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State Water Resources Control Board

Division of Water Quality

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Arnold Schwarzenegger
Governor

TO: Gerald W. Bowes, Ph.D.
Manager, Cal/EPA Scientific Peer Review Program
Office of Research, Planning and Performance

FROM: Rick Humphreys, Mine Cleanup Coordinator
Groundwater Protection Section
DIVISION OF WATER QUALITY

DATE: March 2, 2011

SUBJECT: REQUEST FOR EXTERNAL PEER REVIEWERS: WATER QUALITY
IMPACTS OF SUCTION DREDGING FOR GOLD

The purpose of this peer review is to determine whether the scientific basis of the findings concerning water quality impacts of suction dredging for gold are both supported by the literature evaluated by the consultant team contracted by the Department of Fish and Game (DFG) and are based on sound scientific knowledge, methods, and practices. In January, 2009, the State Water Resources Control Board (State Water Board) adopted Resolution No. 2009-0006 which provided supplemental funding to DFG so that the water quality impacts of suction dredging could be more fully addressed in their Supplemental Environmental Impact Report (SEIR). Resolution No. 2009-0006 is being implemented through Interagency Agreement 08-099-250 between DFG and the State Water Board. Task 5 of Interagency Agreement 08-099-250 requires DFG to provide the water quality portion of the SEIR for scientific peer review, because it will serve as the technical basis for any possible changes to State Water Board policies or regulations and any possible State Water Board permit.

Background

DFG's existing regulations governing suction dredging were promulgated after they prepared and certified an environmental impact report under CEQA in 1994. DFG's current effort to amend the existing regulations and comply with the California Environmental Quality Act (CEQA) is required by a court order issued in a lawsuit brought against DFG by the Karuk Tribe of California. The lawsuit focused on the Klamath, Scott and Salmon River watersheds in northern California; included allegations regarding impacts to various fish species, including Coho salmon; and contended that DFG's administration of the suction dredging program violated the

(CEQA) and various provisions of the Fish and Game Code. Suction gold dredging is currently prohibited statewide by SB 670 (Chapter 62, Statutes of 2009); however DFG's revised regulations are expected to allow suction dredging to resume.

The State Water Board provided \$500,000 to DFG to ensure that water quality impacts of suction dredging were fully evaluated in the SEIR so that any changes to State Water Board policies or regulations, or any new permit, could be based on sound science. State Water Board and DFG staff, and DFG's CEQA consulting firm prepared an SEIR based on existing literature. Existing literature indicates that suction gold dredging performed under DFG's new regulations would result in discharges in pollutants including mercury and sediment.

Because the water quality impacts are complex, we request that you solicit reviewers with expertise in the following areas:

- Inorganic and organic mercury chemistry and mercury transformations in aquatic environments
- Mercury transport in fluvial systems
- Mercury methylation and de-methylation in aquatic environments.
- Mercury toxicity and bioaccumulation in humans and wildlife.
- Stream science
- Fluvial geomorphology
- Channel-floodplain dynamics
- Stream functions
- Sediment transport in fluvial systems
- Aquatic chemistry
- Contaminant migration and transformation in aquatic environments

Included with this cover letter are five attachments as follows:

1. Attachment 1: Description of suction gold dredging and water quality impacts related to the activity.
2. Attachment 2: Scientific Issues To Be Addressed By Peer Reviewers
3. Attachment 3: Persons Involved In Developing SEIR Directly or Indirectly
4. Attachment 4: The SEIR (the entire report is provided on CD, Peers will be asked to review Chapter 4.2).
5. Attachment 5: References (provided on CD).

Expected date the document will be available: November 2, 2010.

Chapter 4.2 of the SEIR is to be reviewed, since it will become the basis for any changes to State Water Board policies or regulations, or any new permit. The entire SEIR is provided on CD for program context purposes. The CD also contains a folder

with all the references used for Chapter 4.2, and an appendices folder. The SEIR, references, and appendices are formatted for on screen commenting, searching etc.

Staff contact is Rick Humphreys: Rhumphreys@waterboards.ca.gov, (916) 341-5493.

Sincerely,

Rick Humphreys
Senior Specialist Engineering Geologist

Attachments (4)

cc: Elizabeth L. Haven
Assistant Deputy Director
Division of Water Quality

WATER QUALITY IMPACTS OF SUCTION GOLD DREDGING

I. Description of the activity

Suction dredging for gold is a common activity in California's rivers and streams in which engine-powered equipment is used to vacuum gold from river and stream bottoms, thereby disturbing sediment and mobilizing mercury and other pollutants in the water. Prior to a SB 670's statewide moratorium on the activity beginning in August 2009, DFG issued about 3,600 permits per year on average.

