PADEP Coal Remining and Reclamation XL Project

PROJECT FINAL REPORT
August 1, 2009

Background

Since 1984, Pennsylvania has recognized the need for limiting water treatment liability on remining operations that reaffect pre-existing pollutional discharges. Remining is the extraction of remaining coal from previously mined areas by surface mining methods. Regulations were implemented in 1986 under 25 Pa. Code Chapter 87, Subchapter F and Chapter 88,Subchapter G, that provide for limited liability when an abandoned mine discharge is affected by a new operation, provided that measures are taken to decrease pollution load from pre-existing discharges and that monitoring shows the discharges have not been adversely impacted by the remining operation. This approach, commonly referred to in Pennsylvania as Subchapter F permits, has yielded marked success in addressing pollution from abandoned mine lands (Smith et.al. 2002, Brady and Hawkins et.al. 2002). However, many potentially reminable abandoned mine lands continue to remain largely unreclaimed because of continuing concerns of incurring liability for pre-existing pollutional discharges. For example, a remining operation may affect multiple discharges, causing an overall water quality improvement even though an individual discharge may be degraded. Under Pennsylvania's Subchapter F regulations, the mine operator may still incur long-term liability for treatment of that discharge back to baseline conditions, preventing bond release and requiring long-term treatment, in spite of the fact that the overall operation caused an improvement in the quality of the receiving stream and reclaimed abandoned mine lands at no cost to taxpayers.

This problem was partially remedied by regulations at 40 CFR 434.72(b)(2) published January 23, 2002 that allow the permitting authority to waive numerical effluent limits under four specific situations where monitoring of individual discharges is impossible or impractical. But these situations are relatively infrequent, limiting the impact of that regulation. Moreover, it is better to measure environmental performance based on actual in-stream impacts, rather than to solely rely on a suite of best management practices (BMPs) in place of numerical effluent limits. Consequently, Pennsylvania DEP petitioned EPA to consider a pilot project under a program in place at the time for innovative regulatory approaches referred to as project XL, for eXcellence in Leadership.

In April, 2000, EPA Region III and Pennsylvania DEP executed an agreement under EPA's Project XL program that allowed for a modified approach to remining permits. Under XL, an 8-watershed pilot project would be conducted for surface mining sites with preexisting pollutional discharges of acid mine drainage (AMD). In this pilot study, water quality performance would be based on in-stream concentrations at a key receiving stream rather than on loading-based effluent standards at individual preexisting discharge points. The mechanism for these pilots was to execute a Consent Order and Agreement (CO&A) with each remining permit. The remining permit includes the conventional effluent standards and remining requirements;

however, the consent agreement implements the XL approach. As long as the mine operator is living up to the provisions of the CO&A, the XL provisions apply.

The key component of the XL consent agreement is that the permittee must establish a baseline in-stream concentration using at least one year of semi-monthly samples. Monthly samples are taken at the XL point whenever mining activities begin. Compliance is determined annually by comparing post-mining in-stream water quality with the baseline. Also, if two monthly samples exceed the 95th concentration percentile, the permittee must initiate weekly sampling. Three months of excursions at the 95th percentile concentration would require action to determine the source of the increase. In either case, a determination that mining has caused an increase in in-stream pollutant concentrations would require corrective action. However, because the compliance point is the XL point, the corrective action could encompass a wide range of activities or treatments that cause the XL point to return to it's baseline condition.

