

Select Panel Review Summary

Proposal No.: 019

Proposal Title: Combie Reservoir Sediment and Mercury Removal Project

Principal Investigator: Tim Crough

Amount Requested: \$4,786,430.00

Recommended Amount: \$0

Summary: The proposed project combines innovative mercury removal equipment (remediation technology) with reservoir maintenance dredging to remove mercury from dredged sediments in Combie Reservoir.

Assessment: The Selection Panel noted that while the proposal made good linkages between the project and CALFED goals and objectives, it had many technical deficiencies associated with the approach and with its feasibility. Of considerable importance was 1) a distinct lack of recognition or discussion of other factors (besides elemental mercury) that drive the mercury methylation process, 2) the use of adult fish (as opposed to juveniles) for assessing a rapid response to removal of mercury laden sediment, and 3) the reliance on a technology that was not proven to remove reactive or methyl mercury, making this a very expensive pilot project. The Panel felt it was not very realistic that this project would have any measurable benefit to the Sacramento River and Delta. Additionally, there was concern of whether any improvement would be realized if deepening of the reservoir caused a more stable hypolimnion and potentially increased anoxic bottom waters thereby serving to increase methylmercury production and bioaccumulation.

CALFED Ecosystem Restoration Program

External Scientific Review Form

Proposal Number: 019

Proposal Title: Combie Reservoir Sediment and Mercury Removal Project

Reviewer: #1

Conflict of Interest Statements:

I have no financial interest in this proposal (please mark correct response).

X Correct
- Incorrect

General Review Questions:

Along with your written observations in response to the questions below, please rate each using the following criteria:

Excellent: Outstanding in all respects
Very Good: High quality in nearly all aspects
Good: Quality work, but with some deficiencies
Fair: Lacking in one or more critical aspects
Poor: Serious deficiencies

1. **Problem/Goals.** Is the problem that the project is designed to address adequately described? Are the goals, objectives, and hypotheses clearly stated and internally consistent? Does the proposal describe the ecosystem goals it is designed to address (link to ERP goals)?

Comments:

The proposal describes the problem as follows: Accumulation of mercury-contaminated sediment in Combie Reservoir causes increased methylmercury production and threatens future water storage capacity, water quality, and recreation opportunities in Combie Reservoir. It also results in continued export of water with elevated methylmercury to downstream reaches of the Bear River, Feather River, Sacramento River, and Bay-Delta. While the rationale appears consistent, the authors have not adequately demonstrated (either in the proposal or by reference to the literature) that accumulation of mercury-contaminated sediment (on top of existing mercury-contaminated sediment) causes increased methylmercury production (presumably due to creation of a shallower and warmer reservoir) in Combie Reservoir.

The evidence for export of methylmercury to downstream reaches of the Bear River is not presented but makes sense conceptually. The idea that Combie Reservoir can export methylmercury to Feather River, Sacramento River, and Bay-Delta, which are many miles downstream is less obvious, and supporting evidence is not presented in the proposal. Alpers et al. (2008) is referenced in the proposal and mentions a mercury mass balance study that USGS is developing for the Bear River but I was unable to find additional information on the study.

Finally, regarding the problem statement, sediment removal will clearly increase water storage capacity in the reservoir. Through water treatment, the proposal addresses the associated hazard of elevated methylmercury concentrations in the dredge pond that led to the 2002 ban on maintenance dredging in Combie Reservoir.

The hypothesis being tested is that removal of elemental mercury from Combie Reservoir will result in 1) a less contaminated aquatic food chain, 2) reduced loads of mercury and methylmercury in the lower Bear River, and 3) if applied to maintenance dredging activities in mercury-laden reservoirs across the Sierra Nevada, a significant reduction in methylmercury exposure to wildlife and loading of mercury and methylmercury in tributaries to the Bay-Delta. The hypothesis is clearly stated and internally consistent.

The goal and objectives of the project are clearly stated and the ecosystem goals are linked to ERP goals. Two of the objectives could use more support. First, documentation that shallow, relatively warm waters promote mercury methylation would be helpful. Second, the objective of determining net environmental benefit to the Bear River watershed and the Bay-Delta of removing elemental mercury from Combie Reservoir, while conceptually plausible, seems to be beyond the scope of the proposal.

