



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

January 15, 1987

SAB-EEC-87-014

Honorable Lee M. Thomas
Administrator
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OFFICE OF
THE ADMINISTRATOR

Dear Mr. Thomas:

The Science Advisory Board's Environmental Engineering Committee has recently completed its review of a document written by the Office of Marine and Estuarine Protection (OMEP) to justify the separate treatment of sewage sludges and dredged materials under the EPA ocean dumping regulations. At the request of OMEP, the subject of this review was originally a draft technical support document developed by the U.S. Army Corps of Engineers. In response to a number of issues raised by the Committee, however, OMEP decided to develop a justification document of its own, which is the actual subject of this review. We are pleased to forward to you the Committee's report for your consideration.

Although the Committee agrees with the Agency that there are significant differences in the properties of most sewage sludges and dredged materials, significant exceptions exist. It is crucial that clearly defined, consistent, rigorous, and peer-reviewed procedures exist to identify these exceptions. OMEP maintains that existing procedures for evaluating dredged materials (under Part 227.13) are adequate; however, based on the documents provided to the Committee, a rigorous protocol for identifying exceptions does not appear to exist. The Committee believes that a technical basis for identifying dredged materials that require special handling and disposal could be developed.

The Committee wishes to note the cooperation it received from the Corps of Engineers on this review, and particularly from the three members of the Corps' Environmental Advisory Board who participated in the Committee's reviews of ocean dumping and sewage sludge issues. Such cooperative interagency review efforts have considerable benefits.

The Committee appreciates the opportunity to conduct this scientific review. We request that the Agency formally respond to the attached report.

Sincerely,

Raymond C. Loehr, Chairman
Environmental Engineering Committee
Science Advisory Board

Norton Nelson, Chairman
Executive Committee
Science Advisory Board

Attachment

NOTICE

This report has been written by the Science Advisory Board, a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The Board is structured to provide a balanced, expert assessment of scientific matters related to problems facing the Agency. This report has not been reviewed for approval by the Agency, and hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency. Nor does mention of trade names or commercial products represent endorsement or recommendation for use.

REVIEW OF TECHNICAL DOCUMENTS SUPPORTING REVISIONS
to the portion of
EPA OCEAN DUMPING REGULATIONS RELATING TO THE
OCEAN DISPOSAL OF DREDGED MATERIALS

REPORT OF
THE ENVIRONMENTAL ENGINEERING COMMITTEE

U.S. Environmental Protection Agency
Science Advisory Board
Washington, D.C.

January, 1987

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I. EXECUTIVE SUMMARY

In late 1985, the Environmental Engineering Committee of the Science Advisory Board was asked by the Office of Marine and Estuarine Protection (OMEP) to review technical documents supporting revisions to the Agency's ocean-dumping regulations. The two main issues were: 1) technical justification for the separate regulatory treatment of the disposal of dredged materials and 2) the consideration, in the ocean disposal of sewage sludges, of both the need for ocean dumping and the availability and impacts of land-based alternatives. This report deals with the first issue only.

The Committee's original charge was to review a draft technical support document for revision of the 1977 ocean-dumping regulations and criteria, dated February 15, 1986, prepared by the Waterways Experiment Station of the U. S. Army Corps of Engineers (1) and to advise OMEP on its technical adequacy. This document was determined by the Committee to be inadequate to support the different treatment of dredged materials. As a result, OMEP subsequently prepared a technical support document of its own (2), which is the subject of this review.

The following summary outlines the Committee's principal findings and recommendations. Section III of this report presents details on each of these areas.

A. Although the general conclusions in the OMEP document appear adequate and accurate, they were not adequately supported by the data in the document. Without this documentation, the Committee was not able to evaluate or agree with all the indicated conclusions.