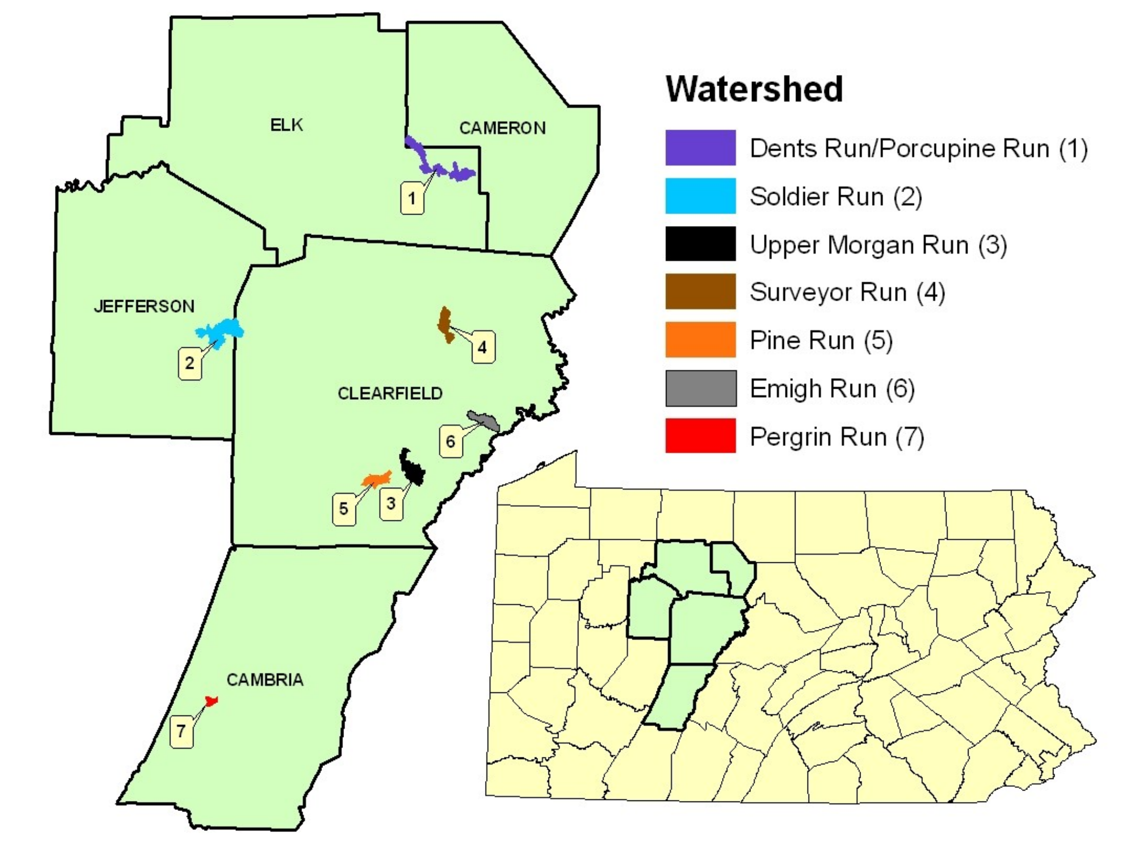

Figure 1. Location of Project XL pilot watersheds.

As of January 2009, surface mining permits and COAs were issued at all 8 pilot project sites; however only a limited amount of mining had taken place on the River Hill Wheatfield Operation.. Therefore, only seven pilot projects were studied in detail. The Amerikohl Rathmel (Soldier Run) pilot site has been mined and reclamation completed. Reclamation was nearing completion on the King Coal Royal Operation. More detailed information on each of the pilot sites can be obtained in the files of the appropriate district mining office (Moshannon, Knox, or Cambria). The permit and COA documents are available at DEPs web site: www.dep.state.pa.us under Mineral Resources Management, District Mining Operations. Figure 1 shows the location of the pilot watersheds in Cambria, Clearfield, Elk, and Jefferson Counties.

Water Quality Results

Each pilot watershed has one remining operation except for the Surveyor Run watershed, which has two separate operations. Table 1 summarizes general data for each pilot site. Water quality data for the XL monitoring point and individual pre-existing pollutional discharge points for each pilot are included in the appendix.

For this report, water quality concentration data for the most recent full water year (October, 2007 through September 2008) from the in-stream XL monitoring point was compared with the baseline in-stream water quality. Baseline and subsequent pollution load data for the individual pre-existing discharges was also examined. In some cases, multiple discharges are grouped together as a hydrologic unit. For statistical comparison, the same test that is applied to conventional remining (Subchapter F) permits in Pennsylvania and described in 40 CFR 434, Appendix B, Method 1 was used. A consecutive 12-month period is compared with the original baseline. Exploratory Data Analysis statistics are used to compare the baseline median with the recent median. If the difference is significant at the approximate 95% confidence level, then the appropriate block on the summary sheet is colored either green, for a significant improvement, or red for significant deterioration. Four of the seven XL monitoring points showed statistically significant improvements in water quality for one or more parameters with numerical effluent limits. Two sites showed no significant change. One site, the P&N Benezette Operation on Porcupine Run, showed a significant increase in in-stream iron and acidity. This was remedied with supplemental water treatment.

