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The Dredged Material Management Office (DMMO) issued draft guidance for implementing the Inland Testing Manual (ITM) locally via PN 99-3 in July 1999. We received numerous comments and have modified the local guidance, where appropriate, to respond to commenters' suggestions. Attached is the final version of the guidance, as well as a summary of significant comments received, along with DMMO's responses. DMMO thanks all reviewers for their constructive suggestions.

DREDGED MATERIAL MANAGEMENT OFFICE

GUIDELINES FOR IMPLEMENTING THE INLAND TESTING MANUAL IN THE SAN FRANCISCO BAY REGION

September 21, 2001

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1. INTRODUCTION

1.1. The pilot Dredged Material Management Office (DMMO) agencies will apply these guidelines when determining the dredged material testing that will be required for dredging projects proposing disposal at designated sites in waters of the U.S. within San Francisco Bay, (Figure 1), until such time as these guidelines are upgraded or replaced (e.g., by a final Regional Implementation Manual (RIM)). Specifically, the disposal sites include SF-9 (Carquinez Strait), SF-10 (San Pablo Bay), and SF-11 (Alcatraz Island).

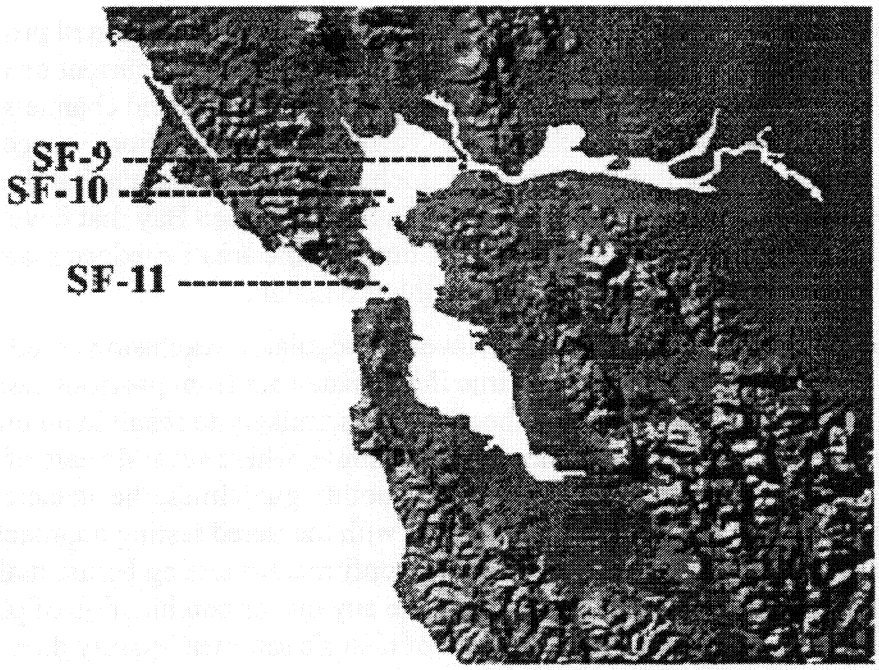

Figure 1. Multi-User Disposal Sites in the San Francisco Bay region

1.2. These local guidelines *supplement* the much more detailed information in the Inland Testing Manual (ITM), and are not intended to be used on their own. These guidelines do not repeat the detailed descriptions of each of the four tiers that make up the ITM's approach to dredged material evaluation (Chapter 3 of the ITM should be consulted for an overview of the tiered testing and evaluation framework). These guidelines also do not provide technical details about laboratory testing protocols. The ITM, its referenced literature, and any other agency guidance (such as any RIM published in the future) should be consulted for the most up-to-date technical information. Questions about any perceived inconsistencies between the ITM and these local guidelines should be directed to DMMO.

1.3. Proposals to use results of testing methodologies that differ from those described in the ITM and these guidelines will be considered by the DMMO, on a case-by-case basis, and should be approved in advance. All applicable Quality Control (QC) procedures should be reported. The ITM discusses these issues in some detail. The DMMO will issue Sampling and Analysis Plan (SAP)[1] guidelines that provide additional sampling, testing, and reporting recommendations to

[1] A SAP is also known as a Quality Assurance Project Plan (QAPP).

further supplement the ITM and these guidelines. Contact the DMMO about availability of the final SAP guidelines.

2. EXEMPTIONS FROM TESTING AND TIER I DETERMINATIONS (see ITM, Chapter 4)

2.1. The ITM, and the federal regulation on which it is based, provide for the possibility of an exclusion from the need to conduct testing on proposed dredged material in certain specific circumstances. The regulatory agencies will determine whether the following potential exclusions may apply in individual cases.

2.2. First, material may be excluded from testing "...where it is composed primarily of sand, gravel, or other naturally occurring inert material...in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels." [40 CFR §230.60(a)] Such material is unlikely to be a "carrier of contamination," especially when it is isolated from sources of pollution. Examples include material from the San Francisco Channel Bar and pre-industrial deposits of Merritt Sand in San Francisco Bay that have not been exposed by previous dredging projects. Unfortunately, much of the area's dredged material is composed of very fine particles and does not qualify for this exclusion.

2.3. Second, even if the material does not meet the regulatory exclusion noted above, additional testing may not be needed. This can be true if adequate data from previous testing in the area are available to establish that discharge of the material is unlikely to result in an unacceptable adverse impact on the aquatic ecosystem. For example, where several years of past data show that the material has consistently met current suitability guidelines, the agencies may determine that additional testing is not needed. Consistent with the tiered testing approach, on which the ITM is based, the agencies may require limited confirmatory testing before making such a determination. Confirmatory testing may include any one or combination of physical, chemical, or biological testing, depending on the nature of historic sediment quality data for the site and the length of time since sediment from the area was last tested.

2.4. If the agencies determine that Tier I determination can not be made, project-specific evaluations including both chemical and biological testing should be conducted in accordance with the ITM and the following sampling and testing guidelines.

3. SAMPLING GUIDELINES (see ITM, Chapter 8)

3.1. Chapter 8 of the ITM should be consulted for a detailed discussion of sediment sampling considerations. Additional agency recommendations that are specific to implementation of the ITM in San Francisco Bay are provided below.

3.2. *Minimum Sediment Sampling*

Table 1 outlines the *minimum* number of sediment samples that should be collected, and composites that should be analyzed. Generally, a minimum of four samples is needed for one composite. However, because every dredging project is unique, this minimum sampling guidance may not be accepted by the agencies as adequate in all circumstances. Additional samples or analyses may be needed based on the results of past testing or the presence of known or suspected pollution sources. Proposed SAPs should be coordinated with the agencies before any sampling or testing begins. The test results from non-approved SAPs may not provide sufficient information for the agencies to make a determination and may require re-testing that

would cause project delays. It is the project proponent's responsibility to obtain approval of proposed sediment testing in advance of sampling.

TABLE 1. Minimum Sediment Sampling Guidelines

DREDGE VOLUME* (*in situ* cubic yards)	MINIMUM # OF SAMPLE STATIONS	# OF COMPOSITES ANALYZED **
5,000 – 20,000	4	1
20,000 – 100,000	8	2
100,000 – 200,000	12	3
200,000 – 300,000	16	4
300,000 – 400,000	20	5
400,000 – 500,000	24	6

* Contact DMMO for guidance on projects smaller than 5,000cy or larger than 500,000cy.
** Numbers do not reflect reference and control sediment, or other QC samples.

3.3. ***Core Sample Location and Depth***

3.3.1. Core samples should be taken to the full project depth, plus the permitted overdepth allowance (generally 2 feet below project depth). The full permitted overdepth allowance should be sampled, even if it differs from the "pay depth" identified in a dredging contract. Any sample material collected below the overdepth should be discarded.

3.3.2. Core sample locations must be appropriate. Samples must be representative of the sediment proposed to be dredged in terms of sediment type and possible pollutant sources throughout the dredging area. Proposed core sample locations should be identified in the proposed SAP and approved by the agencies in advance of sample collection.

3.3.3. SAPs should also describe reference and control sediment sampling locations and methods. Contact DMMO for information about reference sediment collection sites for SF-09 and SF-10. For SF-11, there are multiple reference sites, known as the Alcatraz Environs. The Alcatraz Environs Station locations are listed in Table 2. Reference site databases (e.g., the Alcatraz Environs database) may also be used.

TABLE 2. Alcatraz Environs Station Locations

Station*	Coordinates			
	NAD27		NAD83	
	Latitude, N	Longitude, W	Latitude, N	Longitude, W
R-AM-A	37° 49.75'	122° 25.88'	37° 49.75'	122° 25.94'
R-AM-C	37° 49.75'	122° 24.90'	37° 49.75'	122° 24.96'
R-AM-D	37° 49.27'	122° 25.88'	37° 49.27'	122° 25.94'
R-AM-G	37° 48.83'	122° 25.88'	37° 48.83'	122° 25.94'
R-AM-H	37° 48.83'	122° 25.57'	37° 48.83'	122° 25.63'
R-AM-I	37° 48.83'	122° 24.90'	37° 48.83'	122° 24.96'

* Station R-AM-B has been removed because of the physical danger associated with sampling at this location. Station R-AM-F has been removed because of its proximity to a previous dump site.

3.4. ***Sediment Sample Compositing***

3.4.1. Compositing (combining several sediment cores into a single sample) is often allowed for testing purposes. Careful consideration must be given to the compositing scheme for any project. Sediment samples should only be composited together when:

- they are from contiguous portions of the project area,
- there is reason to believe that sediment throughout that portion of the project area is similar and is exposed to the same influences and pollutant sources, and
- the total volume represented by the composited samples is generally in accord with the minimum sampling guidelines in Table 1.

3.4.2. Proposed compositing schemes should be identified in the SAP and discussed in advance with the agencies. Compositing schemes should be reported and the rationale used fully described.

3.4.3. The amount of material from each core included in the composite sample shall be proportional to the length of the core (or cores if more than one core was necessary to secure adequate volume).

3.4.4. Sediment composites should comprise a sufficient volume for conducting all of the physical, chemical, and biological testing, including any QC analysis.

3.4.5. Table 8-1 in the ITM ("Type of Samples Which May Be Required Following Tier I to Conduct Dredged-Material Evaluations") summarizes the types of tests for which water, sediment, and tissue samples may need to be collected. Table 8-2 in the ITM ("Summary of Recommended Procedures for Sample Collection, Preservation, and Storage") lists appropriate collection methods, sample volumes, preservation and storage techniques, and holding times for the various analyses of sediment, water, and tissue samples. Any proposed modification or substitution of the listed methods must be described in detail in the proposed SAP and approved by the DMMO in advance of sample collection.

3.4.6. If it is suspected that contaminant levels vary with depth in the sediment or where multiple geologic strata are proposed to be dredged, the agencies may direct that core samples be subdivided for compositing and analysis of separate layers. When individual core samples are found to contain distinct layers that were not expected, the layers should be separated for individual testing (or at least sub-samples of each layer should be archived for possible later analysis).

4. SEDIMENT PHYSICAL AND CHEMICAL EVALUATIONS, "TIER II" (see ITM, Chapters 5 and 9)

4.1. Physical and chemical analyses are conducted on each composite sediment sample. In some cases, evaluation of individual core samples may also assist in decision making. When a composite "fails" some aspect of the testing, and individual core data are available, the agencies can sometimes determine that sub-areas are suitable for unconfined aquatic disposal (SUAD) without further sampling and evaluation.

4.2. Routine sediment physical and chemical analyses should be performed for the list of characteristics in Table 3. On a case-by-case-basis, the agencies may determine that additional characteristics of concern must be analyzed. The agencies may also approve the deletion of some of the characteristics listed in Table 3 for individual projects. Proposals to use reporting limits different from those listed in Table 3 should be approved by the DMMO in advance. The agencies may otherwise not have sufficient information to make a determination, which may then result in expensive re-sampling, re-analysis, or project delays.

