Watershed Assessment and Remediation Strategy for Abandoned Mine Drainage In the Upper Tioga River Watershed

SRBC

SUSQUEHANNA RIVER BASIN COMMISSION

This summary report provides an overview of SRBC's technical report entitled *Watershed Assessment and Remediation Strategy for Abandoned Mine Drainage in the Upper Tioga River Watershed* (SRBC Publication No. 230). The summary contains:

- key elements of the executive summary from the full technical report;
- list of project partners and their primary responsibilities;
- select maps showing project location, mining related problem areas, and the water quality of the watershed prior to and after treatment (predictions);
- a graph showing net alkalinity and a pie chart of primary watershed impairments;
- project funding information; and
- project benefits

The full technical report (Publication No. 230) includes an extensive appendix file and is available on CD-ROM. The body of the report, without the appendix, is available on SRBC's web site at http://www.srbc.net/techreports.htm. For copies of the report on CD-ROM or hard-copy format, contact SRBC at (717) 238-0423 or by e-mail at srbc@srbc.net.

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Summary Report

The Upper Tioga River Watershed is part of the Chemung Subbasin and drains an area of 1,391 square miles - 690 square miles in the Pennsylvania portion of the subbasin and 701 square miles in the New York portion.

The Tioga River, which is the main tributary in this watershed, flows 58 miles from Armenia Township, Bradford County, through Tioga County, Pennsylvania, into New York State, where it flows into the Chemung River. The Tioga River flows through two subecoregions, the Northern Appalachian Plateau and Uplands, and the North Central Appalachians.

The Upper Tioga River Watershed is largely rural, with small urban centers - Mansfield and Blossburg. Forested lands, which comprise about 50 percent, is the dominant land use, with agricultural lands comprising about 40 percent. Water use in the watershed is primarily for agricultural, municipal, and domestic use and for wastewater treatment.

Pollution from abandoned mine drainage (AMD) has a dramatic negative impact on the Tioga River. High levels of iron (shown at right near Blossburg) and aluminum (below at the inlet of Tioga Lake), in addition to acid, discolor the water and impact aquatic life.

J. Orr

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A Growing Greener Project

Pennsylvania is... Growing Greener

The Upper Tioga River Watershed in northcentral Pennsylvania is severely impacted by abandoned mine drainage (AMD) from Fall Brook to Bear Creek, impairing or eliminating aquatic life in approximately 13 miles of the mainstem extending downstream to the Tioga/Hammond Dam Complex. Other tributaries in the watershed show reduced pH due to non-AMD acidity sources, including tannins from natural headwaters wetlands and acid rain. Although AMD production will decline over time by depletion of the acid-forming minerals, this is a very slow process, particularly for underground mines, and significant impacts could continue for centuries without some form of abatement. The most common form of abatement is direct treatment of the AMD discharges by either active (chemical) or passive (wetland) systems. Other alternatives may include re-mining or land capping to limit infiltration on disturbed sites, alkaline addition to abandoned surface and underground mine works, streambed sealing to prevent infiltration to mine pools, or indirect treatment, such as increasing the alkalinity of reaches upstream of the AMD sources.

