TECHNICAL MEMORANDUM

Kopta Slough Multi-Benefit Project – Hydraulic Analysis Addendum

Prepared For: DWR Northern Region Office (NRO)

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PURPOSE

This memo serves as an addendum to the report titled *Hydraulic Analysis, Conceptual Design, and Preliminary Cost Estimate for the Kopta Slough Flood Damage Reduction and Habitat Restoration Study of the Sacramento River, RM 216 to RM 224, Tehama County, California* (Ayres Associates 2009). The report was prepared for an earlier iteration of the Kopta Slough Multi-Benefit Project (proposed project).

Because the design of the proposed project has evolved over time, the California Department of Water Resources (DWR) Northern Region Office (NRO) updated the hydraulic analysis for the final project design to evaluate potential changes to the overall project-related hydraulic impacts.

PROJECT DESIGN CHANGES

The current proposed project is similar to Scenario 3 in the Ayres Report (Ayres Associates 2009). The Ayers Scenario 3 was modeled to represent a 100-year flow scenario with restoration of 176 acres of agricultural land to native floodplain habitat on the Kopta Slough Property, full removal of existing rock revetment vertically and longitudinally along the slope of the approximately 5,600-foot section of Sacramento riverbank bordering the Kopta Slough Property, bank protection in the form of rock revetment at Woodson Bridge, and a low berm for the City of Corning sewer outfall. Scenario 3 assumed that all excavated material would be hauled off site.

DWR continued evaluation of the design elements included in Scenario 3 through updated hydraulic modeling, refined planning and design, and environmental impact analysis. Based on updated information about site geology, Caltrans bridge inspection reports, hydraulic modeling results, as-built drawings of the sewer outfall and existing revetment, revetment design and construction challenges, and the significant environmental and recreational impacts that would occur, DWR determined that bank protection (by placement of new rock revetment) at the Woodson Bridge west abutment and City of Corning sewer outfall was not feasible nor warranted under existing conditions. The bank protection element at the Woodson Bridge west abutment and the City of Corning sewer outfall was not retained in the design for further evaluation.

DWR also evaluated options for spoiling and reusing excavated material on site, rather than hauling it off site, to reduce construction-related impacts to air quality and greenhouse gas emissions and reduce the overall cost of project implementation. The project design was revised accordingly to include spoil areas throughout the Kopta Slough Property that could accommodate all excavated material.

The proposed project was then modeled to represent a 100-year flow scenario with restoration of 176 acres of agricultural land to native floodplain habitat on the Kopta Slough Property, full removal of existing rock revetment vertically and longitudinally along the slope of the approximately 5,600-foot section of Sacramento riverbank bordering the Kopta Slough Property, and materials spoiling on site in strategic low-lying areas to minimize impacts to hydraulic conveyance.

MODELING METHODOLOGY

NRO engineering staff performed two-dimensional hydraulic modeling of the existing and proposed conditions using the HEC-RAS 6.0 model to evaluate flood hydraulics between the two conditions. The upstream boundary of the model domain is at river mile 224, approximately 2 miles upstream of the nearest proposed project feature. The downstream boundary of the model domain is at the South Avenue Bridge, approximately 1 mile downstream of the nearest proposed project feature. A flow gauge at the downstream boundary allowed for model calibration for in-channel and overbank flows that overtop South Avenue.

The NRO model was developed independent of the Ayres model. The NRO model is intended to evaluate flood hydraulics in the proposed condition that consider change in land use (riparian forest roughness) and the cut-and-fill earthwork needed to remove existing rock revetment and spoil material within the 176-acre habitat restoration area. The NRO model is not intended to be used for the purpose of mapping inundation areas.

A key element of the NRO model includes the application of a higher magnitude 100-year channel discharge than the Ayers model shows in Table 6 on page 27 of the Ayres report, a higher resolution topography that was not available to Ayres, and inclusion of Sacramento River inflow at river mile 224 plus additional inflow from Toomes Creek, Deer Creek, China Slough, and two unnamed tributaries. The Ayres model appears to apply inflow at river mile 224 and at Deer Creek. NRO added the four additional tributaries within the model domain for a total 100-year flow of 300,600 cubic feet per second. This flow is approximately 2 percent higher than the flow used in the Ayres model.