In summary, the problem that the project is designed to address could be better substantiated in the proposal. Clearly, there is a problem with methylmercury production in Combie Reservoir and there is a problem with widespread mercury contamination in the Bay-Delta watershed; however, the idea that removal of mercury-contaminated sediment in Combie Reservoir could have a measurable impact on the Bay-Delta ecosystem is hard to imagine. The hypotheses, goals, and objectives are clearly stated and internally consistent. The proposal describes the link to the ERP goals (Section 6).

Rating: Good

2. **Approach.** Does the proposal clearly describe its approach (including study design and methods, if appropriate)? Is the approach well designed and appropriate for meeting the objectives of the project as described in the proposal? Will the proposal contribute to our knowledge base?

Comments:

The proposal clearly describes its approach including study design and methods in Section 3. Monitoring includes sampling of fish tissue, water quality, invertebrate tissue, sediment quality, and sediment flux. Site preparation, equipment operation, dredging and dewatering, mercury extraction, and public outreach are described.

The proposal, however, could more clearly link study design to project objectives. The objectives (from Section 1) and my comments are listed below.

- 1) To remove 50 to 150 pounds of mercury and 60,000 to 120,000 cubic yards of sediment

Comment – This is clearly a measurable objective.

- 2) To reduce the conditions that contribute to mercury methylation by removing elemental mercury from shallow, relatively warm waters, and deepening the reservoir back to its original contour

Comment – Measurements of methylmercury concentrations in the water column before and after dredging will address this objective.

- 3) To determine the net environmental benefit to the Bear River watershed and the Bay-Delta of removing elemental mercury from Combie Reservoir

Comment – Pre- and post-dredging monitoring in, upstream, and downstream of Combie Reservoir will help to assess net environmental benefit to Bear River downstream of Combie Reservoir. I would argue that the benefit will be immeasurable for more downstream reaches of Bear River (e.g., downstream of Camp Far West Reservoir) and the Bay-Delta.

- 4) To construct dredging and mercury extraction facilities

Comment – This objective will clearly be met.

- 5) To monitor, refine, and document the dredging and mercury extraction process to develop a Best Management Practice for mercury remediation in reservoirs affected by historical gold mining.

Comment – This is a worthwhile objective; however, I am surprised that there is no mention of the potential for release of fine-grained mercury-contaminated sediment during the dredging process. Presumably the operational water quality monitoring mentioned in Task 5 will address this issue; however, I would have liked to see a more direct discussion of how the proposed dredging will address this concern. A recent USGS report highlighted the concern regarding “recreational” suction dredging in California streams and new regulations for suction dredging have been proposed and are under review.

The proposal will contribute to our knowledge base.

Rating: Very good.

3. **Feasibility.** Is the proposed project’s approach fully documented and technically feasible? Can the project be completed within reasonably foreseeable constraints (e.g., acquiring permits, construction, weather, etc...)? Does the proposal thoroughly address requirements such as environmental compliance and permitting? Is the scale of the project consistent with the objectives?

Comments:

The project’s approach is fully documented and technically feasible. It can be completed within the schedule presented and addresses requirements such as environmental compliance and permitting. Some permits (i.e., CEQA, Mitigated Negative Declaration, Notice of Determination 9-25-2009) have already been completed for the project and a Sierra Nevada Conservancy grant

to the Nevada Irrigation District will pay for completion of environmental permitting by June 1, 2011.

The one objective that will be difficult to achieve is to determine net environmental benefits to the Bear River watershed and Bay-Delta. I anticipate that the watershed and Bay-Delta are too large relative to the action in Combie Reservoir to allow determination of incremental improvements.

Rating: Very good.

4. **Conceptual Model.** Does the proposal provide a conceptual model that describes the interconnections among the key ecosystem components relevant to the action(s) being proposed? Does the conceptual model clearly explain the hypotheses it is testing?

Comments:

The conceptual model clearly describes the connection between hydraulic gold mines, such as those in the Bear River watershed, and mercury contamination in the Bay-Delta ecosystem. The hypotheses being tested are based on the conceptual model. The one area where I continue to be skeptical is the importance of downstream transport of inorganic mercury from the Bear River to the Bay-Delta with respect to methylmercury bioaccumulation in the Bay-Delta. In many systems, chemical and biological conditions (such as in the Bay-Delta) can be as or more important than total mercury concentrations in controlling production and bioaccumulation. I understand this conceptual model is based on years of analysis and discussion by multiple parties and, in the abstract, it makes sense. It's just when it comes down to being able to measure improvement that I become skeptical.

