VII. Load Reduction and Water Quality Evaluation

Water Quality and Monitoring Objectives

The main objective of the restoration-monitoring plan is to measure and assess changes in water quality, based on required TMDL load reductions within Anderson Creek and its impaired sub-basins, as restoration projects are implemented and then progress long-term. Water quality and monitoring criteria established in the QA/QC plan for measuring pollution loads for this assessment should, at a minimum, be maintained for future monitoring. Because in-stream monitoring points for the assessment were established based on identifying impacts to the main stem of Anderson Creek and within its sub-basins, those established points will also serve well for future restoration work. In addition to the established monitoring points, other monitoring points may also be required to better measure load reductions from the implementation of individual restoration projects.

Often, when treating AMD using passive methods, monitoring points are also established within the treatment system itself in order to measure the functionality of the individual treatment system components. Such monitoring protocol will be established for each treatment system constructed.

Depending on the location of the restoration project, varying numbers of in-stream monitoring locations will be necessary to properly determine load reductions. The number and locations of monitoring points will be established during the process of developing a restoration project. Each project will, at a minimum, establish an upstream and downstream monitoring point on the effected tributary and also a point or points on the next larger receiving stream or streams, depending on expected environmental results. A final point should also be established at the mouth of Anderson Creek, and perhaps additional points along the main stem, to assess overall load reductions to the stream system.

Because DEP has identified WRAM as a developmental tool that will likely be used to help predict water quality changes over time, it is recommended that the modeling work begun on this project continue for the life of the restoration activities on the watershed. Such long-term use of the model will help to assess its effectiveness and make necessary adjustments to improve its accuracy. Because the model is presently based only on passive treatment system options, a further recommendation is to also include active treatment as a restoration option within the model. This could be developed within the ongoing restoration-monitoring program.

Because treatment of AMD using either passive treatment or active treatment methods often generate varying but often significant amounts of excess alkalinity, it will be important that the model will be able to be modified to account for the varying amounts of additional alkalinity produced. Presently, the model is limited to a constant amount of alkalinity that is produced by the treatment scenario. In reality, alkalinity generation can vary greatly, depending on numerous factors, which include, but are not limited to, the water chemistry of the discharge, flow rates (which can change drastically throughout the year), detentions times within a treatment system, and the treatment system type, to name a few. For instance, active (chemical) treatment systems can easily be adjusted to discharge high amounts of excess alkalinity in order to neutralize untreated acidic inputs from other areas of the watershed. Passive AMD treatment systems also often provide additional alkalinity beyond the amount needed to neutralize acidity in a particular discharge. To accurately predict in-stream results from the installation of all types of AMD treatment systems, the model's effluent concentrations should be adjustable through a wide range that includes all possible results to depict accurately what may be occurring.

The focus of the monitoring plan for Anderson Creek will be two-fold. The primary short-term focus will be to remediate AMD impacts to Bilger Run and its receiving stream, Kratzer Run, and monitor water quality changes over time. The long-term focus will be to address the discharges affecting Little Anderson Creek (which, in turn, affects the Anderson Creek main stem) and to monitor changes that take place over time.

Because of the sheer number of AMD discharges on Little Anderson Creek, beneficial results will, in reality, be noticed first on the water quality within the main stem of Anderson Creek. Water quality within the main stem above Little Anderson Creek is meeting its designated use, although it is not optimal. Once Little Anderson Creek merges with Anderson Creek, water quality becomes seriously degraded. In addition to impacts from Little Anderson Creek, several discharges enter the main stem directly, via unnamed tributaries to Anderson Creek. Because of the dilution effects from Anderson Creek upstream of Little Anderson Creek, it is likely that load reductions achieved through treating the major discharges affecting Little Anderson Creek and the unnamed tributaries to Anderson Creek will result in enough improvement to Anderson Creek's water quality that some pollution-tolerant aquatic species will return to the stream. Therefore, initial measurable environmental results will most likely have their biggest impacts within the Anderson Creek main stem and monitoring should be focused there. This will be especially true for biological changes. As mentioned earlier, monitoring points to measure improvements will vary depending on the location of the implementation projects within the watershed.

A major component of the overall approach for this restoration-monitoring plan will be a proposal to develop creative approaches to the AMD associated with the abandoned clay mines on Little Anderson Creek. The best approach will be to work with both DEP and EPA to use programs such as Government Financed Construction Contracts, Project XL, or perhaps the Brownfields program to address the worst sites within the watershed. Part of the problem with monitoring large unreclaimed areas is the fact that there are usually many discharges associated with one abandoned site. A program like Brownfields or Project XL might be able to address such sites by using a combined monitoring approach, which considers the entire site as one pollution source and establishes a monitoring point downstream of the entire problem area. Otherwise, it will be necessary to monitor numerous points per site and may be beyond the scope of this assessment, restoration, and implementation plan.