- A WORD ABOUT LIMITS -

Laboratory reporting limits (RL) must be set to not less than the minimum level (ML) as defined in EPA's draft Guide to Method Flexibility and Approval of EPA Water Methods dated December 1996. The definition of ML is: "The lowest concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point for an analyte. It is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method-specific sample weights, volumes, and processing steps have been employed." Method detection limits (MDL) must be established as defined in 40 CFR Part 136, Appendix B. Values < MDL will be reported as not detected (ND) or < [value of MDL]. Values ≥ MDL and ≤ RL will be qualified with the "J" character as estimates. Values > RL will be reported without qualification unless required because of QC problems.

5. BIOLOGICAL EVALUATIONS, "TIER III" (see ITM, Chapters 11 and 12)

5.1. Three types of biological evaluations may be required for routine dredging projects in San Francisco Bay: water column toxicity tests, benthic toxicity tests, and benthic bioaccumulation tests. Issues specific to performing each of these evaluations for dredging projects are summarized in the following sections. The need to conduct any of the biological tests will vary from project to project based on factors such as the degree or type of known or suspected contamination. Proposed SAPs should therefore be coordinated in advance with the DMMO. The chemical analyses of tissues from bioaccumulation tests are conducted for the list of characteristics listed in Table 4.

5.2. Rigid adherence to the test conditions provided in Appendix E of the ITM is not required. Adaptations to improve the efficiency of testing are allowed. Laboratories need only demonstrate that equivalent results are obtained when modifying test conditions.

5.3. ***Water Column Toxicity Testing***

5.3.1. Water column toxicity testing is discussed in detail in Section 11.1 of the ITM. In these tests, an "elutriate" is prepared from dredged material and appropriate organisms are exposed to four elutriate concentrations.

5.3.2. The ITM recommends that three species representing different phyla be tested. This is one area where the agencies have determined that routine sediment testing for San Francisco Bay dredging projects proposing disposal at the existing sites, may appropriately differ from the nation-wide guidance presented in the ITM. Specifically, the agencies have determined that the water column is not a significant contaminant exposure pathway for typical dredging projects using the SF-09, SF-10, or SF-11 disposal sites. This determination is based on the hydrologic characteristics of the designated disposal sites, and on data from more than ten years of water column toxicity testing associated with area dredging projects during which acute water column toxicity has rarely been indicated after taking into account initial mixing. Tripling the number of water column toxicity tests required for routine dredging projects would provide little additional meaningful information for decision making, and would not be in keeping with the Long Term Management Strategy (LTMS) goals to conduct dredging and disposal in the Bay area in an economically and environmentally sound manner.

5.3.3. A single water column bioassay will generally be adequate for determining compliance with the State of California's narrative water quality standard. Results of the water column bioassay combined with the results of the benthic acute toxicity and bioaccumulation bioassays, provide for comprehensive characterization of sediment quality, and allows for consistent decision making (see "Interpreting Sediment Test Results," below).

5.3.4. In some circumstances, the water column may be determined to be an important exposure pathway of concern. For example, if the discharge is proposed in a location with limited water circulation. It could also be a pathway in the case of a relatively continuous, long-term discharge (e.g., where dredged material is being used for large-scale fill, such as for construction of a new shipping terminal). In such cases, the agencies may require additional species for water column testing, as described in the ITM.

5.3.5. A single water column bioassay must be conducted with one of the national "benchmark" species listed in Table 11-1 of the ITM. The species used should be appropriate to the salinity conditions under which the bioassay is run. For typical area projects, recommended test species include echinoderm or bivalve larvae, or *Mysid* shrimp. (Note: the echinoderm "sperm fertilization" bioassay is NOT recommended).

5.3.6. Water column toxicity tests are conducted using a minimum of four elutriate concentrations (100%, 50%, 10%, and 1%), in addition to laboratory control water (0% elutriate). Five replicates of each concentration should be tested. Endpoints in this bioassay are mortality and abnormal development (separate counts for each are to be reported). Both LC_{50} and EC_{50} values are to be calculated and reported. Data should be analyzed as recommended in paragraph 11.1.5 of the ITM (see Appendix D of the ITM). Normally, all test acceptance criteria specified in a test method must be met. However, for organisms tested using ASTM E-724, counts for

abnormal larvae and calculated mortalities are to be added (i.e., it is assumed that abnormal larvae will not survive) when evaluating whether control survival is acceptable (>70 percent) and when calculating LC_{50} concentrations. The abnormality counts are to be used for calculating EC_{50} values. A reference toxicant bioassay must also be conducted at the same time and using the same population of test organisms. To be acceptable, the LC_{50} and EC_{50} values from the reference toxicant bioassay must be documented as being within two standard deviations of the laboratory mean response for that species using the Cusum control chart technique described in *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*, Fourth Edition (EPA/600/4-90/02F, August 1993).

5.3.7. Results of water column toxicity tests are used to determine whether elutriate concentration outside the mixing zone would exceed 1% of the LC_{50}. If so, the State of California narrative water quality standard is not met, and the material represented by that sample is not SUAD at the proposed site (also see "Interpreting Sediment Test Results", below) without some sort of management action or contaminant control measures. The State and USACE are developing appropriate mixing zone boundaries. Project proponents will use the release zone method as documented in reference EPA/USACE 1977 until the State and USACE establish appropriate guidelines for using the STFATE model.

5.4. ***Benthic Toxicity Testing***

5.4.1. Benthic toxicity testing, as described in ITM Section 11.2, involves exposing test organisms to the bulk (or whole) test sediment, as well as to the appropriate reference and control sediment for comparison. Table 11-2 of the ITM lists a number of appropriate species for use in benthic toxicity tests. As discussed in Section 11.2 of the ITM, benthic toxicity tests are to be conducted using a minimum of two species. Two species are adequate if, together, they represent the following three "life history stages:"

- Filter feeder
- Deposit feeder
- Burrower

5.4.2. For example, the amphipod crustaceans listed in ITM Table 11-2 are both burrowers and deposit feeders, while the *Mysid* shrimp listed are filter feeders. Therefore, the use of an amphipod and a *Mysid* shrimp could satisfy the benthic bioassay species requirements. Use of the amphipod *Ampelisca* (also a filter feeder) coupled with a polychaete worm such as *Neanthes* or *Nephtys* (which are both burrowers and deposit feeders) would also satisfy the benthic bioassay species requirements.

5.4.3. An amphipod must be one of the species tested in all cases. For typical San Francisco Bay area projects, the agencies specifically recommend that either *Rhepoxynius abronius*, *Ampelisca abdita*, or *Eohaustorius estuarius* be used, depending on the specific sediment conditions encountered (each species has different requirements and tolerances for salinity, grain size, etc.), along with a polychaete worm or *Mysid* shrimp. Proposals to use alternative amphipod species will be considered and must be approved by the DMMO in advance. Table 11-2 of the ITM lists only a single polychaete species (*Neanthes arenaceodentata*). The species *Nephtys caecoides* has also been used extensively in sediment bioassays throughout the West Coast, including San Francisco Bay. Either species may be proposed for use in dredged material benthic acute toxicity bioassays in this region.

5.4.4. When conducting benthic toxicity tests, special care must be taken to ensure that confounding factors (including anomalous ammonia and sulfide toxicity) do not influence the results. Direct measurement of *interstitial* concentrations of ammonia, salinity, and sulfides must be made prior to the initiation of the benthic bioassays and, if necessary, adjusted to below the species-specific thresholds given in the ITM on page 11-13. The agencies strongly recommend that interstitial total ammonia be no more than 15 mg/L at test initiation whenever possible. Methods for reducing ammonia or sulfide toxicity are provided in the ITM, page 11-13, or Jerretti 2000. Water in the laboratory aquaria above the sediment must also be monitored for the characteristics listed in Table 5.

5.4.5. The number of replicates for the species listed in Appendix E of the ITM should be tested for each composite sediment sample, and for reference and control sediments. The endpoint in benthic acute toxicity testing is mortality (in the case of amphipods, mortality and reburial). Results are compared to reference sediment results tested at the same time and using the same population of test organisms. Data should be analyzed as recommended in paragraph 11.2.4 of the ITM (see Appendix D of the ITM). When acute toxicity is indicated, the material represented by that sample is normally not SUAD at the proposed site. Generally, acute toxicity is indicated when mortality in the test sediment is both statistically significant and at least 10% absolute (20% absolute for amphipods) greater than that in the reference sediment (see "Interpreting Sediment Test Results," below).

5.5. *Benthic Bioaccumulation Testing*

5.5.1. Section 12.1 of the ITM describes bioaccumulation testing procedures. Routine bioaccumulation testing involves 28-day exposures of appropriate benthic organisms to the bulk (or whole) test sediment. The degree to which contaminants accumulate in the tissues of the test organisms is compared to similar results for exposure to reference and control sediments and other indicators of risk.

5.5.2. Bioaccumulation testing will be required by the agencies when concentrations of potentially bioaccumulative or biomagnifying compounds are known or suspected to be present in the sediment at concentrations of concern. Where there is sufficient existing information or confirmatory chemistry data to indicate that such compounds are unlikely to be present at concentrations of concern, the agencies may determine that bioaccumulation testing is not needed. One tool that the agencies use to determine if bioaccumulation testing is required is Theoretical Bioaccumulation Potential (TBP; see ITM Section 10.2). TBP provides an indication of the magnitude of bioaccumulation of potential contaminants that might result from exposure to the proposed dredged material. TBP is calculated using bulk sediment chemistry results and total organic carbon measurements and assumptions regarding organism lipid content and biota sediment accumulation factors. TBP usefulness is limited in that it can only be calculated for non-polar organics, such as chlorinated hydrocarbons, PCBs, and many PAHs. TBP cannot be estimated for metals, metal compounds, organic acids, salts, or organometallic complexes.

5.5.3. Not all contaminants that are routinely measured in dredged material samples (Table 3) are of concern for bioaccumulation. Fewer still have the potential to biomagnify. As discussed in the ITM, highly lipophilic organic compounds (defined as those having a log octanol-water partition coefficient [K_{ow}] > 3.5) may be of concern for bioaccumulation. When organic compounds with a K_{ow} of 3.5 or higher (e.g., see ITM Table 9-5) are present at elevated levels in dredged material samples, the agencies may require bioaccumulation testing. For inorganic

compounds, the ITM recommends bioaccumulation evaluation when compounds have calculated bioconcentration factors (BCFs) greater than 3 are present at elevated levels (e.g., ITM Table 9.6). More information about contaminants of concern for bioaccumulation is contained in ITM Section 9.5.

5.5.4. Table 4 of these guidelines lists a number of bioaccumulative compounds that are often found in area sediment, and that the agencies would typically identify as contaminants of concern for bioaccumulation testing. The agencies may require analysis of additional compounds or only a subset of this list, based on project-specific factors such as proximity to past or present pollutant sources or previous testing data in the area.

5.5.5. When bioaccumulation testing is determined to be necessary, a minimum of two species will normally be required. Table 12-1 of the ITM lists appropriate species for benthic bioaccumulation tests conducted under various salinity conditions. For typical San Francisco Bay projects, the agencies recommend that either of the polychaetes *Neanthes (Nereis) arenaceodentata* or *Nereis (Neanthes) virens* be used, along with the deposit-feeding clam *Macoma nasuta*. *Nephtys* may also be used. Other species from ITM Table 12-1 may be proposed but must be approved by the agencies in advance. Appendix E of the ITM lists the number of replicates that should be tested for each composite sediment sample, and for reference and control sediments. Routine bioaccumulation tests use 28-day exposures; however, for some compounds the 28-day results are adjusted to estimate steady-state bioaccumulation levels.