Rating: Very good.

5. **Performance Evaluation Plan (Monitoring Plan and Performance Measures).** Does the proposal include a plan for project performance evaluation (monitoring to assess results and evaluate assumptions and hypotheses)? Does the project include appropriate performance measures to measure success relative to the project's goals and objectives? Will future studies or restoration projects be able to incorporate the information from this project?

Comments:

The monitoring plan and performance measures are defined well and, for the most part, will be effective in measuring success relative to the project's goals and objectives. Determining net environmental benefits of the project on the Bear River watershed and the Bay-Delta will be difficult if not impossible.

Rating: Very good.

6. **Expected Products/Outcomes.** Are products of value likely from the project? Are products of value also likely from the individual components of the project? Will the results of this study be readily accessible?

Comments:

The project will likely yield products of value including scientific information on the effects of dredging in Combie Reservoir on methylmercury concentrations in fish and water as well as downstream transport and the feasibility of dredging in an environmentally “safe” manner with respect to mercury releases (either on fine sediments during dredging or in dredge water). Costs for this process will also be useful for determining the feasibility of applying the approach throughout the Bay-Delta watershed. The results of this study will be readily accessible. In addition to scientific reports, public education is built into the work and will help in dissemination of findings.

Rating: Very good.

7. **Previous Related Work.** Does the proposed project continue past work or include any work that could be considered a duplication of work previously done or currently being done by others?

Comments:

The proposed project builds on work done previously but does not appear to be a duplication of past or current work. The fact that they have already tested the mercury extraction technology is positive as the proposed work will benefit from lessons learned previously.

Rating: Excellent.

8. **Qualifications.** What is the track record of applicants in terms of past projects? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project? Do they have working knowledge of California streams and rivers?

Comments:

The project team is highly qualified and appropriate for the proposed work. I have no direct information on their track record in terms of past projects. They do have direct experience with mercury cycling issues in California streams and rivers, and have done preliminary work to test the proposed mercury extraction techniques as well as cleanup of water derived from the dredging/extraction process. It appears that they have the infrastructure and support to accomplish the project.

Rating: Excellent.

9. **Cost/Benefit Comments.** Is the budget reasonable and adequate for the work proposed? If the budget is considered to be excessive or inadequate for the work proposed, please highlight areas of the budget that may be of concern.

Comments:

The budget is reasonable and adequate for conducting the proposed work. The proposers clearly have expertise in this area and will be able to conduct the work efficiently and cost effectively.

Rating: Excellent.

Additional comments:

In general, I think this is a solid proposal. My concerns are more related to big picture questions, which are perhaps beyond the scope of this review. I think the largest benefit of the work is to demonstrate that maintenance dredging (to preserve water depths) can be conducted in a manner that will not further exacerbate the mercury problem (i.e., by limiting resuspension of mercury-contaminated sediment and treating dredge water prior to re-release). Maintenance dredging may have the side benefit of reducing methylmercury concentrations (by increasing water depths and thereby reducing water temperature). Mercury extraction, if cost-efficient, will have the added benefit of removing mercury permanently from the environment, but is not necessary for the objective of reducing total mercury and methylmercury concentrations in Combie Reservoir or the Bay-Delta.

I am not fully convinced that dredging throughout the Sierra Nevada will solve the mercury problems in the Bay-Delta (as implied in the proposal). Numerous studies have shown that 1) biological and chemical conditions can be as or more important than total mercury concentrations in determining methylmercury concentrations and 2) methylmercury can be produced and bioaccumulated to potentially hazardous levels, even under pristine conditions. Therefore, I would hope that managers for the Bay-Delta work are also evaluating approaches to control methylmercury production (e.g., aeration of anoxic waters in reservoirs) and assessing whether or not it is feasible to achieve “acceptable” concentrations of methylmercury in fish even in the absence of mining inputs. There is also clearly a cost-benefit analysis required (i.e., the cost of removing mercury from all the streams of the Sierra Nevada versus the benefit of reducing methylmercury concentrations in fish in the Bay-Delta).