Using WRAM as a predictive model in association with the EPA-certified monitoring plan originally developed for the assessment should provide sufficient accuracy and precision within the monitoring program to assure the quality of data while allowing for adaptations to the program over time. In addition, because projects will likely be implemented on a sub-basin approach, but also be part of an overall watershed restoration program, an adaptive management approach should be used to allow the focus of the restoration work within the watershed to shift as load reductions are achieved and biologic conditions improve.

Determining Success

Either in-stream numeric load reduction or biological “trigger points” could be established to indicate success and when it would be appropriate to shift focus to other areas of impairments within the system. Such an approach should maximize restoration efforts by focusing activities where they will provide the most benefit.

To better determine the success of restoration efforts, both chemical and biological sampling should be performed in-stream at selected monitoring points, based on the location of implementation projects. Chemical sampling will clearly indicate load reductions. The goal for chemical sampling should be to achieve water quality standards set forth in the Pennsylvania Code its for each pollution constituent. However, it may be impossible or unnecessary to reach the set chemical standard in order claim success at restoring a stream segment to the point that it supports its designated use. Biologic conditions should also be considered.

Arguably, the biologic health of the stream is a better indicator of its true condition because macroinvertebrates and fish will populate a stream prior to it meeting in-stream chemical standards. In the case of Anderson Creek, the watershed is designated a cold water fishery (CWF) and should support fish species and other aquatic life that are indigenous to such streams.

To measure the health of recovering stream segments of Anderson Creek, a biologic “trigger point”, which indicates that a stream segment contains macroinvertebrates and fish populations of a similar healthy stream, or reference stream, should be used. Because Curry Creek was the reference stream used in establishing the sediment and nutrient TMDL on Anderson Creek, its index of biologic integrity, or IBI, should be used as the standard by which to measure Anderson Creek’s recovery. Because Curry Creek is relatively unimpaired, a measure of recovery to within 90% or greater of an IBI used for Curry Creek, such as the Hilsenhoff biological index (HBI) for macroinvertebrates, would be a reasonable trigger point for Anderson Creek and therefore should be adopted. In addition, meeting a standard of 95% or greater for the in-stream chemical constituents (metals, acidity, pH, sediment, and nutrients, as identified by the TMDL) designated by the Pennsylvania Code would also constitute a trigger point that indicates a reasonable level of successful restoration.

The frequency and location of monitoring will vary, depending on its purpose. In-stream chemical and biologic monitoring should be performed a minimum of every two years once restoration efforts have begun. Monitoring point locations should be dictated by the location of the BMP’s being implemented. When possible, monitoring points established during this assessment should be used. However, locations that best measure the beneficial effects of the project being implemented should be chosen.

If the monitoring program indicates that environmental improvements are not occurring as expected, then a reevaluation of the assessment, restoration, and implementation plan should be conducted and adjustments made to improve beneficial results. Modifications to the program might include: reprioritization of projects to better insure positive results, alteration of the previously implemented projects to make them more efficient, implementation of additional projects, installation of new technologies or techniques, and reconsideration of the established TMDL, which may be incorrect and need revised.

It will be important that Anderson Creek Watershed Association and its partners commit to a long-term monitoring program to assure beneficial environmental results will be recorded over time. Assistance and financial support for the monitoring program should be provided by local, state, federal and private programs.

Overall Program Objectives

A key component of long-term success toward restoring impaired watersheds is to build local support for restoration efforts. One way to strengthen local support is through the implementation of restoration projects, and by actively creating public relations “success stories” related to those projects. ACWA has been very active in providing information about their activities by publishing information in local news media, displaying information in local businesses, and attending local events that are related to their watershed work. It is expected that such activities will continue and increase as implementation work proceeds.

Measuring local buy-in can be accomplished in many ways, including the number of articles regarding watershed activities appearing in news print, newsletters produced, new members joining the group, new partners supporting their efforts, new sponsors for group activities, public or government agencies actively engaged in watershed group-related work, number of promotional events held, and others. It will be important for ACWA to keep an accurate record of such accomplishments in order to show success beyond environmental pollution reduction. Doing so will assure long-term support for their watershed work.

TMDLs and Expected Load Reductions

Measuring pollution load reductions will be a key component to indicating progress toward the goals established by the TMDL. Using the data gathered during the TMDL study and this assessment should provide a sound baseline for measuring progress. However, because of program limitations and the lack of sufficient recent water quality data, the TMDL developed for Anderson Creek was generated primarily from pre-existing data, some of which dates back to the 1974 Scar Lift Report. Scar Lift was a state initiated program that identified all of the abandoned mine related problems throughout Pennsylvania. Although the reports are excellent resources and are still excellent resources, extensive reclamation and restoration performed since that time has changed runoff and recharge patterns dramatically. Therefore, the TMDLs developed for Anderson Creek appear to indicate much worse water quality than actually presently exists. In that regard, EPA Region III has approved the use of the calculated loads measured during the monitoring period of this assessment as appropriate targets or goals for pollution load reduction. Those calculated loads, based on measured samples, have been used to determine expected load reduction.

Performing water quality testing at site-specific implementation projects will provide accurate load reduction measurements for individual pollution sources, while in-stream monitoring at established or new monitoring points will measure load reductions to the overall system.