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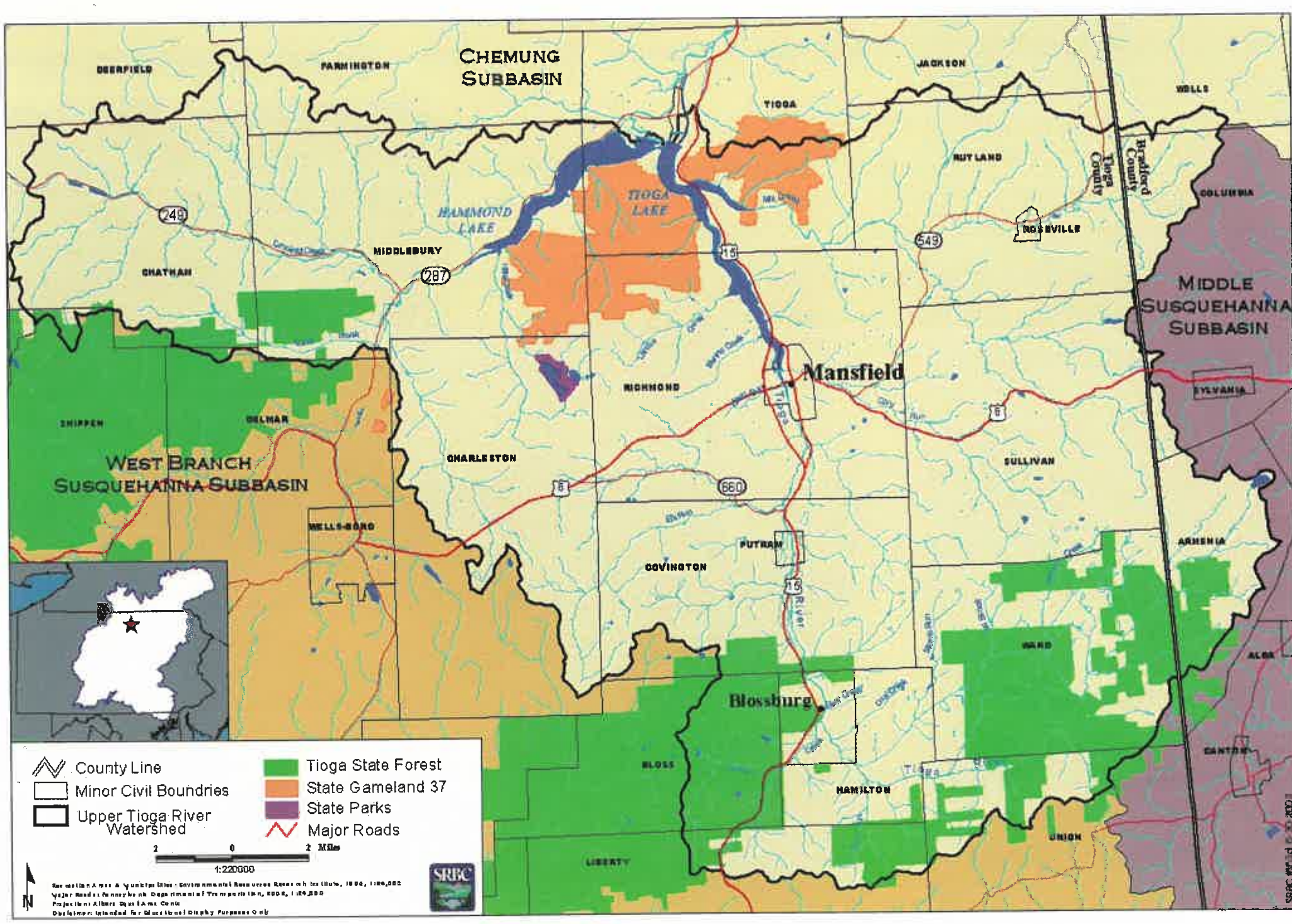
Abandoned mine discharges, such as the one shown in the Johnson Creek Watershed, add thousands of pounds of acid and metals pollutants to the Tioga River and some tributaries every day, destroying aquatic habitat and impairing aquatic life.



H. Allison

Tioga River Watershed Locational Map

Local stakeholders have expressed a final goal of restoring the Tioga River to a natural ecological condition, with interim water quality and ecological improvements to the affected tributaries, contributing to the restoration of the mainstem. While the goal of complete ecosystem restoration may take decades to achieve through implementation of the recommendations of this study as funding and new technologies are made available, many other interim benefits would be realized with the progressive treatment of the mine drainage pollution. These include increased recreational opportunities and revenues in the watershed and at the Tioga/Hammond Complex, increased aesthetic value of the river (decreased staining), decreased maintenance costs for bridges and other man-made structures, and increased benefits to potable water supplies.

> ***"The monitoring program identified 36 AMD features in the Upper Tioga River Watershed..."***

Under a Pennsylvania Growing Greener Grant, the Susquehanna River Basin Commission (SRBC) undertook a water monitoring program in 2001 and 2002 to identify and sample the primary sources of AMD in the watershed and collect instream data to characterize its impact on the mainstem and major tributaries. As part of the grant, SRBC retained Gannett Fleming, Inc. to develop conceptual treatment plans for the identified AMD sources and prepare a progressive restoration plan for the watershed. The monitoring program identified 36 AMD features in the Upper Tioga River Watershed; 20 were flowing and able to be sampled within the study period. Based on field review, Gannett Fleming determined that a number of the AMD sources could be combined in common treatment systems for an economy of scale, resulting in ten treatment plans covering three combined and seven individual treatment systems.