Overall Evaluation Summary Rating

In the space below, please provide an overall rating of the proposal using one of the following categories:

- **Superior:** Outstanding in all respects with superior technical and scientific value and no significant concerns. Expected to add substantial new thinking/concepts to our knowledge/understanding of the topic proposed.
- **Above Average:** A very good proposal with at least high technical and scientific value and no significant concerns. Will add solid basic knowledge/understanding of the topic proposed.
- **Adequate:** A reasonable proposal without serious technical deficiencies and at least adequate value scientifically. Will add some useful knowledge to the topic proposed.
- **Inadequate:** A technically deficient proposal and/or one with low value, serious impediments or concerns. Will not likely change our basic knowledge/understanding of the topic proposed.

Rating: Above average.

Please provide a brief explanation of your summary rating:

I think the proposal is, in general, very good and that the qualifications of personnel, monitoring plans, and schedule are excellent. My chief concern is that the potential benefits to the Bay-Delta ecosystem are overstated.

CALFED Ecosystem Restoration Program External Scientific Review Form

Proposal Number: 019

Proposal Title: Combie Reservoir Sediment & Mercury Removal Project

Reviewer: #2

Conflict of Interest Statements:

I have no financial interest in this proposal (please mark correct response).

X - Correct; I have no financial interest in this proposal.

General Review Questions:

Along with your written observations in response to the questions below, please rate each using the following criteria:

- Excellent: Outstanding in all respects
- Very Good: High quality in nearly all aspects
- Good: Quality work, but with some deficiencies
- Fair: Lacking in one or more critical aspects
- Poor: Serious deficiencies

1. **Problem/Goals.** Is the problem that the project is designed to address adequately described? Are the goals, objectives, and hypotheses clearly stated and internally consistent? Does the proposal describe the ecosystem goals it is designed to address (link to ERP goals)?

Comments:

Yes to all questions. The *problem* is clearly defined: the problem is elevated levels of mercury in fish in the San Francisco Bay and Delta, and the Bear River watershed, including Combie Reservoir (although specific fish tissue levels are not provided). The goal of the project is to reduce loads of mercury and methylmercury in the Reservoir and flowing from the Reservoir into Bear River and into the Delta. The project is designed to remove mercury from bottom sediments of the Reservoir. However, the *link* between removing mercury from bottom sediments of the reservoir and loads of mercury and methylmercury flowing from the Reservoir (downstream of the dam) should be clarified, since the dam keeps most of the contaminated bottom sediment in the reservoir; only suspended sediment and dissolved mercury and methylmercury in the water column flow past the dam.

However, the actual *source* of the problem is not addressed by the project: the contaminated sediments from the upper watershed (from abandoned mines sites, tailing piles, etc.), that wash into the Reservoir mostly during storm events. Stopping contaminated sediments from washing into the Reservoir arguably should be completed first or simultaneously; and could be more cost

effective than periodically dredging and cleaning accumulated bottom sediments. This should be discussed. However, removing the contaminated sediment currently within the reservoir is a critical and necessary step for initially remediating of the watershed.

Rating: Very Good

2. **Approach.** Does the proposal clearly describe its approach (including study design and methods, if appropriate)? Is the approach well designed and appropriate for meeting the objectives of the project as described in the proposal? Will the proposal contribute to our knowledge base?

Comments:

Yes, the proposal clearly describes its approach, and it is well designed and appropriate -- with one potential issue/question: it appears the proposal is designed to dredge the northern portion of the Reservoir near the mouth of the River, where larger grained sediments and gravel have settled, and then remove mercury from them. However, previous “investigations show that total mercury concentrations in dredge tailings tend to be most elevated in the finest grained sediments” (Mercury Contamination from Historical Gold Mining in California, USGS Fact Sheet 2005-3014, Alpers, Hunerlach, May and Hothem, November 2005). At page 2 of the proposal, it notes that grain size in Reservoir decreases to the southwest toward the dam, since water velocity decreases from the river toward the dam, and that fine sediment and silt are closest to the dam. This apparent inconsistency between the more contaminated fine grained sediments near the dam and the removal and remediation of the larger, courser grained sediments at the northern part of the Reservoir near the River should be explained.