Suction dredging equipment ranges widely in size and power, but all units are capable of excavating sediment in volumes measured in yards (a yard of sediment weighs approximately 2,700 pounds) per hour according to manufacture's specifications. Suction dredgers use their equipment to excavate through ambient stream sediment to gold bearing sediment layers or bedrock, where gold often occurs. Once a gold bearing sediment layer or bedrock is found, suction dredgers use their dredge to vacuum up gold bearing sediment for processing on a sluice mounted on the dredge. A sluice is designed to capture dense solids (e.g., oxide mineral sands, gold, lead, iron, mercury + gold amalgam) from a water, sediment slurry. Although capture efficiencies of sluices operated commercially may range up to 90%, capture efficiencies of sluices operated by suction gold dredgers are not well documented.

Mercury is a widespread Gold Rush era (1850's on) legacy contaminant in watersheds where gold is found and suction dredgers operate. It is found in its liquid elemental form, combined with gold (gold + mercury amalgam), and as mercury-enriched sediment. Suction dredgers recover mercury and amalgam while dredging for gold.

Suction dredging is mostly a seasonal activity limited both by regulation and stream conditions (i.e., a summertime activity). Suction dredgers generally do not fill in the holes they excavate in stream alluvium.

Potential suction dredging water quality impacts include:

- Remobilization of mercury and other trace metals.
- Mercury bioaccumulation in aquatic organisms.
- Adverse health effects on aquatic organisms, wildlife, and humans from mercury bioaccumulation.
- Changes in dissolved oxygen levels and temperature.
- Increases in turbidity and suspended sediment.

- Remobilization of persistent organic pollutants.
- Degradation from spilled hydrocarbons (oil and gasoline).
- Degradation from campsite waste.



Suction gold dredge in the South Fork Yuba River

The water quality chapter which is the focus for the requested review, has organized potential impacts from suction dredge mining into six categories, of which four are highlighted for addressing in Attachment 2 to the request : a) Effects of Turbidity/TSS Discharges from Suction Dredging (“Less than Significant”); b) Effects of Mercury Discharges from Suction Dredging (“Significant and Unavoidable”); c) Effects of Other Trace Metals Discharged from Suction Dredging (“Significant and Unavoidable”) ; and d) Effects of Trace Organic Compounds Discharged from Suction Dredging (“Less than significant”).

DESCRIPTION OF SCIENTIFIC TOPICS TO BE ADDRESSED BY REVIEWERS

The statute mandate for external scientific peer review (Health and Safety Code Section 57004) states that the reviewer's responsibility is to determine whether the scientific portion of the proposed rule is based upon "*sound scientific knowledge, methods, and practices.*"

We request that you make this determination for each of the following findings that constitute the scientific basis of the water quality portion of DFG's Suction Dredging SEIR (Chapter 4.2). An explanatory statement is provided for each finding to focus the review, and the entire SEIR is provided for overall context.

For those work products which are not proposed rules, as with the subject of this review, reviewers must measure the quality of the product with respect to the same exacting standard as if it was subject to Health and Safety Code Section 57004 requirements.

- 1) **Sediment/Turbidity and TSS. Pages 4.2-28 to 4.2-33. Available evidence suggests that individual suction dredges have the potential to re-suspend in-stream sediments, resulting in plumes containing elevated levels of turbidity and total suspended solids (TSS) (e.g., up to 300-340 mg/L).**
 - **Such plumes would be localized to individual dredge sites, temporary, and intermittent and thus, resulting plumes would extend relatively short distances downstream from the dredging sites.**
 - **Such individual plumes likely may exceed the applicable Basin Plan objectives, particularly in streams that have low background turbidity levels.**
 - **Literature reviewed indicates that turbidity and TSS concentrations within suction dredging plumes are unlikely to exceed 50 NTUs and 340 mg/L, respectively, and are, therefore, not expected to approach or exceed the levels that would cause lethal or other adverse physiological effects to fisheries or other aquatic resources.**
 - **The potential highest dredging-caused turbidity/TSS levels would be expected to rapidly return to near background levels downstream within a few hundred meters or less of the dredge operation.**
 - **Such individual plumes potentially would exceed Basin Plan turbidity objectives; however, such plumes would not adversely affect aquatic organisms.**

- **Such individual plumes would be not cause long-term degradation of water quality with regards to turbidity, or TSS.**

Suction dredging re-suspends coarse and fine sediment into the water column. Coarse sediment (i.e. > 63 micron) settles out of the water column relatively near the dredge while fine sediment (i.e., < 63 micron) remains in the water column for longer periods. In many rivers and streams, numerous dredges operate relatively close together and simultaneously. Suction dredgers often seek out clay-rich “hardpan” layers because they contain substantial gold.