SRBC spearheaded this comprehensive watershed assessment project in partnership with several key partners. Below are the partners and their primary responsibilities:

- **SRBC -** collected data at various instream points in the watershed, prepared written report and served as overall grant administrator
- **Tioga River Watershed Reclamation Projects, Inc. -** conducted mining problem area identification, provided pre-existing watershed data (members shown below during training)
- **Tioga County Concerned Citizens Committee and Hillside Rod and Gun Club -** hosted series of stakeholder meetings
- **Mansfield University -** conducted mining problem area identification, provided Geographic Information System data
- **Tioga County Conservation District -** provided digital aerial images and other data, coordination
- **Pa. DEP Bureau of Abandoned Mine Reclamation, Wilkes-Barre Office -** provided water quality sampling materials and in-kind laboratory services, coordination
- **Pa. DEP Northcentral Regional Office, Hawk Run District Mining Office -** coordination
- **Pa. DCNR -** allowed access to Tioga State Forest lands, provided instruction for volunteer monitors in Global Positioning System use
- **U.S. Army Corps of Engineers -** provided tours of Tioga/Hammond Complex and pre-existing water quality data
- **Gannett Fleming, Inc. and Tarco Technologies -** provided contracted restoration plan services and portable weirs for volunteer use

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For each plan, conceptual passive and chemical system designs were prepared using the Tarco Technologies, Inc. Watershed Restoration Analysis Model (WRAM v1.2), which generated conceptual component sizing requirements, construction cost estimates, operation and maintenance cost estimates, 15-year present values, and construction area requirement estimates. The more appropriate of the two (active, passive) treatment alternatives was selected based on construction area constraints, cost considerations and ability of the technologies to meet water quality goals. Following development of the conceptual treatment plans, another component of WRAM was used to predict the downstream water quality improvements that could result from implementing these plans and to guide development of the progressive restoration plan.

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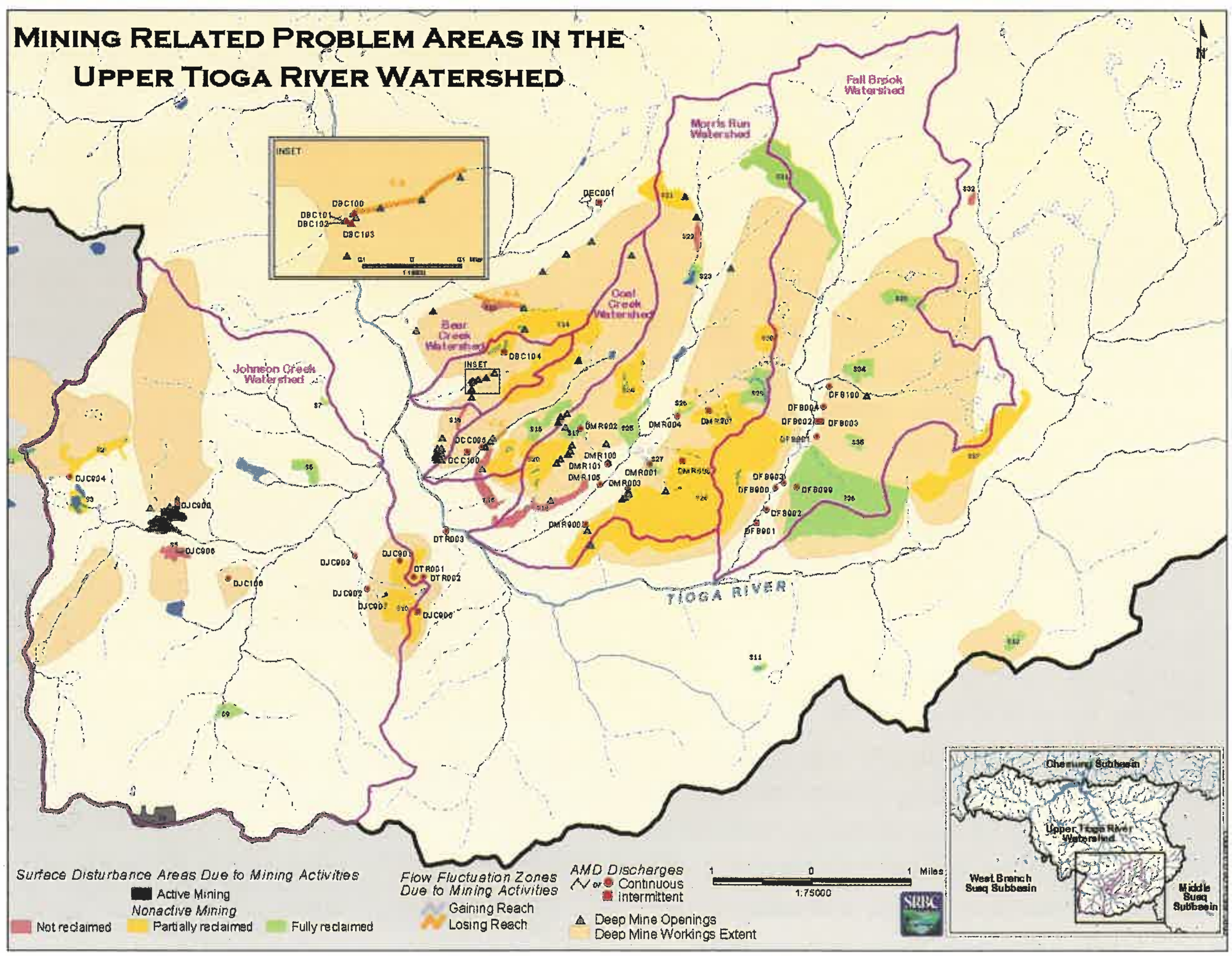
Treatment of AMD will not only benefit aquatic ecosystems, but will also restore terrestrial ecosystems and reclaim lands, such as those shown here on South Mountain in the Johnson Creek Watershed.

