

4.0 DISCUSSION AND CONCLUSIONS

There is a general lack of information on channel and basin characteristics for reclaimed channels at abandoned coal mines in AML library reports and plans. While the success of locating consultant's reports, design plans, and other information on reclamation was high during the inventory, finding specifics regarding channel design criteria and other information was low. The most frequently lacking piece of information was drainage basin area, and it was rarely possible to accurately measure this from available design plans. It is suspected that although a rainfall-runoff analysis was undoubtedly completed for each basin reclaimed, the delineated basin areas were not reported in the submitted documents.

Projects 6C-2 and 6C-8, the Rainbow and Colony mines, are the only sites with complete design information available in AML reports and files. At a minimum, drainage basin area, channel cross sectional geometry, runoff information, and design flow recurrence interval need to be available to reproduce reclamation design and evaluate stability of channels at reclaimed and active coal mines.

From the design information available, it is evident that a wide range of design criteria (design event, Manning's n , curve number, etc.) exist for the 14 reclaimed mines inventoried. It is likely that AML will continue to develop standards for all phases of channel design (Koopman, 1991) to limit the wide range of design variability and reclamation procedures.

The product of drainage basin area and mean basin slope (AGI) influences or correlates strongly with natural channel characteristics of flow depth, channel flow area, hydraulic radius, and hydraulic depth for the Rock Springs and Hanna areas. Natural drainage data show AGI correlates well with flood magnitude.

Reclamation designs for 18 out of the 20 constructed earthen channels at the Rainbow and Colony mines satisfy the recommended two out of three stability tests at $\alpha=0.1$. Channel slopes for all reclaimed basins except Basins 12 and 13 at the Rainbow Mine, and Basin I at Colony Coal Mine are less than the upper confidence limit of 0.0642 feet/foot for $\alpha=0.10$, passing the stability test for channel slope. Reclaimed channel slopes less than the upper limit imply a gentler slope than what exists in the vicinity naturally. The 10-year, 1-hour channel flow areas for reclaimed channels at the Rainbow and Colony mines are acceptable except for reclaimed Basins 8, 12, and 13. Acceptable flow areas include those greater than or equal to the lower limit established by unmined data at $\alpha=0.1$ (Figure 5). At $\alpha = 0.01$, 16 out of the 20 reclaimed channels are stable over the long-term using the two out of three stability test criteria.

Although complete design criteria were not available for the Hanna site, confidence intervals were developed for natural analog areas. The statistical limits can serve to facilitate engineering channel design, and to evaluate design plans for bond release or construction purposes within the vicinity of Hanna. Limiting channel slope and 10-year flow velocity for the Hanna area are 0.0683 feet/foot and 4.86 feet/second, respectively.

Channel slope and flow velocity data from natural basins near Rock Springs and Hanna are not statistically different. Stability analyses for channel slope and flow velocity can thus be applied to the southwestern and south central portions of Wyoming. Further geographic transferability has not been tested but may be important in limiting data requirements and increasing the application of channel stability tests.

Stability tests, if incorporated into regulatory decisions, can quantify differences between reclaimed channel characteristics and natural, adjacent unmined areas. A standardized, quantitative approach will help maintain consistency within a process that has been historically rather subjective, and reviewer-specific. A minimum of work is necessary to develop the requisite data set: 1-2 days of surveying, depending on the desired number of data points, and a relatively basic statistical analysis.

Channel adjustment within reclaimed basins does not necessarily mean instability, and nonerosive conditions for reclaimed earthen channels do not exist. Engineered channels will approach the configuration of natural channels over time, and if designers and regulators have an idea of the direction of adjustments within natural settings, they can better evaluate the success of a designed channel to accommodate regional changes. In addition, natural resource regulators may be better able to recommend steeper slopes to minimize fluvial adjustments if natural systems are known, a priori, to be steeper. If channel reclamation truly intends to replicate natural drainage systems, then it follows that the designs should be judged based on the geomorphic characteristics and relations established in natural areas.

5.0 RECOMMENDATIONS

1. Establish permanent survey locations to monitor changes in channel cross section and longitudinal profiles of reclaimed channels. The cross sections could be resurveyed annually during the 3 year post-construction monitoring.
2. Investigate the geographic variability of relations that show strong correlation within the Rock Springs and Hanna areas. Additional work could verify application of AGI and channel hydraulic parameters to other regions of the state with active or abandoned coal mining.