The most marked improvement in in-stream water quality has been realized at the completed Rathmel Operation (Figure 2). It successfully eliminated acidity in the receiving stream, which is now alkaline. Metals loadings at the discharge points also significantly decreased, however there was no statistically significant change to in-stream water quality. Surveyor Run also has shown a marked visible improvement at Monitoring Point 6, the XL point. Prior to the pilot, iron staining in the streambed was very pronounced. Although the stream is still incapable of supporting aquatic life due to marginal pH levels and possibly aluminum concentrations, the iron staining has substantially disappeared. Acidity, iron, and manganese are significantly lower. The King Coal Royal Operation resulted in significant reductions in acidity and iron concentrations in Emigh Run and the River Hill Coal Company Kasubic Operation significantly reduced acidity and iron concentrations in Upper Morgan Run.

Figure 2. Completed reclamation at Rathmel site and XL monitoring point on Soldier Run.

Summary of XL Pilot Sites

Amerikohl Rathmel Operation: This was a relatively small (127.8 ac) and quickly completed operation. Mining started in July 2004. Regrading was finished in 2005 and reclamation was complete in 2006. As of October 2005, Soldier Run, showed no statistically significant change in quality but pollution loadings of acidity, manganese and aluminum had significantly decreased at the point of discharge. However, by October 2006, in-stream water quality showed a dramatic improvement – going from a median net alkalinity of 0 to a net alkalinity of 28.7, further improving to the mid 30s in 2007 and 2008. Loadings of acidity, Fe, Mn, Al, and sulfate at the combined discharge points (Hydrologic Unit 1) all significantly decreased. The improvement persisted through the 07/08 water year, indicating a permanent change resulting from remining. This operation effectively combined several BMPs to improve water quality. The BMPs included daylighting of 4.4 acres of abandoned deep mines, special handling of potentially acid-forming material, alkaline addition at 100 tons per acre over a 3.5-acre area, exposing underlying alkaline material over a 6.5-acrea area, and collecting deep mine water in a permanent pond to allow dissolved aluminum to precipitate.

Ebensburg Power Company Nanty Glo West Refuse Site: This project was started in October 2004. This operation is removing a large abandoned pile of coal refuse for burning at a fluidized bed power facility. Alkaline fluidized bed ash is being brought back to the site for reclamation. As of December 2008, 722,640 tons of ash have been returned to the site. The abandoned refuse pile leaches worst-case quality acid mine drainage, including elevated concentrations of trace metals into the receiving stream. Water quality data shows promising results; however, the change is not yet statistically significant at the in-stream monitoring point. Four out of nine individual discharges showed significant reductions in acidity and/or iron loadings. Cambria District Office staff believe that the limited improvement seen in the stream water can be attributed to low stream flows during much of the 06/07 and 07/08 water years. This resulted in

Figure 3. Pre-remining conditions at Ebensburg Power Nanty Glo operation showing coal refuse piles and AMD-impacted PergrinRun.

the stream flow being comprised almost entirely of discharges from the refuse pile. Figure 3 shows the refuse pile and receiving stream, Pergrin Run, before the commencement of reclamation. The bright orange stream photo is taken at the XL monitoring point.