Analyses determined that treatment efforts on Fall Brook and Johnson Creek would yield the greatest benefit/cost ratio, and would be the best starting points for restoration efforts, followed by Morris Run and finally the combined watersheds of Coal and Bear Creeks.



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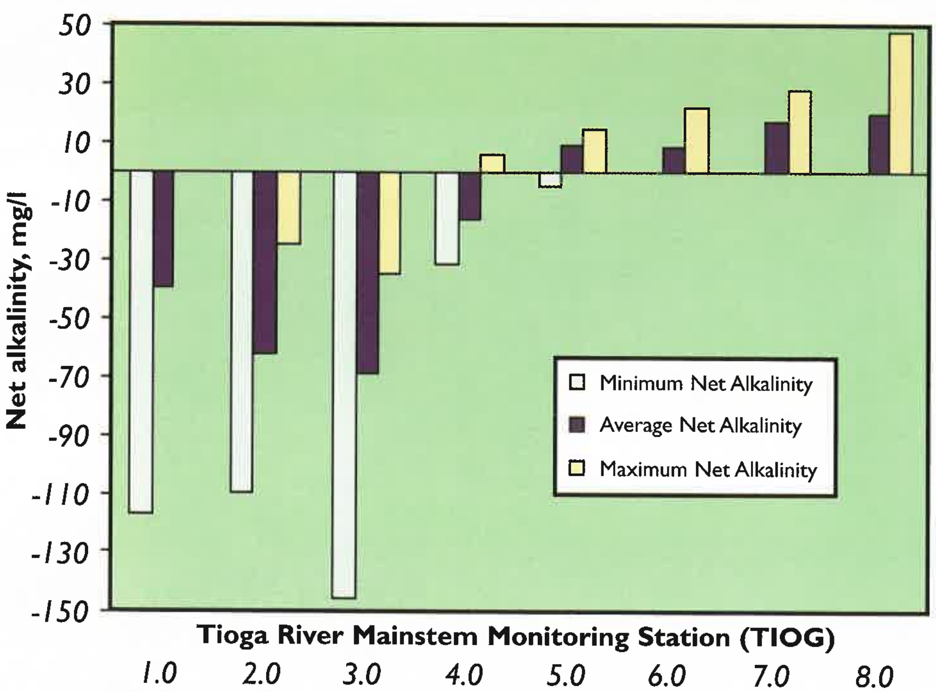
Unreclaimed mining features, such as water filled pits (below) and deep mine openings (bottom right), present a significant human health and safety problem, in addition to creating AMD pollution.

