United States Department of the Interior

OFFICE OF SURFACE MINING
Reclamation and Enforcement
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Charleston, West Virginia 25301

MAR 06 2009

Tom Clarke, Director
Division of Mining and Reclamation
West Virginia Department of
Environmental Protection
601 57th Street, SE
Charleston, West Virginia 25304

Dear Mr. Clarke:

Enclosed is the final version of the Oversight Report covering the evaluation of the effectiveness of Surface Water Runoff Analysis (SWROA) Regulations. In accordance with the current work plan, the report presents a summary of the review team's evaluation of the effectiveness of the regulations, in terms of information provided in permit applications, as well as field application of permit conditions.

Based on our permit and field review of five permits, it is the team's finding that the SWROA concept is valid, and that the associated emphasis on stormwater management has had positive effects. However, issues remain with respect to current modeling techniques and rainfall and runoff discharge monitoring procedures.

We look forward to working with WVDEP personnel to develop and implement training in modeling procedures and in observable indicators of effectiveness of the SWROA onsite. I will be contacting you soon to discuss the next steps in developing the training program and how we want to proceed.

If you have any questions regarding the enclosure, please contact me.

Sincerely,

Roger W. Calhoun, Director
Charleston Field Office

Enclosure

Oversight Report
Surface Water Runoff Analysis Effectiveness
March 6, 2009

1. Executive Summary

The team reviewed five Surface Water Runoff Analyses (SWROA) and field verified the designs by site visits to the corresponding steep slope active surface mining permits (Figure 1). Based on observations from the five site visits, it is apparent that the SWROA concept is valid, and that the associated emphasis on storm water management has resulted in improved surface mine drainage design and timely construction. There is emphasis on more creative and safer water detention and better valley fill drainage and construction practices.

However, the computer modeling for each of the five SWROAs was reviewed and found to be lacking in narrative and descriptions of what the designer was trying to accomplish. Detail concerning justification for decisions and parameter selection would have been helpful. Drainage structures shown on SWROA maps should be referenced so that they are identified by both the number used on the permit drainage map and the SWROA calculations, or a single identifier should be used for each structure throughout the permit. The team also identified concerns with many assumptions used in the models such as inappropriate runoff values and/or failure to model significant scenarios such as the initial denuding of fill areas and final breakdown of fill slopes WVDEP has agreed to address these issues through training and workshops for the industry over the next year.

The team also noted that the effectiveness of the modeling schemes used for the SWROAs cannot be quantitatively analyzed and verified because field monitoring of actual storm water runoff discharges is not required by the regulations. WVDEP has agreed to train its inspectors to document issues that might be related to increases in peak discharges and include revisions to the SWROAS and additional monitoring when the violation relates to an apparent increase in peak discharge not anticipated by the model. WVDEP has also agreed to monitor its violations to determine if there are any trends in violations related to the SWROA process or monitoring that should be addressed by future procedural, policy or regulatory changes.

2. Introduction

The permit application must contain a determination of the probable hydrologic consequences (PHC) of the proposed operation upon the quantity of water and what impact it will have on flooding or stream-flow alteration. In 2003, the OSM approved revisions to the WVDEP excess spoil fill construction and contemporaneous reclamation rules. These rules required all new and existing coal mine operations to complete a surface water run-off analysis demonstrating that the surface disturbance created by the operation would not add to the peak offsite discharges during storm events. The goal of the analysis is to show that the during-mining and post-mining surface conditions will result in no net increase in peak run-off when compared to the pre-mining condition. A runoff-monitoring plan must show how run-off and flow in the receiving stream will be monitored for each permit. The SWROA is both a permit design requirement and a field implementation requirement with the goal of preventing additional flood damage resulting from mining activity. This oversight study was developed to assess the effectiveness of the SWROA rules.

