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10.0 Recommendations

This report should only be used as a standard for the comparison of streams that possess characteristics similar to the segments studied along Robinson Fork because of the limited scope and duration allocated for this project, due to the numerous variables that govern subsidence mechanics and stream characteristics, and considering the myriad of effects that combinations of these variables may have on a stream. Controlling variables include, but are not limited to, geologic and hydrogeologic characteristics, channel and valley gradient, overburden thickness, thickness of coal extracted, stream order, and land use.

In order to derive a comprehensive set of comparative standards, additional studies that are broader in scope and duration need to be developed and implemented. For such studies, thoughtful technical planning in the developmental stage is necessary to eliminate the generation of technically, spatially, and temporarily limited data. Additional studies should be conducted at the watershed level to define all impacting factors including those potentially related to longwall mining as well as anthropogenic disturbances. Studies should also be performed in watersheds with differing controlling variables (as defined above) so that potential subsidence effects can be predicted for a range of common mining scenarios. It is also recommended that future studies be conducted prior to and following mining to provide technically identical and comprehensive datasets for comparative purposes. Additionally, the studies should be of a duration that would provide for the observation of seasonal fluctuations and allow potential subsidence effects to fully manifest. Prospective studies should adhere to current and accepted methods for data collection as were applied for this study.

Although this study has identified variation between the mined and unmined segments, the statistically limited database cannot be used with absolute certainty to conclude whether these changes are attributed solely to subsidence and/or are related to anthropogenic disturbances. Primary anthropogenic disturbances within the study area include increased erosion and/or runoff from crop and pasture lands, mowed areas, roads, and domestic activities. Therefore, approaches for mitigation and monitoring should not currently be recommended.

To supplement the current data base and compensate for the lack of crucial premining data, additional studies are recommended along the unmined segment of Robinson Fork as a preface to broader studies conducted in other watersheds with dissimilar characteristics. The unmined segment will provide an ideal "before and after" evaluation of the potential effects of longwall mining since detailed premining data has already been provided from this study. With a few exceptions, the recommended study would duplicate

the work conducted within the unmined segment as detailed in this report. In general, we recommend the following work scope:

- Initial activities to be conducted prior to longwall mining should include: 1) the installation and surveying of piezometers as well as implementing a program of water level measurements, 2) the surveying of seep and spring locations, and 3) the gathering of supplemental data within other portions of the Robinson Fork Watershed.
- Study techniques should be identical to the procedures described in this report.
- The study should be performed contemporaneous with and following longwall mining.
- Geomorphologic and biologic characteristics should be monitored on a quarterly basis for the first year following mining. This is essential for the geomorphologic component since these changes generally manifest more quickly than biological variation. Also, monitoring on a quarterly basis would provide an evaluation of the seasonal variability of in-stream organisms and discharge.
- Following the initial year of data collection, recommendations for further monitoring would be developed. For example, this may involve replicating the geomorphologic and biologic assessments during the third and fifth year following mining to assess long-term affects.

In addition to the above, lower altitude, higher resolution aerial photography should be generated before, during, and after mining. The recommended study could be conducted in conjunction with broader studies in dissimilar watersheds for more expeditious data gathering.

Following the recommended study, approaches for monitoring and mitigation could then be developed if appropriate. Also, reliable information with respect to expected impacts within similar subsided areas and the types of critical premining data that may need to be collected for postmining comparisons could be generated.