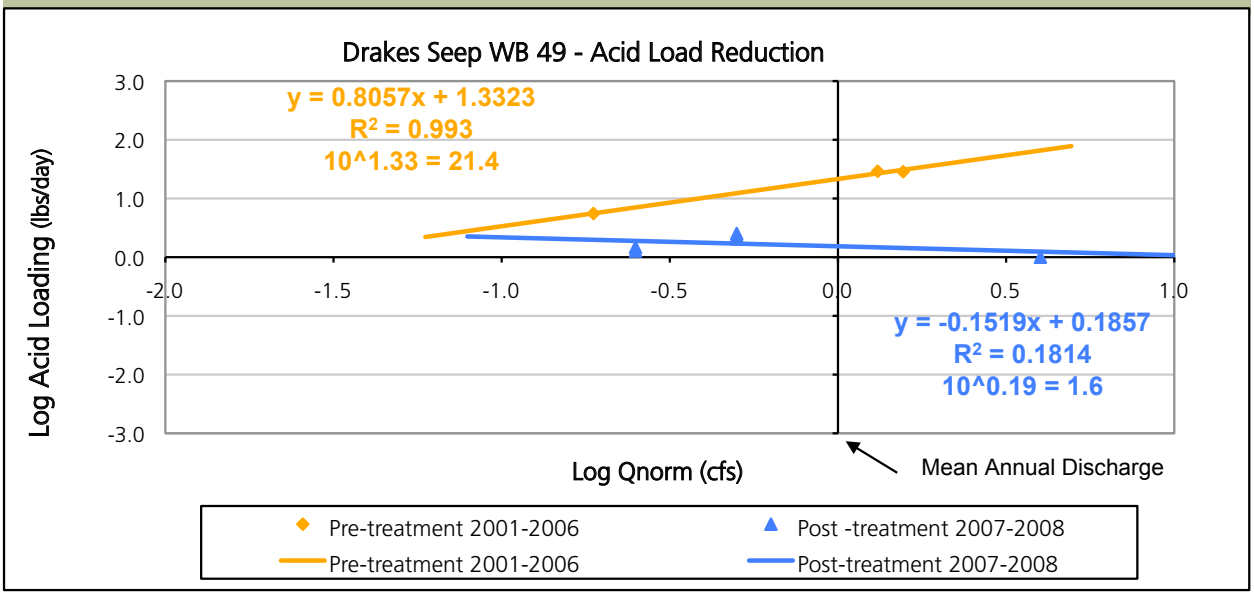
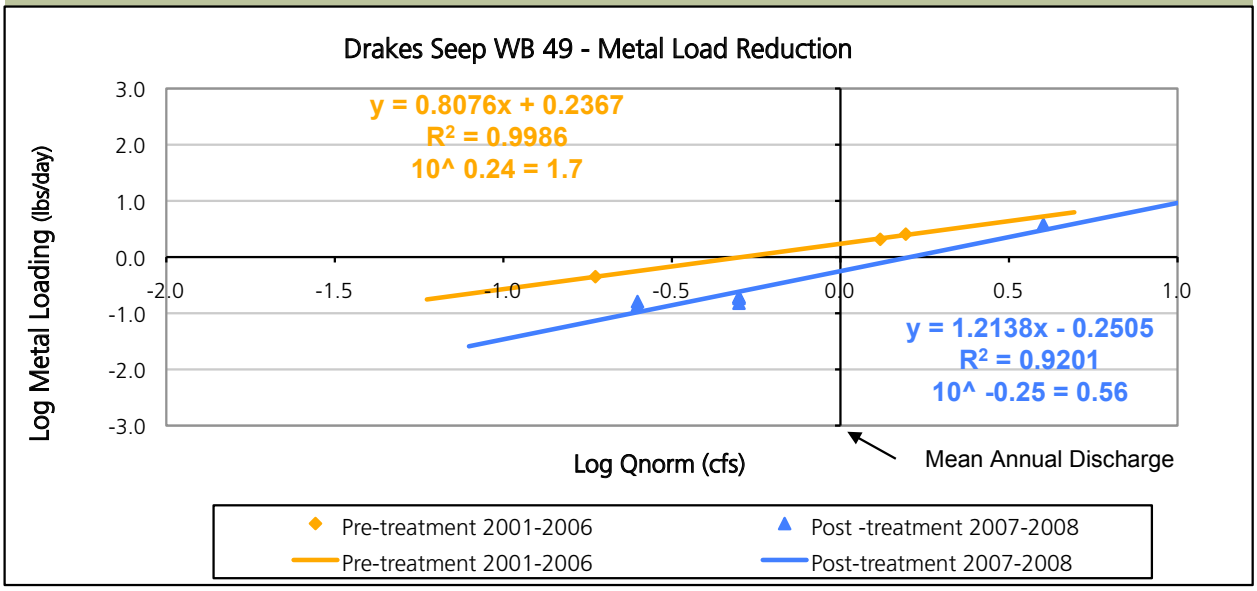
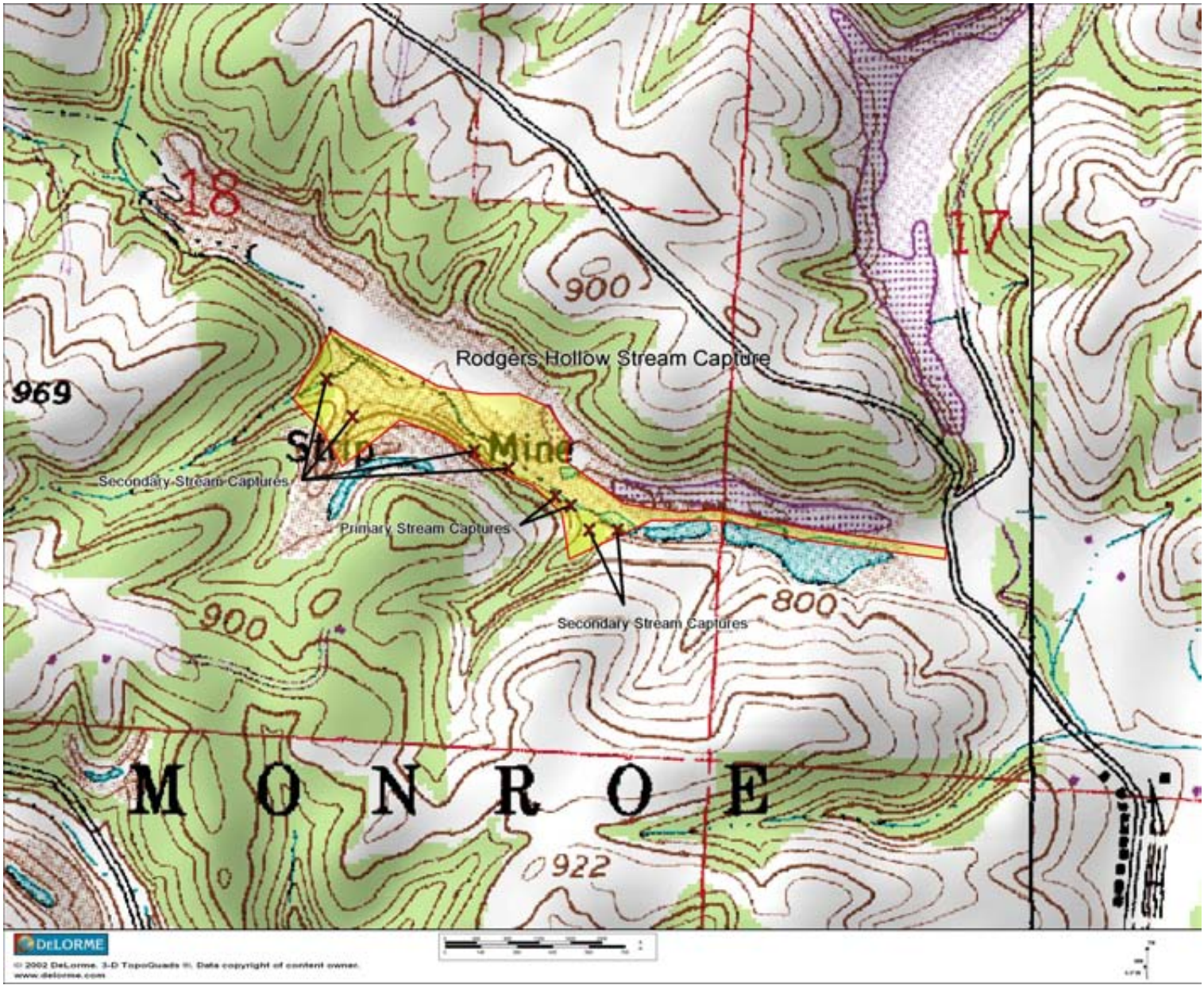


Fig. 4 Metal Load Reduction



As expected a substantial difference in discharge has been recorded at the Drakes Seep site WB49 from pre-subsidence closure to post-closure in Rodger's Hollow. Therefore, when determining the mean annual average discharge for this site for use in the "Mean Annual Acidity Load" calculation, the mean annual discharge was determined separately for each time period (pre-closure 0.16 cfs, post-closure 0.04 cfs).

Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.


18
17
900
969
Rodgers Hollow Stream Capture
Secondary Stream Captures
Primary Stream Captures
Secondary Stream Captures
800
900
M O N R O E
922
DeLORME

Project Status: Completed- 4/30/2007 ODNR Project Number: PR-SI-15

Pre-construction

Pine Run Subsidence under wet conditions
Photo by Sunday Creek Watershed Group

Post-construction

Pine Run newly constructed channel
Photo by Sunday Creek Watershed Group

Post-Construction Estimated Effects

Expected amount of water to return to the stream and divert from entering the deep mine and generating acid mine drainage is:

Gallons/yr = 50,867,000

Expected amount of alkalinity loading added to the streams thus providing buffering capacity to the watershed is:

Alkalinity load = 46 lbs/day

Pine Run Stream Capture is located in Section 14 of Salt Lick Township in Perry County and lies within the 14-digit HUC unit #05030204070030. The site is located in Pine Run subwatershed near Sulphur Springs. There are three subsidence features at the project site. Of the three subsidence features one is a stream capture, while the other two features occur in the valley floor rather than the stream bed, therefore only capturing water during high flow events. Aside from the subsidence caused from the underground mines several seeps also occur including one at the main drift entrance of the mine and an exposed coal that was disturbed when the road was built. The design was completed by ODNR-DMRM for a cost of $36,544. The treatment approach is to create a natural stream channel for fresh water, divert flow into a new channel and to close stream captures and subsidence features to reduce flow into the deep mine. Currently 138 acres of surface water drains into the deep mine complex creating acid mine drainage that discharges, down-dip at mine portals and seeps. The goal of the design is to prevent stream flow into the mine complex Py-76 to reduce flow at down-dip discharges and add alkaline water into Pine Run. Major considerations for this design were to minimize impact to large trees, use a natural stream design and minimize impact on a county road. The construction for this project was completed by Maiden and Jenkins for a cost of $71,981 The major responsibility of the construction company was to close three subsidence features and create natural channel for positive drainage to Pine Run. The funding sources for this project are ODNR-DMRM for design and OEPA 319 and ODNR-DMRM for construction.

Water Quality Report

Water quality data was collected at multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

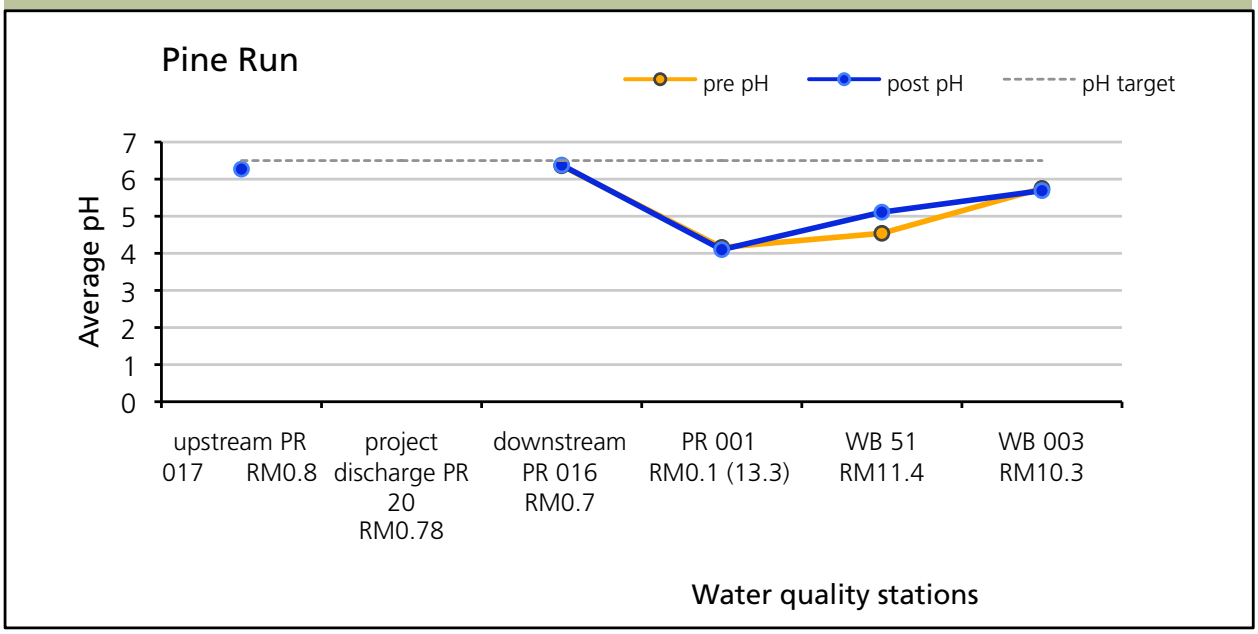
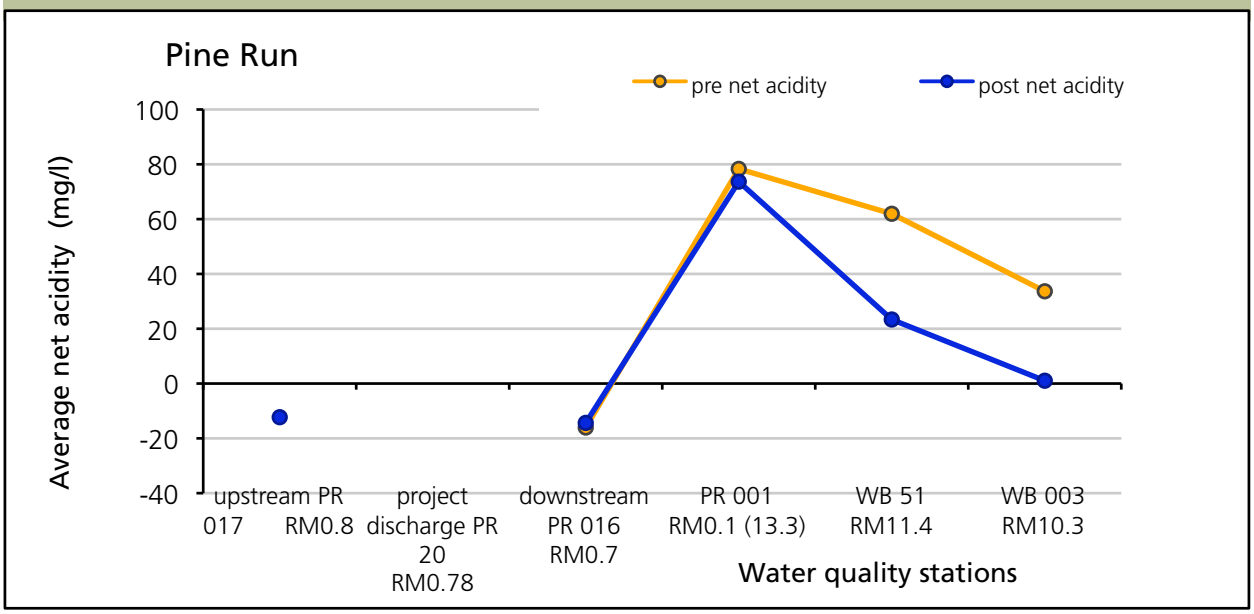


Figure 2. Pre and Post Acidity



As a result of the Pine Run stream capture project, an estimated 50,867,000 gallons/year will be diverted into Pine Run and not into the deep mine Py-76. A slight increase in pH and alkalinity have been measured downstream of the project tributary since last years' report. Pre-construction data shows pH in the range of 4.16 – 6.4 downstream of the project. After closure of the subsidence holes and returning water in Pine Run, post-construction data shows pH in the range of 4.1-6.4 downstream of the project. PR003 is a seep thought to be linked to the py-76 mine complex, a increased in volume and, possibly, acidity was measured this year, pH slightly increased from 4.13 (n:23) to 4.28 (n:6) as well as a slight decrease in flow from 0.302 cfs to 0.235 cfs. Net acidity decreased at the site PR003 see figure 3 and 4, net acidity loading decreased 22 lbs/day, while metals showed no decrease.

Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at site PR003 thouth to be linked to deep mine complex Py–76 from 1/1/2001 to 4/30/2007 for pre-construction and from 5/1/2007 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

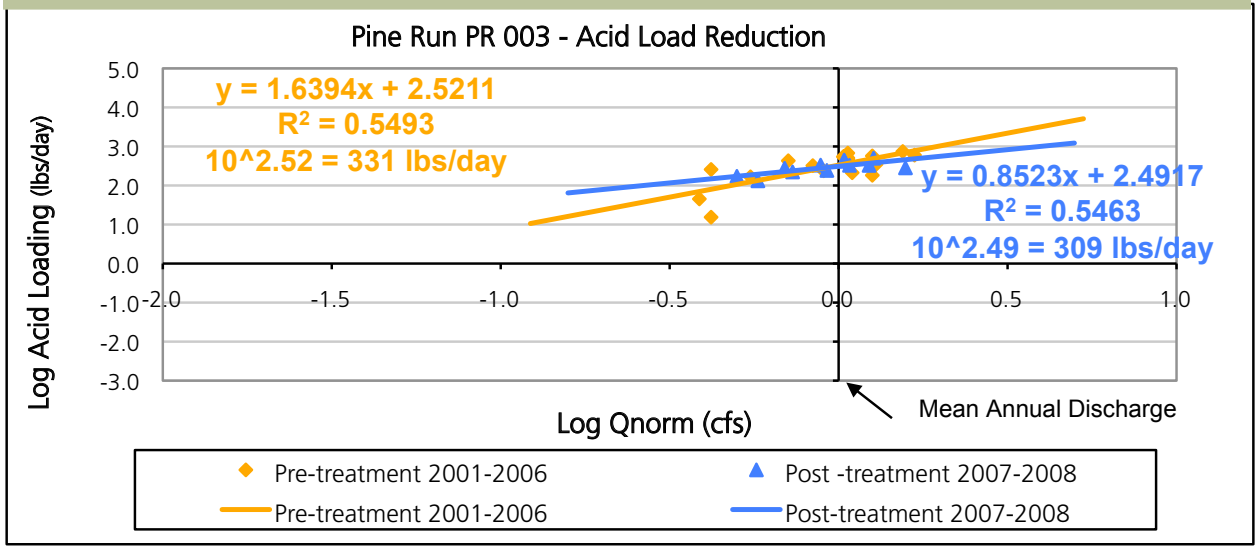
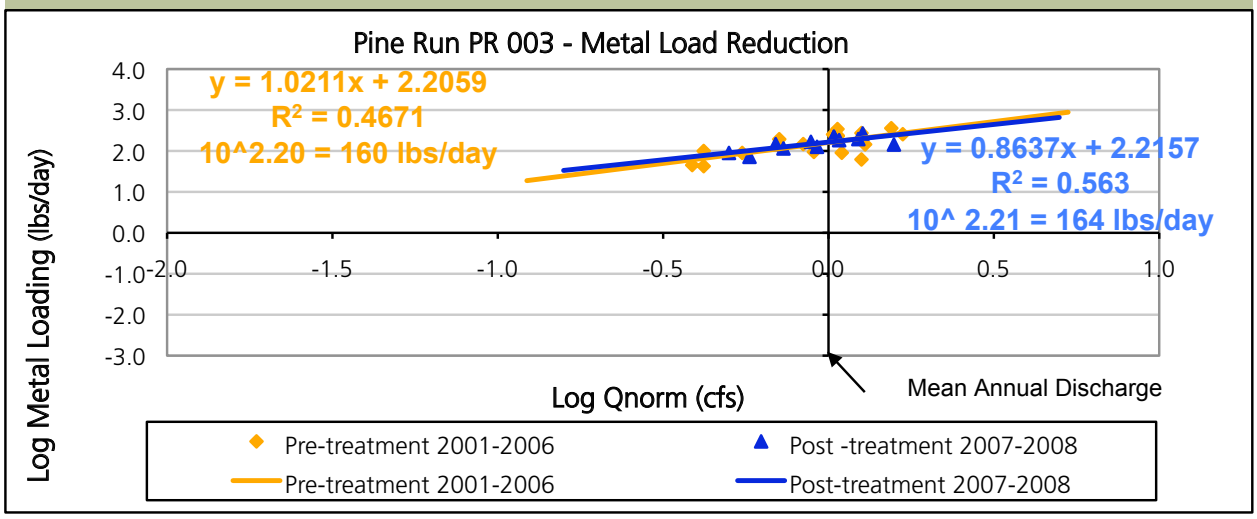
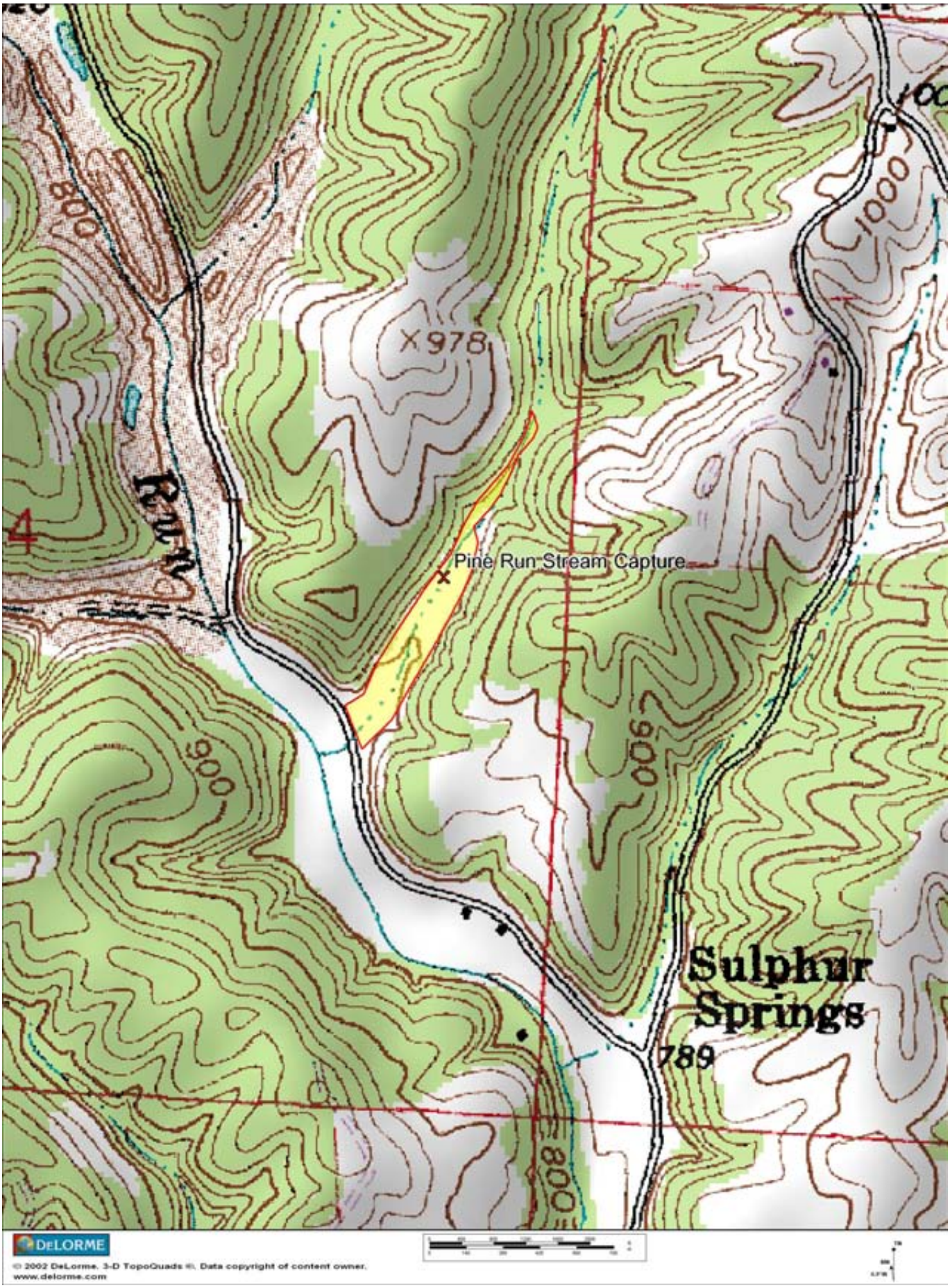


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.


Pine Run Stream Capture
Sulphur Springs
789
X978
800
900
1000
DeLORME
© 2002 DeLorme, 3-D TopoQuads ®\ Data copyright of content owner.
www.delorme.com

Project Status: Completed 11/19/2007 ODNR Project Number: PR-Mn-12

Pre-construction

Coal Refuse along stream bank
Photo by Bill Jonard

Post-construction

Vegetation established on reclaimed gob pile.
Photo by Kaabe Shaw

Corning Gob Pile is located in Section 4 of Pleasant Township in Perry County and lies within the 14 digit HUC unit #05030304070010. The project site is 5 acres and is located in the Headwaters of Sunday Creek north of Rendville. Due to the lack of vegetative cover, the 5 acre gob pile is eroding along the slopes and creating AMD discharge into the Headwaters of Sunday Creek. The upper and lower gob piles are the result of underground mining that occurred east of the area. One AMD seep occurs within the eastern portion of the site at an abandoned entry, but rarely discharges water into Sunday Creek. Project discharge was measured at the pond discharge from coal refuse area (CG02). The design was be completed by ODNR-DMRM for a cost of $1,710. The treatment approach for this site is to remove all coal refuse located in the floodplain and along the stream bank of Sunday Creek. The major consideration for this project was not to impact the stream configuration, re-establish a floodplain, move refuse to higher elevation and cover with soil to reduce contact with air and water. The goal of the design is to reduce metal loadings from headwaters of Sunday Creek. Funding for this project was ODNR-DMRM in house design in conjunction with Federal AML Program site and Ohio EPA 319 for construction. The construction was completed by McMillan on 11/19/2007 for a cost of $130,069.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations downstream pre- and post- construction. The graphs below show pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream to downstream of the project discharge as a result of the gob pile reclamation project.