2. Mercury. Pages 4.2-33 to 4.2-54. Available evidence suggests that suction dredging has the potential to contribute substantially to:

- **Watershed mercury loading (both elemental mercury and mercury-enriched suspended sediment) to downstream reaches within the same water body and to downstream water bodies.**
- **Methylmercury formation in the downstream reaches of the same water body and in to downstream water bodies (e.g., the Bay-Delta) from dredging caused mercury loading.**
- **Mercury bioaccumulation and magnification in aquatic organisms in downstream reaches within the same water body and downstream /water bodies.**
- **Increased methylmercury body burdens in aquatic organisms which increase the health risks to wildlife (including fish) and humans consuming these organisms.**

In California, suction dredging frequently occurs in streams that were contaminated with mercury beginning in the Gold Rush. Suction dredgers encounter mercury in the forms of elemental mercury, mercury alloyed with gold (amalgam), and mercury-enriched sediment. Both elemental and reactive mercury are adsorbed onto the sediments. Suction dredgers recover and process amalgam because it contains gold. Suction dredge sluices do not capture 100% of the mercury, amalgam, and gold in sediment that passes through them (losses are in the percent range). In addition, suction dredgers dredge fine grained sediment (i.e., 63 micron and smaller) in mercury contaminated streams is at least 10x higher in mercury that what would be considered background for an uncontaminated stream. Suction dredges do not recover sediment finer than 63 microns.

Suction dredges then release mercury and mercury enriched fine-grained sediment that was formerly buried. This mercury may then be transported to aquatic environments where it can be converted into bio-available methylmercury.

3. Other Trace Metals. Pages 4.2-54 to 4.2-59. Available evidence suggests that while suction dredging has the potential to remobilize trace elements (e.g., cadmium, zinc, copper, and arsenic), the levels of increase:

- **Would not be expected to exceed state or federal water quality criteria by frequency, magnitude, or geographic extent that would result in adverse effects on one or more beneficial uses.**
- **Would not result in substantial, long-term degradation that would cause substantial adverse effects to one or more beneficial uses of a water body.**
- **Would not substantially increase the health risks to wildlife (including fish) or humans consuming these organisms through bio-accumulative pathways.**
- **Would not exceed CTR metals criteria by frequency, magnitude, and geographic extent that could result in adverse effects to one or more beneficial uses, relative to baseline conditions, unless suction dredging occurs at known trace metal hot-spots (e.g., caused by acid mine drainage caused trace metal contaminated sediment and pore water) where high metal concentrations and bio-available forms are present.**

In California, suction dredging frequently occurs in streams that were contaminated with trace metals beginning in the Gold Rush. Historic base metal mines align along the Sierra Nevada foothill copper belt, and are found in the Klamath-Trinity Mountains. Historic base metal and gold mines discharged their waste to streams if possible until the practice was prohibited in about 1910. In addition, many abandoned base metal mines still discharge metal-rich, acid mine water to streams in California. Although trace metal levels in Sierra Nevada streams have not been thoroughly evaluated (except for site specific data at former mine clean up projects), Regional Water Quality Control Boards have designated numerous stream segments as impaired because of trace metals. Suction dredges discharge trace metal contaminated sediment when operating in a trace metal-contaminated stream

4. Trace Organic Compounds. 4.2-59 to 4.2-60. Available evidence suggests suction dredging has the potential to remobilize trace organic compounds if present:

- **Trace organic compound use was not widespread in areas where suction dredging occurs and trace organic transport into these areas is unlikely.**
- **Suction dredging would not be expected to increase levels of trace organics in any water body such that the water body would exceed state or federal water quality criteria by frequency, magnitude, or geographic extent that would result in adverse effects on one or more beneficial uses.**

