United States Department of the Interior

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Jim Upchurch, Forest Supervisor
Coronado National Forest
300 W. Congress St. 85701
Tucson, AZ

Dear Mr. Upchurch:

As requested, our hydrologists Stan Leake, Jesse Dickinson, Don Pool, and Nick Paretti have conducted a technical review of Pima County report "Impacts of the Rosemont Mine on Hydrology and Threatened and Endangered Species of the Cienega Creek Natural Preserve" by Powell et al. The report documents an analysis of the potential impacts of the Rosemont mine on the hydrology of lower Cienega Creek and Davidson Canyon. The potential impacts described in the report are changes in base flow and length of wetted stream length. The approach used to assess the impacts include regression models with groundwater level as the explanatory variable and base flow and wetted length as response variables. Base flow and wetted length changes are predicted from the regression models for potential drawdowns of -0.1, -0.2, and -0.25 at Cienega well and potential drawdowns of -0.1, -0.2, -0.25, -0.31, and -0.98 at Davidson # 2 well.

As requested, our comments on the report are limited to the regression approach to predict changes in base flow and wetted length due to groundwater level drawdown.

1. The regressions seem to capture a general relation between groundwater levels in the Cienega well and Davidson #2 wells to the wetted length of Cienega Creek and Davidson Canyon. Overall, the wetted length is greater when groundwater levels are higher and lesser when the groundwater levels are lower. However, the regression models are fitted to a limited period of 14 years when data are available. For management purposes, it is possible that the regression models will be used to project stream conditions as far out as decades and possibly centuries. The relation between groundwater levels in the Cienega and Davidson #2 wells may change in the future due to variable climate and landscape conditions. It may be worthwhile to consider the uncertainly inherent in the available data, the model fit, and future hydroclimatic conditions. That is, the regression approach may be enhanced by combining with other tools, such as numerical modeling, may be a useful implement in the overall toolbox for making management decisions.

2. The available explanatory and response data are limited to a period of data collection from 2001-2014. Figure 8 seems to indicate that Cienega Creek was generally wetter prior to 1992 and drier after 1998. The wetted length is at least 5 miles in the earlier period and decreases between 1 to 2 miles in the later period. The differences in these two time periods may be related to larger peak flows from runoff events rather than base flow from groundwater that occurred during the early period in 1981, 1982, and 1988. The peak flows may have resulted in relatively large amounts of recharge near the stream that later discharged in part as base flow to Cienega Creek. There may also have been larger amounts of recharge to groundwater during these wet episodes. Thus, climate may be a useful predictor to the relation of groundwater level to wetted length. The regressions might be improved by including different aspects of the climate, such as meteorological or groundwater conditions in antecedent years or seasons.

3. The regression relates wetted length to groundwater levels from the Cienega Well, which is approximately 150 m from the stream. Because the well is fairly close to the stream, water level changes are closely linked to stream flow and changes in evapotranspiration from nearby plants. Another useful approach may be to use groundwater level data from multiple wells that are both close and more distant from the stream. Water levels from distant wells may be useful for indicating differences in groundwater head gradients near the stream. Ultimately the direction of the groundwater-level gradients control whether the stream is either gaining or losing. Gradients may also be useful in assessing the impact of mine withdrawals on drawdowns, which may affect the direction of the gradients near the stream.

4. Because the regression models do not explain all of the variability, some uncertainty in the predictions is expected. It may be helpful to managers to include the possible ranges of outcomes by computing the uncertainties for each reported prediction. One option would be to report a standard error of regression to provide some measure of model error or a root mean square error. The residual plots can be helpful for visualizing the error.

Thank you for requesting the input of our scientists to help with some of the challenging technical issues facing the Coronado National Forest. Providing scientific information and expertise to benefit resource management decisions is an important part of the USGS mission. If you or your staff has technical questions regarding these review comments, please contact Stan Leake, Jesse Dickinson, Don Pool or Nick Paretti.

Best Regards,

James Leenhouts
Director, USGS Arizona Water Science Center