Figure 1. Pre and Post pH

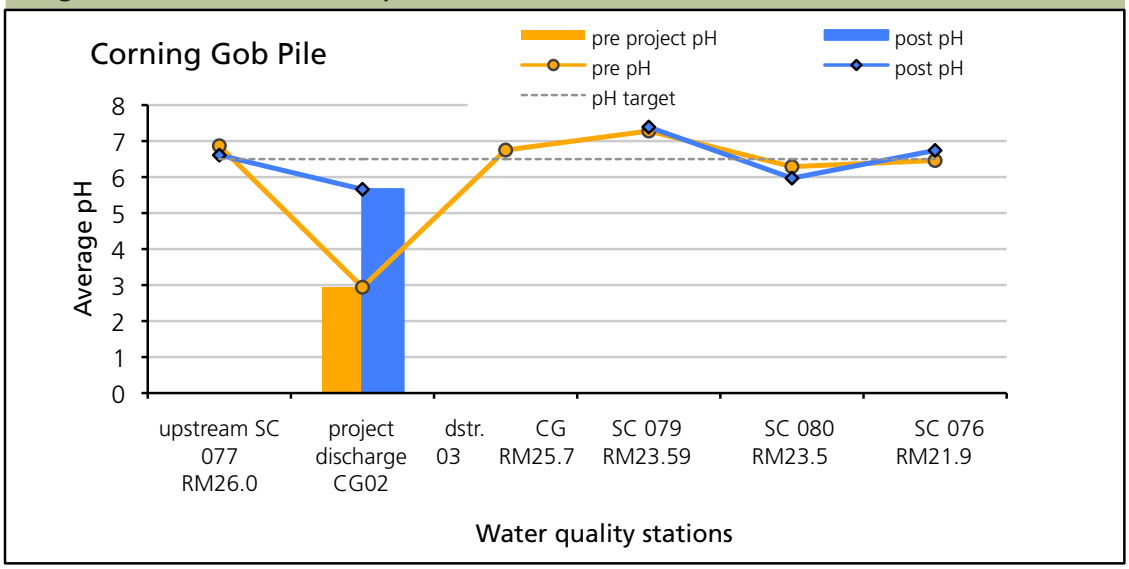
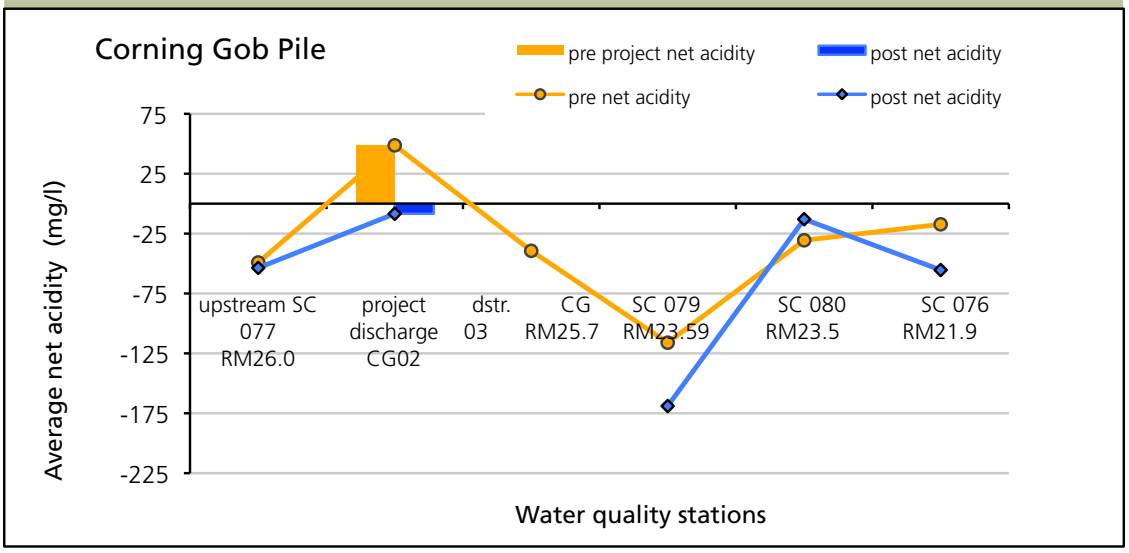
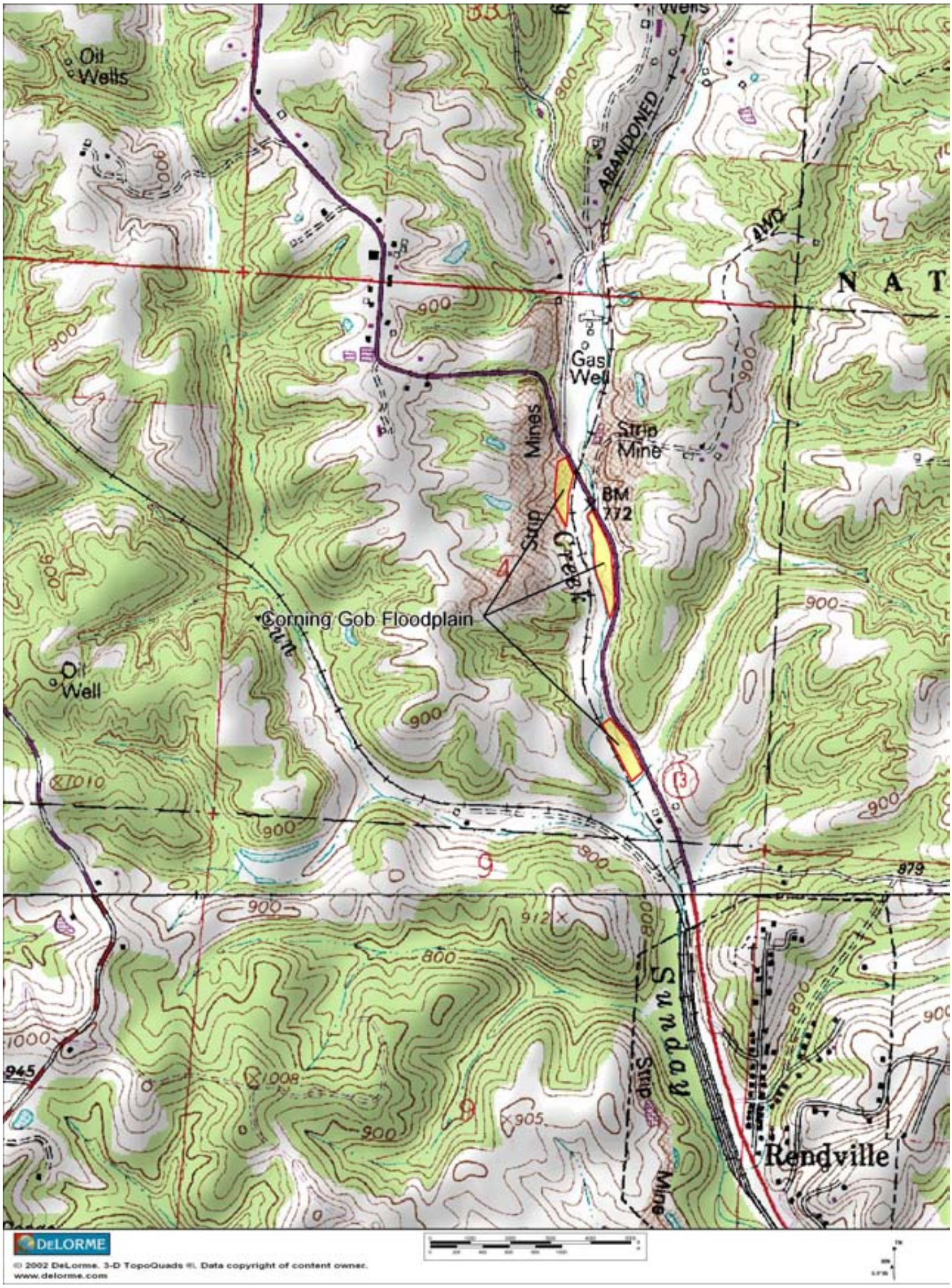


Figure 2. Pre and Post Acidity



As a result of the Corning Gob Floodplain project, pH and net acidity have improved at the project discharge and immediately downstream for two miles. Further downstream between sites SC 079 and SC080, the Corning AMD discharge enters into Sunday Creek and the effect can be seen at site SC 080. However, at the Corning Gob Floodplain project discharge and immediately downstream during pre-construction show pH in the range of 2.9 – 7.27. After construction pH increases and is in the range of 5.66 to 7.39. Net acidity concentration decrease 100% and are now net alkalinity at the project discharge (Site CG 02).


Oil Wells
ABANDONED
Gas Well
Strip Mines
Strip Mine
BM 772
Sugg Creek
Corning Gob Floodplain
Oil Well
Sunday Run
Strip Mine
Rendville
DeLORME
© 2002 DeLorme. 3-D TopoQuads ®. Data copyright of content owner.
www.delorme.com

Project Status: Archive Complete 7-9-2004 ODNR Project Number: PR-Mn-13

Pre-construction

Stream capture at highwall
Photo by Bill Jonard

Post-construction

New channel created above old stream capture
Photo by Bill Jonard

Post-Construction Estimated Effects

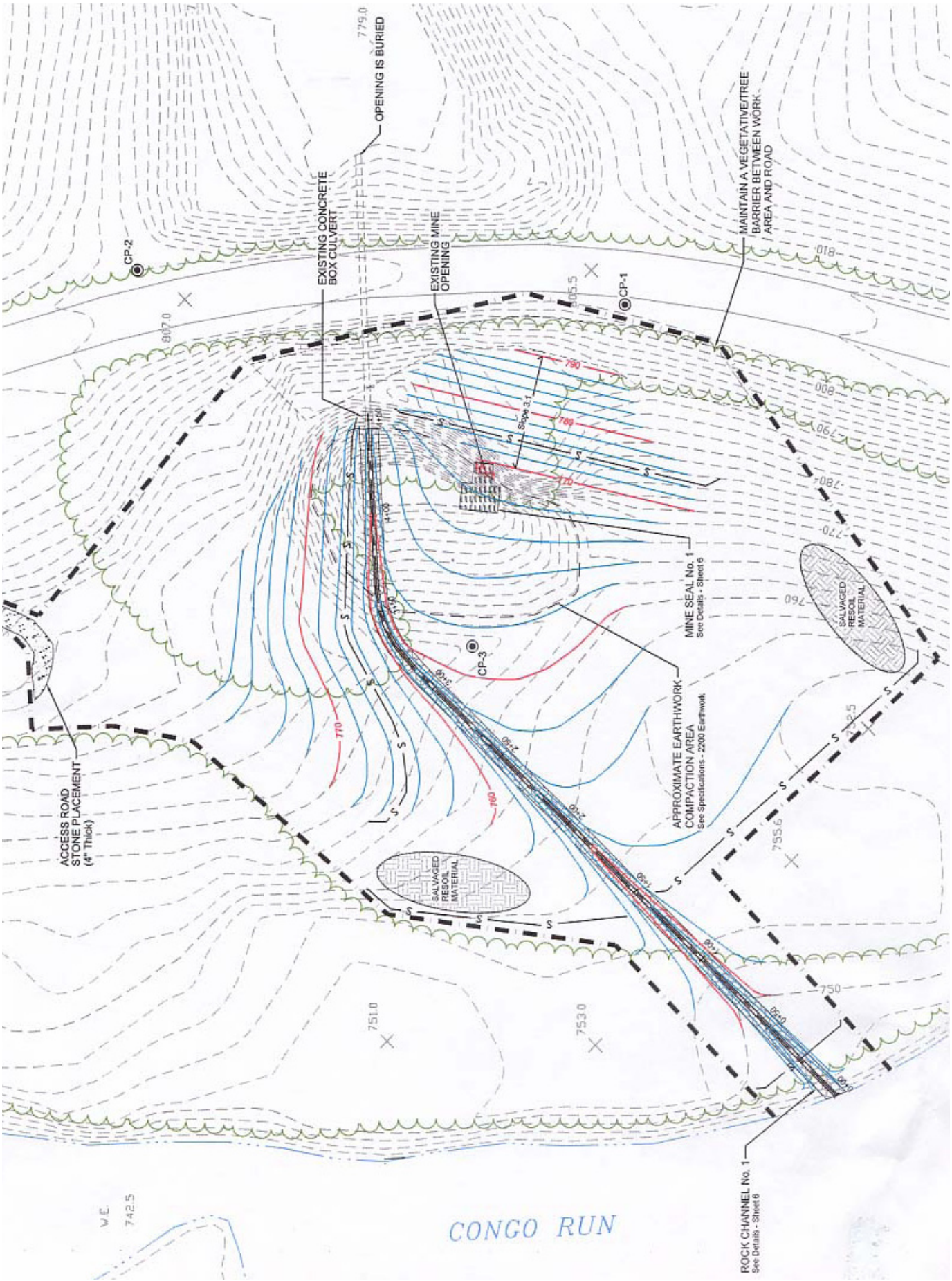
Estimated amount of water diverted from generateing acid mine drainage.

Gallons/yr = 24,000,000

Estimated amount of alkalinity loading added to the streams, thus providing buffering capacity to the watershed.

Alkalinity load = 60 lbs/day

Congo Stream Capture (CR-15) is located in Section 17 of Monroe Township in Perry County and lies within the 14-digit HUC unit #05030204070030. The site is located in Congo Run subwatershed near the town of Congo. The deep mine opening and stream capture is located east of the Congo Strip Lakes and southwest of the town of Congo. The design was completed by ODNR-DMRM. The treatment approach was to seal the mine entry at the abandoned highwall and fill in the pit to allow the stream discharge, of the 72-acre drainage area, to reach Congo Run. The goal of the design was to close the stream capture hole and return 100 percent of the stream flow to Congo Run, thus allowing clean surface water to return to Congo Run and preventing 24 million gallons/yr of water from entering the deep mine and becoming acid mine drainage at surrounding deep mines discharges. The project goal was met by 100 percent. Construction was complete July 9, 2004, by Perry Reclaiming for a cost of $35,522.60. The major responsibility of the construction company was to perform tasks outlined in the plans and specifications to eliminate the stream capture and create a channel to carry flows to Congo Run. The funding sources for this project were ODNR-DMRM for the design and OSM-ACSI for construction.


OPENING IS BURIED
EXISTING CONCRETE BOX CULVERT
EXISTING MINE OPENING
MAINTAIN A VEGETATIVE/TREE BARRIER BETWEEN WORK AREA AND ROAD
CP-1
CP-2
CP-3
MINE SEAL No. 1
See Details - Sheet 6
SALVAGED RESOIL MATERIAL
APPROXIMATE EARTHWORK COMPACTION AREA
See Specifications - 2200 Earthwork
ACCESS ROAD STONE PLACEMENT (4" Thick)
ROCK CHANNEL No. 1
See Details - Sheet 6
CONGO RUN
Slope 3.1

Section III – AMD project reports

Huff Run Watershed comprehensive acid mine drainage projects progress report for 2008.

Section III for the Huff Run Watershed contains, in addition to the individual AMD project, one comprehensive report listing completed and funded AMD projects; displaying photos of the project site, a description of the project, water quality data change at the mouth of Huff Run (station HRR08/HR 32) and the impact of all the reclamation projects from the period 1976-1997 for pre-construction to 1997-2008 for post construction. Acidity and pH graphs have been generated for all completed projects. Acid and metal load reductions were calculated with limited discharge data for: Linden, Lindentree, and Lyons. Farr, Acid Pit #1, and Harsha are lacking either pre or post discharge data to generate the acid and metal load reductions.

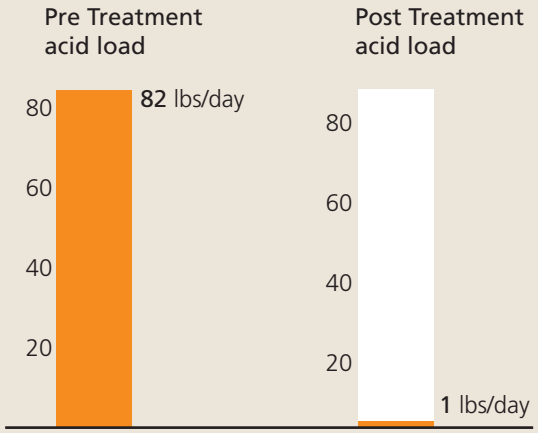
List of acid mine drainage reclamation projects reported on in the 2008 NPS monitoring report:

1. Farr project
2. Linden Bioremediation project
3. Acid Pit #1 (Phase I) project
4. Lindentree project
5. Harsha North project
6. Lyons project
7. Fern-Hill HR-42 project
8. Belden project
9. Thomas project
10. Mineral Zoar Road AMD project

Archive

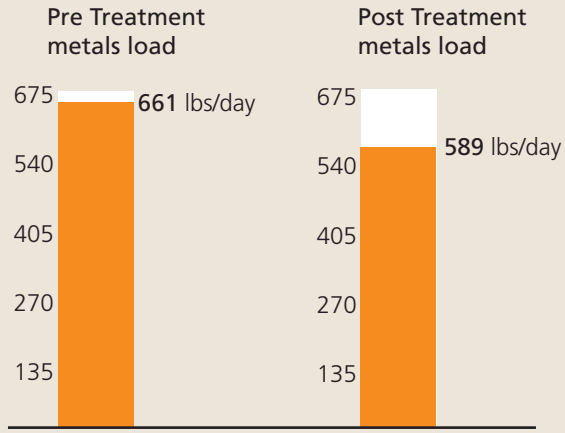
11. Huff Run AML project – Status Completed*

* "Status Completed" projects are no longer being monitored



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Mouth of Huff Run used for this analysis



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Mouth of Huff Run used for this analysis

Huff Run is located in Sandy Township in Tuscarawas County and Rose Township in Carroll County. The watershed has a 14 square mile drainage area and flows ten miles long before discharging into Conotton Creek. The completed projects in Huff Run are evaluated collectively at the mouth of Huff Run (Station HRR08/HR 32). Since 1999 seven projects have been completed and are shown on the following pages. The designs and construction were completed by a variety of companies. The funding sources for these projects for both design and construction were ODNR-DMRM, Ohio EPA 319, and OSM Clean Streams. Figure 3 and 4, estimate that approximately 81 lbs/day of acid and 72 lbs/day of metals were reduced from entering Huff Run as a result of these AMD reclamation projects.