3. Review Procedures

A group of engineers from both OSM and WVDEP offices formed a team with the task of determining the effectiveness of the implementation of the new SWROA rule. The team reviewed five SWROAs selecting one permit from the jurisdiction of each of the four WVDEP permit review offices, and a second from the Logan Office. The SWROA permit selections were made based on the following criteria: the mine had to be located in a steep slope region, currently producing coal, and currently implementing the SWROA in the field. The team selected permits with different permittees, consultants, overburden characteristics, and topography.

The following permits were reviewed (Figure 1):

- Bandmill Coal Corporation, S-5015-96, Wade No. 3, Logan County
- Coal-Mac, Inc., S- 5019-94, Little Muncy Branch, Logan/Mingo County
- Pioneer Fuel Corporation, S-3018-03, Ewing Fork No. 2 Surface Mine, Raleigh/Fayette County
- Brooks Run Mining Company, S-2010-02, Seven Pines Mine, Webster County
- Paynter Branch Mining Inc., S-4003-00, North Surface Mine, Wyoming County

Each mining permit was reviewed in the corresponding permit office. Discussions were held between the SWROA review team, the permit reviewers, and mine site inspectors. Immediately following each office permit review, the team visited the active site to observe how the SWROA was implemented in the field. The team also evaluated the related SWROA plan to determine if its design could be properly constructed in conjunction with the mine plan. Features examined in the field were: runoff storage, measures intended to limit disturbed area, rock check dams, pit storage, increased flow path (lag time), and overflow (weir) storage in on-bench sediment basins. The field team also visited and inspected the designated SWROA off site evaluation points to determine if the rainfall and stream flow monitoring had been properly and promptly installed in accordance with the approved plan.

For each review the team consisted of personnel from both WVDEP and OSM and the WVDEP mine site inspector to ensure that the team had the latest information and data. At the end of the review, the team compiled comments, notes, and findings.

4. Findings

The surface hydrology in each permit was analyzed using the computer-modeling program SEDCAD 4 to fulfill the requirements of SWROA. SEDCAD 4 is the most commonly used of several surface water modeling software packages. It was designed to estimate the hydrologic response of a watershed to specific rainfall events in its pre-mining, during-mining, and post-mining state. SEDCAD uses a variety of parameters to model a watershed including local storm information, eroded particle size distributions, structure networking, and watershed and structure design. By using a trial and error method with the program, the designer can run multiple scenarios to determine which stage in the proposed mining plan will generate the maximum storm-water runoff discharge from the site for a given rainfall event. By comparing discharges predicted by the model to actual discharges, for the same rainfall event, the designer can also calibrate the model such that predicted discharges closely approximate actual discharges. Using the calibrated model, design criteria for retention structures and type of ground cover can be determined. Appropriate design for drainage structures and selection of ground cover can prevent during-mining and post-mining runoff discharges from exceeding pre-mining levels.

The team reviewed the SWROA and associated permit files for each mine selected and examined the parameters used in the SEDCAD model. The team noted the worst case scenario selected by the designer, and judged the reasonableness of assumptions. The selection of runoff curve numbers, flow paths, routing/detention techniques, and other hydrology and hydraulic model input parameters were all reviewed. Review of the SWROA and permit documents was at times difficult due to the lack of correlation between the SEDCAD reports and other documents in the permit file. The SWROAs lacked narrative and descriptions of the designer's parameters and reasoning. The reviewing team often needed more detail regarding the justification for the designer's decisions and parameter selection. Without justification, it was very difficult for the team to replicate the designer's models or understand why certain parameters were chosen. Additionally, drainage structures on SWROA maps were not referenced with the same numbering system used in the remainder of the permit. Most significant was a lack of comparison between actual discharges resulting from specific rainfall events and those predicted by the model for the same event.