The proposed monitoring is extensive and should contribute substantially to our knowledge base of mercury and methylmercury fate and transport within a reservoir. The proposal notes at page 2 that the project will take place over 3 years, but operational monitoring will only take place over 2 years. This should be explained (will one year of operations not be monitored?). If most of the monitoring is intended to take place before the project starts (to establish pre-dredging conditions) and after the project is completed (to establish post-dredging conditions), the proposal should clearly state this and exactly what is to be sampled pre and post dredging vs. what is to be monitored during the dredging operation and more explanation as to why.

Lastly, the proposal notes that if the dredging (for capacity purposes) is not completed within the 3 year schedule, “additional dredging will be implemented using other (matching) funds.” Since the proposal cannot be completed until dredging is completed [post-dredging monitoring], the source of matching funds must be identified and secured before this project starts (if matching funds are not secured and cannot be obtained, completion of the proposal risks significant delay). Alternatively, if this proposal can be completed even if dredging is not completed within the three year timeframe, the proposal should clearly state this. Completion of the proposal should not be dependent on whether dredging is completed within the 3 year project timeframe if sufficient funds to complete the dredging are not secured before the project starts.

Rating: Good.

3. **Feasibility.** Is the proposed project’s approach fully documented and technically feasible? Can the project be completed within reasonably foreseeable constraints (e.g., acquiring permits, construction, weather, etc...)? Does the proposal thoroughly address requirements

such as environmental compliance and permitting? Is the scale of the project consistent with the objectives?

Comments:

The proposed project's approach is documented & appears to be technically feasible; and it appears that the project can be completed as contemplated. Permitting has been addressed, assuming the WDR (Waste Discharge Requirement) is also a NPDES permit (combined WDR/NPDES permit).

As noted earlier, the project is consistent with objectives, until future storm events bring new mine waste into the Reservoir from the upper watershed. The project is a temporary fix until mining waste is stabilized in the upper watershed. However, the project is necessary for the watershed as a whole to be remediated, and would be an informative step in the process.

Rating: Very Good.

4. **Conceptual Model.** Does the proposal provide a conceptual model that describes the interconnections among the key ecosystem components relevant to the action(s) being proposed? Does the conceptual model clearly explain the hypotheses it is testing?

Comments:

Yes, the proposal provides a conceptual model; the model could be clearer in describing the interconnections among the key ecosystem components (the linkage between removing elemental mercury in reservoir bottom, coarse-grained sediments and decreasing downstream mercury and methylmercury levels in water and fish could be explained more clearly).

Rating: Very Good.

5. **Performance Evaluation Plan (Monitoring Plan and Performance Measures).** Does the proposal include a plan for project performance evaluation (monitoring to assess results and evaluate assumptions and hypotheses)? Does the project include appropriate performance measures to measure success relative to the project's goals and objectives? Will future studies or restoration projects be able to incorporate the information from this project?

Comments:

Yes, the proposal includes a detailed plan to evaluate project performance and should provide us with good information concerning whether similar projects in reservoirs will be successful. The proposal does not indicate what the current mercury/methylmercury levels are in fish tissue in the watershed (only that they are elevated); thus, it was difficult to assess the level of need for this proposal at this Reservoir in this watershed. The proposal might add some information on current fish tissue levels, to allow readers to put the project in perspective from the outset.

Rating: Very Good.

6. **Expected Products/Outcomes.** Are products of value likely from the project? Are products of value also likely from the individual components of the project? Will the results of this study be readily accessible?

Comments:

Yes, it appears the products will be valuable – the reservoir will be (temporarily) remediated until future storm events flush new contaminated sediments into the Reservoir. The pre- and post- dredging reports and analyses will be valuable in determining how efficient and effective the remediation is. Post-dredging sampling may be too close in time to fully evaluate the complete effectiveness of the project, since it may take some time for fish tissue levels to decrease after remediation. If possible, a second post-dredging sampling set, after a year or two (or three, depending on when the next big storm event occurs), would be useful to fully evaluate effects.

The accessibility of the results of the proposal will be dependent upon how soon monitoring data results are released, and how soon the pre- and post- dredging reports will be available. The proposal should state that monitoring results and reports will be available to the public within certain reasonable (specifically-stated) timeframes, and that the availability of monitoring data will not be dependent on the completion of the USGS peer-reviewed reports. USGS peer-reviewed reports take a month (sometimes longer) to complete; monitoring data should not be withheld from the public until the reports are completed.