5.5.6. Bioaccumulation testing is expensive and time consuming, and the agencies' intent is to require it only where elevated levels of bioaccumulative compounds are known or suspected. To reduce costs and increase predictability while remaining environmentally protective, the agencies hope to develop numeric "bioaccumulation trigger" values in the future, similar to those used in the Pacific Northwest, to identify when bioaccumulation testing must be conducted. Absent such numeric values for San Francisco Bay, bioaccumulation testing costs may still be minimized by careful design of the SAP and close coordination with the agencies and the testing laboratory.

5.5.7. Ideally, a separate confirmatory physical and chemical survey would be conducted throughout the dredging area first, to serve as the basis for up-front decisions both about the most efficient compositing scheme for the toxicity bioassays, and which composites need bioaccumulation testing. The area would then be re-sampled and only the necessary biological tests run. When a staged sampling program of this type is not feasible, it may be possible to expedite completion of the bulk sediment chemistry results and discuss them with the agencies prior to *initiating* the bioaccumulation bioassays. (For this to work, however, the chemical analyses must be completed and the results discussed with the agencies within the maximum 8-week sediment holding time for initiating the bioassays. Otherwise, the areas for which bioaccumulation testing is indicated would have to be re-sampled.)

5.5.8. When these approaches are not possible, the agencies recommend that the bioaccumulation tests be initiated at the same time as the other bioassays, using one of the approaches listed below. The choice of approach depends on the dredging project proponent's plans and priorities, and the laboratory's capability to expedite data availability. These approaches can still reduce testing costs, by avoiding analysis of tissues from bioaccumulation tests of sediment composites that do not have elevated levels of contaminants or that may have already "failed" other aspects of the testing program. The options are:

- Initiate the bioaccumulation tests on all composites concurrent with the other bioassays, and expedite completion of the bulk sediment chemistry results. Review the chemistry results with the agencies prior to completion of the bioaccumulation tests, completing the tests and analyzing tissues only for those composites indicated by the agencies.
- Initiate the bioaccumulation tests on all composites concurrent with the other bioassays, and complete the exposures but preserve (freeze) the tissues for possible later analysis at the direction of the agencies, after the results of the sediment chemistry and other bioassays have been reviewed.

5.5.9. Results of benthic bioaccumulation tests are reported as wet weight tissue concentrations of the contaminants of concern. Percent lipid content of the test organisms must also be measured. Bioaccumulation test results are compared with the results of the reference sediment bioaccumulation exposure, as well as with other indicators of human health or environmental risk (see "Interpreting Sediment Test Results," below).

6. CASE-SPECIFIC EVALUATIONS, "TIER IV" (see ITM, Chapters 7, 11 and 12)

6.1. For the majority of San Francisco Bay dredging projects, the routine physical, chemical, and biological evaluations described above that comprise Tiers I, II, and III of the ITM's testing framework will provide adequate information to evaluate the potential effects of a proposed discharge of dredged material. In unusual cases where routine testing does not generate sufficient information, more comprehensive case-specific evaluations may be required by the agencies. "Tier IV" evaluations may entail, for example:

- More intensive (higher resolution) sampling and analysis;
- Project-specific computer modeling;
- Steady-state bioaccumulation testing;
- Bioassays using additional species or endpoints (such as chronic endpoints);
- Field surveys of biological communities;
- Project-specific risk assessment; or
- Other case-specific assessments as directed by the agencies

6.2. Tier IV involves case-specific, state-of-the-art evaluations. In all cases where Tier IV assessment is required, the details of the proposed assessment (such as field and laboratory methodologies, sampling locations, and model inputs) must be approved in advance by the DMMO.

7. INTERPRETING SEDIMENT TEST RESULTS

7.1. The sediment testing program outlined above provides for a comprehensive, environmentally protective, yet cost effective evaluation of potential adverse effects that may be associated with the routine discharge of dredged material at established open water disposal sites within San Francisco Bay. Unlike the previous testing program under joint Public Notice 93-2, this ITM-based testing program is more comprehensive and allows for decision making to be somewhat more flexible. Specifically, this ITM-based program fully considers all relevant contaminant exposure pathways of concern by incorporating results from multiple benthic bioassays. The agencies can follow a "preponderance of the information" approach to data

interpretation, as opposed to the rigid application of the benthic toxicity guideline necessitated by the single-species approach in PN 93-2. A higher degree of response is needed to indicate a "failure" in an individual benthic acute toxicity bioassay if all other test results are within acceptable ranges; lower degrees of response indicate "failure" when there are multiple indicators of potential adverse effect.

7.2. The following sections list the general interpretive criteria the agencies will follow when evaluating sediment test results for routine projects within San Francisco Bay. On a project-specific basis, the agencies may deviate from these general interpretation guidelines. This may occur based on project size (greater disposal volumes may translate into a greater risk of adverse impact), confidence in the test results, unrepresentative sampling, confidence in quality control procedures or results, or when results are not based on a pre-approved SAP.

7.3. *Sediment Chemistry, and Water Quality Standards Compliance*

7.3.1. Numeric water quality standards and criteria must be met in all cases. This requirement is not changed by the results of any of the other tests. Compliance with numeric water quality criteria is confirmed by modeling worst case concentrations (after initial mixing) assuming 100 percent solubility of chemical constituents in the bulk sediment. The RWQCB and USEPA will provide the DMMO with the most up-to-date information on specific water quality criteria at any time.

7.3.2. Material represented by any sediment sample that would cause a numeric water quality standard or criterion to be exceeded (after allowing for applicable initial mixing), is by definition not SUAD at the existing San Francisco Bay disposal sites. Any discharge permit for such material must include appropriate management restrictions that adequately address the particular contaminant(s) and exposure pathway(s) of concern.

7.4. *Water Column Toxicity Bioassay, and Water Quality Standards Compliance*

7.4.1. The state's narrative water quality standard (no discharges of "toxic materials in toxic amounts") must also be met in all cases. This need is not modified by the results of any of the other sediment tests. Compliance with the narrative water quality criterion is determined by evaluating whether the elutriate concentration, after initial mixing, would exceed 1% of the lowest of the LC_{50} or EC_{50} from the water column toxicity bioassay.

7.4.2. Material represented by any sediment sample that causes the narrative water quality standard to be exceeded (after allowing for initial mixing) is defined as not SUAD. Such material will not be found suitable for discharge at the existing San Francisco Bay disposal sites unless appropriate management restrictions that adequately address the particular contaminant(s) and exposure pathway(s) of concern are included in any permit.

7.5. *Benthic Toxicity*

7.5.1. Mean survival in benthic control sediment must be at least 90%. Mean survival of less than 90% may result in the agencies rejecting results and requiring re-testing. Mortality in a test sediment composite that is both statistically significant and at least 10% absolute (20% absolute for amphipods) greater than that in the reference sediment is considered to indicate acute toxicity. When acute toxicity is indicated, the material represented by that sample is defined to be not SUAD at the proposed site. When reference survival is less than 85%, project proponents should

immediately consult with the agencies, which may require re-testing to confirm the reference results.

7.5.2. The acute toxicity threshold (10% or 20%) is modified somewhat when the agencies determine that none of the other sediment physical, chemical, or biological tests indicates a significant potential for adverse effect. This could occur when the sediment chemistry is not generally elevated with respect to reference or background conditions, the water column bioassay shows a relatively high LC_{50} or EC_{50}, there is no substantial bioaccumulation (if tested), and survival of the other benthic species is high. In such a circumstance, the sediment tested generally will be considered not SUAD when mortality in the one benthic toxicity test showing a positive response is statistically significant and at least 15% absolute (30% absolute for amphipods) greater than that in the reference sediment.

7.6. *Benthic Bioaccumulation*

7.6.1. Results of benthic bioaccumulation tests are compared first with Food and Drug Administration (FDA) Action Levels, if available, for the contaminants of concern specified by the agencies for the individual project. Material represented by a tissue sample that exceeds any FDA action limit is defined as not SUAD. Where FDA Action Levels are not exceeded, or if the contaminants of concern include compounds for which no FDA Action Level has been established, bioaccumulation test results are compared with reference sediment bioaccumulation results, and with other indicators of human health or environmental risk. These indicators may include, but are not limited to, state fish advisories, cancer, and non-cancer risk models, literature concerning tissue residue effects, and local ambient fish data.

7.6.2. Other than FDA Action Levels, there are currently no nationally established numeric criteria for interpreting bioaccumulation test results. Decisions made based on bioaccumulation results are project specific and are based on best professional judgment of agency personnel. Risk assessment concepts may be applied, and in some cases a formal risk assessment may be required, depending on factors such as the particular contaminant of concern, project size, proposed disposal location and timing, and practicability of other alternatives such as ocean or upland disposal or beneficial reuse. Section 6.3 of the ITM discusses interpretation of bioaccumulation in more detail.

8. FURTHER INVESTIGATION OF SEDIMENTS THAT ARE NOT SUAD

8.1. When a sediment sample does not "pass" the relevant testing requirements outlined above, the dredged material that it represents is considered not SUAD. When the agencies identify dredged material not to be SUAD, the project proponent may choose one of the following courses of action:

- Dredge the unsuitable material and dispose of or reuse it at an appropriate permitted upland or confined location.
- Dredge only those portions of the project that are SUAD (note: in some circumstances, leaving unsuitable material in place may not be appropriate).
- Propose to conduct a more intensive evaluation of the area identified as including the unsuitable material in order to identify the maximum volume of SUAD that may be present.

8.2. More intensive investigation of an identified area of concern does not necessarily imply a Tier IV evaluation. Rather, it is common for project proponents to conduct higher resolution

sampling and analysis in areas that "fail" based on the initial testing scheme. This approach is aimed at determining whether the area in question contains a "hot spot" that caused the original composite to fail, and at identifying any SUAD material in the area. Depending on project-specific circumstances, higher resolution sampling and analysis may entail:

- Analyzing sediment chemistry in individual cores archived from the original sampling event.
- Performing sediment chemical analyses based on high-resolution re-sampling near suspected pollutant sources (such as storm drains, other outfalls, or fuel docks) in addition to analyzing cores from original locations.
- Performing higher-resolution biological testing on multiple smaller composites divided (vertically or horizontally) from the original "failed" composite.

8.3. Higher-resolution testing can often be limited to the specific contaminants or bioassay organisms indicated as being of concern based on the original testing. Every project is unique, and what would be considered adequate further evaluation in one case may not be adequate in another. All proposals for higher-resolution testing should therefore be based on a new proposed SAP, and coordinated with the agencies in advance.

DEFINITIONS

"Appropriate," regarding a permitted upland disposal site, means a site located outside Waters of the State and the U.S. for which all necessary permits have been, or will be, secured.

"Fail," in the context used, means the opposite of "pass," above. For example, a sample meeting all quality control criteria that is at least 10% less than survival in the reference sediment (and statistically different from) fails the acute toxicity test.

"Higher resolution," in the context used means increased density (horizontal or vertical) of sampling or analysis with the intent of defining the areal extent of contamination more precisely than the original sample could.

"Hot spot," in the context used, is a localized area where either elevated levels of contaminants of concern in sediment or relatively elevated levels of toxicity occur.

"Pass," in the context used, means that the bioassay met quality control requirements, the difference between the reference testing and the sample sediments was less than 10%, or other value if appropriate, or if the difference was greater than 10% that the results were not statistically different from the reference. More simply, in the context used, "pass" means the material is SUAD.

REFERENCES

The following references shall be used in place of the similar outdated references in the ITM or as new reference material as appropriate. (See ITM, Chapter 13).

APHA, *Standard Methods* for *the Analysis of Water and Waste Water*, 19th edition.