List of construction projects completed since 1999:

1. Huff Run AML 1999 "status complete"
2. Farr 2003
3. Linden Bioremediation 2003
4. Acid Pit #1 2004
5. Lindentree 2005
6. Lyons 2005
7. Harsha North 2006
8. Fern Hill
9. Belden

List of funded projects to be complete within the next year:

1. Thomas
2. Mineral Zoar

Water Quality Report

Water quality data was collected along the mainstem at long-term monitoring stations during pre- and post- construction conditions. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of Huff Run. Changes between the pre- and post- conditions are attributed to the completed AMD reclamation projects.

Figure 1. Pre and Post pH

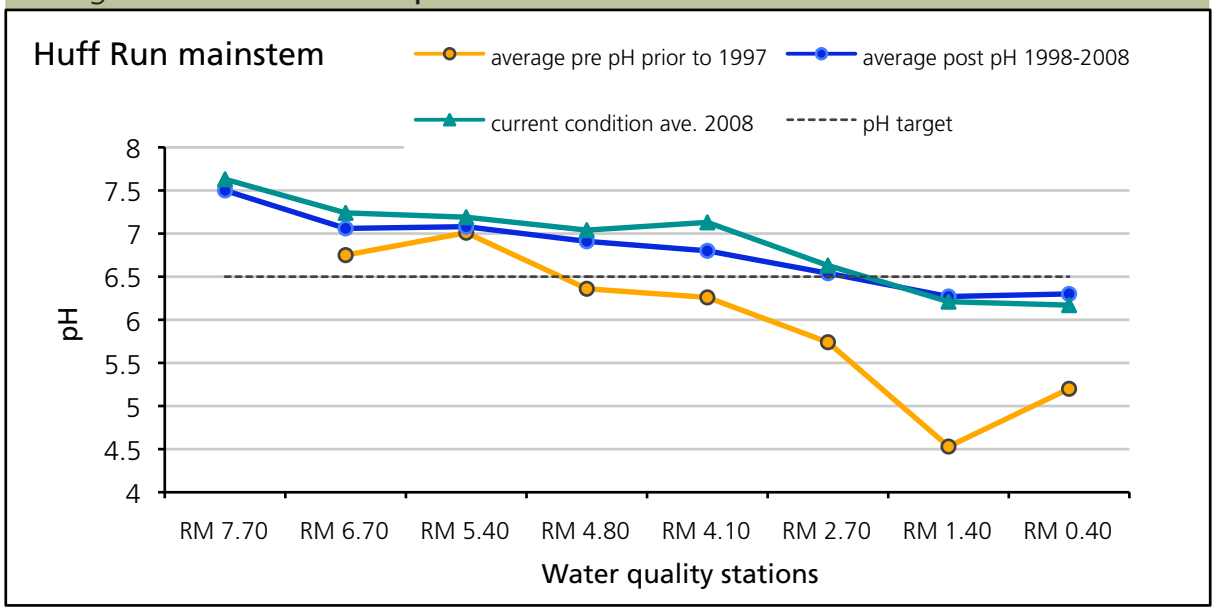
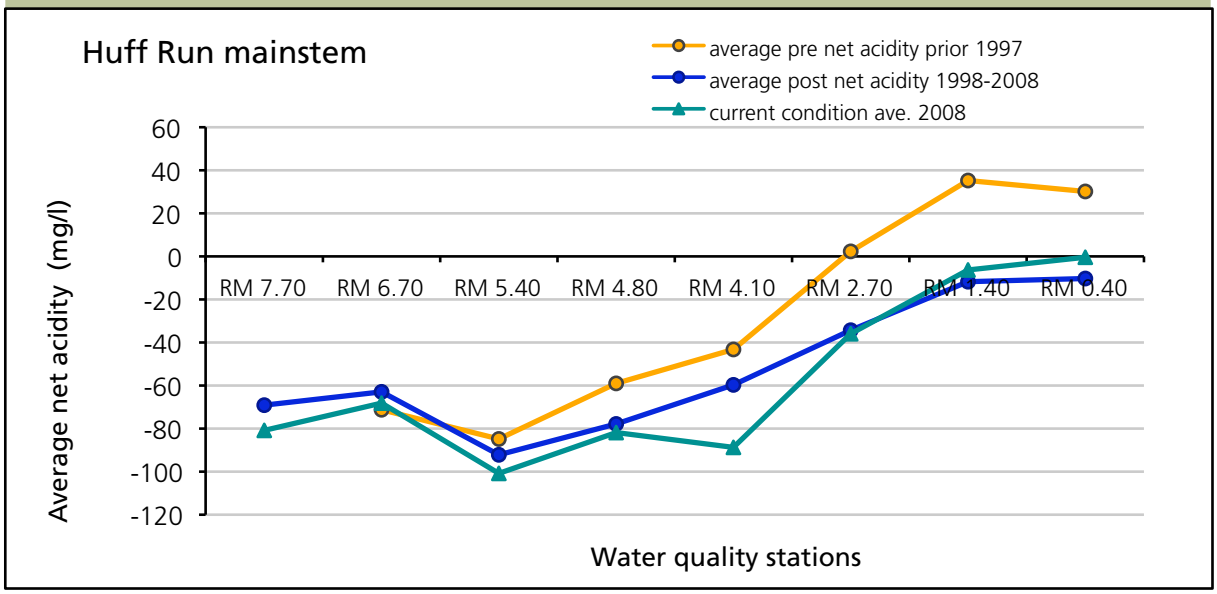


Figure 2. Pre and Post Acidity



As a result of these projects completed in Huff Run Watershed, the pH and net acidity has improved downstream of the reclamation sites for 5 miles to the mouth. Pre-construction data shows average pH in the range of 4.5 – 7.0 along the mainstem. However after the completion of seven major AMD reclamation projects, post-construction data shows average pH in the range of 6.17 – 7.5. The net acidity concentrations decreased resulting in net alkaline conditions the entire length of Huff Run, 10 miles.

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project (site HRR08) were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1985 to 1997 for pre-construction and from 1998 – 2008 for post-construction.

Figure 3. Acid Load Reduction

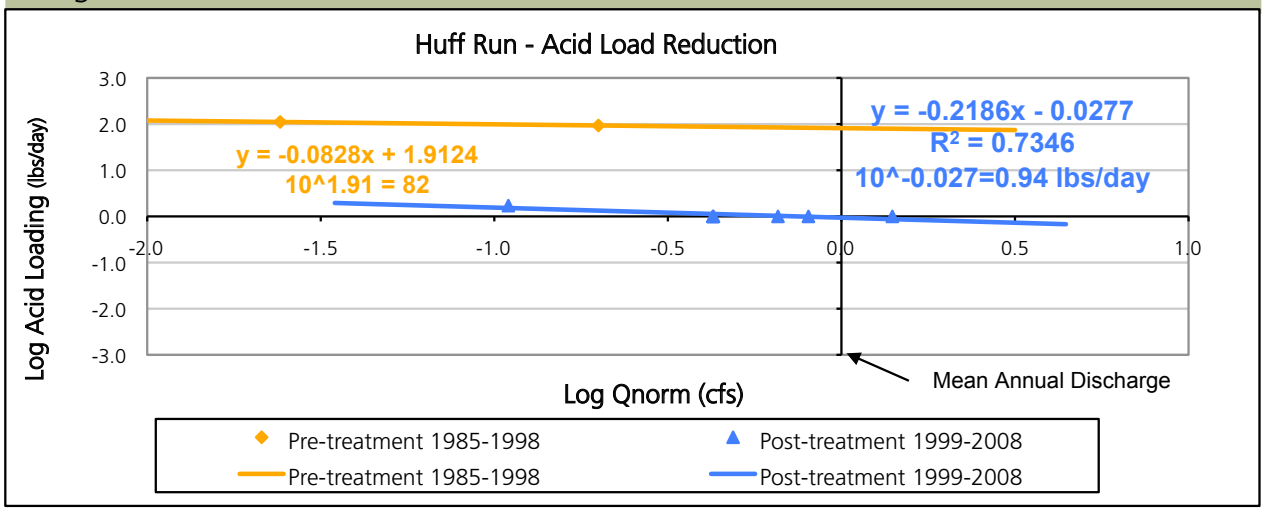
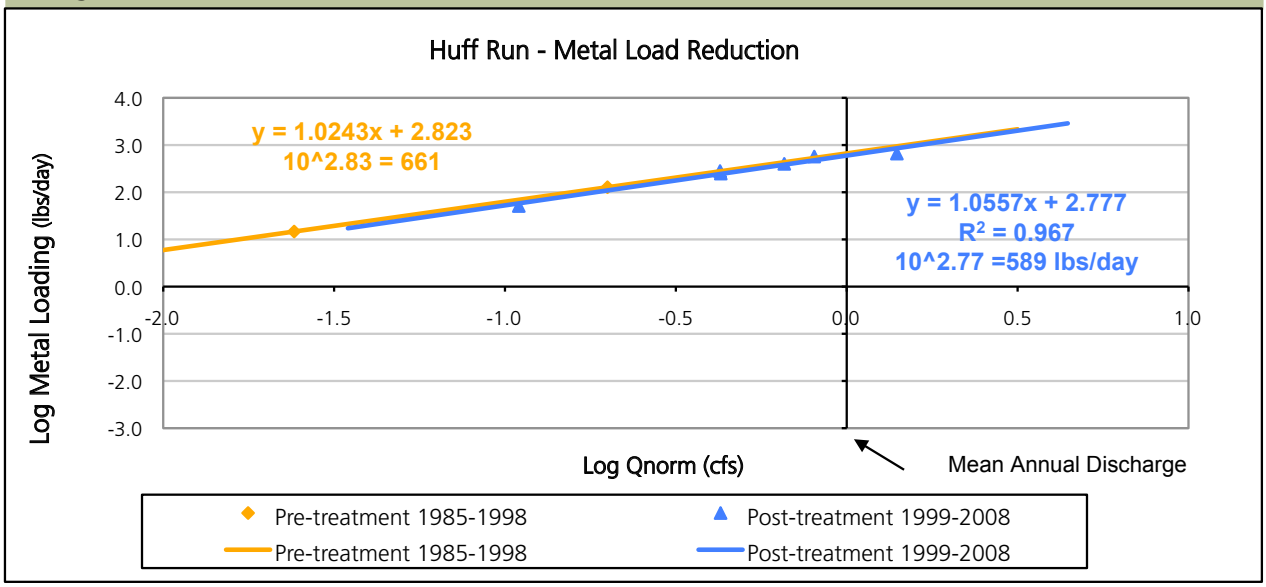


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Project Status: Complete 2003 Project Number: TS-SN-06 and TS-SN-20

Pre-construction

Site:
Pre FAR01/02
Post FAR09

Farr AMD discharge pre-construction
Photo by Huff Run Watershed

Post-construction

View from finishing cells looking upstream
Photo by Douglas Leed

The Farr Project is located in Sandy Township in Tuscarawas County. The site is located at the open limestone channel before entering Huff Run. The Farr Project discharges into Huff Run at river mile 1.0. This area was affected by unreclaimed gob piles and an impoundment fed by deep mine discharge. The design was completed by Gannett Flemming for $30,976. The treatment approach was to passively treat deep mine discharge with a anoxic limestone system. The treatment consisted of installing 500 linear feet of limestone channels, a 10,000 cubic foot anoxic limestone drain, a 0.5 acre wetland and complete 1.2 acres of surface reclamation. The goal of the design was to reduce high metals from deep mine discharges to the mainstem of Huff Run. Construction was complete May 2003 by Tucson Inc. for a cost of $150,000. Problems with the construction were unexpected high flows versus design flow of system, inadequate retention in system, continue high metal output, limited space for reconstruction or improvements. The funding sources for this project were, ODNR-DMRM for the design and for construction was OSM Clean Streams, ODNR/DMRM and Ohio EPA.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

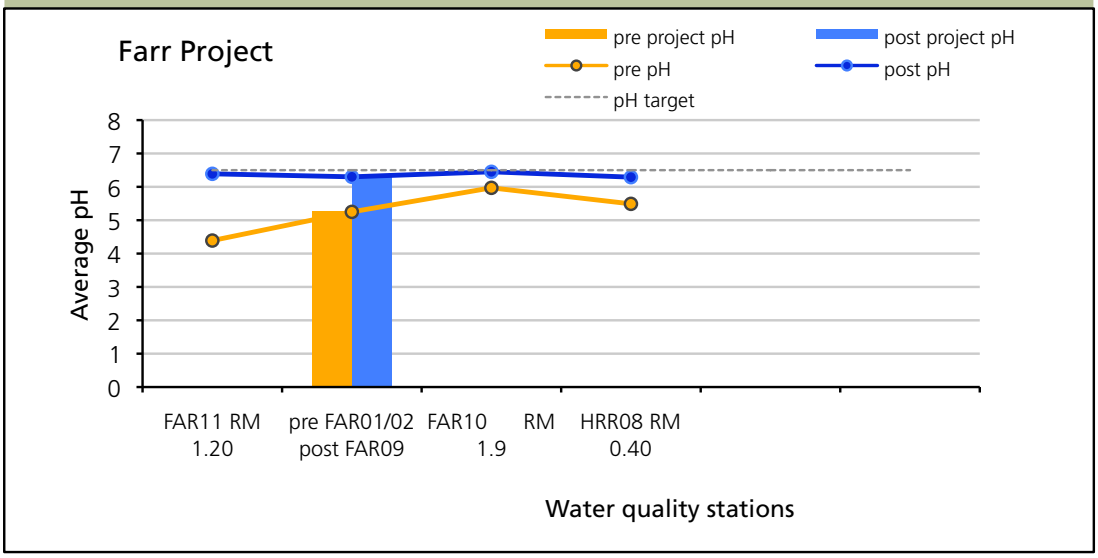
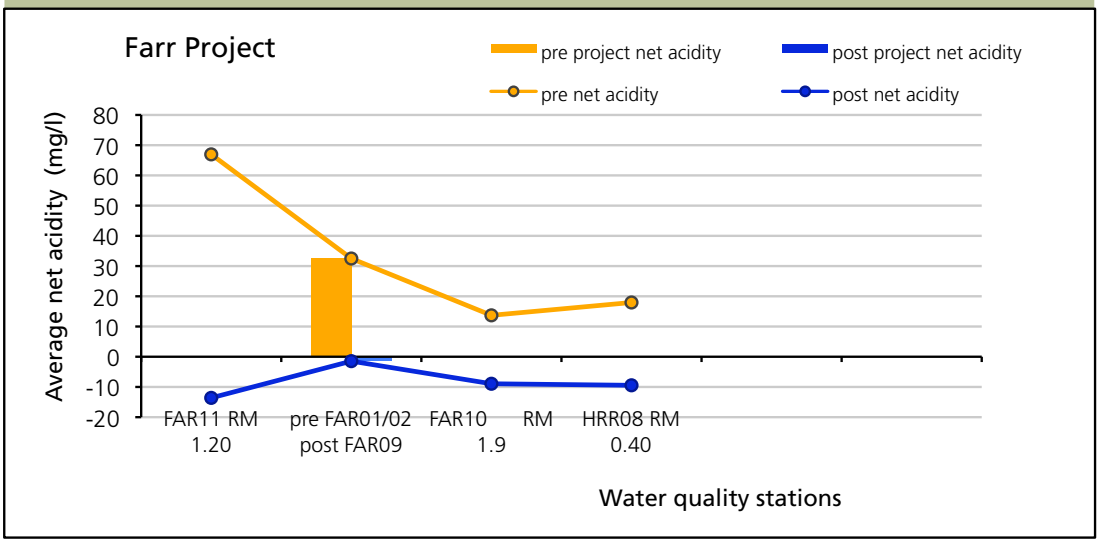


Figure 2. Pre and Post Acidity



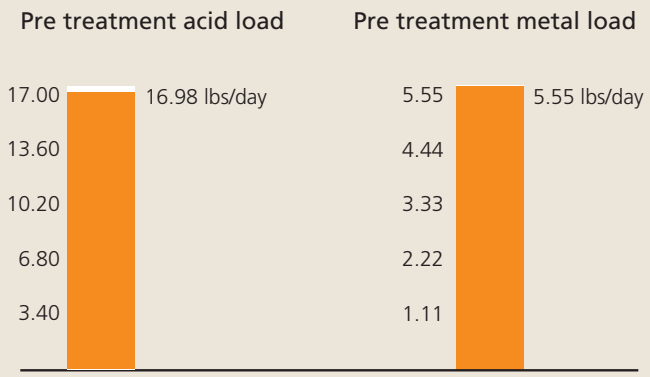
As a result of the Farr Project, pH and net acidity have slightly improved downstream approximately 1.0 mile. Pre-construction data shows pH range of 5.25-5.97 at the project discharge and downstream. After installation of the Farr Project, post-construction data shows pH range of 6.3-6.45 at the discharge and downstream. The net acidity concentration decreased 100% at the project discharge and downstream on Huff Run. This project needs post construction discharge measurements at site FAR09 to show acid and metal load reductions.