The proposal should require that all sampling follow State and Federal established protocol (such as for SWAMP) and that all data be promptly entered into the appropriate State and regional databases, such as CEDEN, to facilitate information sharing.

Rating: Good.

7. **Previous Related Work.** Does the proposed project continue past work or include any work that could be considered a duplication of work previously done or currently being done by others?

Comments:

I do not believe any work in the proposal is a duplication of work previously completed. The proposal is for work that is consistent with mercury/methylmercury TMDLs in the Central Valley and in other parts of California, and will inform these analyses.

Rating: Very Good.

8. **Qualifications.** What is the track record of applicants in terms of past projects? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project? Do they have working knowledge of California streams and rivers?

Comments:

It appears the applicants are well-qualified to effectively implement the proposal. As noted previously, if the dredging cannot be completed within the 3 year timeframe contemplated in the proposal, funds to complete the project must be secured immediately and dredging must be completed expeditiously to fully accomplish the project. Funds should be secured prior to beginning the proposal as a contingency.

Rating: Very Good.

9. **Cost/Benefit Comments.** Is the budget reasonable and adequate for the work proposed? If the budget is considered to be excessive or inadequate for the work proposed, please highlight areas of the budget that may be of concern.

Comments:

The budget appears reasonable. However, since the proposal intends to dredge and clean sediments from the gold rush era, it must be stated very clearly that all recovered gold will be used to offset project expenses.

Rating: Good.

Additional comments:

In the dewatering facility, it appears that the liquid effluent will be returned to the Reservoir. Will there be any monitoring of the effluent to determine the levels of mercury and methylmercury in the water column? The water should not be returned to the Reservoir if levels are high; the effluent may need to be treated prior to discharge.

In the mercury extraction process, it states that physical separation (through centrifuging) and chemical removal using a polymer and an electromagnetic charge separator will be used. Any liquid effluent from these processes must be monitored (and treated if necessary) prior to any discharge back into the Reservoir.

As noted above, gold recovered from amalgam must be used to offset the cost of the project.

The Education and Outreach tasks should be more limited and more focused on activities associated with Combie Reservoir and downstream stretches of Bear River. This proposal is for remediation of the sediments in Combie Reservoir, and not for outreach activities.

On page 20, it states that Pegasus Earth –Sensing Corp tested mercury extraction equipment for the Combie Reservoir project, but this testing was not discussed in the proposal. Did the equipment work efficiently? What was successful and what could be improved? Does this proposal take into account what was learned during this testing, to improve the effectiveness of the proposed project?

Overall Evaluation Summary Rating

In the space below, please provide an overall rating of the proposal using one of the following categories:

- **Superior:** Outstanding in all respects with superior technical and scientific value and no significant concerns. Expected to add substantial new thinking/concepts to our knowledge/understanding of the topic proposed.
- **Above Average:** A very good proposal with at least high technical and scientific value and no significant concerns. Will add solid basic knowledge/understanding of the topic proposed.

- **Adequate:** A reasonable proposal without serious technical deficiencies and at least adequate value scientifically. Will add some useful knowledge to the topic proposed.
- **Inadequate:** A technically deficient proposal and/or one with low value, serious impediments or concerns. Will not likely change our basic knowledge/understanding of the topic proposed.

Rating: Above Average.

Please provide a brief explanation of your summary rating:

The proposal provides a unique opportunity to test the feasibility and effectiveness of reservoir sediment remediation through dredging and contaminant removal. The results should be useful in determining appropriate methods of badly needed mercury remediation of lakes and reservoirs in watersheds throughout California and other areas of impaired by mining activities. As noted above, there are a few areas that should be further clarified and/or discussed, prior to moving forward. However, overall, the project should be very informative and useful.

CALFED Ecosystem Restoration Program External Scientific Review Form

Proposal Number: 019

Proposal Title: Combie Reservoir Sediment and Mercury Removal Project

Reviewer: #3

Conflict of Interest Statements:

I have no financial interest in this proposal (please mark correct response).