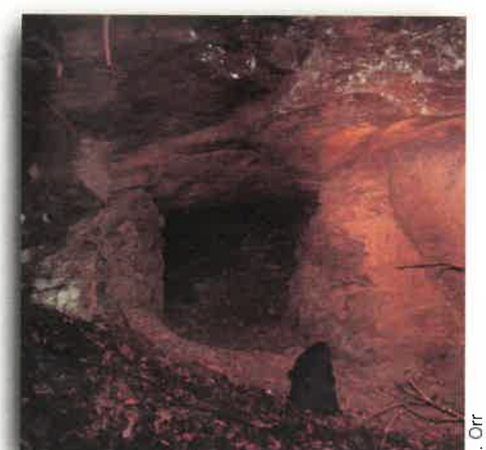
If fully implemented, the conceptual treatment activities would cost about $9.3 million to construct, $2.6 million per year to operate and have a 15-year present value of $41 million. This equates to about $130,000 per stream mile per year for 8.4 miles of tributaries and 13.1 miles of mainstem, or 21.5 miles of total stream improvements throughout the watershed. These costs are specific to the construction, operation, and maintenance of the selected treatment alternatives over a 15-year projection period. There are a number of other factors that could not be predicted at this level of assessment, including property acquisition, access development, electric service, and design and permitting costs.

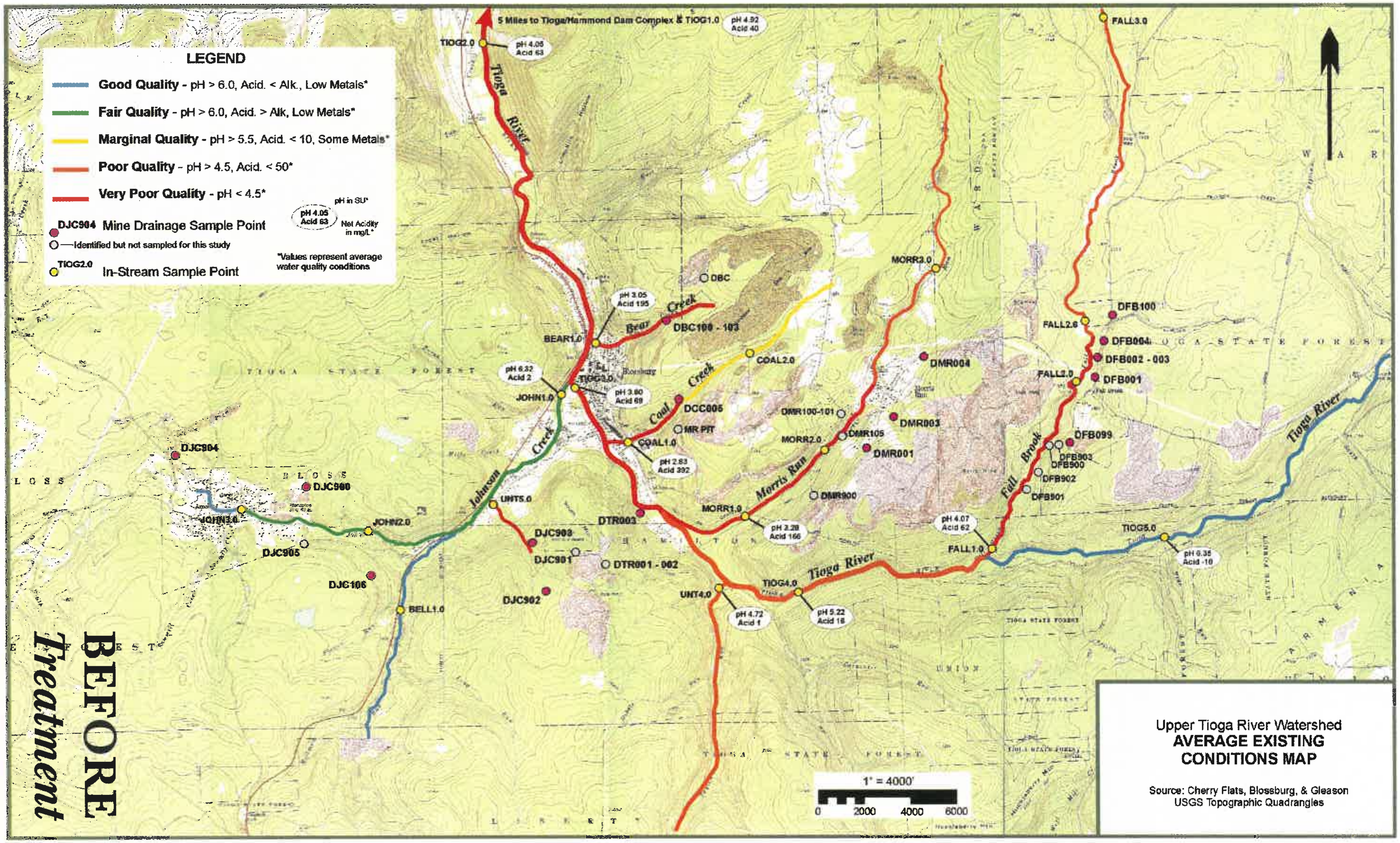
Net alkalinity (alkalinity - acidity) is used to measure the ability of a water to neutralize additional acid. A net alkalinity profile for the Tioga River is shown in the graph below. At best, stations upstream of TIOG4.0 have some net alkalinity; at worst, the Tioga River has no net alkalinity along its length. Note difference above and below TIOG4.0 (most upstream AMD influence).