ASTM D 2487-93, Standard *Classification of Soils for Engineering Purposes (Unified Soil Classification System)*

ASTM E 724-98, *Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Four Species of Saltwater Bivalve Molluscs*

ASTM E 729-96, *Standard Guide for Conducting Acute Toxicity Tests on Test Materials with Fishes, Macroinvertebrates, and Amphibians*

ASTM E 1022-94, *Standard Guide for Conducting Bioconcentration Tests with Fishes and Saltwater Bivalve Mollusks*

ASTM E1367-99 *Standard Guide for Conducting 10-day Static Sediment Toxicity Tests with Marine and Estuarine Amphipods*

ASTM E 1391-94, *Standard Guide for Collection, Storage, Characterization, and Manipulation of Sediment for Toxicological Testing*

ASTM E 1463-92, *Standard Guide for Conducting Static and Flow-Through Acute Toxicity Tests with Mysids from the West Coast of the United States*

ASTM E 1562-94, *Standard Guide for Conducting Acute, Chronic, and Life-Cycle Aquatic Toxicity Tests with Polychaetous Annelids*

ASTM E 1563-98, *Standard Guide for Conducting Static Acute Toxicity Tests with Echinoid Embryos*

ASTM E 1611-99 *Standard Guide for Conducting Sediment Toxicity Tests with Marine and Estuarine Polychaetous Annelids*

ASTM E 1688-00, *Standard Guide for Determination of the Bioaccumulation of Sediment-Associated Contaminates by Benthic Invertebrates*

ASTM E 1850-97, *Standard Guide for Selection of Resident Species as Test Organisms for Aquatic and Sediment Toxicity Tests*

Jerretti, James A., Calesso, Diane F., and Hermon, Tonia R. (2000). Evaluation of Methods to Remove Ammonia Interference in Marine Sediment Toxicity Tests. *Environmental Toxicology and Chemistry* 19:1935-1941.

Gandesbery, Tom, and Hetzel, Fred (1988) "Ambient Concentrations of Toxic Chemicals in San Francisco Bay Sediments," Cal/EPA, Regional Water Quality Control Board, San Francisco Bay Region. http://www.swrcb.ca.gov/~rwqcb2/Downloadable_Files/sfbaysediment.pdf

Sims, J.G., and Moore, D.W. (1995). "Risk of pore water ammonia toxicity in dredged material bioassays," Miscellaneous Paper D-95-3, U.S. Army engineer Waterways Experiment Station, Vicksburg, MS

Sims, J.G., and Moore, D.W. (1995). "Risk of pore water hydrogen sulfide toxicity in dredged material bioassays," Miscellaneous Paper D-95-4, U.S. Army engineer Waterways Experiment Station, Vicksburg, MS

USEPA/USACE (1977). "Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters" July 1977.

Ward, J.A., et. al. (1994). "Suggested Methods for Environmental Sampling and Analysis in San Francisco Bay," 3 volumes, Pacific Northwest Laboratory, Richland, Washington, December 1994.

TABLE 3. Routine Sediment Physical and Chemical Evaluation

Characteristic	Reporting Limit*
Total Solids [TS](%)	0.1
Total Organic Carbon [TOC](%)	0.1
Grain Size (%)	0.1

Metals (mg/kg)		
Element (total)	**CAS No.**	
Arsenic	7440-38-2	2.0
Cadmium	7440-43-9	0.3
Chromium	7440-47-3	5.0
Copper	7440-50-8	5.0
Lead	7439-92-1	5.0
Mercury	7439-97-6	0.02
Nickel	7440-02-0	5.0
Selenium	7782-49-2	0.1
Silver	7440-22-4	0.2
Zinc	7440-66-6	1.0

Butyltins (µg/kg)	
Monobutyltin	10 each compound
Dibutyltin	
Tributyltin	
Tetrabutyltin	
Total Butyltins	

TABLE 3 (cont'd). Routine Sediment Physical and Chemical Evaluation

Characteristic	Reporting Limit*
PAHs (µg/kg)	
Compound	**CAS No.**
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo(a)anthracene	56-55-3
Benzo(a)pyrene	50-32-8
Benzo(b)fluoranthene	205-99-2
Benzo(g,h,i)perylene	191-24-2
Benzo(k)fluoranthene	207-08-9
Chrysene	218-01-9
Dibenzo(a,h)anthracene	53-70-3
Fluoranthene	206-44-0
Fluorene	86-73-7
Indeno(1,2,3-cd)pyrene	193-39-5
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0
Total PAHs	

TABLE 3 (cont'd). Routine Sediment Physical and Chemical Evaluation

Characteristic		Reporting Limit*
Pesticides (µg/kg)		
Compound	**CAS No.**	
Aldrin	309-00-2	2 each compound
α-BHC	319-84-6	
β-BHC	319-85-7	
δ-BHC	319-86-8	
γ-BHC (Lindane)	58-89-9	
Chlordane	57-74-9	20
2,4'-DDD	53-19-0	2 each compound
4,4'-DDD	72-54-8	
2,4'-DDE	3424-82-6	
4,4'-DDE	72-55-9	
2,4'-DDT	789-02-6	
4,4'-DDT	50-29-3	
Total DDT		
Dieldrin	67-57-1	2 each compound
Endosulfan I	959-98-8	
Endosulfan II	33213-65-9	
Endosulfan sulfate	1031-07-8	
Endrin	72-20-8	
Endrin aldehyde	7421-93-4	
Heptachlor	76-44-8	
Heptachlor epoxide	1024-57-3	
Toxaphene	8001-35-2	20

TABLE 3 (cont'd). Routine Sediment Physical and Chemical Evaluation

Characteristic		Reporting Limit*
PCBs (µg/kg)		
Aroclor 1016	12674-11-2	20 each Aroclor
Aroclor 1221	11104-28-2	
Aroclor 1232	11141-16-5	
Aroclor 1242	53469-21-9	
Aroclor 1248	12672-29-6	
Aroclor 1254	11097-69-1	
Aroclor 1260	11096-82-5	
Total Aroclors	12767-79-2	

*Note: Sediment reporting limits are on a dry-weight basis. To achieve the recommended reporting limits for some compounds in sediment, it may be necessary to use a larger sample size than the method describes, a smaller extract volume for gas chromatography/mass spectrometry analyses, or recommended sample cleanup methods to reduce interference.

TABLE 4. Bioaccumulative Contaminants of Concern for Routine Tissue Evaluation

Characteristic	Reporting Limit[A]
Total Lipid (%)	0.1
Cadmium (mg/kg)	0.1
Copper (mg/kg)	1.0
Mercury (mg/kg)	0.02
Selenium (mg/kg)	0.5
PAHs[B] (µg/kg)	20
Pesticides[B] (µg/kg)	2
PCBs[C] (µg/kg)	20
Butyltins[B] (µg/kg)	10

A. Tissue reporting limits are on a wet-weight basis. To achieve the recommended reporting limits for some compounds in sediment, it may be necessary to use a larger sample size than the method describes, a smaller extract volume for gas chromatography/mass spectrometry analyses, or recommended sample cleanup methods to reduce interference.

B. Use same list of compounds as in Table 3

C. If bioaccumulation tests are necessary because of elevated levels of PCBs, the agencies expect to require PCB congener analysis rather than Aroclor analysis. The agencies are currently working on the specific list of congeners that will be required. A separate public notice will be issued listing the congeners of concern.

TABLE 5. Interstitial and Overlying Water Measurements

Characteristic	Reporting Limit
Salinity (ppt)	0.1
pH (pH units)	0.1
Ammonia (mg/kg)	0.2
Soluble Sulfides (mg/kg)	0.1
Dissolved Oxygen (mg/kg)	0.1
Temperature (°C)	0.1

DREDGED MATERIAL MANAGEMENT OFFICE

Response to Comments on DMMO Public Notice (PN) 99-3, Draft Guidelines for Implementing the ITM in the USACE San Francisco District (retitled Guidelines for Implementing the ITM in the San Francisco Bay Region)

The Dredged Material Management Office (DMMO) issued draft guidance for implementing the Inland Testing Manual (ITM) locally via PN 99-3 in July 1999. We received comments from a variety of sources and have modified the local guidance, where appropriate, to respond to the commenters. Substantive comments are summarized below, along with DMMO's responses. Where practicable, the comments have been categorized by subject. DMMO thanks all commenters for their constructive suggestions.

In the revised guidance and in this Response to Comments, we make a distinction between "DMMO" and "the agencies" (U.S. Army Corps of Engineers San Francisco District (USACE SF District), U.S. Environmental Protection Agency Region IX (EPA), the San Francisco Regional Water Quality Control Board (RWQCB), the Bay Conservation and Development Commission (BCDC), and State Lands Commission, SLC). DMMO is responsible for reviewing and approving Sampling and Analysis Plans (SAPs), as well as for making suitability recommendations for disposal of dredged material. Each of the member agencies, however, retains the responsibility and authority for approving disposal of dredged material. When used in the "Guidelines for Implementing the Inland Testing Manual in the San Francisco Bay Region" and this document, "DMMO" refers to the staff of the member agencies comprising DMMO.

The term "guidance" in the following refers to the "Guidelines for Implementing the Inland Testing Manual in the San Francisco Bay Region."

U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105-3919

San Francisco Bay Conservation and Development Commission
50 California Street, Suite 2600
San Francisco, CA 94111-4704

U.S. Army Corps of Engineers San Francisco District
333 Market Street
San Francisco, CA 94105-2197

San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612-1413

California State Lands Commission
100 Howe Avenue, Suite 100-South
Sacramento, CA 95835-8202

Scope of Guidelines Document

Comment: During the workshop held on the ITM in 1999, DMMO indicated that it was likely that there would be separate guidance for San Francisco Bay and the Central Coast. The stakeholders in the Central Coast region feel that they have not been well represented in the process. While Central Coast agencies were included as signatories on PN 99-3, the level of staff involvement in development of the guidance is unclear. Other stakeholders in the Central coast region should be consulted as well.

Response: Because DMMO, as a group, has limited jurisdiction, the scope of this guidance has been modified to include only the San Francisco Bay Area. Guidelines for other portions of the USACE SF District will be published as separate document(s) or incorporated into this guidance at a later date. We encourage project proponents and other interested parties to contact USACE SF District to facilitate this process.

Comment: Figure 1 should be revised to show the disposal sites off Santa Cruz harbor, SF-12, and SF-14, and Moss Landing Harbor.

Response: Because the scope of this guidance has been modified to include only the San Francisco Bay Area, this comment is no longer relevant.

Comment: Section 1.1 should include clarification that the guidance is "to determine the suitability of dredged material for unconfined aquatic disposal in estuarine locations only (not ocean disposal)."

Response: Section 1.1 clearly states that this guidance is applicable to disposal in "waters of the U.S." Therefore, the guidance generally only applies to disposal at the sites shown in Figure 1. (Note, however, that disposal proposed for jurisdictional wetlands is also covered by the guidance and we encourage project proponents to use this guidance as an aid to developing projects for upland disposal and reuse.)

Tiered Testing Framework

Comment: Add the following to Section 2.4: "At the applicant's [project proponent's] discretion, the Tier I exemption may be waived, and analysis for a dredging episode may begin at Tier II or one of the higher tiers."

Response: DMMO believes that there is some confusion regarding the intent of Tier I. Information gathered in Tier I can be essential to making an evaluation of dredged material suitability. While a project proponent may not wish to request an exemption from testing in Tier I or a "Tier I decision", the process of data gathering is a required step and assists the proponent in developing an adequate SAP for further Tiers. Please note the first sentence of section 3.1 of the ITM. It states, "[t]he tiered approach to testing used in this manual **must** (emphasis added) be initiated at Tier I". DMMO has published detailed information about exemptions and Tier I decisions in PN 00-1, Guidance for Requests for Tier I Decisions.

Comment: The guidance should contain a section discussing "sandy material" intended as beach replenishment. The general rule has been that material finer than 80% sand should not be disposed on the beach. A discussion of this policy would be most beneficial.