- CORRECT

General Review Questions:

Along with your written observations in response to the questions below, please rate each using the following criteria:

- Excellent: Outstanding in all respects
- Very Good: High quality in nearly all aspects
- Good: Quality work, but with some deficiencies
- Fair: Lacking in one or more critical aspects
- Poor: Serious deficiencies

1. **Problem/Goals.** Is the problem that the project is designed to address adequately described? Are the goals, objectives, and hypotheses clearly stated and internally consistent? Does the proposal describe the ecosystem goals it is designed to address (link to ERP goals)?

Comments:

The proposal has a straightforward goal: to reduce the inputs of mercury to the immediate aquatic ecosystem and downstream waters by removing mercury contaminated sediments from the Combie Reservoir. The development of BMPs for contaminated sediment dredging is an expected outcome. The proposal is linked to several ERP goals according to the applicants. They indicate that the work undertaken will directly and indirectly lead to the “reduction of mercury and sediment loading into the Bay-Delta, improving sediment and water quality.” If the proposed work is successful then indeed these goals would be addressed.

Hypotheses generally follow from the objective statement of the proposal, however: Hypothesis a) is not a hypothesis if dredging is only “expected” to result in lower MeHg levels in the food web. Is it, or isn’t it? Hypothesis c) is not testable in the context of the proposed work and is therefore not a project hypothesis per se.

Rating: **GOOD**

2. **Approach.** Does the proposal clearly describe its approach (including study design and methods, if appropriate)? Is the approach well designed and appropriate for meeting the objectives of the project as described in the proposal? Will the proposal contribute to our knowledge base?

Comments:

The proposed work is ambitious in that it involves the dredging of 60-120 000 cubic yards of sediment and removal of 50-150 pounds of mercury. The ‘experimental’ design is a pre and post-dredging Hg in various compartments, and ongoing monitoring of water quality both within and downstream of the Combie Reservoir. The proposal also addresses the monitoring of zooplankton, invertebrate and fish for pre and post dredging effects. It is unclear how fish, which have integrated Hg over a potentially long exposure period, are expected to respond to such short term changes. Other biotic compartments may be more promising as biosentinels. The relatively sparse temporal scheme for biotic sampling may also lead to hydrological/climatic influences on Hg exposure that could confound interpretations.

Rating: **FAIR**

3. **Feasibility.** Is the proposed project’s approach fully documented and technically feasible? Can the project be completed within reasonably foreseeable constraints (e.g., acquiring permits, construction, weather, etc...)? Does the proposal thoroughly address requirements such as environmental compliance and permitting? Is the scale of the project consistent with the objectives?

Comments:

The environmental sampling and monitoring is completely feasible. There are other sections that are deeply concerning with respect to feasibility. For example:

Monitoring will take place throughout the project because it is possible that ... reactive mercury(II) or methylmercury ... are not removed by the concentrator. (p.13)

And

If reactive mercury(II) or flowered elemental mercury is released by the concentrator then the best course of action will be to cease the operations until such time that the project can be modified to eliminate water discharge that exceeds applicable water-quality criteria specified in the 401 certification from RWQCB. (p.13)

I may be missing something here, but if the proponents don't actually know if either of these two options are a likely possibility, then I really cannot see how this work could be allowed to proceed. The first statement indicates that there could be a preferential release of MeHg in water released from the Hg removal process, and the second statement suggests a potentially endless course of modifications and testing with a nebulous outcome. There is some mention of pilot scale work in the proposal, but no information on pilot data are presented.

Rating: **POOR**

4. **Conceptual Model.** Does the proposal provide a conceptual model that describes the interconnections among the key ecosystem components relevant to the action(s) being proposed? Does the conceptual model clearly explain the hypotheses it is testing?

Comments:

The conceptual model, as presented in Figure 2, p. 8, is not a conceptual model for the processes that are expected to be elucidated by the proposed work. In fact, it is simply a schematic of all of the known sources and transformations of mercury in the system, of which reservoir sediments contaminated with mercury are one component. A conceptual model for this proposal should focus on the anticipated changes to the manipulated reservoir, the changes in Hg biogeochemistry, and food-chain exposure. There are no estimates of magnitude of impact, degrees of change, or sensitivities that should be addressed.

Rating: **POOR**

5. **Performance Evaluation Plan (Monitoring Plan and Performance Measures).** Does the proposal include a plan for project performance evaluation (monitoring to assess results and evaluate assumptions and hypotheses)? Does the project include appropriate performance measures to measure success relative to the project's goals and objectives? Will future studies or restoration projects be able to incorporate the information from this project?