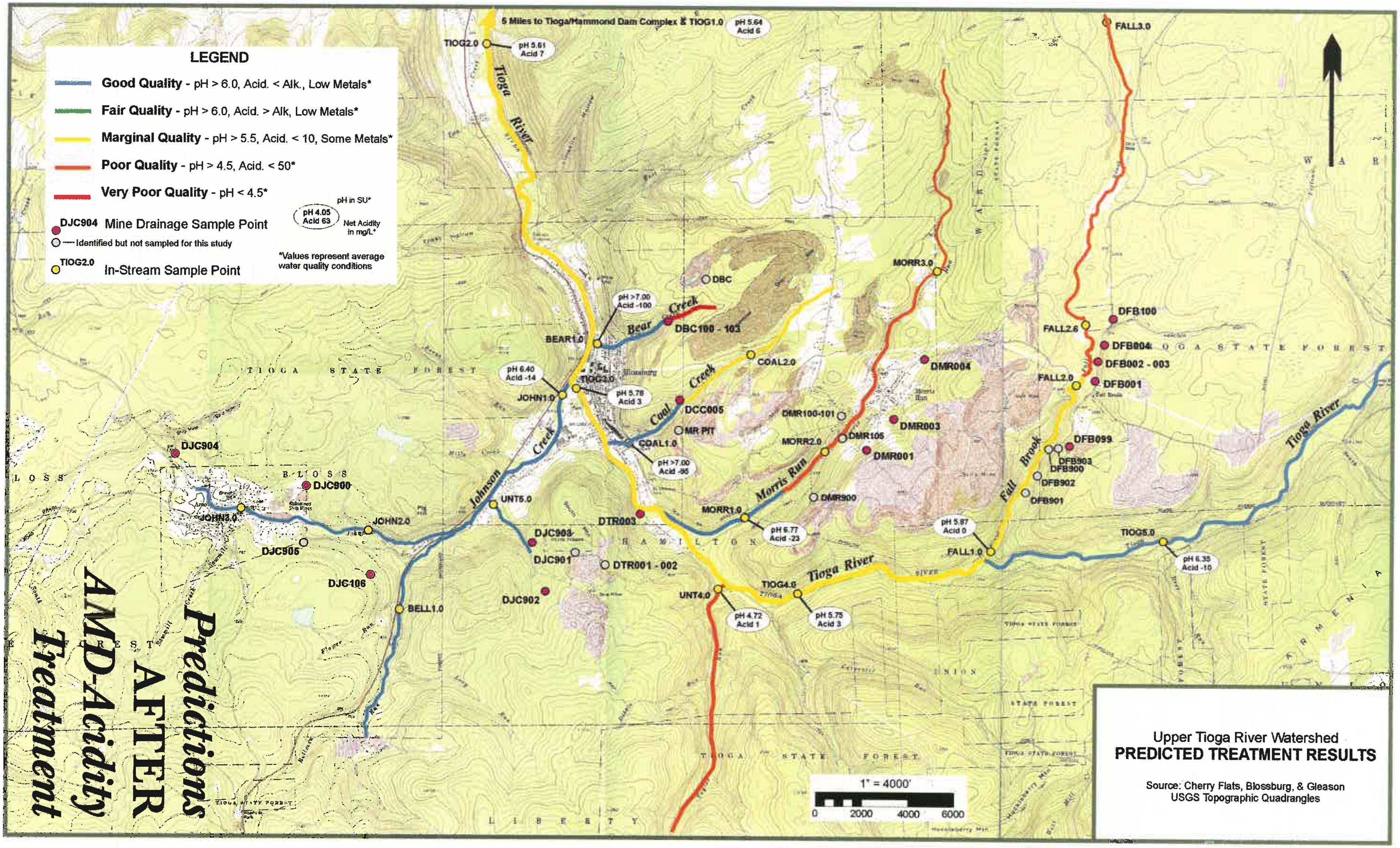
The conceptual construction costs include a 25 percent contingency to estimate these factors, but the ultimate costs of implementing the individual treatment projects may be greater than stated.

