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Julie Roth, Executive Director
DSCSOC

Review of the UCD Ecological Risk Assessment Revised Draft

When the first draft of the Ecological Risk Assessment (ERA) was released, I provided DSCSOC with comments on the technically invalid, inconsistent and inappropriate approaches that UCD and its contractors had used, where I indicated that UCD needed to start over with respect to developing this ERA. Subsequently, DTSC and the US EPA concluded that UCD should be required to redo the Ecological Risk Assessment. After several exchanges with the US EPA, finally the US EPA ordered UCD to develop a credible Ecological Risk Assessment which has been properly proofread and presented.

On June 21, 2004, UCD (Brian Oatman) provided Ms. Patti Collins of the US EPA, the other RPMs and DSCSOC with a revised Draft Site-Wide Risk Assessment, Ecological Risk Assessment, Risk Estimate. This is the revised ERA that was required by the US EPA and DTSC because of the inattention to detail in the preparation of the initial Ecological Risk Assessment. I am concerned about the following statement in Mr. Oatman's June 21, 2004, ERA transmittal letter:

“Though we tried to be comprehensive in our approach, from a practical standpoint we were limited in time and felt an urgency to get the document back into the review process. Therefore, there were some details that will have to wait to be addressed in the Draft Final ERA.”

Does this mean that the document that UCD provided in June is not of sufficient quality and detail to be reviewed? As you know, DSCSOC does not have funds to continue to review sloppily prepared reports. As we pointed out, this has been a chronic problem with UCD's reports. As we have agreed, for now I will wait until the US EPA, CVRWQCB and DTSC have completed their review on this revised ERA, and then review the final version to see if the issues that I originally raised on the deficiencies in the approach that UCD was following have been adequately and reliably addressed, as well as any new issues that have arisen from subsequent review of this ERA.

There are, however, two aspects of this revised version that I will comment on at this time. These are the use of what are called “co-occurrence-based” sediment quality guidelines to evaluate the potential significance of chemical constituents in aquatic sediments, and the failure of UCD to consider and investigate the potential presence of dioxins in wastes, soils and

sediments at the LEHR site. Both of these issues have been raised previously in DSCSOC comments to the RPMs. Neither has been adequately addressed.

Unreliability of Co-Occurrence-Based Sediment Quality “Guidelines”

When I first saw the co-occurrence-based sediment quality guideline approach in the initial draft ERA, I commented on the well-known unreliability of this approach. As you know, UCD has decided that it does not need to respond to DSCSOC comments, with the result that we have not seen any responses on our comments now for some time. The situation still stands, however, that we discussed a year ago, that there will be a request for public review and support of remediation approaches. To the extent that the remediation approaches rely on these unreliable co-occurrence-based approaches for evaluating the significance of constituents in sediments, I will be commenting on the inadequate approach that UCD has used in support of a particular remediation approach.

The issue of particular concern is Table I-8 in Appendix I (“Tier 1 Soil, Surface Water and Sediment Screening Numbers”) of the June 2004 Site-Wide Risk Assessment Volume 2: Ecological Risk Assessment, Risk Estimate, which lists the “Sediment Value” that was used by UCD in evaluating excessive concentrations of various chemical constituents in sediments. As listed in this table, the “Source” is “ER-L (OSWER),” “TEL (SQuiRT),” “SQB” or “SQC.” The ER-L and TEL values are co-occurrence-based so-called “sediment quality guidelines.” As I commented when I first saw that UCD was attempting to use this approach in its original Ecological Risk Assessment, this approach is recognized by those who understand aquatic chemistry, aquatic toxicology and the effects of chemicals on aquatic life, to be highly unreliable for relating the concentrations of constituents in sediments to their potential impact on aquatic life.

As background to my comments on the unreliability of co-occurrence-based sediment quality “guideline” values, Dr. Jones-Lee and I have developed several peer-reviewed papers and reports on these issues, in which we have discussed our own experience in sediment quality evaluation, as well as the experience of others. Presented below is a summary of this information.

The co-occurrence-based approach, which involves the use of Long and Morgan ER-L and ER-M or MacDonald PEL (TEL) values, is fundamentally flawed because it is based on the total concentrations of a limited number of constituents in the sediments. While some will claim that there is some validity to this approach and will even make the false statement that these have been adopted as NOAA values, in fact they are not NOAA values, and the Chief Scientist for NOAA Status and Trends program (Tom O’Connor) has repeatedly pointed out the unreliability of the approach with respect to whether a Long and Morgan sediment quality “guideline” is a reliable indicator of sediment toxicity. The facts are that, with a large database representing a variety of sites where chemical concentrations and sediment toxicity have been measured, the Long and Morgan and MacDonald “guideline” values are no more accurate in predicting sediment toxicity than flipping a coin.