King Coal Sales Royal Operation: Mining began at this site in December 2002. Coal removal and backfilling is now completed, but revegetation is still being done as of this report. King Coal Sales mined remaining reserves of the Lower Kittanning Coal, which is a notorious acid producer in eastern Clearfield County. BMPs employed at this operation included importation of large quantities of limestone waste, reclamation of an abandoned coal processing facility and associated coal refuse, and through a contract with the Commonwealth of Pennsylvania, reclamation of a large abandoned pit filled with acid mine drainage that was left behind by a forfeited mine operator. The XL

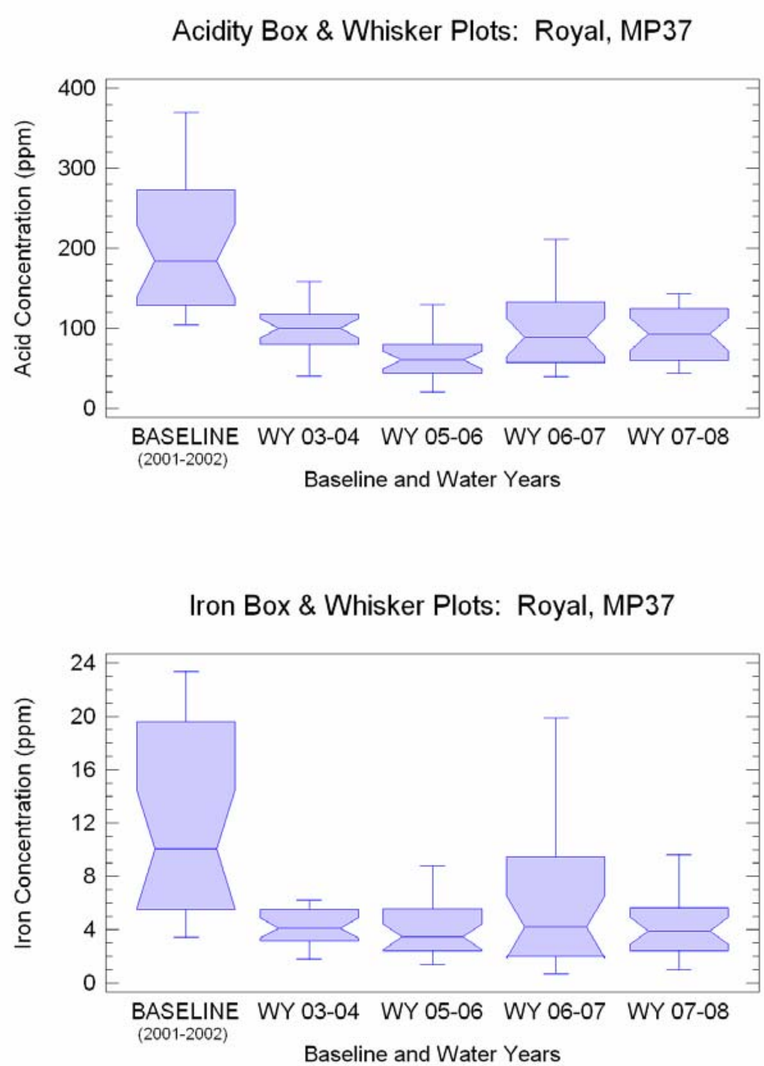

Figure 4. Boxplots showing distribution of in-stream acidity and iron concentrations for XL monitoring point MP-37 on King Coal Royal Operation.

monitoring point in Emigh Run (MP 37) shows significant improvements in acidity and iron concentrations. This is also reflected in reduced acidity and iron loads at individual discharge points comprising Hydrologic Unit 1 (HU-1) and by reduced acidity load at Hydrologic Unit 4 (HU-4) discharge points. Conversely, acidity loads increased in the discharges comprising Hydrologic Unit 3 (HU-3). This is believed to have resulted from the beneficial impact of reclaiming the tipple and abandoned pit – which are chiefly monitored in HU-1 and HU-4, while the alkaline addition rate was not high enough to effect a positive change in HU-3. Nevertheless, the overall impact on all the individual discharges (hydrologic units 1 through 4) was to reduce in-stream acidity and iron concentrations to roughly half of the pre-remining baseline. Figure 4 shows a series of box plots at MP 37 for the baseline period and in successive water years. Both acidity and iron concentrations showed a rapid and sustained decrease.