The WRAM modeling showed that treatment of AMD acidity alone may not result in consistently net alkaline conditions in Fall Brook or the Tioga River mainstem below their confluence due to the presence of the non-AMD acidity sources. The slightly acidic, low-metals flows in the headwaters of Fall Brook and Morris Run, and found in Fellows Creek, McIntosh Hollow and Taylor Run are ideal for passive treatment, which would benefit the overall restoration efforts at a comparatively low cost. Based on findings from other projects, net alkaline conditions could be restored in these streams using vertical flow wetlands, or other passive technologies. Current estimates to implement vertical flow wetland treatment in the headwaters of Fall Brook and Morris Run would cost $560,000 and $340,000, respectively. Non-AMD acidity treatment also may be necessary on additional tributaries to fully restore the Tioga River mainstem to net alkaline conditions.





LEGEND
Good Quality - pH > 6.0, Acid. < Alk., Low Metals*
Fair Quality - pH > 6.0, Acid. > Alk, Low Metals*
Marginal Quality - pH > 5.5, Acid. < 10, Some Metals*
Poor Quality - pH > 4.5, Acid. < 50*
Very Poor Quality - pH < 4.5*
DJC904 Mine Drainage Sample Point
—Identified but not sampled for this study
TIOG2.0 In-Stream Sample Point
pH 4.05 Acid 63
pH in SU*
Net Acidity in mg/L*
*Values represent average water quality conditions
5 Miles to Tioga/Hammond Dam Complex & TIOG1.0
pH 4.92 Acid 40
TIOG2.0
pH 4.05 Acid 63
Tioga River
BEAR1.0
pH 3.05 Acid 195
Bear Creek
DBC100 - 103
DBC
COAL2.0
Coal Creek
DCC005
MR PIT
COAL1.0
pH 2.83 Acid 392
TIOG3.0
pH 3.80 Acid 69
JOHN1.0
pH 6.32 Acid 2
Johnson Creek
UNT5.0
JOHN2.0
JOHN3.0
DJC904
DJC900
DJC905
DJC106
BELL1.0
DJC903
DJC901
DJC902
DTR003
DTR001 - 002
UNT4.0
pH 4.72 Acid 1
TIOG4.0
pH 5.22 Acid 16
Tioga River
MORR1.0
pH 3.28 Acid 166
Morris Run
MORR2.0
DMR105
DMR100-101
DMR001
DMR003
DMR004
DMR900
MORR3.0
FALL3.0
FALL2.6
DFB100
DFB004
DFB002 - 003
DFB001
FALL2.0
DFB099
DFB903
DFB900
DFB902
DFB901
Fall Brook
FALL1.0
pH 4.07 Acid 62
TIOG5.0
pH 6.35 Acid -10
Tioga River
TIOGA STATE FOREST
1" = 4000'
0 2000 4000 6000
Upper Tioga River Watershed
AVERAGE EXISTING
CONDITIONS MAP
Source: Cherry Flats, Blossburg, & Gleason
USGS Topographic Quadrangles
BEFORE
Treatment