Comments:

There isn't an explicit discussion of performance measures that gauge the relative success of the proposed work (e.g. by what degree will ecosystem Hg concentrations be decreased?).

In other sections performance measures are identified as operational monitoring and adaptive management (Task 5; p. 12). There is a range of monitoring activities identified here that certainly will measure the efficacy of the processes put in place for sediment and Hg removal.

Rating: **FAIR**

6. **Expected Products/Outcomes.** Are products of value likely from the project? Are products of value also likely from the individual components of the project? Will the results of this study be readily accessible?

Comments:

There are potentially high value products generated by the project, including a region wide set of BMPs for the dredging of mercury-contaminated sediment, which is profoundly important. The challenge with the project is that it is something of an all or nothing proposition given the pre and post dredging experimental structure. As written, it would also appear that it would be possible that the entire outcome could be net neutral to negative with respect to mercury. Proposing two USGS reports and an ERP report as the only written outcomes for a project of this magnitude is insufficient, in my opinion. The project will generate useful mercury data for a wide range of environmental compartments, which has general utility to the ERP and future work.

Rating: **FAIR**

7. **Previous Related Work.** Does the proposed project continue past work or include any work that could be considered a duplication of work previously done or currently being done by others?

Comments:

There is mention of pilot scale work in the proposal, but no inclusion of details on the work done, or outcomes.

Rating: **POOR**

8. **Qualifications.** What is the track record of applicants in terms of past projects? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project? Do they have working knowledge of California streams and rivers?

Comments:

I find it interesting that the proponents list organizations as applicants. I cannot assess the track record of the NID for undertaking a scientific project. I acknowledge the expertise of Dr. Alpers as the lead on sampling and mercury analyses. I see no connection between the description of the Sierra Fund expertise and the ability of the organization to “assist with Task 5” as identified, or the role of CABY. I have no reason to doubt the expertise of the private consultants and their expertise.

Rating: **FAIR**

9. **Cost/Benefit Comments.** Is the budget reasonable and adequate for the work proposed? If the budget is considered to be excessive or inadequate for the work proposed, please highlight areas of the budget that may be of concern.

Comments:

The budget is adequate in some areas, but grossly problematic in some areas, in my opinion. I am not going to go into details except to draw attention to a few things that I see as seriously problematic.

Hg extraction equipment rental – 450,000. I understand that the co-investigators at PES have to earn income for their company, but I would like to see this large number justified and I find the unjustified value to be verging on conflict of interest.

Dredge and dewatering system rental – 2,000,000. This is a completely unjustified number with an unknown supplier. Unacceptable.

I am perhaps more concerned about the additional 1,000,000 listed for “additional dredging, if warranted” with funding source “To be Determined”. Unacceptable, and leads to a very uncomfortable feeling that the project will not go as planned.

Rating: **POOR**

Additional comments:

There are sections of the proposal that have unfortunately sloppy formatting, grammatical and spelling errors. I generally expect proposals with budgets in the millions of dollars to be a bit more polished.

Overall Evaluation Summary Rating

In the space below, please provide an overall rating of the proposal using one of the following categories:

- **Superior:** Outstanding in all respects with superior technical and scientific value and no significant concerns. Expected to add substantial new thinking/concepts to our knowledge/understanding of the topic proposed.
- **Above Average:** A very good proposal with at least high technical and scientific value and no significant concerns. Will add solid basic knowledge/understanding of the topic proposed.
- **Adequate:** A reasonable proposal without serious technical deficiencies and at least adequate value scientifically. Will add some useful knowledge to the topic proposed.
- **Inadequate:** A technically deficient proposal and/or one with low value, serious impediments or concerns. Will not likely change our basic knowledge/understanding of the topic proposed.

Rating: **INADEQUATE**

Please provide a brief explanation of your summary rating:

The proposed work has a high level of potential significance, but the proposal is marred, in my opinion, by an all or nothing outcome, the lack of a conceptual model, the failure to include pilot scale results to give the reviewer some confidence in the field scale work, and a budget that has millions of dollars of budget that are unjustified and open ended. I would strongly

recommend against support for this work AS WRITTEN. It is possible that there are pilot scale results and other information that, if incorporated into a revised proposal, could clarify many of the uncertainties presented here.