The NRO model was used to evaluate post-project velocity, depth, and shear stress as compared to the existing condition.

MODELING RESULTS

The figures presented in this memo are a comparison between the existing and proposed condition in the NRO hydraulic model. Comparison between the NRO and Ayres hydraulic models are not included in this evaluation. The subjectivity between the models and methods yields this comparison less valuable than evaluating the existing versus proposed conditions results of each model.

VELOCITY

Figure 2 in this technical memorandum shows the velocity change predicted by the NRO hydraulic model. This figure can be compared to Plate 36 on page 37 of Appendix A in the Ayres report. Results from Ayres' model and results from NRO's model predicted very similar changes in velocity and in the magnitude of change.

WATER DEPTH

Figure 3 in this technical memorandum shows the water depth change predicted by the NRO hydraulic model. This figure can be compared to Plate 38 on page 39 of Appendix A in the Ayres report. Results from Ayres' model and results from NRO's model predicted the same magnitude of change but different areas where change will occur. This difference can be attributed to the fact that the NRO hydraulic model used a higher flow than the Ayres model and that the NRO model used a higher resolution terrain than was available to Ayres. However, the magnitude and location where the maximum difference occurs is the same.

SHEAR STRESS

Figure 4 in this memo shows the shear stress change predicted by the NRO hydraulic model. This figure can be compared to Plate 42 on page 43 of Appendix A in the Ayres report. Specific changes in shear stress are not called out on Plate 42,but results from Ayres' model and results from NRO's model predicted very similar affected areas and magnitude of change.

CONCLUSION

The proposed project, upon establishment of vegetation in the habitat restoration area, would increase the roughness in most of the area compared to the existing "crop" land-use type. The largest land use change would be the conversion of "crop" to valley oak riparian forest (VORF). VORF has a roughness value approximately three times higher than crop. Because of the change in roughness, the land use change plays a much bigger role in the change in hydraulic properties than the earthwork needed to remove rock slope protection from the banks of the Sacramento River and spoil it onsite. The roughness of the earthwork areas is not predicted to change because post-project vegetation reestablishment is anticipated. Additionally, the change in the hydraulic conveyance as a result of the earthwork would not be significant because areas of excavation would in large part be offset by on-site placement of excavated material in nearby areas.

It is the opinion of the NRO (S. Kennedy P.E. C63801) that, when comparing Scenario 3 from the Ayres report to the revised Kopta Slough Multi-Benefit project evaluated in the NRO model, the Ayres report adequately describes the hydraulic effects of the proposed project and that no additional analysis is required.

REFERENCES

Ayres Associates. 2009. *Hydraulic analysis, conceptual design, and preliminary cost estimate for the Kopta Slough Flood Damage Reduction and Habitat Restoration Study on the Sacramento River, RM 216 to RM 224. Tehama County, California.* 51 pp. Prepared by: Ayes Associate. Prepared for: Tehama County. Viewed online at: https://www.sacramentoriver.org/forum/publications/kopta_slough/Kopta_Final_December_28_2009.pdf.