Project Status: Complete 2003 Project Number: CR-RS-04

Pre-construction

Farr AMD discharge pre-construction, Photo by Huff Run Watershed

SITE: PRE LIN01, POST LIN08

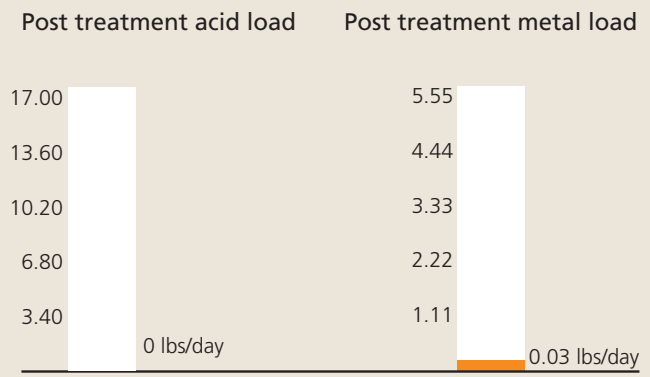


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Huff Run Awareness Day 2003, Photo by Huff Run Watershed

SITE: PRE LIN01, POST LIN08



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Linden Bioremediation Project is located in Rose Township in Carroll County. The Linden project discharges into Huff Run near river mile 4.6. The Linden project consists of treating a deep mine discharge by directing the water sequentially through a flow control system with a wetland to reduce metal concentrations and provides microbial nutrients. This water then flows through an inoculated Pyrolusite limestone treatment bed, discharge structures, and diversion ditches, before being discharged to the receiving stream. The design was completed by Office of Surface Mining (OSM) engineers at no cost. The treatment consisted of installing a 0.5 acre Pyrolusite limestone bioremediation treatment bed and a 0.3 acre passive wetland. The goal of the design was to generate alkalinity in the upper reaches of Huff Run, with the potential for reduction in metals requiring low maintenance. Construction was complete June 16, 2003 by Tucson Inc. for a cost of $321,619. Problems encountered included complications with the bedrock for liner installation, unknown pre-existing gas well in location of treatment bed, and high expense of the inocculant. The funding sources for this project were Ohio EPA, OSM, and ODNR/DMRM. Figure 3 & 4 (shown page 3 of this report) estimate approximately 16.98 lbs/day of acid and 5.47 lbs/day of metals were reduced from entering into Huff Run.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

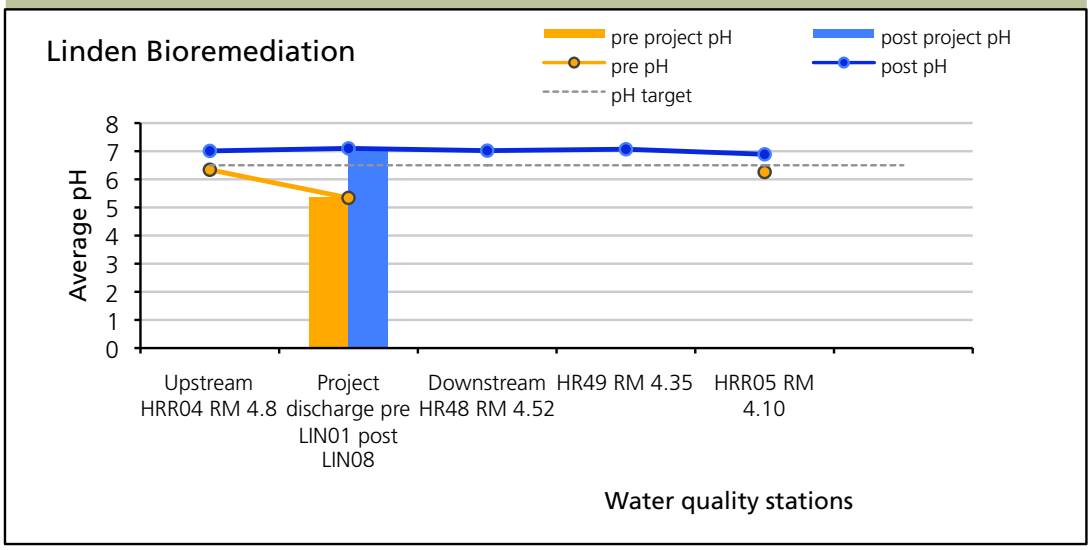
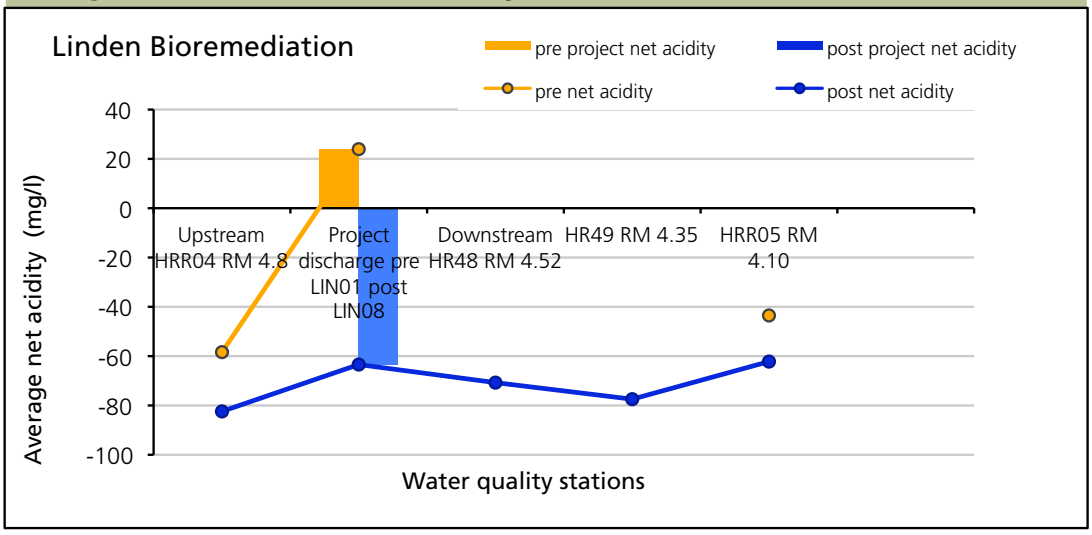


Figure 2. Pre and Post Acidity



Data Analysis

As a result of the Linden Project, pH and net acidity have improved downstream approximately 0.5 miles. Pre-construction data shows pH in the range of 5.34 – 6.26 at the project discharge and downstream. After installation of the Linden Bioremediation Project, post-construction data shows pH in the range of 6.89 -7.07 at the discharge and downstream. The net acidity concentration decreased 100% at the project discharge.

Water quality – acid and metal load reduction

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 6/17/1998 to 6/21/1999 for pre-construction and from 8/4/2005 – 12/31/2008 for post-construction. Post-construction data with discharge measurements was very limited for this site (n=3).

Figure 3. Acid Load Reduction

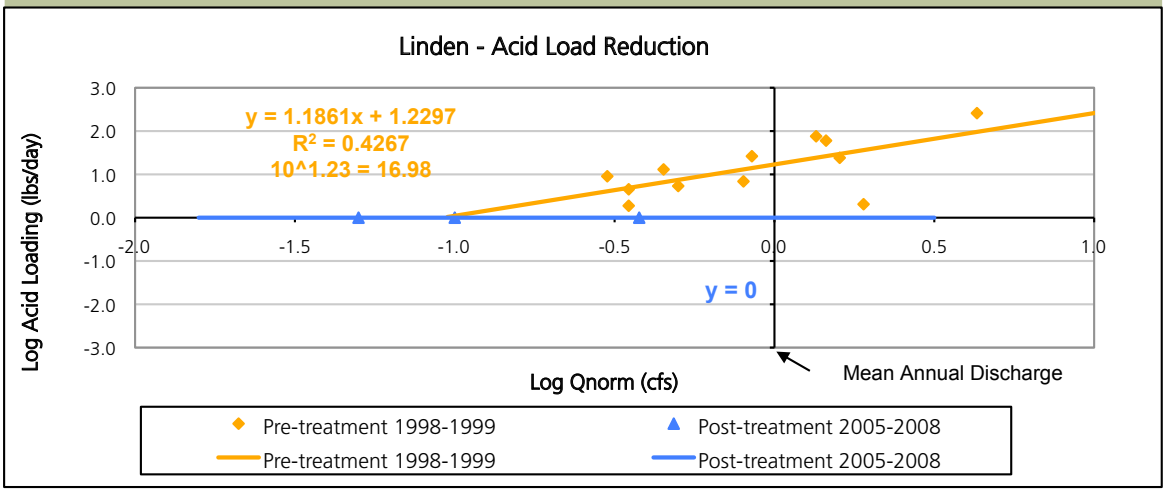
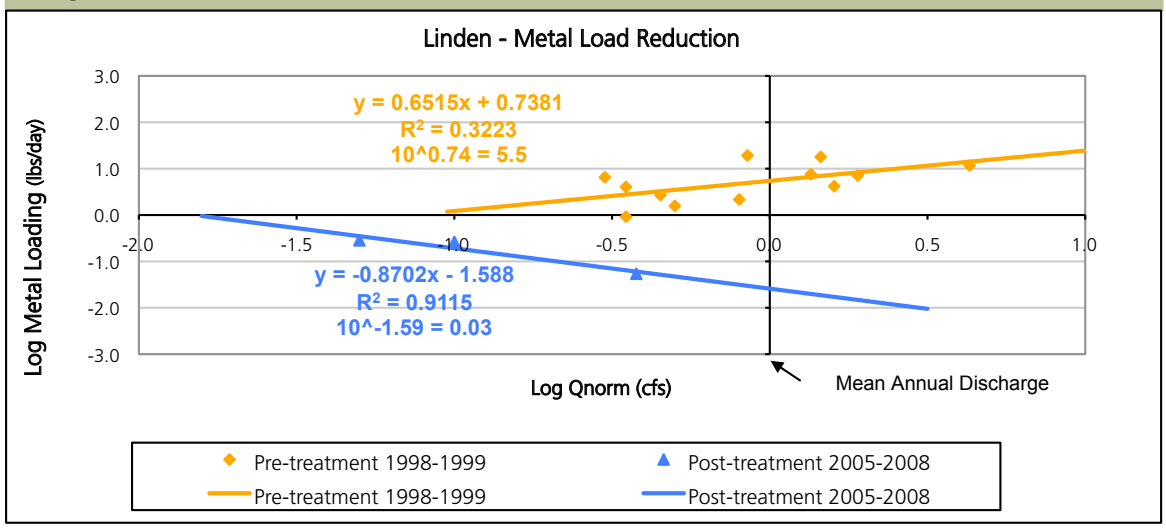


Figure 4. Metal Load Reduction



Average measured discharge values were used to calculate load reductions using the Mean Annual Load Method (Stoertz, 2004) in last year's 2007 NPS report for the Linden Project thus estimating 18.2 lbs/day of acid pre-construction. However in this years' 2008 NPS report, mean annual discharge was derived from drainage area using USGS StreamStats web-based program and used it in the Mean Annual Load Method to estimate 16.98 lbs/day of acid pre-construction.

Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Project Status: Complete 2004 Project Number: TS-SN-28

SITE ID: ACDO1

Pre-construction

Post-construction

Acid pit completed project
Photo by Jim Gue

Acid Pit #1is located in Rose and Sandy Township in Tuscarawas County. The site is located at the effluent from Acid Pit #1. The Acid Pit #1 discharges into Huff Run at river mile 3.78. The design was completed by Ohio Department of Natural Resources – Division of Mineral Resources Management for a cost of $14,000. The treatment approach was to eliminate the acid-filled impoundments, reclaim the mine spoil, eliminate the recharge through the spoil and provide positive drainage. The treatment consisted of installing 2000 linear feet of limestone channels and reclaim 15 acres of gob spoil. The goal of the design was to eliminate the and recharge of extremely acidic water through spoil material and draining into the mainstem Huff Run. Construction was complete March 2004 by Tucson Inc. for a cost of $150,000. The problem encountered during construction was the lack of solid base (underclay), to effectively place underdrains for subsurface collection of mine drainage flows. The funding sources for this project were for the design was ODNR-DMRM and for construction was OSM Clean Streams, ODNR/DMRM.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

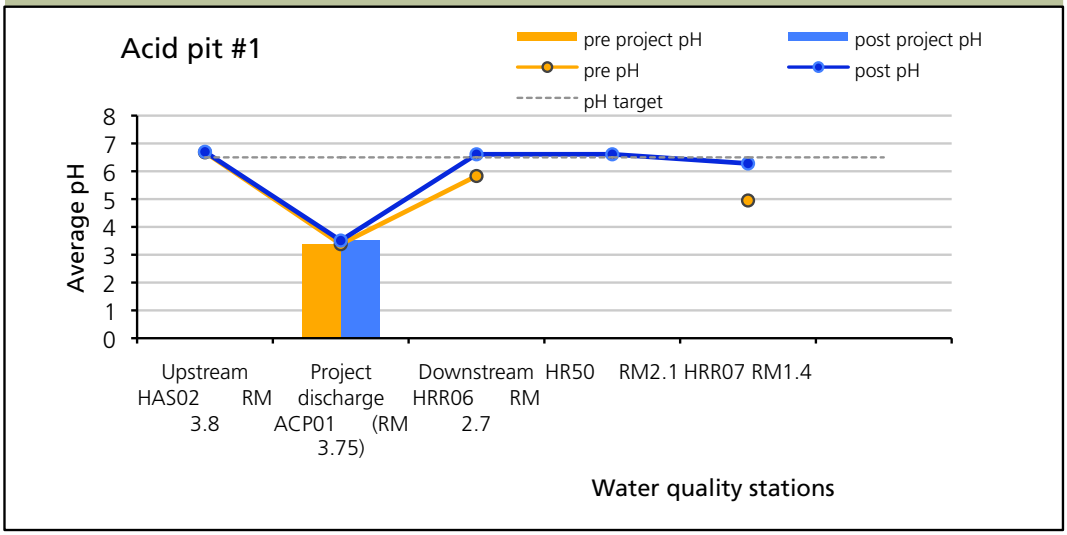
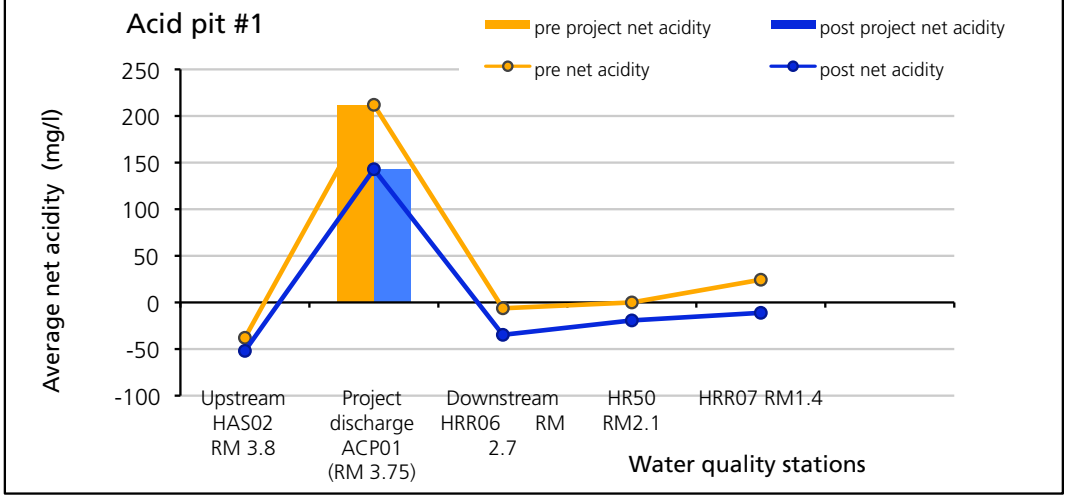


Figure 2. Pre and Post Acidity



Data Analysis

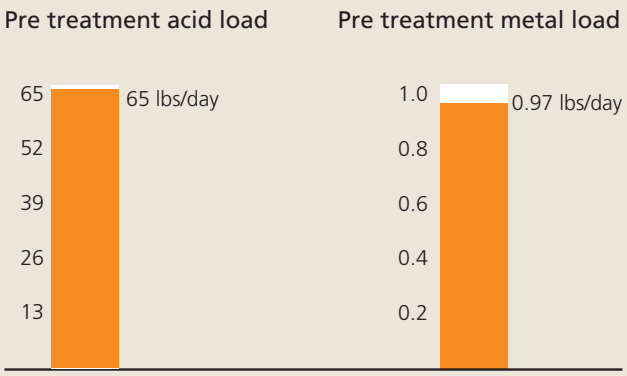
As a result of the Acid pit #1 Project, pH and net acidity have improved downstream approximately 2.4 miles. Pre-construction data shows pH in the range of 3.38–5.8 at the project discharge and downstream. After installation of the Acid Pit #1 Project, post-construction data shows pH in the range of 3.5-6.6 at the discharge and downstream. The net acidity concentration decreased 33% at the project discharge. This project needs discharge measurements at site ACP01 to show acid and metal load reductions.

Project Status: Complete 2005 Project Number: CR-RS-07

Pre-construction

One of four acidic ponds on project site, Photo by Jim Gue

SITE: PRE HRT06, POST LNT01

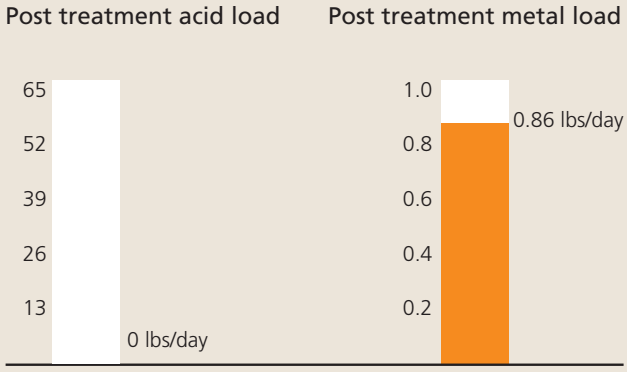


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

Lindentree reclamation area, Photo by Maureen Wise

SITE: PRE HRT06, POST LNT01



Data derived using the Mean Annual Load Method (Stoertz, 2004).

The Lindentree Project is located in Rose Township in Carroll County. The Lindentree project discharges into Huff Run near river mile 5.0 and consists of many acidic ponds, high walls, and exposed gob piles. Baker Consulting completed the design for a cost of $60,240. The treatment approach consisted of filling the acid pits, raising alkalinity with the use of steel slag, and 100 linear feet of limestone channels. The goal of the design was to reduce acid infiltration from old impoundments, introduce alkaline recharge with steel slag and open limestone channels to upstream reaches of Huff Run. Construction was complete February 17, 2005 by Monarelli for a cost of $210,000. The funding sources for this project were Ohio EPA and ODNR/DMRM. Figure 3 & 4 (shown on page 3 of this report) estimate approximately 65 lbs/day of acid and 0.11 lbs/day of metals were reduced from entering into Huff Run.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

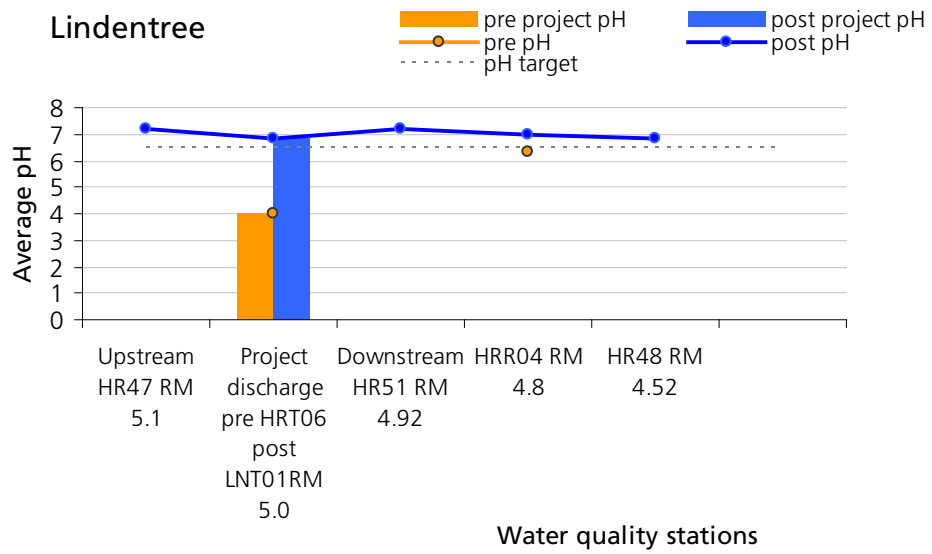
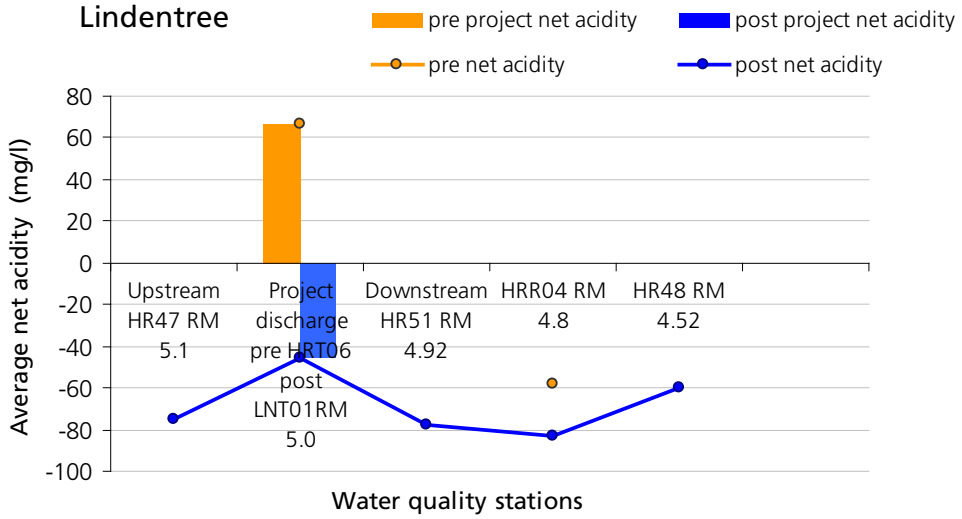


Figure 2. Pre and Post Acidity



Data analysis

As a result of the Linden Project, pH and net acidity have improved downstream approximately 0.5 miles. Pre-construction data shows pH in the range of 4.1 – 6.34 at the project discharge and downstream. After installation of the Linden Bioremediation Project, post-construction data shows pH in the range of 6.81-7.18 at the discharge and downstream. The net acidity concentration decreased 100% at the project discharge.

Water Quality – acid and metal load reduction

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 2/11/1997 to 3/1/1999 for pre-construction and from 8/4/2005 – 12/31/2008 for post-construction. Pre and post-construction data with discharge measurements were very limited for this site (pre n=2 and post n=5).

Figure 3. Acid Load Reduction

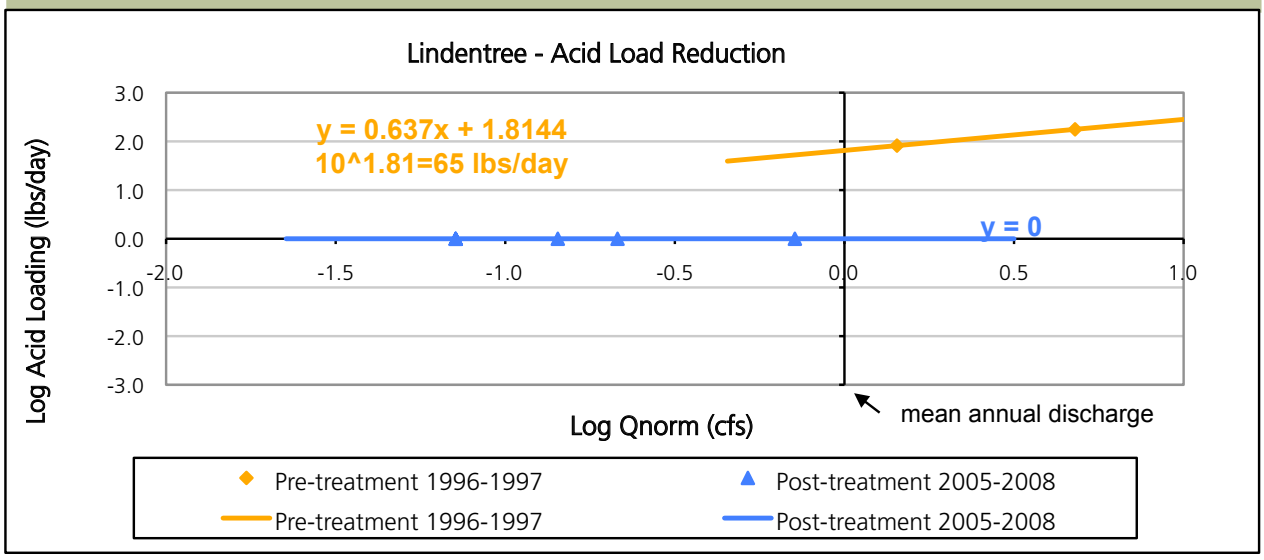
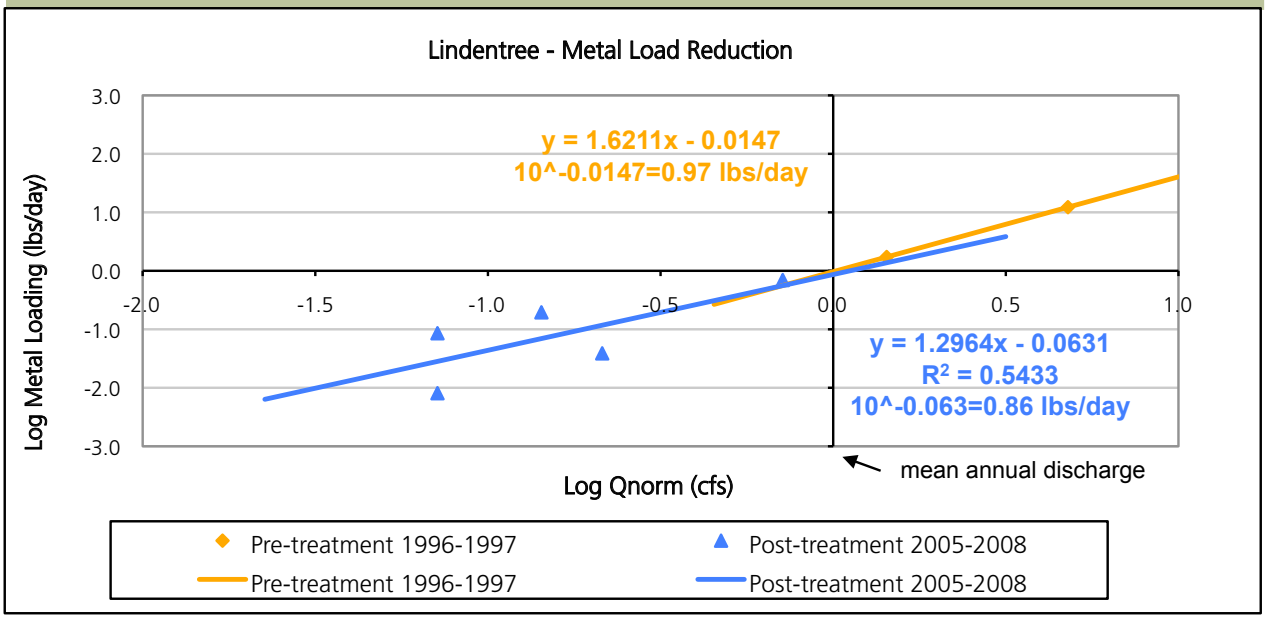


Figure 4. Metal Load Reduction



Average measured discharge values were used to calculate load reductions using the Mean Annual Load Method (Stoertz, 2004) in last years' 2007 NPS report for the Lindentree Project thus estimating 81 lbs/day of acid pre-construction. However in this year's 2008 NPS report, mean annual discharge was derived from drainage area using USGS StreamStats web-based program and was used in the Mean Annual Load Method to estimate 65 lbs/day of acid pre-construction.

Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Project Status: Complete 2006 Project Number: CR-RS-06

SITE ID: HAN03

Pre-construction

Post-construction

Harsha North spoil and gob pile, Photo by Jim Gue

Harsha North is located in Rose Township in Carroll County. The sample site is located at the effluent from the Harsha North project. Harsha North discharges into Huff Run at river mile 4.19. The site was primarily toxic coal refuse piles and highwalls along with areas affected by deep mine drainage and unreclaimed contour surface mines. The treatment approach was to eliminate discrete acid mine drainage sources via open limestone channels and surface reclamation of acid-forming and refuse material. Major considerations were to collect diffuse acid seeps and discharges and direct them through constructed open limestone channels. The design was completed by ATC Associates for $106,909. The treatment consisted of 22.2 acres of surface reclamation, 4,725 linear feet of limestone J-trenches, and reclaiming a 6-acre gob pile. The goal of the design was to reduce diffuse seeps to a concentrated location via open limestone channels for future passive treatment if necessary, neutralize deep mine discharges with alkaline limestone channels, and add alkalinity to streamflow. Construction was complete September 2006 by Tucson Inc. for a cost of $686,186. Problems encountered were concerns with intended borrow/resoil material. The funding sources for this project were ODNR/DMRM, for the design, and ODNR-DMRM, 319 OEPA grant, and OSM Clean Streams grant for construction.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

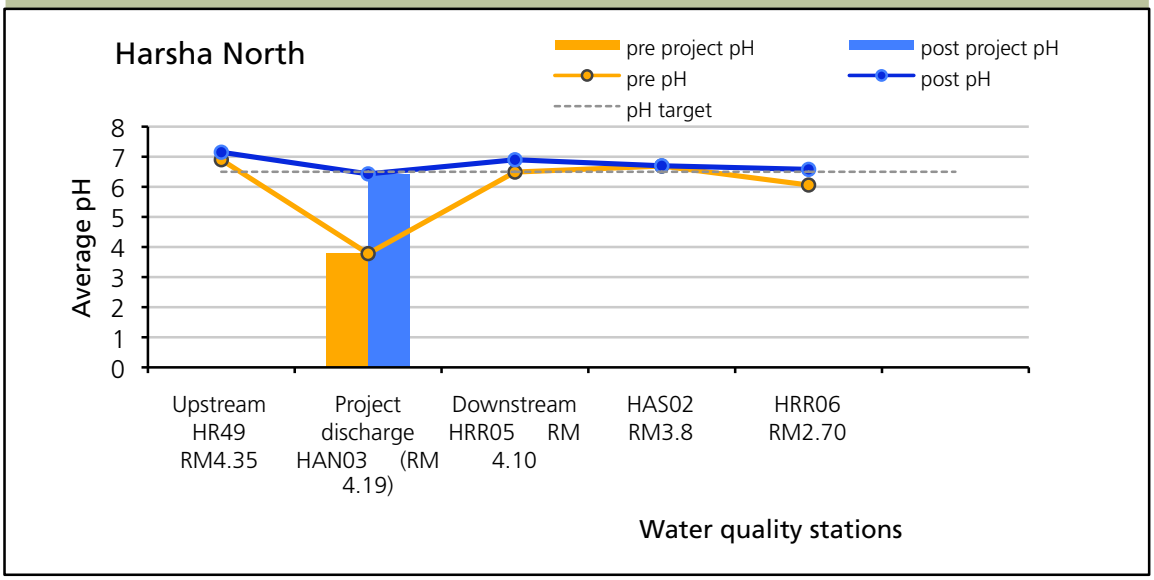
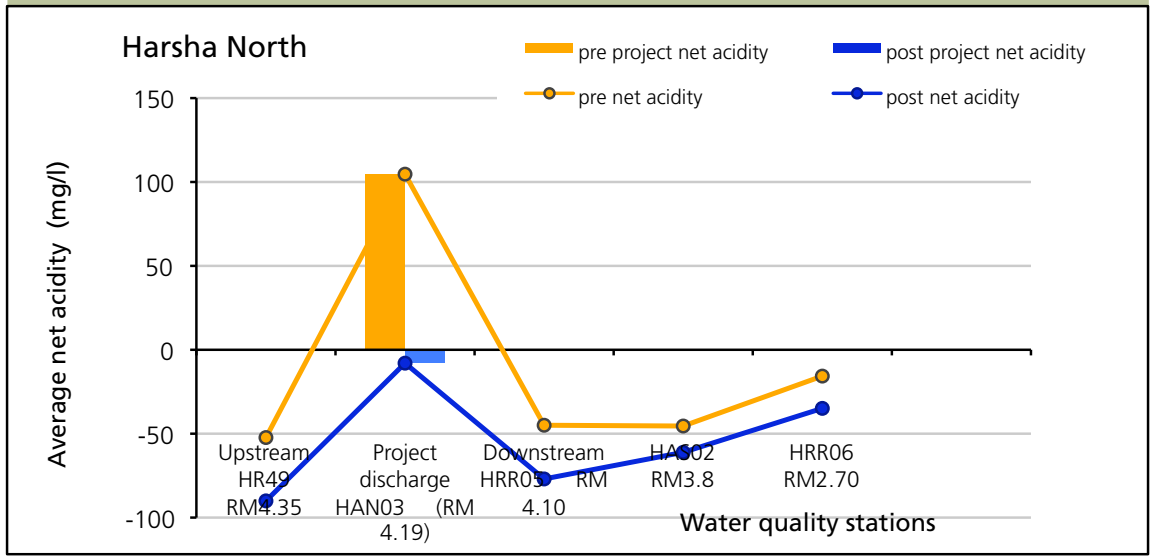


Figure 2. Pre and Post Acidity



Data Analysis

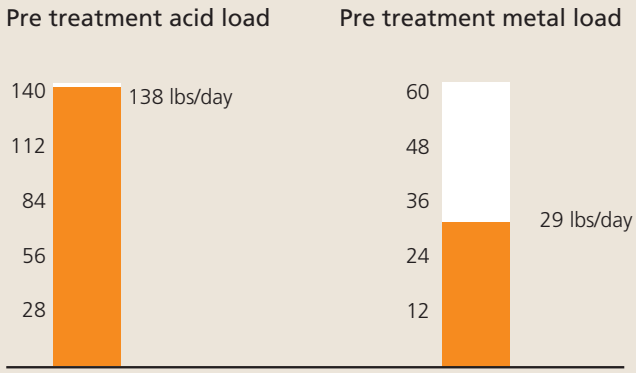
As a result of the Harsha North Project, pH and net acidity have improved at the project discharge and downstream. Pre-construction data shows pH at the project discharge at an average 3.78. After installation of the Harsha North Project, post-construction data shows an average pH of 6.43. The net acidity concentration decreased 100% at the project discharge. This project needs post construction discharge measurements at site HAN03 to show acid and metal load reductions.

Project Status: Complete 2005 Project Number: TS-SN-3

Pre-construction

Overview of gob on the project site, Photo by Brent Miller

SITE: LYN01

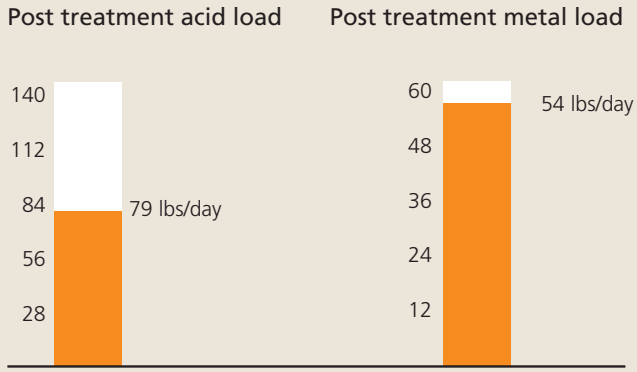


Data derived using the Mean Annual Load Method (Stoertz, 2004).

Post-construction

After construction major outlet, Photo by Jim Gue

SITE: LYN01



Data derived using the Mean Annual Load Method (Stoertz, 2004).

Lyons is located in Sandy Township in Tuscarawas County. The project site is 35 acres. Lyons discharges into Huff Run at river mile 1.90. The Lyons site was one of the highest contributors of AMD within the lower reaches of the watershed. The AMD problems were caused by unvegetated coal refuse, highwalls, acid pits and exposed spoil. The design was completed by ATC Associates for $53,335. The treatment approach was to reclaim eroding mine spoils, eliminate acid impoundments, install alkaline recharge with steel slag berms and open limestone channels. The treatment consisted of installing 3,000 linear feet of limestone channels and 1,500 linear feet of steel slag channel and reclaim a 15 acre of gob pile and 5 acres of surface reclamation. The goal of the design was to eliminate eroding acid spoils and impoundments, generate alkalinity to deep mine pools, decrease AMD discharges and neutralize acidic discharges prior to draining into the mainstem. Construction was complete December 2005 Malcuit for a cost of $794,030. Problems with the construction were placement of underdrain tiles to effectively collect subsurface flows to constructed OLC/steel slag channels. The funding sources for this project were Ohio EPA and ODNR/MRM. Figure 3 & 4 (shown on page 3 of this report) estimate approximately 59 lbs/day of acid were reduced from entering into Huff Run. No reduction in metals were measured.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. Pre and Post pH

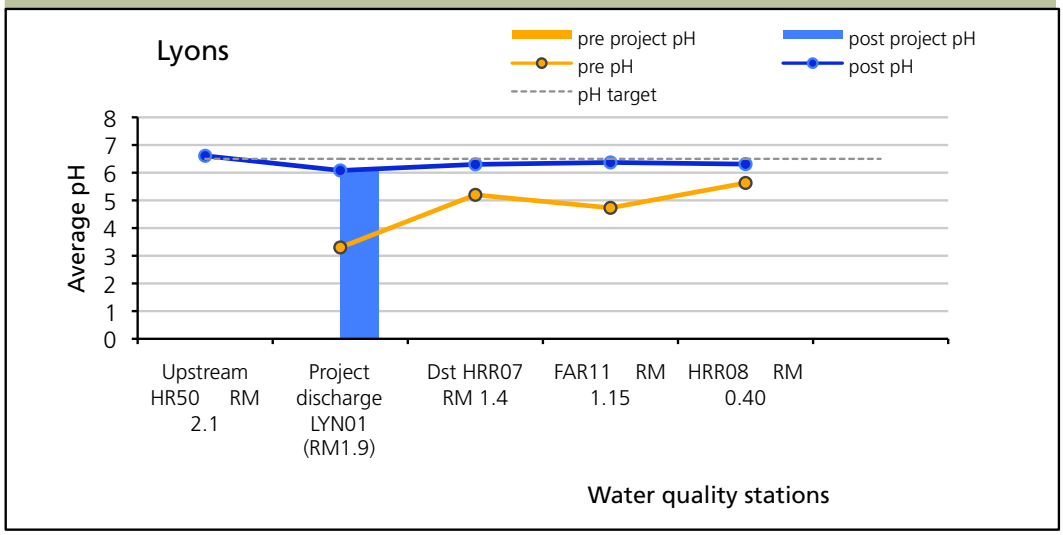
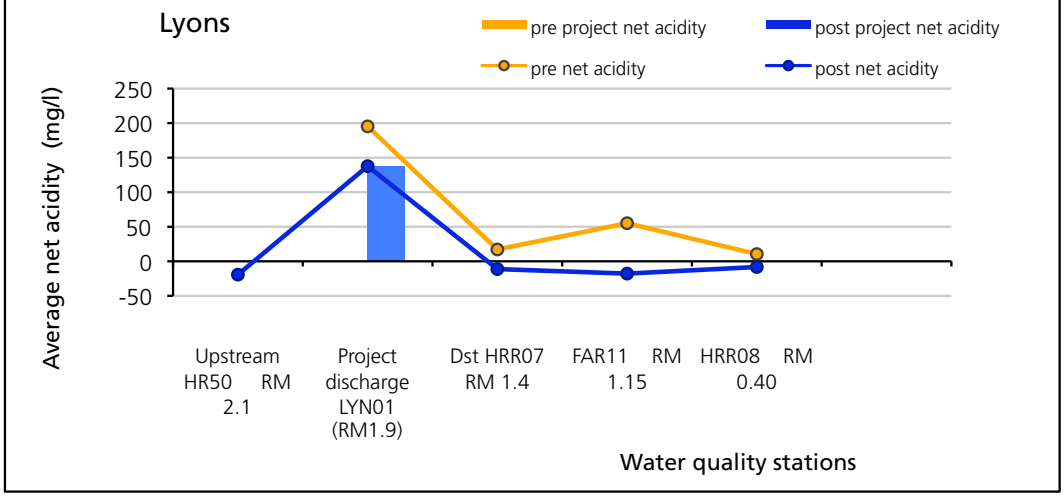


Figure 2. Pre and Post Acidity



As a result of the Lyons Project, pH and net acidity have improved downstream approximately 1.5 miles. Pre-construction data shows pH in the range of 3.3 – 5.63 at the project discharge and downstream. After installation of the Lyons Project, post-construction data shows pH in the range of 6.08-6.37 at the discharge and downstream. The net acidity concentration decreased 29% at the project discharge.

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 8/25/76 to 6/21/1999 for pre-construction and from 1/4/2006 to 12/31/2008 for post-construction.