In the mid-1990s Lee and Jones-Lee developed a comprehensive review of why co-occurrence-based approaches are not reliable for evaluating the potential impacts of chemical constituents in aquatic sediments:

Lee, G. F. and Jones-Lee, A., “‘Co-Occurrence’ in Sediment Quality Assessment,” Report of G. Fred Lee & Associates, El Macero, CA, February (1996).
<http://www.members.aol.com/apple27298/COOCCUR2PAP.pdf>

This paper provides background information on the development of and problems with Long and Morgan ER-Ls/ER-Ms and MacDonald PELs. It contains a number of references to previous writings on this issue, which lead to the conclusion that co-occurrence-based values should not be used for any purpose, including the screening of sediments for potential water quality problems.

In 2002, through a contract issued by the California State Water Resources Control Board to CSU Fresno’s California Water Institute, Drs. Lee and Jones-Lee were asked to develop a comprehensive review on the occurrence and management of organochlorine legacy pesticides, PCBs and dioxins (collectively referred to as OCl)s in Central Valley fish. This report is available as

Lee, G. F. and Jones-Lee, A., “Organochlorine Pesticide, PCB and Dioxin/Furan Excessive Bioaccumulation Management Guidance,” California Water Institute Report TP 02-06 to the California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 170 pp, California State University Fresno, Fresno, CA, December (2002). <http://www.gfredlee.com/OCITMDLRpt12-11-02.pdf>

Excessive bioaccumulation of the OCl)s is one of the (if not the) most important water quality problems in the Central Valley of California, since most waterbodies in the Central Valley contain edible fish with concentrations of OCl)s that have been determined by California EPA’s Office of Environmental Health Hazard Assessment (OEHHA) to be a threat to cause cancer in people who eat these fish.

Since one of the issues of particular concern is the occurrence of OCl)s in sediments which serve as a source for the excessive bioaccumulation of these chemicals in edible aquatic life, a section of this report was devoted to a review of approaches for evaluating excessive concentrations of OCl)s in aquatic sediments. A detailed discussion was included in this section on the unreliability of co-occurrence-based approaches, such as Long and Morgan values, in predicting the water quality impact of the OCl)s on the beneficial uses of waterbodies. An issue of particular concern was the use of Long and Morgan or MacDonald values to determine excessive concentrations of these chemicals in aquatic sediments. As Lee and Jones-Lee discuss, excessive concentrations of these chemicals should be based on evaluating whether the chemicals are toxic to aquatic life and whether the sediment-associated OCl)s are sources that lead to excessive bioaccumulation in fish and other aquatic life tissue.

Lee and Jones-Lee point out that some regulatory agencies, including the US EPA Region 9 in connection with their development of a TMDL for control of excessive

bioaccumulation of the OCIs in edible fish in the Upper Newport Bay, Orange County, California, watershed and Bay, are inappropriately using the Long and Morgan values as TMDL cleanup goals. This is inappropriate, since the Long and Morgan values and MacDonald values are not based on bioaccumulation, but on sediment toxicity to aquatic life. Bioaccumulation of these chemicals to excessive levels in edible fish can occur at concentrations well below those that are toxic to benthic organisms associated with the sediments. The US EPA Region 9's use of co-occurrence-based values for regulatory purposes is one of the examples that Lee and Jones-Lee (2002) discuss as "horror stories" on the waste of public and private funds associated with implementing regulatory approaches based on the use of co-occurrence-based sediment quality guidelines. Co-occurrence-based values should never be used to provide any inference on the potential for sediment-associated chemicals such as the OCIs, mercury, etc., to bioaccumulate to excessive levels in edible aquatic life. The development of these values did not consider bioaccumulation as an impact of the sediment-associated constituents.

