RESPONSE TO PEER REVIEW COMMENTS ON RIPARIAN VEGETATION RESULTS PRESENTED IN THE GLEN CANYON DAM LONG-TERM ENVIRONMENTAL AND MANAGEMENT PLAN DRAFT ENVIRONMENTAL IMPACT STATEMENT

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1. Introduction

This report addresses the peer review of the LTEMP Draft EIS (DEIS) Appendix G: Vegetation Technical Information and Analysis. The review covered the vegetation analysis approach for the DEIS and results, which included the analyses for the old high-water zone, New High Water Zone, and wetlands. The riparian vegetation model and performance metrics, used in the New High Water Zone analysis, were also reviewed. The development of the model and methodology for applying the model is described in Ralston et al. (2014), published by the U.S. Geological Survey (USGS). That document was peer reviewed and finalized separately following standard USGS review procedures.

The peer review was conducted by two researchers with extensive experience in riparian systems: a researcher with the USGS, Fort Collins Science Center, and a researcher with the USDA Forest Service, National Stream and Aquatic Ecology Center.

2. Major comments

Comment: Statements about model validation are recommended. For example, "we ran the model for the period xx past decades and it predicted xxx, this compares to measurements in the field xx". How well does the model predict observed patterns? Some presentation of observed cover type transitions on specific sampled features in response to specific flow sequences would provide corroboration and confidence in the model.

Response: Although full validation of the model is not really practicable due to the lack of suitable vegetation cover data prior to that of Kearsley et al 2015, the model transitions and thresholds are based on the observed effects of specific flow sequences and regimes from vegetation studies conducted within Grand Canyon National Park, described in the Colorado River literature and included in the EIS citations. Section 3.6 and 4.6 of the DEIS present observed transitions in response to specific flow sequences. These types of observations have been included in a new summary section added to Appendix G.

Comment: How the model runs are upscaled to overall area is not clear – it appears that no consideration is given to the relative area of the different geomorphic features.

Response: It is correct that the relative area of the different features is not included. It was not possible to determine the present total area of each of the three geomorphic surfaces. Therefore the model is not spatially explicit.

Comment: Arrowweed (*Pluchea sericea*) should not be excluded from native species in the metrics. It adds a level of non-objectivity, it is a native species (one of the objectives of dam operations is to maintain native species), and it would be cleaner if all species were treated the same.

Response: A footnote was added to the text indicating that this species was selected to be excluded from the native species metrics and to comprise a fourth metric. It is managed differently than other native species because of its tendency to form monocultures and because of its importance to sandbar and campsite management.

Comment: It is not clear how the interrelationships between cover types and flows have been developed, whether through empirical data and analysis, observation, or an evaluation of aerial images and vegetation cover relative to floods. In Ralston et al. 2014, the states and transitions to other states are presented, but it remains unclear where the thresholds were developed, and how they have been validated.

Response: The interrelationships were developed primarily from the Colorado River literature, which was based on analysis of empirical data, including that of the primary author of the model. A team of subject matter experts with extensive working experience in the Colorado River riparian system reviewed the model transitions, making adjustments to ensure the results matched their research experience. Relevant text was added to Section G.1.

Comment: The variance of some of the metric results is quite high. More discussion about the high variability of some metrics and low variability of others should be considered. It is advisable to test the assumptions of ANOVA. The homogeneity of variance assumption might be violated; either transform (which would make these less readable) or consider Kruskall-Wallis instead.

Response: High variability in results is typically due to a single trace. A discussion of why metrics increase more under some alternatives than others is included in Section 4.6. The level of conformance with the assumptions of ANOVA was considered acceptable.

Comment: Consider whether Metric 4 should be equally weighted to the others. Change in diversity seems more important than the change in cover of a single species.

Response: Various weighting schemes were considered by the subject matter experts when developing the overall performance metric for riparian vegetation. The team determined that equal importance should be given to each metric due to the fundamental changes to the riparian system reflected in each.

Comment: A concluding paragraph with an overview and recommendations would be helpful. Regarding the interactions between the different metrics, more discussion about why one might go up quite a lot and another hardly change at all under a different scenario should be given.

It is not clear how the models were parameterized. Because all the runs, and outputs, and the comparisons between scenarios hinge upon how the models were created and run, a discussion of how the thresholds of change from one state to another were derived is recommended. If it was professional judgement, that should be stated. Or if it is form extensive vegetation mapping through time, that should be mentioned as well.

Response: A concluding summary section has been added describing the causes of the transitions, and text was added to Section G.1 explaining the basis of the transitions. A discussion of why metrics increase more under some alternatives than others is included in Section 4.6 of the DEIS. Section 3.6 and 4.6 of the DEIS present observed transitions in response to specific flow sequences. The subject matter expert team refined the model transitions based on their own extensive field experience.

3. Minor comments

Minor text additions or changes were requested for clarification. Formatting errors in Table G-1 were corrected; text changes were made to Table G-2; more explanation of the 63 traces was given; references were given to other EIS sections, such as for climate change; the differences between means were clarified; names of states were listed as needed; symbology in figures of results was explained (however significantly similar means or names of alternatives could not be shown); initial values were clarified as mapped cover; calculating metrics including arrowweed with native species was not feasible; a legible composite hydrograph of alternatives was not feasible; and "starting" condition was not changed to "initial" to avoid confusion.

4. References

Kearsley, M.J.C., K. Green, M. Reid, M. Tukman, M. Hall, T.J. Ayers, and K. Christie, 2015, *The Grand Canyon National Park/Grand Canyon–Parashant National Monument Vegetation Classification and Mapping Project*, Final Report, U.S. Department of the Interior, National Park Service, Grand Canyon National Park, Grand Canyon, Ariz.

Ralston, B.E., A.M. Starfield, R.S. Black, and R.A. Van Lonkhuyzen, 2014, *State-and-Transition Prototype Model of Riparian Vegetation Downstream of Glen Canyon Dam, Arizona*, Open-File Report 2014-1095, U.S. Geological Survey, U.S. Department of the Interior.