Figure 3. Acid Load Reduction

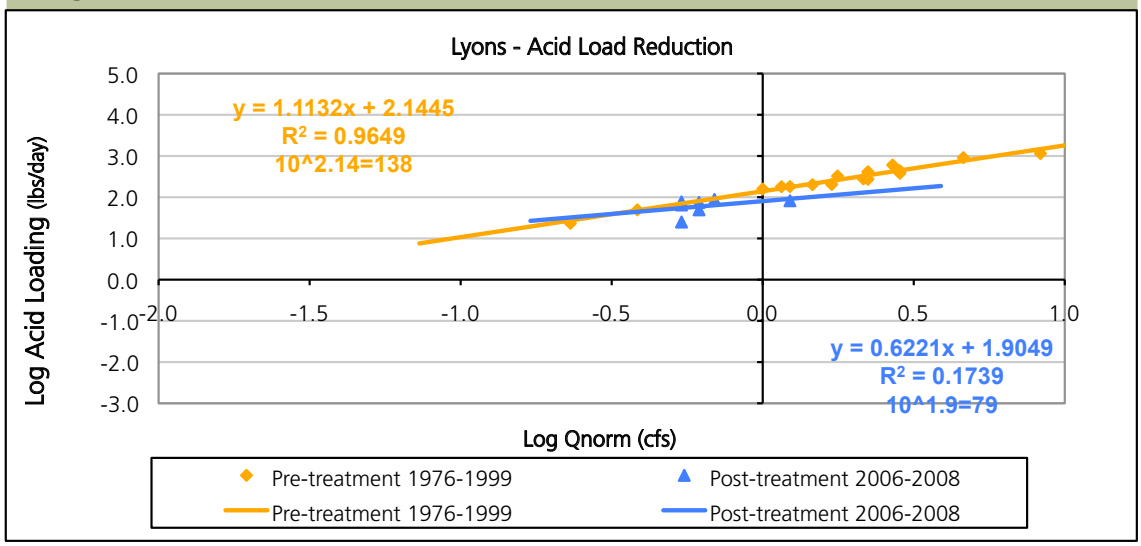
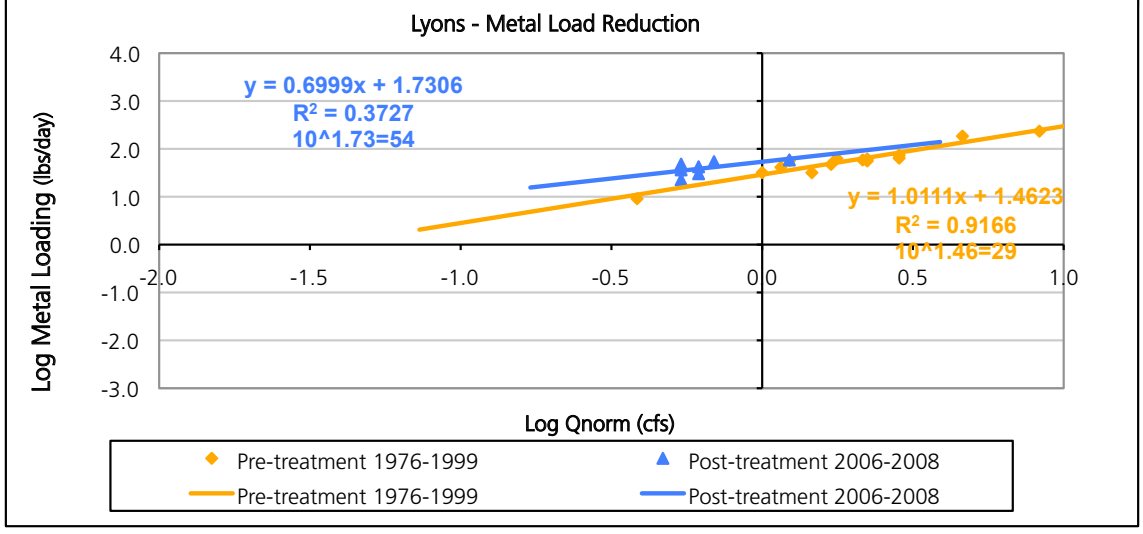


Figure 4. Metal Load Reduction



Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.

Project Status: Complete Oct. 2008, will be evaluated in 2009 Report | Project Number: CR-RS-15

Pre-construction

AMD plume, Photo by Maureen Wise

Post-construction

Caption: Fern Hill AMD project entrance, Photographer: Linda March

Fern Hill is located in Section 27 of Rose Township in Carroll County and lies within the 14-digit HUC unit #05040001080050. Fern Hill site FRN01, discharges into Huff Run at river mile 4.9. Fern Hill HR-42 consists of a few acid pits and a large AMD plume that sits directly beside Huff Run and discharges AMD directly into Huff Run. The treatment approach was to reclaim three acidic ponds that were situated up-dip from the AMD plume on the site through basic surface reclamation and open limestone channels. The design was completed in-house by ODNR-DMRM. The treatment consisted of 6.0 acres of surface reclamation and 500 linear feet of limestone channels. The goal of the design was to reduce flow of the underground mine seep and reduce acidity and metal loadings to Huff Run. Construction was complete October 2008 by Malcuit for a cost of $106,573.75. The funding sources for this project were ODNR/DMRM for the design and OSM Clean Streams and ODNR-DMRM for construction.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge.

Figure 1. **Pre pH**

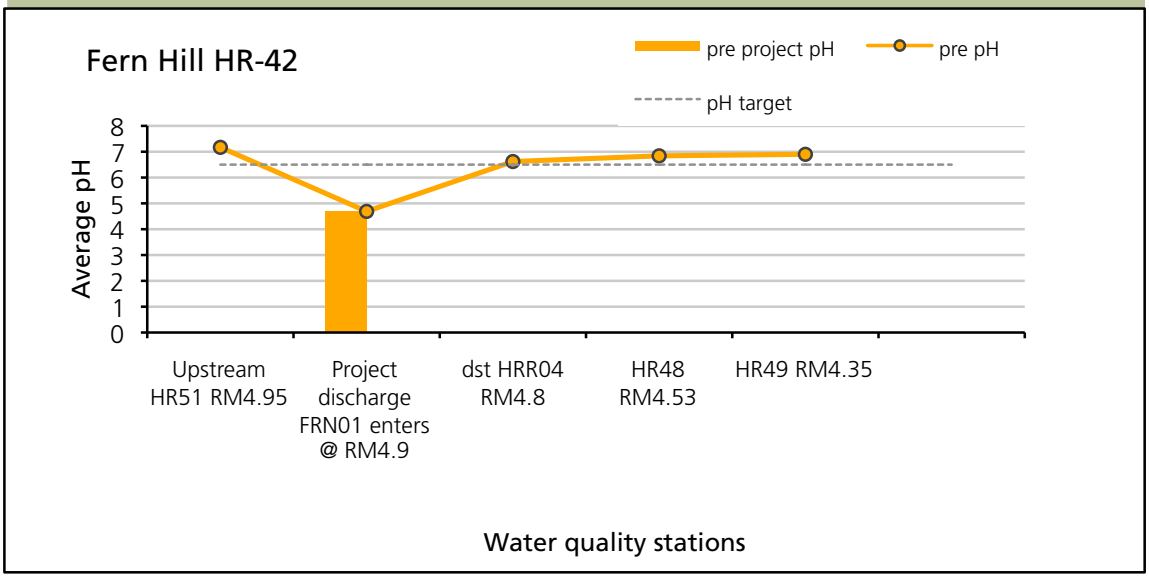
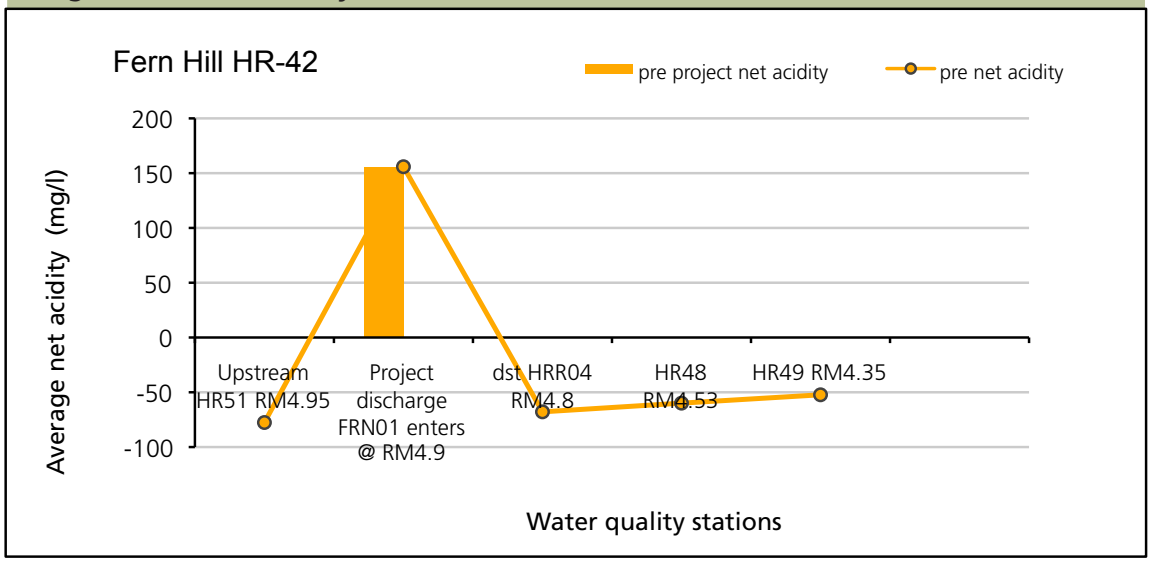


Figure 2. **Pre Acidity**



Data Analysis

Fern Hill HR-42 Project pre-construction monitoring show pH and net acidity upstream, at the project discharge and along the mainstem of Huff Run downstream of the project. Pre-construction data show pH in the range of 4.7 to 6.9. At the project discharge and downstream. Post-construction data will be evaluated in the 2009 annual report.

Pre-construction

Gob pile with impounded acidic water, Photo by Huff Run Watershed

Post-construction

Caption: Steel Slag Bed #3, Photographer: Maureen Wise

Belden is located in Section 33 of Rose Township in Carroll County and lies within the 14-digit HUC unit #05040001080050. Belden site BLD01, discharges into Huff Run at river mile 4.5. The Belden site consists of large gob piles, exposed toxic clay, and strip pits north of the former Kopp Clay Plant. These sources contributed to the degradation of a 20-acre area in the Huff Run watershed. The treatment approach was to conduct surface reclamation, install steel slag beds to boost alkalinity, and install a sediment pond to allow metals to precipitate. The design was completed by ATC Associates for $123,000. The treatment consisted of 4.0 acres of surface reclamation, 10 acres of gob pile reclamation, install 9,600 square foot steel slag leach bed and a 7 acre settling pond. The goal of the design was to boost alkalinity and reduce iron metals and acidity from entering Huff Run. Construction was complete December 2008 by Tuscon for a cost of $688,330.25. The funding sources for this project were ODNR/DMRM for the design and USEPA Targeted Watershed Grant and ODNR-DMRM for construction.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge.

Figure 1. **Pre pH**

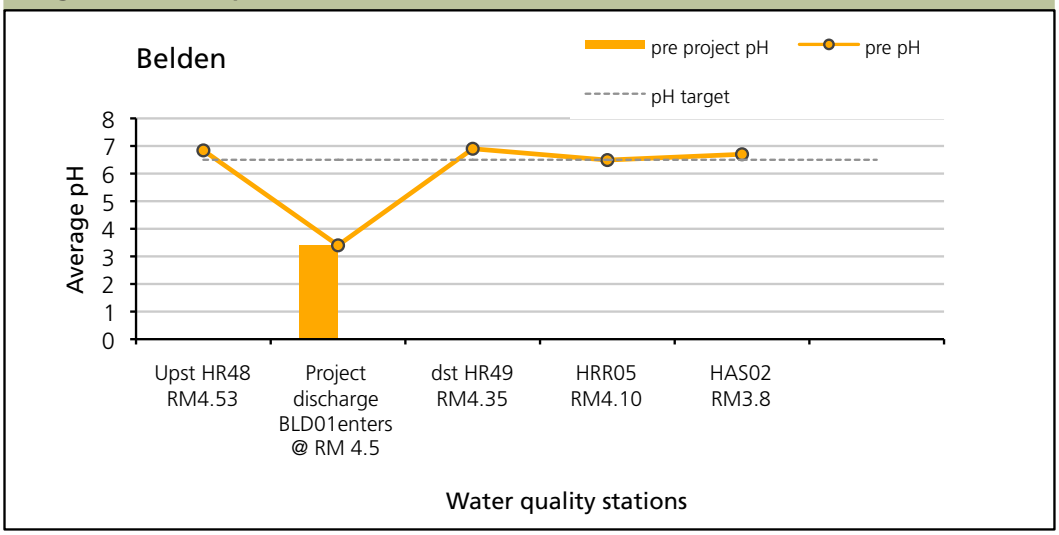
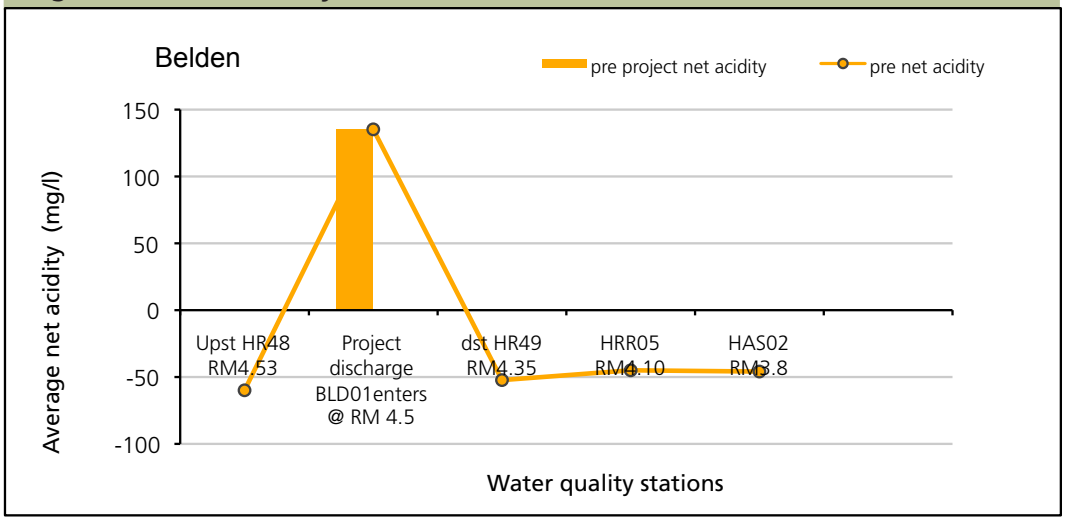


Figure 2. **Pre Acidity**



Data Analysis

Belden Project pre-construction monitoring show pH and net acidity upstream, at the project discharge and along the mainstem of Huff Run downstream of the project. Pre-construction data show pH in the range of 3.4 to 6.9. At the project discharge and downstream. Post-construction data will be evaluated in the 2009 annual report.

Project Status: Funded Project Number: CR-Rs-08

Pre-construction

Southern area with large beaver ponds
Photo by Maureen Wise

Treatment Approach: The site is composed of approximately twenty acres of surface mine water impoundments and toxic mine spoil. The impoundments are recharging a shallow deep mine, allowing for large contributions of metals and acidity to Huff Run. Plans for restoration include a limestone channel for drainage and erosion control plus regrading and revegetation of the spoils and pits. (www.huffrun.org)

Design: ODNR-DMRM

Expected Costs:$275,000

Funding Source: Ohio EPA and ODNR-DMRM

Expected Completion: Fall 2009

Project Status: Funded

Project Number:

Pre-construction

The Mineral City Park/Mineral-Zoar Road Project will take place in 2009. Two deep mines feed highly acidic water into wetlands associated with the longest tributary to Huff Run which runs through the Mineral City Park. The reclamation will include a reverse alkaline producing system that will not only fix AMD problems but also help with flooding in the direct vicinity. This project is located in Mineral City. An Office of Surface Mining grant will fund the construction.

Design: Baker Consulting

Expected Costs: $315,000

Expected Completion: Spring 2009

References

Johnson, Kelly, 2009. Personal Communications, Ohio University Biological Sciences

Kinney, Chad, 2006. A Comparison of Two Methods of Bioassessment in Streams. Master Thesis at Ohio University

Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University

US Geological Survey (USGS) StreamStats website – flow characteristics http://water.usgs.gov/osw/streamstats version 2