Response: As the commenter has noted, the general rule of thumb is 80% or greater sand-sized material for beach nourishment. However, because the guidance is now limited to San Francisco Bay and beach replenishment/nourishment projects are rare or non-existent, we have chosen to not modify the guidance. We recognize that this issue may be of importance elsewhere in USACE SF District and expect to address it in the future.

Comment:

a. Paragraph 2.3 of guidance is very confusing. Please clarify DMMO's intent.

b. How will confirmatory testing be used in decision-making?

c. How is the determination to be made regarding confirmatory testing?

d. The ITM indicates that Tier 1 exclusions generally would be based on three years of data or the dredging cycle, whichever is longest. In the absence of a more detailed explanation of the term dredging cycle, we presume that this term refers to dredging episodes.

e. Include the validity of PN 93-2 data in justifying exclusions and Tier I decisions. This information is critical to long-term planning (timing and cost) for dredgers.

Response:

a. DMMO's intent in this paragraph is to indicate how Tier I evaluations take place. The Tiered evaluation process is explained in Chapter 3 of the ITM. Please note that DMMO has published detailed information about exemptions and Tier I decisions in PN 00-1, Guidance for Request for Tier I Decisions. Confirmatory testing is limited to evaluation of the physical and chemical properties.

b. Confirmatory test results are used to confirm that the physical and chemical characteristics of the site have not substantially changed since the last testing episode, a strong indication that the proposed dredged material is substantively the same as the material last subject to full testing.

c. DMMO's decision to accept confirmatory testing as sufficient is based on the length and consistency of the historical data and the likelihood of the site having become contaminated since the last testing. There is no rote formula for making this determination. Therefore, DMMO exercises Best Professional Judgment in determining if there is sufficient information for a Tier I decision, if confirmatory chemistry is necessary to make a Tier I decision, or if full (physical, chemical, and bioassay) Tier III testing is required.

d. As the commenter states, page 4-2 of the ITM recommends that the interval between reevaluation of Tier I data not exceed three years or the

dredging cycle, whichever is longest. The commenter's assumption is correct. Dredging cycle refers to the interval between dredging episodes.

e. All data are useful; therefore, DMMO can use data gathered under the guidelines published in PN 93-2, if provided, in making Tier I evaluations. Whether that information is sufficient to justify a suitability determination at Tier I is a separate issue. DMMO has issued guidance in PN 00-1 on submitting Tier I requests.

Comment: Lines 4 and 5 of Section 2.2 should be modified to read "...especially when it is isolated from sources of pollution and when total organic carbon is comparatively low."

Response: DMMO disagrees. Although we recognize the importance of organic carbon to contaminant bioavailability, the ITM only addresses isolation from sources of pollution, not the organic carbon content of the sediment. We have not changed the guidance.

Comment: In Section 2.3, lines 1 and 2 could be improved by deleting "due to either grain size or proximity to possible sources of pollution" as being redundant of the preceding section.

Response: DMMO agrees; we have incorporated the suggested change.

Comment: Section 2.3 can be improved by adding the following sentence at the end of the section: "Confirmatory testing may include any one or combination of physical, chemical, or biological testing, depending on the nature of historic sediment quality data for the site and the length of time since sediment from the area was last tested."

Response: DMMO agrees; we have incorporated the suggested change.

Sediment Sampling

Sampling Frequency/Density

Comment: The guidance requires dredging projects with less than 5,000 cubic yards to have a minimum of four sampling stations and at least one composite.

Response: Table 1 of the guidance is intended to indicate that appropriate sampling for very small (less than 5,000 cy) and very large (more than 500,000 cy) projects will be determined on a case-by-case basis. Please note, however, that even if only one sample is to be tested (e.g., for a small-volume project), multiple core samples are usually recommended for compositing.

Comment: The minimum sediment sampling frequency outlined in Table 1 of the guidance is identical to the sampling guidelines in PN 93-2.

Response: The commenter is correct.

Comment: During workshop held on the ITM in 1999, project proponents expressed concern about retaining the "one composite per 20,000 cy" rule. The concern was based on the significance of the number "20,000" and the increased cost of analyzing multiple composite samples.

Project proponents should be allowed a single composite for more than 20,000 cy of material if the composite sample is comprised of a large number of cores from one site. This sampling adequately characterizes dredged material, particularly when the samples are from contiguous areas subject to the same potential pollution sources and hydrodynamic regimes. DMMO's concern that such a large compositing scheme could lead to "missing something" applies to all levels of testing, even the 20,000 cy "rule". Furthermore, because sampling and testing often occurs well in advance of dredging, dredging is likely to remove sediment that was not characterized by the sampling effort. Given this unavoidable delay, the concept of "missing something" just because of a lower sampling frequency becomes somewhat irrelevant. The guidance should make explicit (as was noted by DMMO at the workshop held on the ITM in 1999) that the 20,000 cy "rule" is a starting point and is flexible, especially at locations with a long dredging history.

Response: The rule of thumb shown in Table 1 of the guidance was actually described as "**minimum** sampling guidelines" (emphasis added) and is not strictly one composite per 20,000 cy of dredged material. These sampling guidelines are presented for project proponents' planning purposes, and can be modified on a project-by-project basis, based on specific information justifying another sampling scheme.

Comment: The shift from PN 93-2 to ITM was to enact a more accurate and rigorous testing program, presumably compensating for lower testing frequencies. Why then still rely on sampling frequencies established under a less rigorous testing program?

Response: The presumption is incorrect. We have moved to the ITM because it is national guidance. Sampling frequency and "rigor" are not directly related. Sampling density is directly related to the need to obtain a representative characterization of the sediments proposed to be dredged.

Sampling Locations, Procedures

Comment: If sediment layers are present at the proposed dredging site, samples of the area should be representative of the different sediment layers. The guidance recommends that where contamination may vary with depth or where separate geologic strata are to be dredged, cores may need to be split and testing conducted in "layers." However, any testing of layers needs to consider the minimum dredgeable depth. Additionally, dredging is not typically conducted in layers. Core samples should, in general, be representative of the entire depth to be dredged

Response: DMMO believes that the guidance, as written, allows for flexibility with individual projects, including layers of different sediments. DMMO will provide specific guidance on sampling when project proponents submit SAPs.

Comment: Section 3.2.2 should be modified to clarify that sediment collected below the project depth and the permitted overdredge allowance should be discarded and not analyzed with the sample that will be used to characterize the proposed dredging area.

Response: DMMO agrees; this has been our standard procedure. We have added clarifying language to the guidance.

Comment: The guidance indicates that samples should be taken to the project depth plus the allowed overdepth allowance. In the field, individual cores may hit refusal due to hard-packed sand or debris before this depth is reached. If all cores cannot be taken to the target depth, it is reasonable to permit dredging only to the depth sampled. However, if only one or two cores do not sample the full depth either (a) dredging should be allowed to the project depth plus the allowed overdepth allowance, or (b) if easily split off, dredging could occur to different depths within sub-areas, based on the achieved depth. If the target depth is missed by a "small margin," dredging of the whole area should be allowed to proceed to the project depth plus the allowed overdepth allowance. DMMO needs to define a "small margin," which will vary depending on the proposed length of the cores.

Response: Use of the term "must" in Section 3.2.2 ("The full permitted overdepth allowance must be sampled...") is in error, the correct word is "should." We have modified the guidance. DMMO believes that the guidance otherwise is written to allow for flexibility as needed with individual projects. Although the agencies, rather than DMMO, are responsible for permitting decisions, DMMO will provide guidance to project proponents when they submit their Results Report.

Physical and Chemical Analyses

Comment: Text in Section 4.2 indicates that analytical methods are listed in Table 2. However, no analytical methods are specified in Table 2. At the workshop held on the ITM in 1999, DMMO indicated that methods should be proposed in the SAP, and that any method that would achieve the required reporting limit may be acceptable. However, DMMO appears to have preferences for certain extraction and analytical methods. A list of suggested methodologies should be included.

Response: The guidance has been corrected to remove reference to analytical methods. Analytical methods are discussed in PN 99-4, "Proposed Guidance for Sampling and Analysis Plans (Quality Assurance Project Plans) for Dredging Projects within the USACE San Francisco District."

Comment: Arsenic (which includes the sum of trivalent arsenic and pentavalent arsenic) and chromium (which includes the sum of trivalent chromium and hexavalent chromium) should be defined as total arsenic and total chromium.

Response: All metals currently listed are totals. We have clarified Table 2.

Comment: Chlordane should be defined as total chlordane, which includes the sum of seven isomers of chlordane, all of which are included in the EPA Priority pollutant list and in the definition of chlordane in the 1997 California Ocean Plan.

Response: Technical grade chlordane contains at least 50 compounds. Standard laboratory procedure is to use a technical grade chlordane mixture as a standard, thereby incorporating all of the compounds in the analytical scheme. We do not consider it constructive to specify only seven of the compounds that comprise chlordane, but instead want laboratories to report the sum of all the identifiable chlordane

components as "chlordane not otherwise specified under CAS 57-74-9," as indicated in Table 2.

Comment: Total Aroclors in Table 2 should include Aroclors 1016, 1221, and 1232, which are included in EPA's Priority Pollutant list and in the definition of PCBs in the 1997 California Ocean Plan.

Response: DMMO agrees; we have modified Table 2 to include these additional Aroclors. Please note that although DMMO is currently requiring Aroclors for bulk sediment chemistry, we may modify this requirement to congeners in the future.

Comment: Analytical laboratories may not be able to meet reporting limits for Toxaphene and Chlordane. The reporting limit for Toxaphene should be changed from 20 μg/kg to 25 μg/kg and for Chlordane from 2 μg/kg to 5 μg/kg.

Response: The Chlordane reporting limit should have been specified as 20 μg/kg; we have modified this in the final guidance. We believe, however, that most laboratories can meet the 20 μg/kg reporting limit for Toxaphene and have not changed the guidance.

Laboratories that cannot achieve the listed reporting limits within a factor of two should note this in SAPs and Results Reports. If the difference between the guidance reporting limit and the laboratory's reporting limit is greater than a factor of two, the laboratory should consult with DMMO prior to proceeding with the analysis.

Comment: In Section 4.1, the first sentence seems to suggest that individual cores should be analyzed simultaneously with composite samples, which could be very costly. Core samples should only be analyzed if a composite analysis indicates contamination. Remove the second sentence of this Section and change the third sentence to: "When a composite "fails" some aspect of testing, individual core samples that comprised the composite can be analyzed to determine occurrence of local contamination."

Response: DMMO's intent was to stress that composite samples must be analyzed for physical and chemical properties. The second sentence was for information only. DMMO does not intend for project proponents to test individual cores routinely.

Toxicity Testing

Comment: The guidance should require measurement of total and water soluble sulfides with an MDL of 0.1 mg/kg dry weight. This information can be useful in interpretation of bioassay test results and potential impacts of sulfides on marine ecosystems.

Response: DMMO has not found any correlation between total sulfides and acute toxicity.

Water Column Toxicity Testing

Comment: Because of the seasonal nature of bivalve reproductive conditions, the use of any of the listed species should be allowed and the laboratory should be given latitude to change species without informing the DMMO of the change. The four listed species provide the same endpoints and are generally equivalent in toxicity response. A specific species may be proposed in a SAP, but the use of an

alternative species on the list should be considered a basic element of this test protocol.

Response: The ITM recommends three species for water column toxicity testing. Because we have reduced this to one species, a benchmark species (see the ITM for further information) must be used in the test. Laboratories are free to choose a benchmark species tolerant of appropriate salinity levels. DMMO agrees that if the SAP identifies multiple possible species and the conditions under which a species change would be made, then the laboratory is free to make that change without informing the DMMO beforehand, provided that the Results Report documents the change. However, if it is necessary to use a species that was not addressed in the SAP, then the project proponent should inform DMMO before the test is initiated. Failure to notify the DMMO under these circumstances could result in the test being deemed unusable for purposes of the suitability determination.