Figure 1 **Proposed Kopta Slough Project**

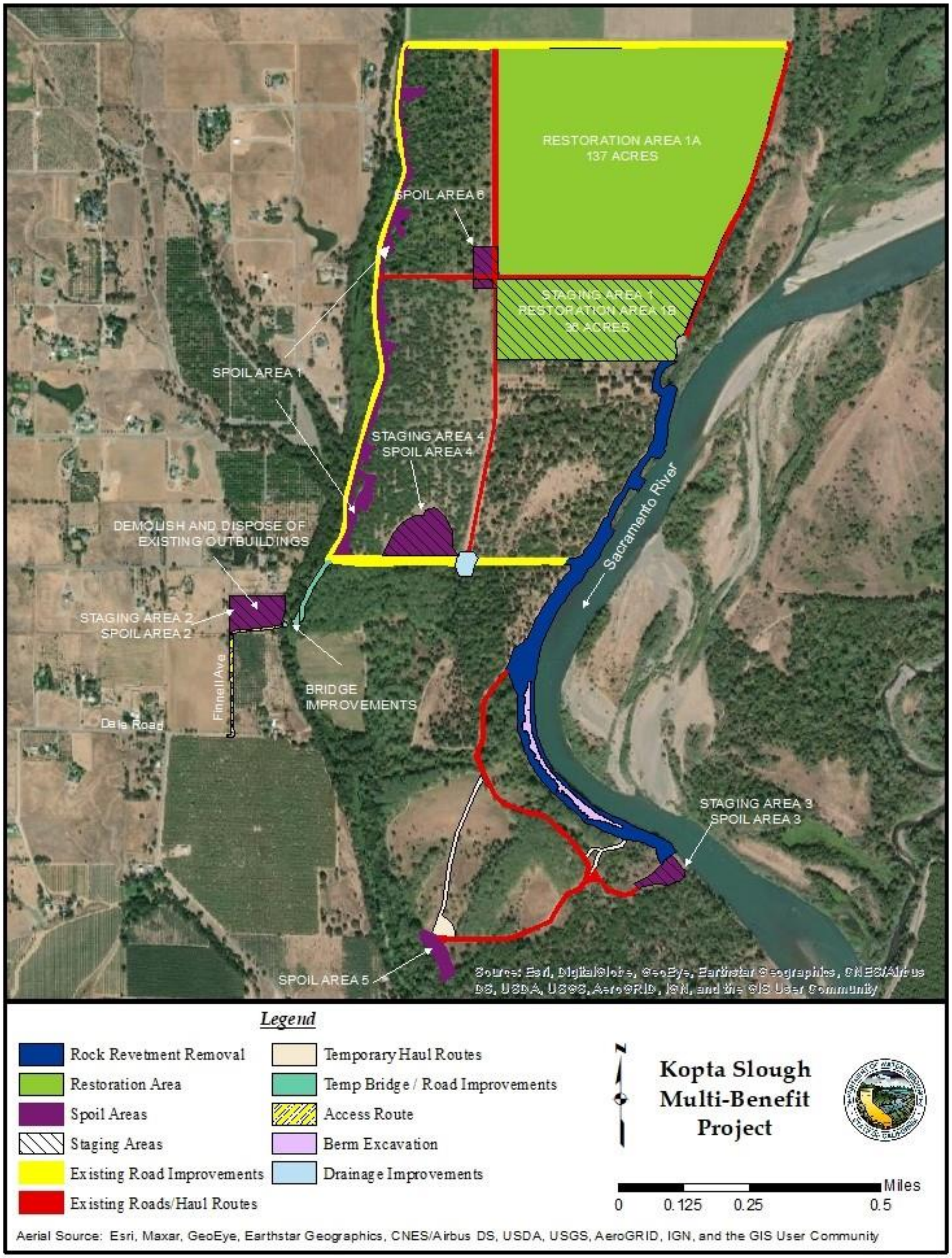

Figure 2 Predicted change in water velocity (feet/second). Red and yellow colors represent a predicted increase in water velocity. Blue and green colors represent a predicted decrease in water velocity. This figure can be compared to Plate 36 on Page 37 of Appendix A in the Ayres report.