B. The Committee does not agree that separate testing of dredged materials is justified in all cases. While most dredged materials could well be sufficiently different from sewage sludge to justify separate testing procedures, significant exceptions exist, particularly when dredged materials have been, or are suspected to be, highly contaminated by toxic materials. It is therefore crucial that clearly defined, consistent, rigorous, peer-reviewed procedures be developed to identify these exceptions. A clear, technically sound, and unambiguous protocol should be available to determine, for each dredging site, whether or not the dredged material is sufficiently different from sewage sludge and should be disposed differently than sewage sludge. This protocol should include consideration of the nature of the planned dredging and dumping operations themselves, since they can influence the amount of toxicants available for exposure to humans or marine organisms. Based on the documents provided to the Committee, such a protocol does not appear to be available. It should be developed.

II. INTRODUCTION

In late 1985, EPA's Office of Marine and Estuarine Protection (OMEP) requested that the Science Advisory Board (SAB) review technical documents supporting revisions to the Agency's ocean-dumping regulations, which implement the Marine Protection, Research, and Sanctuaries Act (MPRSA). The documents were to be divided into two categories addressing, respectively, ocean disposal of sewage (POTW) sludge and ocean disposal of dredged material.

At the same time, the Science Advisory Board was also asked by the Office of Water Regulations and Standards (OWRS) to review technical documents supporting the development of regulations (under Section 405(d) of the Clean Water Act) for the disposal/reuse of POTW sludges. Both of these reviews were assigned to the Environmental Engineering Committee, which decided to conduct both reviews simultaneously, since the subject material was very similar and since, in fact, the same methodology was being used in some cases to support both regulatory efforts.

The Environmental Engineering Committee accepted the task, and augmented its existing membership with a number of consultants, including three members of the Environmental Advisory Board of the U. S. Army Corps of Engineers; three members of the SAB's Environmental Effects, Transport and Fate Committee; one member of the SAB's Environmental Health Committee; and others. The Committee organized itself for the reviews by creating a number of subgroups, each dealing with one or more options/documents. A listing of the Committee membership, which includes the subgroup breakdown, is provided in Appendix A. The Committee decided that, rather than issue one large report covering all reviews, it would issue separate reports on the disposal of dredged materials and on the disposal/reuse of sewage sludges.

This report, then, is confined to a review of technical material supporting revisions to that portion of the ocean-dumping regulations relating to the disposal of dredged materials. The specific charge to the SAB appears in Appendix B. The Committee recognizes that there could well be beneficial uses of dredge materials, but it has omitted any discussion of this issue, as it was not within the charge of this review.

Revisions to the MPRSA relate to two separate and distinct issues. First, the Agency must make revisions to the portion of the regulations dealing with the disposal of POTW sludges. These revisions, mandated by a lawsuit brought by the City of New York, will require that consideration be given to the need for ocean dumping and to the availability and impacts of land-based alternatives (whereas the current regulation considers only marine impacts). This issue will be dealt with in conjunction with the Committee's review of materials supporting revisions to the 405(d) regulations, and will be the subject of a separate SAB report. Second, the Agency must, as a result of a second lawsuit brought by the National Wildlife Federation, provide adequate technical justification for current regulations permitting different regulatory treatment for the disposal of dredged materials.

Documents for review began to arrive in April, 1986, and on May 1-2, 1986 the Committee held its first meeting, at which it was briefed by personnel from OWRS, OMEP, and the Corps of Engineers on the technical rationale for the disposal of dredged materials (1), which was to form the technical underpinning for proposed revisions to the ocean-dumping regulations. A second meeting of the Committee was held on June 10-11, at which it was briefed in more detail about the dredged material technical rationale.

Subsequent meetings of the full Committee were held on July 23-24, August 19-20, September 29-30, October 27-28, and December 15-16. The purpose of these meetings was primarily for Committee discussions and drafting of the Committee report. At most of these meetings, EPA and Corps of Engineers staff were present to either brief the Committee or to answer questions and clarify points that were not clear. (The Committee notes the assistance of Mr. David Mathis, Mr. Robert Engler, Dr. Dick Peddicord, and Cpt. Glen Lozier of the Corps of Engineers; and of Mr. Al Wastler of EPA.)