Comment: The ITM requirement for the 100% elutriate for the water column test to be prepared using dredge site water does not accurately reflect what occurs in the real world. It seems that using disposal site water to prepare the 100 percent elutriate would more accurately reflect what occurs in the real world.

Response: DMMO disagrees and has not modified the protocol in the guidance. The water column test uses a long-standing protocol and is required in the ITM. However, disposal site water can be used when diluting the elutriate to create the 50%, 10%, and 1% concentrations used for testing. On a case-by-case basis, DMMO may approve the use of clean seawater to make the initial elutriate, particularly if the salinity of dredge site water is inappropriate for the bioassay species chosen.

Comment: In San Francisco Bay, the EC_{50} rather than the LC_{50}, is used, and the guidance should so indicate, unless use of the LC_{50} is acceptable.

Response: Both the ITM and the guidance recommend calculating both end points and using the more sensitive end-point in mixing calculations.

Comment: Add ASTM E 1563-95, Standard Guide for Conducting Static Acute Toxicity Tests with Echinoid Embryos to the reference list.

Response: We have added the current version of ASTM E 1563-98 to the reference list.

Comment: The procedure described in Section 5.1. to determine the acceptability of the water column test is not consistent with ASTM guidelines. One criterion is control survival and another is abnormal development. The ASTM guidelines state that the control survival must be greater than 70% and that abnormal development be less than 10%. The guidance combined percent mortality and percent abnormal development to determine if control survival has been met.

Response: We have corrected and clarified this issue.

Comment: Test concentrations for all water column tests should be the same. Specifically:

a. ITM Appendix E-8: *Citharichtys stigmaeus*, Appendix E-13: Oysters and Mussels, and Appendix E-14: sea urchins and sand dollars, test

concentrations should be the same as for all water column tests at 1%, 10%, 50%, and 100%.

b. The guidance states that a minimum of four elutriate concentrations (100%, 50%, 10%, and 1%) is to be used in conducting water column toxicity tests. Section 11.1.4 of the ITM requires only "[a]t least three concentrations..." with 100%, 50%, and 10% recommended. (Additional concentrations are required if <50% survival is found in the 10% exposure). We have found three concentrations (100%, 50%, 10%) to be sufficient in virtually every case. Will testing labs be expected to run the 1% exposures and (if yes) be required to count the 1% exposures if ≥ 50% survival is found in the 10% concentration?

Response: For San Francisco Bay dredged material disposal projects, all water column toxicity tests must be run at 1%, 10%, 50%, and 100%.

Comment: ITM Appendix E-14: sea urchins and sand dollars, generally 96 hours are necessary to get adequate development in place of the specified 48 hours.

Response: Both the California 96-1 WQ manual and EPA /600/R-95/136 specify test duration as 72 hours. Furthermore, Section 11.6 of the national consensus manual, ASTM E 1563-98 states, "[t]he duration of each test will depend on the species used and the test temperature." Experience with local test species will dictate the length of the test, which should be 48, 72, or 96 hours. In all cases, the duration of a test will be based on the time to development to the pluteus stage of at least 70% of the embryos in the control solutions. If a test requires additional time beyond the usual for a given species and temperature, continue the test as necessary for > 70% control development to normal pluteus larvae, but record this time extension as a test deviation." DMMO uses the national consensus guide

Comment: ITM Appendix E-14: sea urchins and sand dollars, the development of echinoderms is slower than bivalves and stocking time varies from 1-3 hours. The test is initiated with known numbers of developing embryos and if the stock solution embryos have not started to divide it is unknown if they are acceptable for the test.

Response: The national consensus document, ASTM E 1563-98, states that test initiation should be within 4 hours of fertilization. DMMO uses the national consensus guide.

Comment: The reference provided for conducting polychaete bioassays seems to be inappropriate for sediment tests. ASTM E-1611-94, *Standard Guide for Conducting Sediment Toxicity Tests with Marine and Estuarine Polychaetous Annelids* as referenced in the ITM is the correct protocol for benthic tests.

Response: DMMO's intent was to reference the protocol in ASTM E-1611-94 to indicate the possibility of using polychaetes in water column tests. We recognize that other protocols apply to benthic testing. Please note, however, that DMMO has not performed an evaluation of the sensitivity of the polychaetes to determine if they are an appropriate water column test species. Project proponents proposing such a

test need to supply adequate information on the sensitivity of polychaetes in water column toxicity tests.

Comment: The sentence in Section 5.1.5 of the guidance "...for typical projects, recommended test species include echinoderm or bivalve larvae, larval development tests, or Mysid shrimp" is confusing as larval development tests are not a species.

Response: We have clarified this sentence.

Mixing Zone Calculations

Comment: The RWQCB has not established a mixing zone for use in dredged material toxicity evaluations in San Francisco Bay, despite reference in both Sections 7.3 and 7.4 of the guidance to initial mixing zones. Although DMMO has suggested use of USACE's STFATE model, current lack of an approved model is an obstacle to implementation of the ITM and the guidance. DMMO should run extensive tests of the proposed STFATE model to determine:

a. that it is applicable to disposal sites in San Francisco Bay;

b. that the parameters needed to run the model are available; and

c. that the model provides accurate and reliable results.

DMMO should conduct one or more workshops on the use of this model and confer with the stakeholder to develop standard sets of values for parameters that are common to all disposal events, or a subset of disposal events. DMMO should publish guidelines for the use of STFATE and discuss interpretation of the model results.

Response: STFATE is a nationally developed, tested, and validated model that has been run successfully on several Bay Area dredging projects. DMMO does not see a need to re-evaluate the model's accuracy, its basic applicability to San Francisco Bay, or the availability of appropriate input parameters. DMMO is currently working to develop guidance on the use of STFATE to model disposal of dredged material at the in-Bay disposal sites and will hold public workshops when development is complete.

Comment: Section 7.2 of the guidance discusses a mixing zone, but no mixing model is currently approved. The guidance needs to be revised to provide interim guidelines for evaluation of water column toxicity tests. Otherwise, these tests should not be required.

Response: DMMO agrees on the need for interim guidance on mixing zones while STFATE is being evaluated. We have modified the guidance to include interim procedures.

Comment: Comparison of 1% of the LC_{50} using STFATE model should not be required until the model is validated.

Response: See response to previous comment. Please note that the STFATE model has been validated.

Comment: The ITM specifies that STFATE be used to determine the water column impacts of dredged material disposal. Use of this model is difficult for several reasons, including the lack of an established mixing zone and the fact that SF-11 is a dispersive site. Parameters necessary to calculate the LPC are not published and are not readily available.

Response: See previous responses. Furthermore, the dispersive nature of the in-Bay disposal sites is taken into consideration in the STFATE model through the input of parameters such as current speeds. Please note that STFATE is designed to model short-term (i.e., water column) effects, which is DMMO's intent. The guidance is not intended to address long-term effects of disposal (although such evaluations may occur through the LTMS process at a later date).

Benthic Toxicity Testing

Comment: Mean control survival must be at least 90% for all species with no one replicate less than 80%; there should be no exception for *Ampelisca.*

Response: The commenter is correct. We have removed the *Ampelisca* control survival of 85% from the guidance.

Comment:

a. The guidance requires a minimum of 85% survival in reference sediment. To be consistent with the requirement for control performance, an additional 5% "leeway" for amphipod bioassays should be allowed; i.e., the reference requirement should be 80% for amphipods.

b. We are concerned about a reference survival guideline. We have seen test events where control survival met the minimum criterion and reference toxicity results were in range, but reference sediment survival was below the expected level for reasons that were not obvious. While we understand the need for good reference sediment performance, this guideline could put a testing laboratory in the position where they are obligated to bear the cost of a retest even though all protocol QA/QC requirements have been met. The guidance does state that retesting "may be required" rather than "will be required", which provides a measure of confidence that the guideline will be interpreted reasonably, taking into account the entire associated data sets and QA results.

Response:

a. The 85% criterion for amphipod survival in control sediments is in error. We have deleted this text.

b. DMMO has requested that project proponents immediately notify us if reference survival is below 85%. Some disposal sites have survival rates in this range and in such cases, DMMO may not require re-testing. We hope to alleviate this problem by specifying more appropriate reference sites (see comments and responses related to Reference Sites).

Comment: Measuring interstitial concentrations of salinity, ammonia, dissolved sulfides and pH is appropriate and through manipulation can reduce the potential for confounding effects. However, daily measuring of sulfide is excessive.

Response: The guidance did not state that sulfide must or should be measured daily. DMMO believes that the requirement to test sulfide can be met by testing at the beginning and the end of the test.

Comment: In general, temperature controls for bioassay testing should be ± 2°C. Specifically:

a. ITM Appendix E-7, Fish: temperature should be 20 ± 2°C for the acute larval fish test. 25 ± 2°C is used for chronic growth studies.

b. ITM Appendix E-1, Mysid: temperature for acute tests should be 20 ± 2°C. The 25 ± 1°C temperature control is used in the chronic reproduction and growth study and does not seem appropriate.

c. ITM Appendix E-8: temperature range should be ± 2°C.

d. ITM Appendix E-13: temperature for *Crassostrea* should be 20 ± 2°C and for mussels 16 ± 2°C.

e. ITM Appendix E-17: temperature should be 20 ± 2°C.

f. ITM Appendix E-27: temperature for *Neanthes* should be 20 ± 2°C.

g. ITM Appendix E-27: use of *Nephtys* would be an appropriate exchange species and would be tested under the same basic conditions. Temperature for *Nephtys* should be 16 ± 2°C because they are collected in colder water. A 20° test would kill *Nephtys*.

h. ITM Appendix E-31: temperature for the acute *Mysid* test should be 20 ± 2°C. The use of 25 ± 1°C in the chronic reproduction and growth study and does not seem appropriate here.

i. ITM Appendix E-45: use of *Nephtys* can be carried out under *Neanthes* conditions with a reduction in temperature (16 ± 2°C) and a replicate stocking rate of 50-60 organisms.

Response: The ITM Appendix E summary sheets are abstracts from the referenced documents. The reference documents provide appropriate details about temperature controls. Any proposed deviations from the reference document requirements should be documented in the SAP. Also, please note, DMMO is not responsible for, nor do we have the authority to modify the ITM. We have, however, included a discussion in the guidance clarifying our use of national consensus documents where they are appropriate. The following responses are for further clarification:

a. Section 9.12 in EPA/600/4-90/027 states "The average daily temperature of the test solution must be maintained within ± 1°C of the selected test temperature, for the duration of the test." Section 11.3.2 of ASTM E 729-96 states "For each individual test chamber … the time-weighted average measured temperature at the end of the test should be within 1°C of the selected test temperature. The difference between the highest and lowest time-weighted averages for the individual test chambers must not be greater than 1°C. Each individual measured temperature must be within

3°C of the mean of the time-weighted averages. Whenever temperature is measured concurrently in more than one test chamber, the highest and lowest temperature must not differ by more than 2°C." DMMO interprets temperature requirements by following the national consensus guide.

b. ASTM E-729 makes the distinction between chronic reproduction and growth testing from survival testing clear. The cited EPA publication lists a 1°C tolerance. DMMO accepts the wider tolerance allowed by the national consensus document, with proper documentation in the SAP.

c. Commenter is correct; Appendix E-8 of the ITM should specify a 2°C tolerance.

d. Section 11.3.2 of ASTM E 724-98 states exactly the same words as item d in the comment above. DMMO interprets temperature requirements by following the national consensus document.

e. Section 13.2 of ASTM E 1367-99 states "Within an experiment, individual temperature readings should not vary by more than 3°C from the selected test temperature, and the time-weighted average measured temperature at the end of the test should be within 1°C of the selected test temperature. When temperature is measured concurrently in more than one test chamber, the highest and lowest temperatures should not differ by more than 2°C." DMMO interprets temperature requirements by following the national consensus document.

f. Section 13.2 of ASTM E 1611-99 states "Individual temperature readings should not vary by more than 3°C from the selected test temperature within an experiment, and the time-weighted average measured temperature at the end of the test should be within 1°C of the selected test temperature. The highest and lowest temperatures should not differ by more than 2°C when temperature is measured concurrently in more than one test chamber." DMMO interprets temperature requirements by following the national consensus document.

g. DMMO agrees that *Nephtys* is an appropriate test species. Because *Nephtys* is not listed in the ITM, the laboratory must provide data equivalent to the Appendix E "Summary of Test Conditions and Test Acceptability Criteria" tables for the test in the SAP. Note that the temperature controls of ±1°C will be required and will be interpreted as previously discussed.

h. Appendix E of the ITM was trying to be inclusive. Guidelines in the national consensus document, ASTM E 1463-92 (1998) should be followed. Again, DMMO will use a 1 °C temperature tolerance as previously discussed in interpreting data.

i. DMMO agrees that *Nephtys* is an appropriate test species. Because they are not listed in the ITM, the laboratory must provide data equivalent to the Appendix E "Summary of Test Conditions and Test Acceptability

Criteria" tables in the SAP. Note that the temperature controls of ±1°C will be required and will be interpreted as previously discussed.