The five permits did have a number of similarities. The predominant method used to detain water and reduce peak flows for each permit was storage provided by multi-cell on-bench sediment basins. Examples of these design features in the form of small check dams within basins can be seen in Figures 4 and 5. Drainage schemes and flow paths modeled in the analysis were often reasonable. However, the following discrepancies and inconsistencies were noted:

- Improper selection of channel type for the routing method used in the SEDCAD modeling procedure. In one instance the channel type selected yielded a water velocity of 64 feet/second, which is not realistic, equating to 44 miles per hour.

- When predicting the amount of run-off from a particular storm event, one designer used a runoff curve number of 56 to represent surface mine spoil. The designer did not include the reasoning or data to justify this number. The use of such a low curve number for mine spoil would reduce the amount of run-off the SEDCAD model would predict for the overall site. This may have been appropriate, but was not explained or substantiated.

- In one instance the designer assumed that the basin was dry when the precipitation event occurred. A more conservative, or safer, approach is to assume all structures to be full when the event begins.

- In one SWROA the flow path for the pre-mining condition of forest with heavy litter was transitioned to a paved area or small upland stream with no intermediate zone. This shortens the travel time (time of concentration) and inflates the pre-mining peak flows.

- Worst case during-mining scenarios did not consider the critical situation that occurs when valley fill sites are totally denuded and dumping begins. If the site is not stage cleared and adequate ditches and detention structures in place to compensate for the drastic changes in ground cover, then peak runoff leaving the site will increase. This critical condition was not considered in any of the SWROAs.

- For the majority of the sites reviewed, the permit runoff monitoring plan did not include specific references to monitoring locations, mechanisms, and details. Two sites did designate pipes (culverts) that could be used for estimating flows; however the peak flow level at these locations were not being actively measured.

- The regulations relating to SWROA do not require monitoring of all discharges from a site. In each case reviewed, the operator's monitoring plan included one SWROA compliance point, which was presented as representative of the entire permitted site of hundreds of acres and multiple drainages. However, in one instance the representative compliance point was placed in a drainage area in which the only mining related activity was placement of additional spoil in an existing valley fill. By placing the monitoring point in this location, the data collected at the site would show a reduction in run-off for that particular drainage area that does not accurately depict how the overall mining operation is affecting all impacted drainage areas.

During the course of the study, the team found that, in general, sediment control systems were in place and appeared to be making positive contributions toward runoff control. One site actually added a large dugout pond to store water for farm use (Figure 2). All sites evaluated had implemented SWROA controls in the field although some operations did not closely follow what was proposed in the permit. In general, sediment control structures were in good functional condition; although, in some cases, maintenance in the form of tree removal from embankments would have been appropriate.

In all cases, the operators appeared to be maintaining the capacity of sediment ponds in the best way possible: the sediment was being trapped in sediment ditches and check dams long before it reached the ponds. Some valley fills had check dams immediately below the active fill toe to reduce the amount of sediment entering the pond. No excessive sediment build-up was observed in any pond. Some sites enlarged sediment ditches at protruding points along the contour beyond what was required in the permit. This additional storage was also beneficial in reducing peak flows; however, may not have been credited in the SWROA. Also dry or less than full sediment ditches were typical. This also supplies some added attenuation of runoff peaks although ditches must be assumed to be full for the analysis (Figures 6 and 7).

The team also observed that there was good transition for storm flow between sediment ditches and valley fill perimeter and groin ditches for the sites visited. This is usually a weak or vulnerable area during high intensity storms and can easily lead to a washout and subsequent sediment overload and flooding (Figure 8).

One observable shortcoming of the SWROA, as currently approved by the State, is a lack of a mechanism to measure its effect. The current regulations do not include a requirement that storm water runoff peak discharges be measured. Nor do the regulations require actual measurement of pre-mining discharges, or real time correlation between rainfall and runoff.