In late June, 1986, OMEP decided that it would, in response to a number of questions raised about the adequacy of the dredged material technical rationale drafted by the Corps of Engineers, draft a technical support document of its own. This document (2) was furnished to the Committee on July 31, 1986, with an explanation that it, rather than the Corps of Engineers document, was to be the basis for regulation development. This OMEP document is the subject of the Committee's report.

This report, while largely drafted by the subgroup chaired by Dr. Robert Huggett, has been contributed to, reviewed, modified as necessary, and approved by the full Committee.

III. REPORT ON THE DREDGED MATERIAL TECHNICAL RATIONALE

A. General Comments

The Committee agrees with the Agency's contention that there are significant, basic differences in the physical, chemical, and biological characteristics of some, possibly even most, dredged materials and sewage sludges which can warrant different toxicological, chemical, and physical testing. The higher water content and lower particle density of some typical sewage sludges indicate that the material will often remain in suspension more so than some typical dredged materials with lower water content and higher particle density. Therefore, it is logical to assume that, in general, each of the two general classes will have a different potential to affect a given segment of the marine ecosystem.

The Committee does not agree that separate testing of dredged materials is justified in all cases. The Agency should distinguish between different biological impact potentials, whether they are between sludges and dredge materials or between different sludges and different dredge materials themselves, and the testing mandated should be based on these potentials.

It is important to note that dredged materials and sewage sludges vary considerably among themselves depending on the sources and anthropogenic inputs of toxic materials and pathogens. Because of this variability, there may be situations in which dredged materials are transported like and have a fate similar to sewage sludge. For example, most of the toxic organics, if present, will be preferentially partitioned to the organic fraction of the materials being disposed of in the ocean. The solid material in sewage sludge is (usually) mostly organic, while commonly encountered dredged materials typically contain only 2-8% organics. The concentrations of toxicants would be much higher in the organic fraction of the dredged materials if the bulk, dry-weight concentrations were similar to those in sewage sludge which, in fact, sometimes occurs.

The document argues that sewage sludge remains in suspension. Organic solids suspended in the water column should act similarly, whether from sewage sludge or dredged materials. Since the toxicants could conceivably be an order of magnitude (or more) concentrated in the dredged material organics, the potential clearly exists for transport and resultant biological impacts outside the dump site. In such a case, not likely to be an especially rare case, it is logical that similar toxicological and chemical testing be required for both dredged materials and sewage sludges.

Another situation in which similar testing may be required concerns the actual dredging/disposal operation. The dredged material in a transporting barge or vessel is not homogeneous. The upper section (the last to enter the water) usually consists of a very fine grained, unconsolidated, low-solids mixture. The bottom is more consolidated with a lower water content. In harbor dredging or deepening operations, the uppermost material may be very highly contaminated with metals and organics. This material would not be expected to deposit rapidly on the ocean floor and could well be transported by ocean currents off the designated disposal site. While a very high percentage of the "dumped" material may rapidly deposit, what remains in suspension can contain a higher percentage of any toxicants.

The Agency maintains that field experiments to validate model predictions of particle transport and deposition during and after ocean disposal of dredged materials have been performed, but we were not supplied with the documentation. For ocean disposal of sewage sludges, however, adequate validation data do not exist. Therefore, predictions of transport, persistence, dilution, and biological impact of these sludges are much more uncertain.

There are components of sewage sludge which may not remain in suspension and may thus be more appropriately dealt with using the testing procedures which would normally be considered more appropriate for dredged materials. This aspect should be given serious consideration in the Agency's decisionmaking on testing requirements for sewage sludge and dredged materials, as well as the Agency's research efforts.

Although the Committee agrees that most dredged materials are substantially different from sewage sludge, it is clear that exceptions do exist. These exceptions could result in off-site impacts which could be significant. Therefore, it is crucial that clearly defined, consistent, rigorous (peer-reviewed) testing procedures for identifying these exceptions should be available before any changes to the ocean-dumping regulations are implemented.