Comment: Test chamber sizes specified for bioassay testing could be laboratory specific:

a. ITM Appendix E-1, *Mysid* shrimp and E-7, Fish: test chamber size is normally 1000 mL; 250 mL does not allow for sufficient removal of water samples for ammonia analysis.

b. ITM Appendix E-13, oyster and mussel embryos: size of the test chamber is highly variable. The stocking rate is determined by counting an aliquot of the stocking embryos and calculating the amount of material needed to achieve a stocking rate of 15-30 embryos per mL.

c. ITM Appendix E-14, sea urchin and sand dollars: size of the test chamber is highly variable and can range from 20 mL to 1 L. The normally used size is 125 to 250 mL.

d. ITM Appendix E-31, *Mysids*: test chamber size is normally 1 L with 200 mL of sediment. The study is run either as a static, renewal study or under intermittent flow through. A 250 mL beaker does not allow for sufficient removal of water samples for ammonia analysis.

e. ITM Appendix E-45, polychaetes: the laboratory should be given latitude to use chambers they have found to provide sufficient tissue for analysis. For *Neanthes,* larger chambers are needed to provide the numbers of worms necessary to provide adequate tissue. The use of the parameters described in the test condition summary will not be sufficient to provide adequate tissue volume.

f. ITM Appendix E-51, *Macoma nasuta*: the laboratory should be given latitude to use chambers they have found to provide sufficient tissue for analysis. For *Macoma,* larger chambers (20-30 L) are needed to provide the numbers of clams necessary (20-30 per replicate) to provide adequate tissue. The use of the parameters described in the test condition summary will not be sufficient to provide adequate tissue volume

Response: The ITM Appendix E summary sheets are abstracts from the referenced documents. Please note that DMMO is not responsible for, nor do we have the authority to modify the ITM. The following responses are for further clarification:

a. The 250 mL beaker size is stated as minimum. No upper limit is imposed.

b. DMMO agrees that rigid adherence to the test conditions provided in ITM Appendix E is not required. Adaptations to improve the efficiency of testing are allowed. Laboratories need only demonstrate that equivalent results are obtained when modifying test conditions. We have added wording to the guidance to make this clear.

c. The 20 mL is a specified minimum.

d. The 250 mL and 2 cm depth of sediment are specified minimums.

e. The 1 L specified is a minimum. Larger chamber sizes are permitted.

f. Section 7.4 of ASTM E 1688-00 states "Test chamber designs should consider the conditions required to maintain an adequate environment for the test organism."

Comment: ITM Appendix E-27, *Neanthes arenaceodentata*: the procedure described is a mixed test method based loosely upon the Reish growth test where five animals are stocked per chamber, the test is run for 20 days and the dry weights of the individual polychaetes are determined. For a 10-day acute test, larger chambers can be used, up to 3 L. Some flexibility should be given the laboratory to test this species appropriately.

Response: The 20-day growth protocol is not relevant to testing in San Francisco Bay at this time. Section 4 of ASTM E 1611-99 states that "[i]f smaller worms are used...five worms are placed in a 1-L glass test chamber..." It further states, "[i]f larger worms are used...ten worms are placed in a glass aquaria (4 to 37L)..." Based on this guidance, laboratories are free to choose the chamber size they deem efficient for each test.

Comment: The benthic toxicity testing as described in Section 11.2 of the ITM is not realistic. Dilution and nonabsorption of contaminants and sediments by benthos should be considered as a factor that influences the results.

Response: The benthic toxicity testing described is the national standard, accepted methodology. DMMO is not responsible for, nor do we have the authority to modify the ITM.

Comment: We agree that test preparation methods must eliminate confounding factors that may influence toxicity. However, a cost/benefit analysis must be applied to the proposed reduction of total ammonia to no more than 15mg/L. Because the purging curve is not linear, every incremental reduction can substantially increase the time required to complete the test. Additionally, reducing ammonia to 15 mg/L is only beneficial for certain species. The appropriate concentration of ammonia in test sediments should be determined on a species by species basis.

Response: The guidance regarding reduction of interstitial ammonia is a recommendation. Project proponents are not required to lower ammonia to less than 15 mg/l. They may choose to use the national guidance of 20 mg/l or may choose not to do any adjustment. DMMO has seen, however, evidence of ammonia-related toxicity at concentrations close to 15 mg/l. Failure to reduce the ammonia levels to less than 15 mg/l may result in confounding factors that could express themselves as false-positive toxicity results, especially in marginally contaminated samples. This could result in re-testing which is likely to be even more expensive for project proponents.

Bioaccumulation Testing

Comment: All heavy metals listed in Table 2 should also be included in Table 3 for bioaccumulation testing.

Response: Based on the current state of scientific knowledge, DMMO chose to include in Table 3 only those metals for which research has documented the potential for bioaccumulation.

Comment: "Extrapolation" factors should not be used to estimate "steady-state" tissue concentrations from 28-day bioaccumulation test data. The difference between steady state and 28-day body burdens is dependent on a number of factors and is highly site-specific. Few factors are available from the literature and those available tend to be overly conservative and unrealistic. For many chemicals and many sites, steady state can be reached in 28 days. The ITM does not require the use of such factors. Steady-state evaluations are discussed only under Tier IV.

Response: Guidance contained in the ITM (see Section 6.3) indicates that the time to reach steady state is dependent primarily on the compound of concern and "to a lesser extent" on the species being tested. The ITM suggests using a correction factor to estimate steady state exposure values from the results of the 28-day tests, based on the log K_{ow} of the compound of concern. Unless provided with additional information, DMMO does not propose to modify this part of the guidance. If project proponents believe these conditions will result in too conservative an estimate of bioaccumulation, they may choose to run longer test exposures, with tissues analyzed at multiple intervals, to confirm that steady state has been reached for all contaminants of concern (COCs). Please note that "extrapolation" factors are not used in comparing the test sediments to reference sediments to determine if bioaccumulation is occurring, but rather evaluate perform risk when significant bioaccumulation is determined to be occurring.

Comment: Bioaccumulation should not be "required" if contaminants are "suspected" at levels of concern. DMMO should allow confirmatory chemical testing and acute bioassays to verify the existence of contamination/toxicity prior to requiring costly bioaccumulation test exposures. It should be left up to the project proponents to decide whether they want to run exposures simultaneously or after results of chemistry and bioassay analysis are back. The commenter recommends removing "… or suspected…" from the fourth sentence of 5.3.1 of the guidance.

Response: By "suspected," DMMO means based on bulk sediment chemistry test results. Toxicity tests do not provide information regarding the potential for bioaccumulation or food web effects. DMMO would not normally require bioaccumulation testing without first having sediment chemistry results. (Also see response below.)

Comment: Bioaccumulation test exposures are much more expensive than tissue analysis and DMMO should not recommend that project proponents initiate them until chemical and bioassay [i.e., acute toxicity] results have been reviewed, if possible. It should be the prerogative of the project proponent whether to run exposures simultaneously or wait until results are in. Emphasis should be placed on the need to collect sufficient volume of sediment for all potential tests during the initial sampling event.

Response: Costs for running the 28-day bioaccumulation exposures are usually considerably less than costs for tissue analyses, but this varies by project, number of samples

being tested, and number of COCs. The guidance allows project proponents flexibility to initiate bioaccumulation tests simultaneous with the other tests, or to wait for results. By following the guidance, project proponents could potentially save time and money (especially if further sampling is necessary).

Comment: The narrative in section 5.3.6 about an ideal, rarely utilized, staged survey is unnecessary in the guidance. Guidance should advise the most practical approach to expedite sediment chemistry analyses, provide results to DMMO, and begin bioaccumulation tests if needed.

Response: Although the commenter is correct that such a staged testing situation is rare, we choose to retain this paragraph to inform project proponents of the appropriate procedures in an "ideal" situation. Text in the guidance should be clear that DMMO has no intention of requiring these procedures for each project.

Comment: If Theoretical Bioaccumulation Potential (TBP) is to be calculated, standard values for percent lipid and biota sediment accumulation factors (BSAFs) should be developed, with input from the stakeholders. Organic carbon content is site-specific. There are ranges of literature values for percent lipid and BSAF. The range of BSAFs for some chemicals varies widely. An open public process should be used to come to agreement on these methods.

Response: A comprehensive discussion of TBP is included in Section 10.2 of the ITM. In the absence of site- or contaminant-specific information, the ITM suggests a generic, conservative BSAF of 4. A number of references are available for contaminant-specific BSAFs, however. For example, USACE maintains a database, available at www.wes.army.mil/el/dots/database.html of BSAF values. Project proponents may choose to use the default value of 4, or to propose other values, with appropriate references.

Based on limited information, DMMO recognizes that lipid content may vary by a great deal, even in organisms of the same species. Ranges may be found in the literature and DMMO will work with project proponents to determine which values may be most appropriate.

Comment: Section 5.1.3, second sentence, indicates that bioaccumulation bioassays are not a measure of toxicity. The commenter suggests changing the sentence to read: "...combined with the results of benthic bioassays...."

Response: We have modified the sentence for clarification.

Comment: Reporting limits in Table 3 should be checked against MDLs for tissue samples.

Response: We have verified Table 3. It contains correct values for tissue reporting limits expressed in wet weights.

Comment: *Nephtys* should be allowed for bioaccumulation testing. This species can be tested in combination with *Macoma*. *Neanthes* is small and is not compatible with *Macoma* in the same chamber.

Response: DMMO agrees that *Nephtys* is appropriate for bioaccumulation testing. We have added it to the list of acceptable species.

Bioaccumulation Triggers

Comment: There are no bioaccumulation trigger values available for San Francisco Bay. Without trigger values, the basis for initiating bioaccumulation tests is questionable. The bioaccumulation trigger value for PCBs in Puget Sound is 38,000 µg/kg, total organic carbon (TOC) normalized. The guidance states that DMMO uses TBP to evaluate if bioaccumulation testing is required. However, the entire subject of bioaccumulation testing is really a "black box." More detail on the schedule and mechanism for developing and implementing bioaccumulation trigger values applicable to San Francisco Bay is needed.

Response: The agencies have formed a working group and are evaluating the potential for developing bioaccumulation triggers (screening values) for determining when bioaccumulation will be required for proposed in-Bay disposal. We are currently awaiting completion of a national bioaccumulation model, which we plan to modify for San Francisco Bay. We hope to publish draft values soon. DMMO will continue to use Best Professional Judgment in the interim for making decisions. We have no plans to adopt triggers or screening levels developed for other locations to make regulatory decisions regarding suitability of dredged material for disposal in San Francisco Bay.