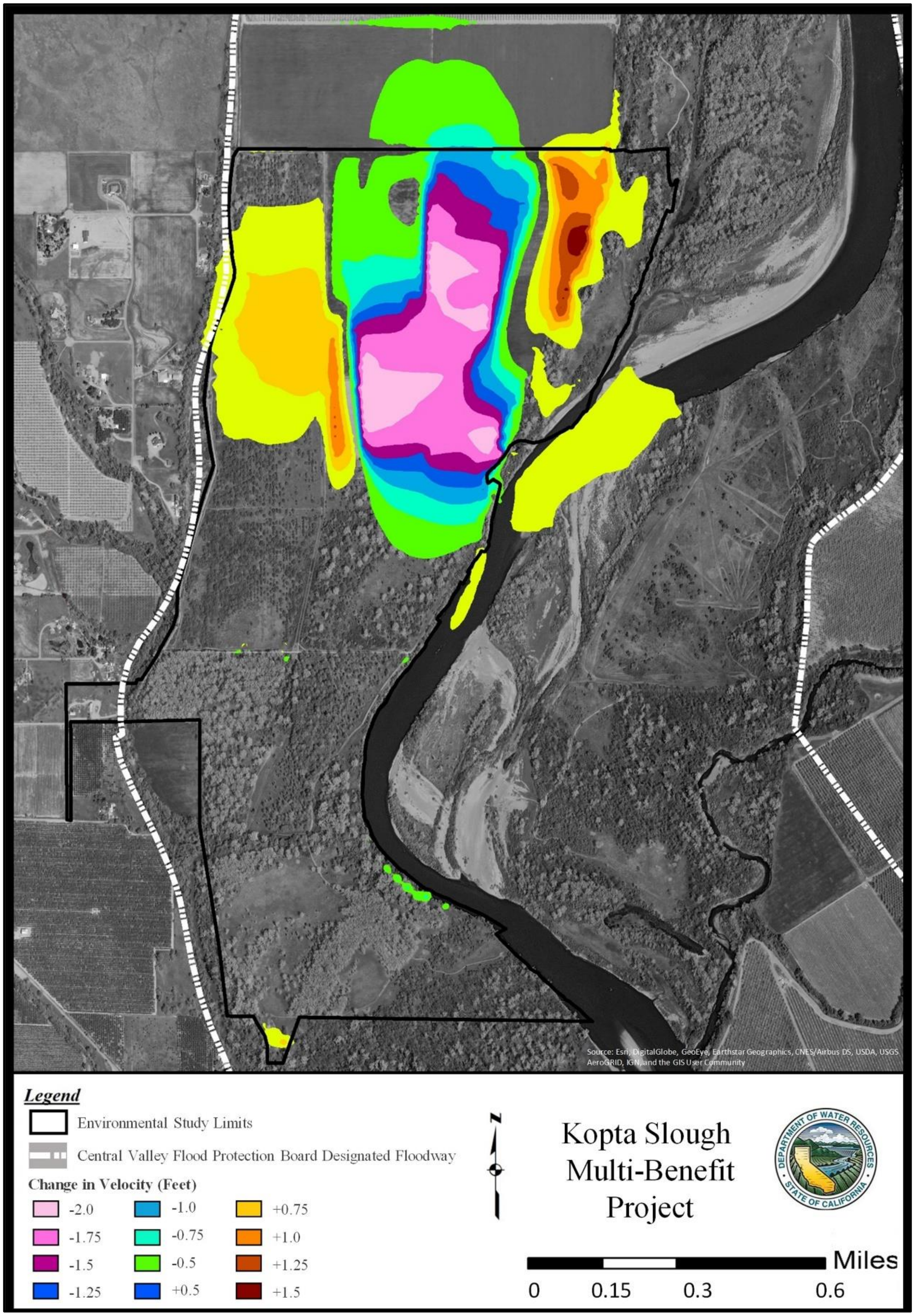

Figure 3 Predicted change in water depth (feet). Red and yellow colors represent a predicted increase in water depth. Blue and green colors represent a predicted decrease in water depth. This figure can be compared to Plate 38 on Page 39 of Appendix A in the Ayres report.