It concerns the Committee that there is a lack of information in the document on the procedures to be used to evaluate the toxicity of dredged materials. It is important to provide a comparison of the dredged material toxicity procedures with those for sewage sludge, with particular emphasis on the relative rigor of the two methods. The Committee questions how effective the evaluation procedure is for identifying dredged materials which contain toxic substances. A diagram of the decision trees used for these evaluations (that is, identifying dredged materials not excluded from testing under Part 227.13) should be incorporated. It should be consistent with other environmental risk assessment evaluations in the Agency. A testing procedure is needed to classify material from any source to determine which disposal procedures are appropriate. A simple, but adequate, set of tests may be sufficient to permit a relatively large fraction of dredged material to be treated separately from sewage sludge, but the burden is on the Agency to make such a case conclusively.

Finally, the Committee finds a lack of supporting data and primary references in the document. The conclusions are not adequately supported by the data presented in the document. The Committee believes that a technical basis for identifying which dredged materials require special handling and disposal may well exist, or could be developed. The OMEP document, however, does not present a convincing argument to justify separate testing in all cases.

B. Specific Comments

1. Pages 1 and 2, Executive Summary (and Page 42) -- The technique used to determine particle size distribution (PSD) should be clearly identified. Were material samples for PSD determination dispersed or not? Depending on whether dispersed or non-dispersed samples are used, the PSD can be quite different. Dispersed PSDs yield data on primary particles, whereas non-dispersed PSDs indicate how the material actually behaves in the environment. If the dredged materials consist of cohesive materials, organic material, or small and large aggregates, chemically oxidizing and chemically dispersing the sample

produces substantial changes in the sample as compared to the actual material as encountered in the real world environment. For example, if there is a high clay content and high enough electrolyte concentrations, there may be enough flocculation in a nondispersed sample to create zone settling. A PSD determination based on this behavior indicates no particles smaller than, say, approximately 20 to 30 microns. If the same sample is chemically dispersed using common engineering property soil testing procedures, results may indicate, say, 20% clay-size (diameters less than or equal to four microns) primary particles. These differences are important because they indicate whether the fines will remain in suspension to be transported off site in the water column or settle to the bottom in the dump area.

2. Page 3, line 5 (and Page 43, Table VI) -- References to "silt." Are these primary particles in the 4-62 micron range or aggregates? Are these data from dispersed or nondispersed PSDs?

3. Page 3, middle (and Page 49) -- Reference to dredged material rapidly affecting the sea floor. The fate of material depends on how the material is introduced. This discussion should cite options such as pumping overboard, bottom dumping, discharge from a pipeline, and in-channel spoiling. There are various ways a material can be released into the water column, and this makes a big difference in the amount of water entrained in the plume, concentrations, and sedimentation characteristics. This should be acknowledged, instead of giving the impression that dredged material simply drops to the bottom inside the designated disposal area just because it is "dredged material."

4. Page 4 (and Pages 14-18) -- The discussion does not acknowledge that there are different types of sewage sludges with different characteristics, e.g. raw primary sludge and digested sludge.

5. Page 4, bottom 2 lines -- "Sludge behaves as a liquid." If it is 95-98% water and released so as to provide or facilitate mixing, density could be close to that of seawater. This could also be true for many dredged materials if a high-mixing release is used. On the other hand, if sludge is jettied down or pumped down in a way to minimize entrainment or dilution, it is not likely that sludge would behave like seawater -- nor would the fines in dredged material, if similarly jettied or pumped. Dredged material and sewage sludge do not necessarily behave totally differently simply because one is labeled as "sewage sludge" and one is called "dredged material."

6. Page 7, Overview -- The discussion should explicitly state what "act" is being referred to.

7. Pages 11 and 12 -- We recommend that detailed explanation of what is entailed in each box be presented, with particular attention given to the criteria on which the decisions are made.

8. Page 13, last part of top paragraph -- The argument concerning procedures for a "buoyant water-soluble liquid waste" and a "weighted containerized waste" was not clear. Were the last two sentences in this top paragraph intended to provide a comparison to illustrate sewage sludge versus dredged material?