Comment: If Sediment Quality Guidelines (SQG) are developed, all stakeholders need to be included in the process. For organic chemicals, criteria should be expressed normalized to TOC. A through literature search needs to be conducted before embarking on any development of sediment screening values. These values, if developed, should be based on sound science and not be arbitrary in nature.

Response: DMMO agrees; see also responses above.

Interpretation of Bioaccumulation Testing

Comment: Methods for evaluating bioaccumulation data [i.e., tissue concentrations] are based largely on Best Professional Judgment. Very little information is available to evaluate bioaccumulation, especially in the context of the disposal environment. In the absence of good data, a viable framework for decision-making needs to be constructed. This framework should include factors to consider in addition to chemical concentrations in sediment and tissue, such as sediment characteristics (e.g., TOC and grain size), disposal site characteristics (to evaluate fate and transport), volume of material to be disposed, time of year, disposal method, etc.

Response: A basic framework for interpreting bioaccumulation results is included in section 6.3 of the ITM and section 7.6 of the guidance. DMMO does take into account the various characteristics mentioned by the commenter (e.g., TOC and lipid content) when interpreting bioaccumulation test results. Although we recognize that this approach provides little predictability to the regulated public, interpretation of bioaccumulation is an active field of inquiry. As better tools and techniques become available we will incorporate them into future decision-making.

Comment: The third sentence in section 7.6.1 is not clear. A statistical comparison of test sediment to the reference sediment determines if bioaccumulation has occurred.

Response: The ITM has details regarding statistical analyses and interpretation of bioaccumulation data. This section of the guidance is not meant to replicate the ITM; rather, the pertinent section of the ITM is cited in Section 7.6.2 of the guidance.

Comment: Explain the FDA action levels and how they are related to real pathways and toxicity effects.

Response: As stated in Section 6.3 of the ITM, because contamination of food in excess of FDA levels is considered a threat to human health, DMMO considers concentrations greater than these levels in test organisms indicative of adverse impacts associated with bioaccumulation.

Reference Sites

Comment: Does the guidance calling for reference sediment to be tested concurrently with dredged material mean that project proponents must always collect and test reference and the option to utilize the Alcatraz Environs "database" is no longer an option?

Response: Project proponents may still use the reference database approach. DMMO's intent in this section of the guidance was to emphasize that when using reference sediment samples, they must be tested concurrently with project samples to minimize the risk of introducing confounding factors. We have modified the guidance to specifically allow use of reference database(s).

Comment: The reference site definition should soon be changed. The identification of these sites and the requirements and guidelines for the use of these sites need to be incorporated into the guidance.

Response: DMMO is actively working on guidelines to allow more appropriate (i.e., fine-grained, off-disposal site) reference sites. We hope to publish these guidelines by the end of FY01.

Comment: Although reference sites have been identified for San Francisco Bay, no such study has been conducted for the Central Coast. DMMO needs to begin this process immediately. Because this effort has not yet started, an interim policy on reference sites in the Central Coast needs to be developed. Once reference sites are established, the requirements and guidelines for the use of these sites need to be incorporated into the guidance.

Response: Because the scope of this guidance is now limited to San Francisco Bay, it is not appropriate to include reference sites outside of San Francisco Bay in this document. We encourage project proponents and other interested parties to contact USACE SF District to evaluate the need for reference sites in other locations within the District.

Interpretation of Sediment Analyses

Comment: The last sentence of section 7.1 should be deleted or rewritten. It may cause serious restrictions on a decision made to protect sensitive aquatic ecosystems. The Federal and State agencies should be allowed the flexibility to work together and develop a consensus opinion on the suitability of sediment for unconfined aquatic disposal without the potential restrictions suggested by this sentence.

Response: The sentence in question provides an elaboration of the "preponderance of information" approach to suitability determinations, which is also further addressed in section 7.5.1, which describes the "one hit rule." We do not agree that the sentence limits the flexibility or authority of DMMO in making suitability determinations, and have not modified this portion of the guidance.

Comment: The guidance needs to clarify and specify which documents and criteria are used to evaluate sediment chemical concentrations. At the workshop held on the ITM in 1999, the RWQCB ambient concentration document [i.e., the Regional Monitoring Program report] was mentioned. If this document is used to evaluate suitability, this document should be cited in the guidance. Other documents used in test interpretation should also be listed and a flowchart with the decision rules presented. Such tools would ensure consistent interpretation of test results between projects, provide valuable information that can be used in planning of sediment sampling and testing programs, and provide an understanding of the decision-making process to all stakeholders.

Response: There are no established sediment quality values directly applicable to regulatory decisions about San Francisco Bay sediments at this time. All information available and relevant is considered by DMMO in project evaluations. For example, the RWQCB ambient concentrations are used as screening values. If sediment chemical concentrations are at or below ambient levels, this is one indication that excess adverse effects might not be expected. Other references, including information on sediment quality guidelines or criteria used elsewhere, are also considered in DMMO evaluations, as appropriate. We have included the citation for the RWQCB's Regional Monitoring Program report in the revised guidance.

Comment: Sections 7.3 and 7.4 of the guidance should reference the State and Federal Water Quality Criteria that must be complied with for a project to be authorized. Acknowledgement of these criteria will aid the Federal and State project reviewers in assessing the impacts of a proposed project and it will also inform project proponents about the criteria with which their projects need to comply.

Response: Sections 7.3 and 7.4 explicitly note the need for compliance with both the State's numeric and narrative water quality criteria. We have modified the guidance to note that the RWQCB and USEPA will update DMMO with specific water quality criteria as necessary. Please also note that Federal water quality standards are not directly applicable in State waters, such as San Francisco Bay.

Comment: Please define and explain this sentence: "Sediment samples should "pass" each applicable physical, chemical and biological tests in order to be considered SUAD" in section 7.1 of the guidance.

Response: DMMO agrees that this sentence does not adequately express our intent, and have revised the sentence. Please refer to the new "Definitions" section in the revised guidance.

Reporting and Detection Limits

Comment: Please provide information on the significant changes between the detection limits in PN 93-2 and the reporting limits in the guidance. Lower detection limits for the analysis of dredged material proposed for disposal should be used.

Response: The reporting limits in Table 2 of the guidance were chosen based on ambient values in sediments of San Francisco Bay. (Please note that reporting limits are, by definition, higher than detection limits - see the sidebar in Section 4.2 of the guidelines about limits.) These changes were made in an effort to provide DMMO with adequate information to identify contaminant concentrations that may be of concern, without incurring undue costs to project proponents. In certain cases, reporting limits may be modified for project specific requirements. Arbitrarily requiring current state of the art detection (or reporting) limits would only serve to drive up the cost of analyses without necessarily providing information pertinent to decision making

Comment: The Reporting Limit(s) in Table 2 may not be achieved by laboratories at a reasonable cost.

Response: See previous response. In some cases, the reporting limits are higher (easier – and cheaper - to achieve) than previous detection limits required under PN 93-2. DMMO believes that these levels are routinely attainable, at reasonable cost.

Comment: Because sediments are complex matrices, the specified reporting limits are not always achieved, due to matrix interferences. Please clarify whether J-qualified (estimated) results will be accepted in these instances. In some cases, additional cleanups can be performed to achieve lower detection limits. However, in cases where matrix interferences are severe, there may be no techniques that will achieve these limits.

Response: Laboratories should always strive to meet required reporting limits, and in some instances, this may entail additional cleanup steps. DMMO recognizes that matrix effects can cause interferences. J-qualified estimates are usually acceptable. Results may not be acceptable when reported as ND or <MDL where the reporting limit is substantially higher than that required. Laboratories that cannot achieve the listed reporting limits within a factor of two should note this in SAPs and Results Reports. If the difference between the guidance reporting limit and the laboratory's reporting limit is greater than a factor of two, the laboratory should consult with DMMO prior to proceeding with the analysis.

Sediment Quality Guidelines and Water Quality Criteria

Comment: The agencies need to adopt Sediment Quality Criteria (SQC); lack of SQC is an obstacle to the implementation of the ITM and this guidance.

Response: DMMO does not intend to adopt SQC, that is, concentrations of COCs that would be used for pass/fail decisions for in-Bay disposal. The lack of SQC does not, however, hinder implementation of the ITM. Sediment chemistry values aid in decision making regarding the need for bioaccumulation testing and in cases where benthic and water-column toxicity test results are ambiguous. DMMO does hope to adopt SQG that will be used as screening values in the Bay Area for determining when bioaccumulation testing will be recommended (see comments and responses regarding Bioaccumulation Triggers).

Comment: The text in Section 7.3 and 7.4 implies that both biological- and chemical-based water quality standards will be developed. The process of developing any criteria or standards with which to judge suitability needs to include all stakeholders.

Response: Sections 7.3 and 7.4 discuss **water** quality criteria, not **sediment** quality criteria. The reference to water quality criteria was intended to refer to the prohibition against discharge of "toxic substances in toxic amounts," which is assessed by the water-column bioassays. DMMO has no authority to modify water quality criteria. (See also response above regarding sediment quality.)

Definitions

Comment: Request definition of the following terms:
Section 8.1 "pass"
Section 8.1 "appropriate permitted upland location"
Section 8.2 "hot spot"
Section 8.3 "higher resolution testing"

Response: Definitions have been added to the guidance.

Miscellaneous

Data Quality Objectives

Comment: DMMO should consider using the Data Quality Objective (DQO) process in developing guidelines for sampling, testing, and evaluating the suitability of dredged materials, especially given the goals of the LTMS. All of the different disposal options have different "acceptability" criteria. The DQO process would allow the agencies together with the stakeholders, to build a framework that could work for all potential disposal options. The DQO process identifies, up front, the decision to be made and the data quality and quantity needs to support these decisions.

Response: DMMO agrees that the DQO process is useful, and will consider scheduling a workshop to obtain interested party input. Modification of the guidelines could occur after a public process for developing a DQO approach. In the meantime, we encourage, but do not require, project proponents to follow the DQO process.

SAPs and Results Reports

Comment: Section 3.1 of the guidance should note that all final SAPs should be approved in writing by the USACE SF District, in consultation with other Federal and State regulatory and resource agencies.

Response: The current practice is that the host agency (USACE SF District) writes a letter to the project proponent approving the SAP after the document has been reviewed by DMMO. The exception is that USACE SF District project proponents do not receive a formal letter. We have added an explanation of this to the SAP guidance (originally published as PN 99-4, "Proposed Guidance for Sampling and Analysis Plans (Quality Assurance Project Plans) for Dredging Projects within the USACE San Francisco District").

Comment: The suggested outline for test result reports, which was in PN 93-2, was omitted from the guidance. A report format should be included (amended from PN 93-2, as needed).

Response: The DMMO has developed much guidance on preparing SAPs and data reports. This guidance was published originally as PN 99-4, "Proposed Guidance for Sampling and Analysis Plans (Quality Assurance Project Plans) for Dredging Projects within the USACE San Francisco District."

References

Comment: The three-volume Battelle report (1994), which includes testing methods for physical, chemical, and bioassays for many analytes and species, should be included in the reference list in Section 1.2. Also include the Battelle report in the reference section.

Response: The 1994 Battelle report contains valuable information and may form one basis for our planned Regional Implementation Manual. We have included it as a reference in the guidance. DMMO, however, considers this document dated; we are not using it as stand-alone guidance.

Comment: The first sentence under "References" states that the list replaces all 17 pages of references in Chapter 13 of the ITM. Is this is correct?

Response: It was not the intent to replace all the ITM references, but to update and supplement them. We have clarified this sentence.

Comment: The reference list provided does not include a protocol specifically applicable to amphipod bioassays.

Response: We only included new and updated references in our guidance. ASTM E 1367 was not listed, because at the time we issued the guidance, the reference in the ITM was current. The revised guidance contains a reference to ASTM E 1367-99.