Based on the restoration priorities established for the watershed’s sub-basins and the suggested treatment type, the following load reductions can be expected. Again, all load reductions are based on the pollution loads measured during this assessment rather than those developed through the TMDL process.

Little Anderson Creek Expected Load Reductions - Code10332

Implementation Date - Planning to Construction	Pollution Source	Preferred Treatment Type	Measured Existing Load Lbs./Day	Expected Load Reduction Lbs./Day	Expected Load Reduction Percentage
Jun-06 to Jan-10	**DMP- Drauckers 1**				
	Iron	Active Treatment	89.34	89.34	100
	Manganese		24.95	24.95	100
	Aluminum		71.68	71.68	100
	Acidity		781.71	781.71	100
Jun-07 to Jun-10	**DMP-Korb 4**				
	Iron	Active Treatment	37.59	37.59	100
	Manganese		7.43	7.43	100
	Aluminum		20.47	20.47	100
	Acidity		338.51	338.51	100
Jun-08 to Jan-11	**PAMP-LA 4.3**				
	Iron	Active Treatment	11.73	11.73	100
	Manganese		15.48	15.48	100
	Aluminum		14.56	14.56	100
	Acidity		167.29	167.29	100
Jun-08 to Jun-12	**PAMP-LA 3.0**				
	Iron	Passive Treatment	2.82	2.68	95
	Manganese		2.22	0.67	30
	Aluminum		9.84	9.35	95
	Acidity		99.83	99.83	100
Sep-09 to Jan-13	**DMP-Drauckers 2**				
	Iron	Passive Treatment	3.43	3.26	95
	Manganese		9.50	2.85	30
	Aluminum		3.36	3.19	95
	Acidity		69.03	69.03	100

Anderson Creek Expected Load Reductions - Code 9938

Implementation Date - Planning to Construction	Pollution Source	Preferred Treatment Type	Measured Existing Load Lbs./Day	Expected Load Reduction Lbs./Day	Expected Load Reduction Percentage
Mar-07 to Mar-10	**DMP-Korb 2**				
	Iron	Active Treatment	20.52	20.52	100
	Manganese		1.45	1.45	100
	Aluminum		21.44	21.44	100
	Acidity		295.21	295.21	100
Jun-07 to Jun-10	**DMP-AC 3.75-3**				
	Iron	Passive Treatment	0.30	0.29	95
	Manganese		0.50	0.15	30
	Aluminum		4.80	4.56	95
	Acidity		38.84	38.84	100
Jun-07 to Sep-11	**DMP-AC 3.75-2**				
	Iron	Passive Treatment	0.40	0.38	95
	Manganese		0.20	0.06	30
	Aluminum		1.20	1.14	95
	Acidity		17.91	17.91	100

Bilger Run Expected Load Reductions - Code 5661

Implementation Date - Planning to Construction	Pollution Source	Preferred Treatment Type	Measured Existing Load Lbs./Day	Expected Load Reduction Lbs./Day	Expected Load Reduction Percentage
Dec-05 to Jan-08	**DMP- BR 4.5**				
	Iron	Active Treatment	13.95	13.95	100
	Manganese		19.19	19.19	100
	Aluminum		7.35	7.35	100
	Acidity		103.76	103.76	100
Dec-05 to Jan-08	**DMP-BR 4.0**				
	Iron	Active Treatment	2.38	2.38	100
	Manganese		6.10	6.10	100
	Aluminum		3.30	3.30	100
	Acidity		33.20	33.20	100
Jan-07 to Jan-08	**DMP-BR 3.9**				
	Iron	Passive Treatment	0.41	0.39	95
	Manganese		0.86	0.26	30
	Aluminum		0.29	0.28	95
	Acidity		4.61	4.61	100
Jan-08 to Jan-11	**DMP-Wildwood**				
	Iron	Passive Treatment	9.28	8.82	95
	Manganese		2.55	0.77	30
	Aluminum		0.06	0.06	95
	Acidity		15.95	15.95	100

Kratzer Run Expected Load Reductions - Code 10355

Implementation Date - Planning to Construction	Pollution Source	Preferred Treatment Type	Measured Existing Load Lbs./Day	Expected Load Reduction Lbs./Day	Expected Load Reduction Percentage
Sep-06 to Sep-10	**PAMP-KR 1.45**				
	Iron	Passive Treatment	0.30	0.29	95
	Manganese		5.82	1.75	30
	Aluminum		8.61	8.18	95
	Acidity		70.19	70.19	100
Jun-09 to Sep-13	**DMP-Widemire**				
	Iron	Passive Treatment	6.30	5.99	95
	Manganese		2.57	0.77	30
	Aluminum		6.21	5.90	95
	Acidity		55.06	55.06	100
Sep-10 to Jan-13	**DMP-879**				
	Iron	Passive Treatment	1.89	1.80	95
	Manganese		0.24	0.07	30
	Aluminum		0.01	0.01	95
	Acidity		0.90	0.90	100