9. Page 14, reference and first paragraph -- There seem to be considerable references to the NRC 1977 report. There are more recent works (such as the EPA "40 City Study" [3]) which may be more pertinent with respect to anthropogenic chemicals.

10. Page 14, paragraph 2, first sentence -- Some of the particulate solids that could result from a typical wastewater treatment plant could well consist of grit chamber solids. These would probably contain a great deal of inorganic material and aggregate particles--containing organic material--which could settle rapidly.

11. Page 19, paragraph 1 -- The particle size range of 5-50 microns would likely include particles well up into the coarse silt range. While those in the lower particle size range would tend to settle rather slowly, those at the upper end could settle reasonably well. This a too large a range to make general conclusions about settling characteristics.

12. Page 20, first sentence of first full paragraph -- The statement "The results of these studies indicate that ..." is not compelling to the Committee.

13. Page 20, Paragraph 2 -- The bottom sediments near a sewage outfall sometimes contain a very high organic load, presumably from sewage particulate matter. These solids are similar, if not identical, to sewage sludge, and they certainly have deposited. Therefore, they should deposit in the ocean disposal environment.

14. Page 24, Table III -- "Environmental Effects," third item; This may render them unfit for human consumption. Such an economic impact could be far reaching and should be considered in the reports.

15. Page 24, Table III -- The far right column corresponding to "metals" seems to be incomplete.

16. Pages 24 and 25, last two lines on page 24 and remainder of sentence at top of page 25 -- The Committee agrees that, where the concentrations are quite high after dumping, coagulation can be effective and large aggregates can form and settle. This indicates the importance of being very specific about the schemes used to introduce materials--whether they be dredged materials or sewage sludges--into the ocean environment. This is poorly treated in the document, and therefore the Committee is unable to determine the conditions under which coagulation might or might not take place in typical real-world situations.

17. Page 25, Paragraph 2 -- Again, for low concentration wastes and/or conditions of high initial dilution, it is not clear that coagulation will occur.

18. Page 27, Paragraph 2 -- This argument is logical as far as it goes. Low-level contamination over long periods of time can also have damaging impacts.

19. Page 29, Paragraph 1 -- Bioaccumulation and/or biomagnification may render the biota not fit for human consumption, for example contamination of the James River with Kepone.

20. Page 36, Paragraph 3, Line 9 -- add "turbidity maximum in estuaries."
21. Page 40, Paragraph 2, Lines 5/6 -- This can be very site specific.
22. Page 49 and Page 50, Figure IX -- The document must improve its treatment of methods used to introduce dredged materials and sewage sludges into the marine environment. The statement "The discharge of materials from a hopper or scow...." provides inadequate information on the type of jet created and how much entrainment of ambient water will be caused. This makes a great deal of difference and is inadequately treated in this report.
23. Page 52, Paragraph 3 - Many polar organic compounds (such as Kepone) associate with sediment. Perhaps "hydrophobic organic compounds" would be better wording.
24. Page 56, Paragraph 1, Lines 8-10 -- It is important to note that in the cases where sediments are contaminated with numerous toxicants, it is often not possible to distinguish the independent variable(s). This is particularly true when only a preselected set of substances are analyzed.
25. Page 57, Paragraph 1, Lines 12-15 -- The Committee agrees with this statement.
26. Page 59, section VII -- The Committee is very uncomfortable with the material that leads to conclusions numbers 5 and 7. In number 5, it is stated that "water column impacts associated with ocean disposal of dredged material are short-termed, and predictable." Item 7 deals with fine-grained sediments containing anthropogenic contaminants. The fine-grained material can cause problems in the water column. Conclusion 7 goes on to state that this "may have long-term adverse effects on the marine environment which, at the present, are largely unknown." The Committee does not agree that the water column impacts, particularly for fine-grained materials, are "short-term" and predictable. In addition, the Committee is troubled by the existence of "long-term" effects which are presently acknowledged as being "largely unknown."
27. Page 60 -- Various items that deal with guidance on whether dredged material might pose an environmental or water quality problem are somewhat troublesome. There is frequent reference to the composition being "predominantly" one thing or another and "substantially" one thing or another. Relatively small concentrations and small masses of damaging or highly toxic materials are potentially very significant. The document must explicitly define the terms "substantially," "predominantly," and "mostly."
28. Page 60 -- There is also a good bit of emphasis on the "history" of the material that is being dredged. The Committee cannot support decisionmaking that potentially relies only on understanding the history and sources of the material that is being dredged and considered for ocean disposal. The Committee recommends more rigor in evaluating the composition of a material as part of making sound decisions on proper disposal methods.
29. Page 60 -- The Committee suggests that more specific information be provided about how the "history" of the dredged material would be evaluated or documented and how this leads to a defensible decision that no substantial chemical or biological evaluation is warranted. Potentially significant decisions should not be made without clear, adequate, and scientifically sound guidance.