- **Suction dredging would not cause substantial, long-term degradation from trace organic compounds and thus, there would be no substantial adverse effects to one or more beneficial uses of a water body.**
- **Suction dredging is not expected to mobilize trace organic compounds in a manner or to an extent that would increase levels of any bio-accumulative trace organic compound in a water body by frequency and magnitude such that body burdens in populations of aquatic organisms would be expected to measurably increase, thereby substantially increasing the health risks to wildlife (including fish) or humans consuming these organisms.**

Suction dredging may remobilize sediment with elevated concentrations of organic compounds (e.g., persistent pesticides and PCBs) from atmospheric deposition of these compounds, and in some cases spills. It is generally believed that use of such compounds in rural areas where suction dredging occurs was rare. However, the characteristics and distribution of trace organic compounds in aquatic sediments has not been evaluated through out the State.

The Big Picture

Reviewers are not limited to addressing only the specific issues presented above, and are asked to contemplate the following questions.

(a) In reading Chapter 4.2 of DFG's in the context of the entire Suction Dredging SEIR, are there any additional scientific issues that are part of the scientific basis not described above? If so, please comment with respect to the statute language given above in the first three paragraphs of Attachment 2.

(b) Taken as a whole, is the scientific evaluation of the water quality effects of suction dredging presented in Chapter 4.2 of DFG's Suction Dredging SEIR based upon sound scientific knowledge, methods, and practices?

Reviewers should also note that some proposed actions may rely significantly on professional judgment where available scientific data are not as extensive as desired to support the statute requirement for absolute scientific rigor. In these situations, the proposed course of action is favored over no action.

The preceding guidance will ensure that reviewers have an opportunity to comment on all aspects of the scientific basis of the water quality effects of suction dredging presented in Chapter 4.2 of DFG's Suction Dredging SEIR. At the same time, reviewers also should recognize that the Board has an obligation to consider and respond to all feedback on the scientific portions of the water quality effects of suction dredging presented in Chapter 4.2 of DFG's Suction Dredging SEIR. Because of this obligation, reviewers are encouraged to focus feedback on the scientific issues highlighted.

Attachment 3

PERSONS AND AGENCIES INVOLVED IN DEVELOPING THE WATER QUALITY PORTION OF DFG'S SUCTION DREDGING SUPPLEMENTAL ENVIRONMENTAL IMPACT REPORT DIRECTLY OR INDIRECTLY

Persons and agencies directly or indirectly involved; i.e., persons who have reviewed or commented on the water quality portion of DFG's Suction Dredging Supplemental Environmental Impact Report, or who have provided specific feedback on scientific or technical issues relating to the water quality portion of DFG's Suction Dredging Supplemental Environmental Impact Report, are listed below. Persons who may have participated in more than one capacity may be listed more than once.

**Consultant Team (Principal Investigators)
(Affiliations identified below)**

Name	Organization	Address	Title	Degree Type (B.S., M.S., etc) and Subject
Michael Stevenson	Horizon Water and Environment	1330 Broadway Oakland, CA 94612	Principal	M.S., Watershed Management and Restoration B.A. Environmental Studies
Ken Schwarz	Horizon Water and Environment	1330 Broadway Oakland, CA 94612	Principal	Ph.D., Geography (Geomorphology and Hydrology) M.A., Geography (Geomorphology and Hydrology) B.A., Regional Development
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Megan Gosh	Geografika	1108 Palm Avenue San Mateo, CA 94401	Owner, GIS Specialist	B.A., Geography/ Planning
John Durnan	Durnan Design	3113 Valencia Way Sacramento, CA 95825	Owner, Computer Graphic and Design Artist	B.S., Biochemistry B.A., Music Theory Composition

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Mary K. Stanbrough	Applied Research and Evaluation	California State University, Chico Chico, CA 95929	Office/Project Manager	B.S., Recreation Administration
Joseph Domagalski	Independent Contractor	3230 St. Mathews Drive Sacramento, CA 95821	n/a	Ph.D., Geochemistry (Low Temperature Geochemistry of Trace Metals) M.S., Environmental Chemistry A.B., Chemistry and Biology
Tom Trexler	URS Corp	2870 Gateway Oaks Drive, Suite 150 Sacramento, CA 95833	Senior Scientist/Planner	B.A., Geography (Focus on geomorphology) - Minor in Environmental Studies
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Department of Fish and Game Team

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Rick Humphreys	1001 I Street, Sacramento, CA 95814	Engineering geologist
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**REFERENCE LIST
(REFERENCES WILL BE PROVIDED ON CD)**

4.2 Water Quality/Toxicology

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