The section of the CSU Fresno OCI report devoted to the unreliability of co-occurrence-based values for evaluating sediment quality has been developed into a separate report:

Lee, G. F. and Jones-Lee, A., "Unreliability of Sediment Co-Occurrence-Based Approaches for Evaluating Aquatic Sediment Quality," Excerpts from Lee, G. F. and Jones-Lee, A., "Organochlorine Pesticide, PCB and Dioxin/Furan Excessive Bioaccumulation Management Guidance," Excerpted from California Water Institute Report TP 02-06 to the California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 170 pp, California State University Fresno, Fresno, CA, December (2002). <http://www.gfredlee.com/UnrelSedCooccur.pdf>

In the fall of 2002 the International Aquatic Ecosystem Health and Management Society held a three-day conference in Chicago (Fifth International Conference on Sediment Quality Assessment - SQA5) where there were several presentations (including several invited keynote presentations) on sediment quality evaluation. Several of the leading authorities on sediment quality evaluation, including DiToro, Chapman and Burton, discussed the unreliability of co-occurrence-based approaches for evaluating sediment quality, including the updated information developed by Long et al. (1995) and MacDonald et al. (2000) cited in UCD's revised draft ERA,

Long, E. R.; MacDonald, D. D.; Smith, S. L. and Calder, F. D., "Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments," *Environ. Mgmt.* 19:81-97 (1995)

MacDonald, D. D.; Ingersoll, C. G. and Berger, T. A., "Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems," *Arch. Environ. Contam. Toxicol.* 39:20-31 (2000),

involving the use of summed quotients of co-occurrence-based values. DiToro characterized any so-called agreement between the results of co-occurrence-based values and observed sediment toxicity as a "coincidence," and certainly not cause and effect. While Long, MacDonald, and others claim that their co-occurrence-based values have predictive capability based on a

particular dataset, a critical review of this dataset shows that it is not a reliable basis for evaluating the ability of co-occurrence-based values to predict sediment toxicity.

Chapman's presentation at SQA5 has recently been published as

Chapman, P. M., "Paracelsus' dictum for sediment quality (and other) assessments," *Aquatic Ecosystem Health & Management*, 7(3):369-374 (2004).

The focus of his discussion is on assessing bioavailable forms of contaminants in sediments, where he points to the unreliability of trying to assess bioavailability based on chemical measurements. As he pointed out in his presentation, co-occurrence-based sediment quality guidelines fail to reliably assess bioavailable forms.

Tom O'Connor that he has recently developed a paper on this issue, which has been peer-reviewed and is in press,

O'Connor, T. P., "The Sediment Quality Guideline, ERL, is not a chemical concentration at the threshold of sediment toxicity," To be published in *Mar. Poll. Bull.* (In Press, 2004), (A preprint of this paper is available on Drs. Lee and Jones-Lee's website at <http://www.members.aol.com/apple27298/oconnor.pdf>),

in which he has provided additional information on the unreliability of using co-occurrence-based approaches for assessing sediment toxicity.

Lee and Jones-Lee (2004) presented a paper at the SQA5 conference entitled

Lee, G. F. and Jones-Lee, A., "Appropriate Incorporation of Chemical Information in a Best Professional Judgment 'Triad' Weight of Evidence Evaluation of Sediment Quality," Presented at the 2002 Fifth International Symposium on Sediment Quality Assessment (SQA5), In: Munawar, M. (Ed.), *Aquatic Ecosystem Health and Management* 7(3):351-356 (2004). <http://www.gfredlee.com/BPJWOpaper-pdf>

This paper contains an updated review of the unreliability of co-occurrence-based values for evaluating sediment quality. Particular emphasis in the paper is given to a discussion of how sediment quality evaluation should be conducted, involving a best professional judgment (BPJ) triad weight-of-evidence approach. This approach integrates information on aquatic toxicity and excessive bioaccumulation, altered organism assemblages relative to habitat characteristics, and chemical information. Lee and Jones-Lee discuss the inappropriateness of using total concentrations of a chemical or group of chemicals in a sediment to predict sediment toxicity and/or bioaccumulation. Of particular concern is the unreliability of using co-occurrence-based sediment quality "guidelines" in evaluating the potential for a sediment to be adverse to the beneficial uses of the waters in which the sediments are located. The approach that must be used for incorporating chemical information into the BPJ triad weight-of-evidence approach involves conducting toxicity investigation evaluations (TIEs) or sediment bioavailability testing to determine the toxic available forms and their concentrations in sediments. Failure to use this type of chemical information, where total concentrations of exceedances of sediment quality

guidelines is used instead, can lead to an erroneous BPJ weight-of-evidence conclusion on the role of chemicals in the sediments in affecting a waterbody's water quality.