The current method used to compare pre-mining runoff discharges to worst-case mining and post-mining discharges involves computer modeling the three phases (pre-mining, worst case during-mining and post-mining) of a selected onsite watershed. Modeling is performed using generalized runoff characteristics developed by the National Resources Conservation Service. The models as well as the generalized guidelines for input parameters are meant to be conservative for design purposes (i.e., over estimate peak flows and volumes to be safe). However the models are very sensitive to any change in the input parameters, which means that just increasing a run off curve number from 70 to 73 could change the outcome of the entire SWROA, and both numbers would appear to be equally reasonable and defensible. Verification that the generalized runoff characteristics are indeed representative of the site in question (calibration of the model) is not performed. Without verification (field calibration), the validity of such analyses cannot be guaranteed.

5. Conclusions

It is the conclusion of the team that the concept of determining runoff discharges for a site prior to mining, and restricting during-mining and post-mining discharges to pre-mining levels is valid and, when properly executed, should minimize the potential for mining-related downstream flood damage. Based on observations from the five site visits, it is apparent that the SWROA concept and emphasis on storm water management has resulted in many improvements. These include: surface mine drainage design, timely construction, emphasis on more creative and safer water detention, and better valley fill drainage and construction practices (Figures 9 and 10).

The team identified many concerns with the assumptions used in the models. In many cases the worst case scenario was questionable or the assumed runoff values did not appear to be based in known science. In some cases the discharge monitoring point locations did not appear representative of the mine.

The team also noted that the West Virginia regulations do not require measurement of actual runoff discharges for comparison with those predicted by the models. Determining the actual effectiveness of the SWROA is therefore limited to professional judgment and general field observations without an actual field verification of all assumptions.

Excessive runoff and off-site damage caused by delayed reclamation and failure of temporary drainage control during final grading of valley fills can not be entirely controlled through the SWROA. These events often include mud and debris flows, which are a separate issue from those addressed by a SWROA. They can be controlled only through vigilant drainage and fill construction management. If significant rainfall occurs during final grading, the only SWROA provision that will help minimize increased flow is adequate flood detention and sediment detention capacity in downstream structures (Figure 11).

6. Action Items:

WVDEP concurs in the findings in the report and has agreed to take the following corrective actions:

Training

Within 12 months WVDEP has agreed to develop, jointly with OSM, training for its permit reviewers, and to host a workshop for the industry. Emphasis will be placed on ensuring:

- That the SWROA include analysis of multiple stages of construction, for each onsite drainage area; such that the worst case scenario for each, in terms of runoff discharge magnitude, can be identified.

- That any computer modeling reports submitted as part of the SWROA requirements contain narratives and thorough descriptions of the assumptions made when modeling the site.

- that drainage structures on SWROA maps be referenced so that both the number used on the permit drainage map and the SWROA calculations identify the structure, or a single number or identifier should be used for each structure throughout the permit.

- That the worst case scenario includes consideration of the clearing and grubbing, as well as, final breakdown stages of valley fills.
- That the assumptions in each model are well explained and reasonable and that reviewing officials are supported if they question some of the base assumptions.
- That the runoff monitoring plan includes discharge monitoring for all points of discharge from the site.

Violations and Remedial Measures

Within 12 months WVDEP will develop training for its field staff to ensure that inspections include reviews of indicators related to the effectiveness of the SWROA beyond just compliance. For example, changes downstream of the permit should be reviewed as they might relate to increased runoff. Where impacts are observed that could be related to increases in peak discharge remedial measures will include revisions to the SWROA as necessary and the development of a monitoring plan that could be used to verify the assumptions in the new model.

Examples of indicators would be:

- Stream scour or erosion;
- Sedimentation (silt snakes);
- Boulder movement below detention ponds;
- Visible high water marks;
- Visible evidence of movement of logs, trees, or brush (obstructing stream or culverts).

Policy and Regulatory Changes

WVDEP will monitor its violation history on a yearly basis to determine if there are offsite impacts related to excessive peak discharges. Depending on these field conditions WVDEP may consider further changes to the SWROA process including increased monitoring and verification of the models.