P&N Coal Benezette Operation: Mining started on this operation in June, 2003 and continues to the time of this report. The main objective of this operation is to improve water quality by encountering a significant limestone deposit, the Johnstown Limestone, while removing the Upper Kittanning and Middle Kittanning Coals. The area is underlain by an extensive deep mine complex on the Lower Kittanning Coal that produces severe AMD at two individual discharge points. The main BMP is to leave sufficient limestone in the backfill such that it will generate alkaline water, which will infiltrate into the Lower Kittanning deep mine and improve the quality of drainage from the mine. Some of the limestone is to be removed from the mine and used for passive treatment projects elsewhere in the watershed. The remainder is to be redistributed on other portions of the mine site. The discharges flow to Porcupine Run, which impacts Dents Run, a major tributary of Bennetts Branch. Other BMPs include regrading and revegetating abandoned mine lands. One of the discharge points, MP17, has shown increased pollution load for acidity and iron while the other discharge point, MP 19, has posted an improvement in acidity loading. MP 17 is much larger than MP 19 and thus dominates the in-stream impact. The XL monitoring point on Porcupine Run initially showed a significant increase in iron concentrations but not acidity. This may reflect that BMPs on this operation have increased alkalinity that are not manifest in the deep mine discharges, keeping the increased acidity at MP 17 from impacting Porcupine Run.

An additional goal of this project was to collect AMD and direct it to an area for future treatment. To do this, a large cut was made on the Lower Kittanning deep mine to channel water to MP 17. This may have resulted in a temporary increase in pollution load that will eventually stabilize at lower levels. Due to the increase in in-stream iron, the PA Bureau of Abandoned Mine Reclamation installed a lime dosing device to improve water quality. Despite some early technical difficulties with the equipment, the data from the 07/08 water year show the results - a statistically significant improvement in in-stream acidity and iron concentrations back to baseline conditions.

Figure 5. Elk bugling adjacent to the P&N coal Benezette Operation; the MP-17 discharge emanates from the reclaimed Lower Kittanning cut; lime silos for treatment system at MP-17.

This operation is in the middle of Pennsylvania's elk range, and the reclaimed mine lands are heavily used by elk. Figure 5 shows discharge MP-17 and the limestone-filled trench excavated into the Lower Kittanning underground mine complex, just upgradient from MP-17; a view of the remining project from the Pennsylvania Game Commission's elk viewing area and an elk grazing on the reclaimed surface mine.

River Hill Kasubic Operation: Mining on this operation began in August 2002, and has positively impacted the receiving stream, Upper Morgan Run. Although the stream is still heavily impaired by abandoned mine drainage, it has shown statistically significant improvement in acidity and iron concentrations. Pollution loads from the pre-existing discharges (Hydrologic Unit 1) have also shown significant decreases from baseline loading rates for acidity, iron, and manganese. The principal BMP on this operation is to redistribute naturally occurring alkaline rock (the Johnstown Limestone) as well as regrading and revegetation of abandoned mine spoil, and daylighting an abandoned underground mine. Sulfate loads at HU-1 discharge points increased, which is common following remining, since freshly exposed pyrite can oxidize in the course of disturbing previously mined spoil and new overburden. Sulfate is not a regulated parameter on this operation.

Figure 6. The Kasubic Operation showing the principal pit, and a pit where the Johnstown Limestone is obtained for alkaline redistribution throughout the mine. The lighter colored, irregular-shaped blocks are limestone. XL monitoring point is on Morgan Run, above.

River Hill Mid Penn No. 1 Operation: Coal removal at the River Hill Mid Penn No. 1 operation didn't begin until February, 2007, so there has been limited time for this remining operation to have had much water quality impact. The principal BMPs on this operation are regrading and revegetation of abandoned mine lands as well as the application of large quantities of imported alkaline material and special handling of potentially acid-forming material. A small area of coal refuse will be removed. Only four surface acres, including 1,400 feet of highwall, has been reclaimed and 11.7 acres of deep mine have been daylighted. No significant changes have yet to be noted in the XL point although some isolated changes have been noted in individual Subchapter F discharge points MP 11 (Fe) and MP 14 (sulfate). Sulfate is not a regulated parameter but is useful as an indicator that the geochemical effects of remining are being detected in the XL monitoring point.