Lee and Jones-Lee have provided additional discussion on the unreliability of co-occurrence-based approaches in evaluating sediment quality:

Lee, G. F. and Jones-Lee, A, "Regulating Water Quality Impacts of Port and Harbor Stormwater Runoff," Proc. International Symposium on Prevention of Pollution from Ships, Shipyards, Drydocks, Ports, and Harbors, New Orleans, LA, November (2003). Available on CD ROM from www.ATRP.com.
<http://www.members.aol.com/duklee2307/PHStormwater-papfinal.pdf>

They point out that the frequently used approach of examining a sediment for the total concentrations of a selected group of chemicals relative to an exceedence of a co-occurrence-based sediment quality guideline is not a valid approach for assessing whether the sediments contain a chemical or chemicals that are altering the numbers, types and characteristics of aquatic life in the sediment and in the overlying waters associated with the sediment.

The lack of technical validity in using the co-occurrence-based approach for evaluating sediment quality stems in part from the chronic problem that the sediment quality guidelines consider only a small number of the thousands of chemicals that can be present in sediments which can affect aquatic life. The failure to find any exceedances of an ER-M, ER-L or PEL value in the sediments should never be assumed to be a reliable indication of a lack of impact of the sediment-associated chemicals on aquatic life. Lee and Jones-Lee discuss the fact that one of the most common types of pesticides that is now widely used in agricultural and urban areas (pyrethroid-based pesticides) tend to accumulate in sediments. Weston, You and Lydy, in

Weston, D. P.; You, J. and Lydy, M. J., "Distribution and Toxicity of Sediment-Associated Pesticides in Agriculture-Dominated Water Bodies of California's Central Valley," *Environmental Science & Technology* 38(10): 2752-2759 (2004),

have reported finding aquatic sediments in the Central Valley with measurable toxicity and measurable concentrations of pyrethroid pesticides. Therefore, a sediment could be toxic to aquatic life and not exceed any co-occurrence-based sediment quality guideline, since these "guidelines" do not include values for the pyrethroid-based pesticides. A similar situation could occur with ammonia, hydrogen sulfide and low dissolved oxygen in sediments, as discussed by Lee and Jones-Lee (1996) cited above. These chemicals/conditions are the most common cause of sediment toxicity, yet the co-occurrence-based sediment quality guidelines do not include guideline values for them. This is another fundamental flaw of the co-occurrence-based approach developed by Long and Morgan and MacDonald.

In the 1970s Dr. Lee and his graduate students conducted about a million dollars of studies for the US Army Corps of Engineers devoted to developing dredged sediment disposal criteria. These studies involved taking sediments from about 100 sites across the US and determining the total concentrations of about 30 conventional potential pollutants, including heavy metals, organochlorine pesticides, PCBs, nutrients, etc. They also examined the amount

of these chemicals that was released upon suspension of the sediments in water, and conducted sediment toxicity tests. This effort generated about 50,000 data points, which were published in two reports:

Lee, G. F., Jones, R. A., Saleh, F. Y., Mariani, G. M., Homer, D. H., Butler, J. S. and Bandyopadhyay, P., "Evaluation of the Elutriate Test as a Method of Predicting Contaminant Release during Open Water Disposal of Dredged Sediment and Environmental Impact of Open Water Dredged Materials Disposal, Vol. II: Data Report," Technical Report D-78-45, US Army Engineer Waterway Experiment Station, Vicksburg, MS, 1186 pp., August (1978).

Jones, R. A. and Lee, G. F., "Evaluation of the Elutriate Test as a Method of Predicting Contaminant Release during Open Water Disposal of Dredged Sediment and Environmental Impact of Open Water Dredged Material Disposal, Vol. I: Discussion," Tech Report D-78-45, US Army Engineer Waterway Experiment Station, Vicksburg, MS, August (1978).

The work done in this project served as the basis for the US EPA and Corps of Engineers to develop criteria for open water disposal of contaminated dredged sediments. These studies clearly demonstrated that the total concentration of a particular chemical in sediments, such as a heavy metal or the sum of all heavy metals, bears no relationship to the toxicity of those sediments to aquatic life. It was clear that the toxicity of sediments was largely independent of the total concentrations of various conventional pollutants, such as heavy metals, pesticides, etc. Many of the sediments collected from near urban-industrial waterways were toxic to aquatic life. The cause of the toxicity, however, was not identified.