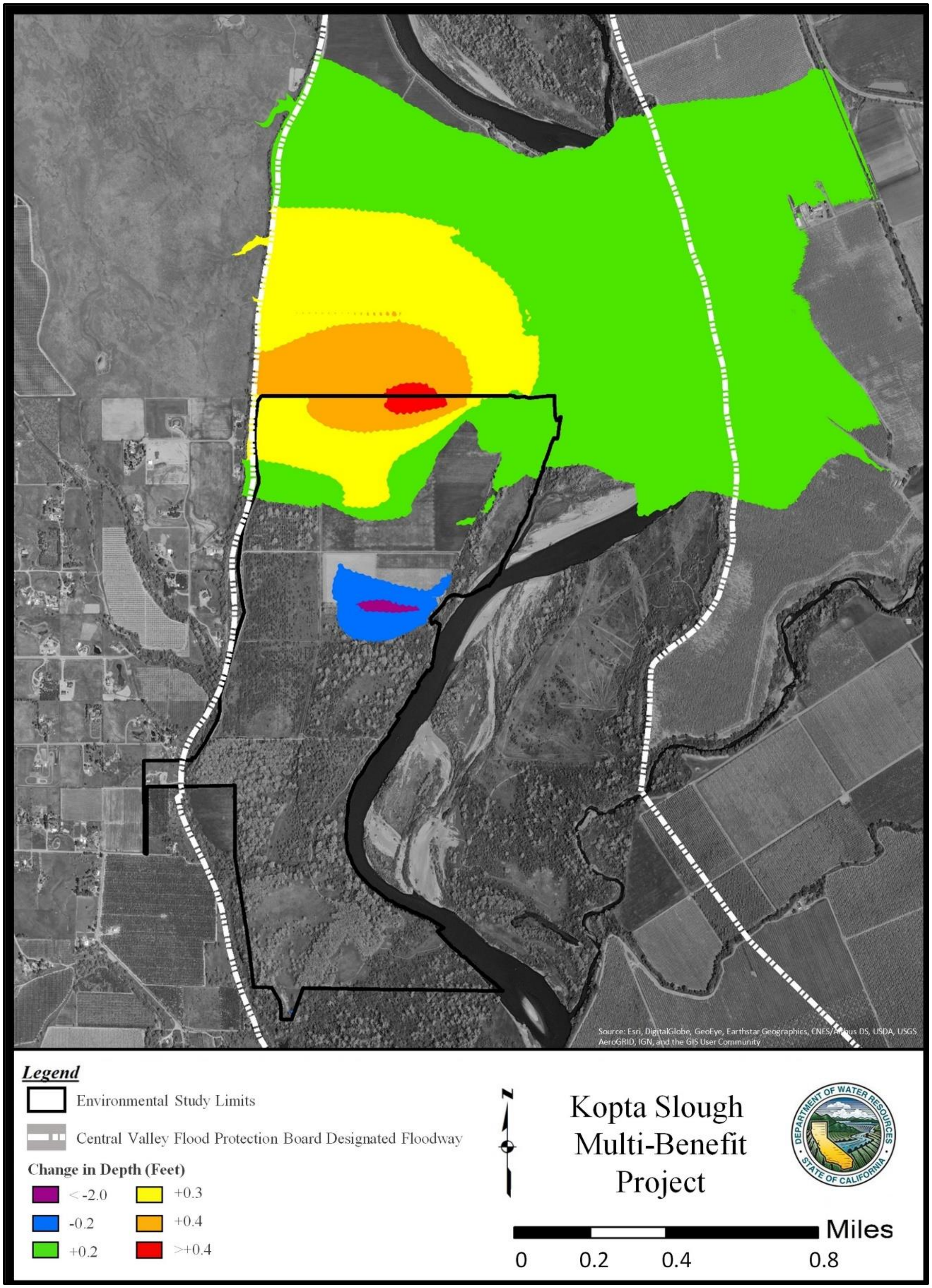

Figure 4 Predicted change in shear stress (pounds per square foot). Red and yellow colors represent a predicted increase in shear stress. Blue and green colors represent a predicted decrease in shear stress. This figure should be compared to Plate 42 on page 43 of Appendix A in the Ayres report.