Sky Haven Surveyor Run and Ridge Road Operations: This project consists of two separate surface mining permits and two reclamation projects. The Surveyor Run Operation was started in 1995 and was later incorporated into this project. The Ridge Road Operation was started in 2002. Mining and reclamation is nearing completion on the Surveyor Run Operation. This site had been badly scarred by unreclaimed surface mines, with little or no topsoil preserved, and thus, poor vegetative cover. Biosolids were extensively and successfully used to enhance revegetation efforts. In addition, an abandoned coal tipple operated by the defunct Shawville Mining Co. was also reclaimed as part of the XL agreement and an abandoned Shawville bond forfeiture site was reclaimed under an "Act 181" reclamation contract. BMPs include regrading and revegetation of unregraded mine spoil, refuse removal, alkaline redistribution, and biosolids application. A portion of the reclaimed Surveyor Run Operation and reclaimed tipple area are shown in Figure 7.

Figure 7. Reclamation at the Surveyor Run site. Active mining ongoing in the background on left.

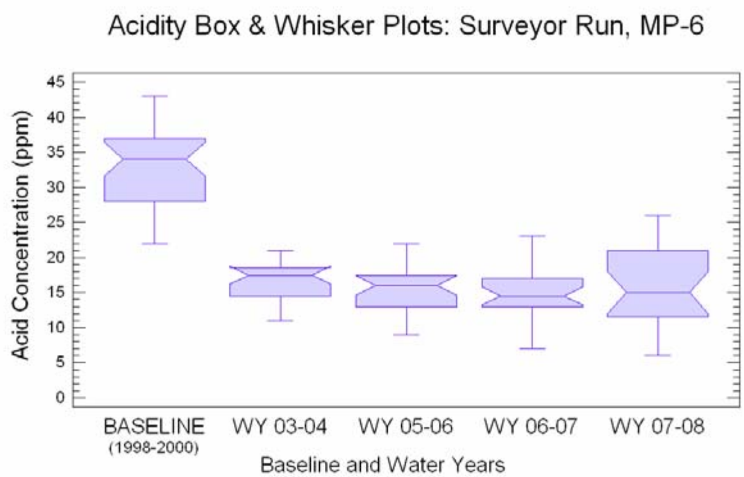

Figure 8. Surveyor Run XL monitoring point. Pre-remining iron staining greatly diminished. Boxplots show marked decrease in acidity following remining.

Surveyor Run at in-stream monitoring point MP 6 is showing statistically significant water quality improvements. Figure 8 shows the in-stream monitoring point MP 6 in Surveyor Run and its change in acidity concentrations through time. Although still impacted, the visible appearance of the stream has greatly improved from its pre-remining condition, which was heavily iron stained. Mine drainage discharge points MP-7, MP-17, and MP-30 have also shown a significant decrease in acid and/or iron and manganese load while discharge point MP-2 showed a significantly increase in manganese load. The increase in manganese load is not surprising because the BMPs employeed are generally less effective at reducing manganese than acidity and iron. Also, discharge point MP-4 showed an increase in acidity. So while the overall impacts of the two operations was to reduce acid loading rates and in-stream acidity concentrations, the BMPs were not uniformly successful in affecting all discharge points and in fact, some of them got worse despite an overall improvement.

Comparison with "Subchapter F – type" Monitoring

The principal goal of this project was to determine whether in-stream monitoring was as sensitive to mining impacts as the traditional "Subchapter F" approach of measuring load at discrete discharge points. Thus, each site had been monitored using both methods, in-stream and at discrete discharge points. This allowed for a comparison between the two alternate regulatory approaches. In most cases, changes in pollution loads at individual Subchapter F points have been very consistent with changes noted at the XL in-stream monitoring points. The study sites indicate that the XL approach can be an equally sensitive measure of water quality performance, at least for the watershed and mine-site sizes used in the pilot study.