30. Page 62, Paragraph 1, Line 11 -- It is very likely that if one did a broad spectrum tissue analysis, something would always differ by 10%.

31. Page 62, Paragraph 2, Lines 1-5 -- This may be generally true, but certainly with numerous exceptions, such as larval fish.

32. Page 63, Paragraph 1 -- The Committee agrees with this statement.

33. Page 64, Conclusion 8 -- Chemical analyses should be required for fine-grained sediments from non-pristine environments, and decisions to dispose of these materials should be based on logic similar to that in Conclusion 7.

C. Corrections

1. Page 17, Table II -- Two significant figures, at most, are all that are warranted.

2. Page 38, Table IV -- Provide units for chemical oxygen demand.

3. Page 43, Table VI -- It appears that a radical sign has been omitted from the captions.

4. Page 44, Figure 5 -- Is 10^{-2} correct?

U.S. ENVIRONMENTAL PROTECTION AGENCY
ENVIRONMENTAL ENGINEERING COMMITTEE
SCIENCE ADVISORY BOARD

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REFUSE AND DISPOSAL OF SEWAGE SLUDGE

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APPENDIX B

Environmental Engineering Committee
Science Advisory Board
U.S. Environmental Protection Agency

REVIEW OF TECHNICAL MATERIAL SUPPORTING REVISIONS TO
PORTIONS OF EPA OCEAN DUMPING REGULATIONS
RELATING TO THE OCEAN DISPOSAL OF DREDGED MATERIALS

Charge to the Committee

To review and advise the Office of Marine and Estuarine Protection (OMEP) on the overall technical and scientific validity of the OMEP justification for separate treatment of sewage sludge and dredged materials under the EPA Ocean Dumping Regulations, with particular attention to

1. How can technically sound equal consideration and weight be given throughout the permitting process to potential effects of ocean, estuarine, and land disposal alternatives in evaluative efforts?
2. Is it technically sound to use different tests to provide equally rigorous evaluation of the potential environmental impacts of dredged material and other material discharged to the oceans?
3. Are there technical reasons the ocean dumping regulations should not have a completely separate and "stand alone" regulation that treats dredged material differently from other materials proposed for ocean disposal?

REFERENCES

1. "Dredged Material Disposal, Draft Technical Support Document for Revision of the 1977 Ocean Dumping Regulations and Criteria, 40 CFR 220-228," U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Miss., February 15, 1986.
2. "Sewage Sludge and Dredged Material: Justification for Separate Treatment under the EPA Ocean Dumping Regulations based on Differences in Intrinsic Properties and Behavior in the Marine Environment (Draft)," U. S. Environmental Protection Agency, Office of Marine and Estuarine Protection, Washington, D.C., July, 1986.
3. "Fate of Priority Pollutants in Publicly Owned Treatment Works - Final Report," (EPA 440/1-82-303) Volumes 1,2, U.S. Environmental Protection Agency, Washington, DC, September, 1982.