Subsequently, through followup studies that were conducted in the 1980s, Drs. R. A. Jones and G. F. Lee published a paper,

Jones, R. A. and Lee, G. F., "Toxicity of US Waterway Sediments with Particular Reference to the New York Harbor Area," In: Chemical and Biological Characterization of Sludges, Sediments, Dredge Spoils and Drilling Muds, ASTM STP 976 American Society for Testing Materials, Philadelphia, PA, pp 403-417 (1988),

in which they identified that the most common cause of sediment toxicity is ammonia. It is now well-recognized, based on studies conducted by numerous investigators, that ammonia is one of the (if not the) most common causes of sediment toxicity. This has particular relevance to co-occurrence-based sediment quality guidelines, since these guidelines do not include ammonia as a potential cause of sediment toxicity. It should be noted that Long and Morgan, in developing their original paper on co-occurrence, made use of the 1970s database that Dr. Lee and his graduate students had developed from about 100 sites across the US. This database included ammonia and hydrogen sulfide. However, Long and Morgan, while using the heavy metal, organochlorine pesticide and PCB data from the database, ignored the ammonia and hydrogen sulfide data. This makes their original and all subsequent co-occurrence-based sediment quality guideline evaluations fundamentally flawed. Any sediment quality evaluation concerned with

assessing toxicity to aquatic life that does not consider ammonia as a potential toxicant can be highly unreliable.

Lee and Jones-Lee (2003) (cited above) have also discussed the fact that there is increasing evidence that the toxicity of pesticides and some other potentially toxic constituents, such as heavy metals, are additive and, in some cases, synergistic. This means that a sediment that does not exceed a co-occurrence-based sediment quality guideline for a particular constituent could be causing sediment toxicity through additive or synergistic impacts with other chemicals for which there is not an exceedence of a sediment quality guideline or for which there is no sediment quality guideline. Therefore, any sediment evaluation that relies on exceedence of a co-occurrence-based sediment quality guideline can fail to detect additive and synergistic toxicity. It is for this reason that the only reliable way to assess whether sediments are toxic is through toxicity measurements. Toxicity cannot be assessed through chemical measurements.

The US EPA Superfund management has been concerned for a number of years about the potential for using co-occurrence-based sediment quality guidelines as values upon which remediation decisions are made. The managers of US EPA Superfund have made it clear that this approach should not be followed, because of the unreliability of co-occurrence-based sediment quality guidelines. In April 2003 the US Army Corps of Engineers, US EPA Superfund and others held a national workshop, "Environmental Stability of Chemicals in Sediments," where the issues of appropriately regulating contaminated sediments were discussed. While there is no Proceedings from this workshop, the PowerPoint slides from those making presentations are available at <http://www.sediments.org/sedstab/agenda.pdf>. Leah Evison of the US EPA Office of Emergency and Remedial Response made a presentation, "Contaminated Sediment at Superfund Sites: What We Know So Far," in which a summary was presented on the magnitude of the problem of contaminated sediments at Superfund sites. Further, Stephen Ellis, Sediments Team Leader with the US EPA Office of Emergency and Remedial Response, made a presentation, "Superfund Cleanup Issues at Contaminated Sediment Sites." According to Mr. Ellis, the US EPA Superfund program still supports the position that co-occurrence-based sediment quality guidelines are not appropriate for establishing the impacts of chemicals in sediments or to serve as the basis for sediment cleanup objectives.

UCD's use of co-occurrence-based sediment quality guidelines in its Ecological Risk Assessment should not be allowed if this use could in any way influence the characterization of LEHR site sediments with respect to whether they represent a potential threat to aquatic life and, therefore, should or should not require remediation. The bottom line issue is that UCD's draft Ecological Risk Assessment, in which co-occurrence-based sediment quality guidelines, such as those listed in Table I-8, are used to establish the potential for constituents in sediments to be influencing aquatic ecosystems, is unreliable and should not be accepted.

Dioxins

Another issue that has not been adequately addressed as part of investigating the LEHR Superfund site is the potential for LEHR site wastes and soils to contain dioxins. DSCSOC has repeatedly pointed out that there is need to assess whether dioxins are present in the site soils and runoff waters. I am raising this issue again, since at the August 22-26, 2004, American Chemical Society (ACS) national meeting held in Philadelphia, a paper was presented by Suffet,

Augustenborg and Pedersen, entitled "Polychlorinated Biphenyls in Surface Runoff from Agricultural Fields in Southern California." Dr. Suffet is affiliated with UCLA. The key finding from this paper is that agricultural runoff in the Los Angeles area has been found to contain dioxins. This is not surprising, since dioxins are being found in many areas, such as in stormwater runoff from streets and highways. In some areas, such as San Francisco Bay, the concentrations are sufficient to bioaccumulate to excessive levels in some edible fish. Any Superfund investigation of a site located in an urban/agricultural area, which has received a variety of wastes, that fails to determine whether there are dioxins in wastes, soils and sediments, is deficient in properly evaluating potential public health and environmental problems associated with the site.

If you have questions about these comments, please contact me. If you feel it would be appropriate, please pass these comments on to the RPMs.

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