The four pilots with improved in-stream water quality all showed significant reduction in pollution load at one or more "Subchapter F" discharge points. However, even though these four projects all had multiple discharges where pollution loads decreased, two of the four pilots (Emigh Run and Surveyor Run) also had one or more discharges with increased load for one parameter. Under a conventional Subchapter F permit, the surface mine operators at these two discharges could have incurred treatment liability for those discharges, even though their overall impact was to improve stream quality. Hence, the in-stream monitoring served exactly the intended function – to look at overall water quality impacts rather than at specific individual discharge points.

Of the two pilot sites that did not show any statistically significant change in water quality, one (Nanty Glo) had several individual discharges with significantly reduced pollution loads. As discussed earlier, this lack of improvement may be an artifact of very low stream flows. Individual "Subchapter F" discharges at the Pine Run pilot were consistent with in-stream monitoring. Neither showed a significant change. It should be noted that both the Nanty Glo and Pine Run sites have been started relatively recently and therefore there is not a lengthy period of time for water quality to have been affected by the remining operation. Finally, the Benezette Operation, which showed worsening in-stream water quality in terms of iron concentration, also showed significantly increased acidity and iron loads at the larger of two Subchapter F discharge points. The Subchapter F monitoring and XL monitoring appear to be consistent because other measures taken on the remining operation (mining and redistribution of a limestone unit) are likely to have offset the acidity increase shown at point MP-17.

Reclamation of Abandoned Mine Features and Coal Recovery

Remining at the pilot sites has already resulted in extensive reclamation activities at no cost to the public. All combined, 299 acres of abandoned mine lands have been reclaimed, 109 acres of abandoned underground mines daylighted, and 24,350 linear feet of abandoned highwall have been reclaimed while over 2.8 million tons of coal and coal refuse have been recovered.

Reclamation activities at the pilot sites are summarized in the table below. Upon completion of these operations, the estimated value of reclamation is $5.3 million, which will be completed with no public funds.

Table 1. Reclamation Accomplishments and Coal Recovery at Pilot Sites

Company	Operation	Acres AML Reclaimed	Acres Daylighted	Ft. Abnd. Highwall Reclaimed	Tons Coal and Refuse	Est. Rec. Value
Amerikohl	Rathmel	0	30	0	81,000	$34,311
Ebg. Power	Nanty Glo	0	0	0	722,640	$112,472
King Coal	Royal	59	0	600	466,763	$320,000
P&N	Benezette	33	1	5,850	527,821	$205,000
River Hill	Kasubic	27	45	2,100	143,950	$210,900
River Hill	Mid Penn	4	12	1,400	37,555	$217,000
River Hill	Wheatfield	0	0	0	847	$1,561,859
Sky Haven	Ridge Road	58	6	5,400	307,172	$150,000
Sky Haven	Surveyor Run	118	15	9,000	528,310	$2,493,770
Total		299	109	24,350	2,816,058	$5,305,312

Summary and Discussion

The chief purpose of the pilot was to evaluate the efficacy of monitoring water quality performance at a key in-stream monitoring point rather than at individual pollutional discharges. This is particularly important where it is impossible to monitor individual pollution sources due to their shear number or because it is impossible to measure flows. For example, where the pollutional discharge is manifested as diffuse baseflow to a receiving stream rather than at discrete discharge points, it is impossible or at least very impractical to measure pollution loads. Other abandoned mine drainage areas are characterized by large numbers of individual discharge points, making load measurements very difficult and costly. Another problem arises where surface drainage commingles with pollutional discharges. Storm runoff can greatly influence pollution load data, skewing the data and making pre- and post-mining comparisons invalid. For all these reasons, using an appropriate in-stream monitoring point and a concentration, rather than load-based baseline is frequently much more practical and cost-effective. It is also more practical from a regulatory standpoint, because it is easier to monitor concentration data than loadings, which require precise flow measurements that tend to change quickly depending on precipitation. But does this approach yield as good of results as the more rigorous conventional method of monitoring pollution loads at individual discharge points? And is it as effective in detecting more subtle changes in pollution loading rates? In this pilot study, measurement of pollution loads at individual discharge points very closely paralleled water quality performance in receiving streams. This demonstrates that the XL approach is an effective method of monitoring water quality performance. It was noted, however, that the individual discharge points sometimes showed remining-induced water quality changes more quickly than the in-stream XL monitoring point. Placement of XL monitoring points on large receiving streams would be a poor choice as any water quality changes would be very susceptible to being masked by the large flow. In this study, in-stream XL monitoring points had watershed drainage areas ranging from 1.3 to 5.8 square miles (3.3 to 15 km^2). Mine sites ranged in size from 5 to 12% of the watershed area. Watersheds outside of this size range may not be appropriate for use of the XL monitoring approach.