LEGEND
Good Quality - pH > 6.0, Acid. < Alk., Low Metals*
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DJC904 Mine Drainage Sample Point
Identified but not sampled for this study
TIOG2.0 In-Stream Sample Point
pH 4.05 Acid 63
pH in SU*
Net Acidity in mg/L*
*Values represent average water quality conditions
5 Miles to Tioga/Hammond Dam Complex & TIOG1.0
pH 5.64 Acid 6
TIOG2.0
pH 5.61 Acid 7
Tioga River
BEAR1.0
pH >7.00 Acid -100
Bear Creek
DBC100 - 103
DBC
COAL2.0
Coal Creek
DCC005
MR PIT
COAL1.0
pH >7.00 Acid -95
TIOG3.0
pH 5.78 Acid 3
JOHN1.0
pH 6.40 Acid -14
Johnson Creek
UNT5.0
DJC904
DJC900
JOHN3.0
JOHN2.0
DJC905
DJC106
BELL1.0
DJC908
DJC901
DJC902
DTR003
DTR001 - 002
MORR3.0
DMR004
DMR100-101
DMR003
DMR105
MORR2.0
DMR001
Morris Run
DMR900
MORR1.0
pH 6.77 Acid -23
UNT4.0
pH 4.72 Acid 1
TIOG4.0
pH 5.75 Acid 3
Tioga River
FALL3.0
DFB100
FALL2.6
DFB004
DFB002 - 003
FALL2.0
DFB001
DFB099
DFB903
DFB900
DFB902
DFB901
Fall Brook
pH 5.87 Acid 0
FALL1.0
TIOG5.0
pH 6.35 Acid -10
Tioga River
TIOGA STATE FOREST
HAMILTON
UNION
LIBERTY
BLOSS
WARD
Upper Tioga River Watershed
PREDICTED TREATMENT RESULTS
Source: Cherry Flats, Blossburg, & Gleason USGS Topographic Quadrangles
1" = 4000'
0 2000 4000 6000
Predictions AFTER AMD-Acidity Treatment

Watershed Assessment and Remediation Strategy for Abandoned Mine Drainage In the Upper Tioga River Watershed

STREAM ASSESSMENT

The assessed waterways were selected because they were known to be impacted by AMD:

BEAR CREEK • COAL CREEK
FALL BROOK • MORRIS RUN
TIOGA RIVER • JOHNSON CREEK

PROJECT FUNDING

$145,000 grant from DEP's Growing Greener program and in-kind donations from project partners.

PRIMARY IMPAIRMENTS

The most pressing issues are those caused by, or related to AMD, and they include:

- continued and long-term degradation of aquatic habitat
- loss of aquatic life and revenues that would be provided as a result of healthy fishery and a healthy aquatic community
- mixing of water at the Tioga/Hammond Complex
- aesthetic impacts on recreation and tourism
- non-AMD acidity

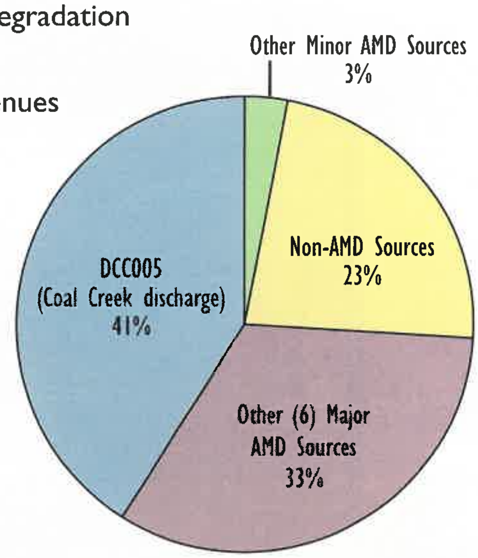

Chart shows the sum of acidity sources to the Tioga River (measured at TIOG2.0 below Blossburg).

PROJECT BENEFITS

While the goal of complete ecosystem restoration may take decades to achieve, many other interim benefits would be realized with the progressive treatment of mine drainage pollution. Ecosystem restoration in the watershed would include waters containing both cold and warm water fishery communities, including Tioga Lake, causing benefits realized in both ecosystem health and integrity, and in increased recreational use. Fishing, swimming, canoeing, and other water-based recreational activities will likely all increase with pollution remediation. Revenues will be increased and jobs created with the input of recreational monies into the local economy. Another benefit of watershed restoration will be easier and more cost efficient operations at the Tioga/Hammond Complex. Additional benefits will be realized throughout the watershed in the areas of increased aesthetics of the river corridor system, decreased structural maintenance of bridges and other man-made structures and improvements to existing and future supplies of potable water for area communities.

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Headwater wetlands in the Johnson Creek Watershed.

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