Another benefit of the XL monitoring approach is that it integrates the overall water quality impacts of a remining operation. For example, where there are multiple discharges, some may worsen in pollution load while others improve. Conceivably, a mine operator could incur treatment liability for a discharge that increased in load, even though load reductions at other discharges more than offset the increase. This can have a chilling effect on the willingness of operators to reaffect abandoned mine lands with preexisting discharges. The XL approach looks at the total impact of the project on water quality rather than at individual discharge points. Without XL, many or all of these projects would not have been undertaken. To date, this XL pilot has been responsible for the reclamation of nearly 300 acres of abandoned surface mined lands, elimination of almost five miles of unreclaimed highwall, and daylighting of over 100 acres of underground mines while allowing for the recovery of coal and coal refuse that otherwise may have been mined from virgin sites. Ultimately, the pilot sites will result in over $5million worth of reclamation through remining, at no cost to the public, as well as the recovery of significant reserves of coal.

Conclusions

1. Monitoring the impact of remining permits on stream quality using concentration data at an in-stream monitoring station was just as effective at indicating the success or failure of pollution abatement as the conventional Subchapter F approach of measuring pollution loads at individual or grouped discharge sampling points. The XL approach is deemed appropriate for watershed areas similar to those in this study. It would probably not be appropriate where there are other potential impacts on water quality that may make it difficult to ascertain the impacts from a single remining operation. However, impacts, whether negative or positive, tend to show up sooner at individual discharge points.

2. Use of an in-stream monitoring point integrates the combined impact of a remining operation on water quality. Operations that had multiple individual discharges with mixed results (some pollution loads increased while others decreased) could have incurred liability for discharges with increased pollution loading, even if the combined effect was a reduced overall pollution load and improved in-stream water quality.

3. The in-stream monitoring approach can be simpler and cheaper to implement than conventional Subchapter F monitoring, particularly where there are numerous individual discharge points or where the flow rates are difficult or impossible to accurately measure. The Subchapter F approach requires accurate flow measurements, which often means maintenance of weirs or other flow measuring devices. The XL approach reduces the need for such precise and oftentimes difficult flow measurements. The XL approach can also greatly reduce sampling costs. Sampling of individual discharges could be reduced to quarterly or altogether, rather than monthly. Where there are multiple discharges

being sampled, this cost savings could be considerable, making remining operations more feasible.

4. Most remining operations result in improved or unchanged water quality. Although infrequent, a few do degrade water quality. This has been the case regardless of whether the results are measured through pollution loads or in-stream water quality.

5. In the event that responsibility is incurred for a pre-existing discharge, the XL approach improves regulatory flexibility for achieving compliance. The operator can opt to treat the discharge directly affected or could undertake alternate reclamation or treatment activities in the watershed to restore in-stream water quality.

6. Baseline pollution calculations for in-stream concentrations were much more stable than baselines for pollution loads from discharges because concentration data tend to be much less variable than loads, which are very subject to flow rates. Where highly variable flow rates occur, measuring the baseline using in-stream concentrations may be superior to using individual pollution loads.

7. Significant additional reclamation of abandoned mine lands can be encouraged by employing the XL permit approach on a broader scale. Because it reduces liability concerns, decreases monitoring costs, and enhances flexibility in dealing with water quality issues, surface coal operators would be more likely to undertake economically marginal remining projects. Water quality performance is still effectively measured and compared against the pre-remining baseline, so there is no added incentive to secure permits that may pose undue risk of worsening water quality.

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