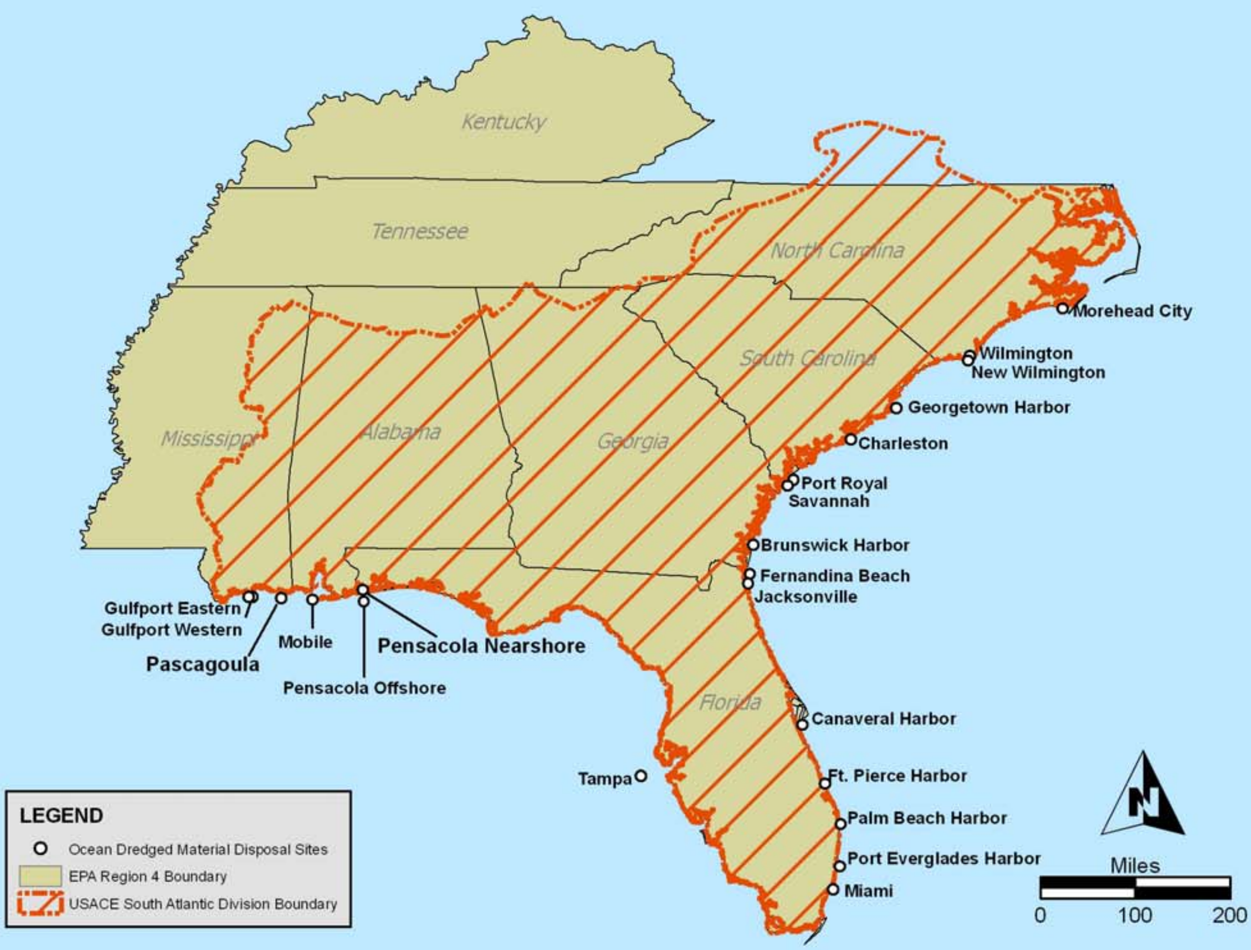
# Southeast
# Regional Implementation Manual
# (SERIM)

US Army Corps
of Engineers
South Atlantic Division

Region 4

## Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coast Waters




August 2008

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EPA 904-B-08-001
August 2008

# Southeast Regional Implementation Manual (SERIM)

## Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coast Waters

Prepared by:

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and

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EPA Contract No. EP074000027

August 2008

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The U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE) published national guidance on procedures to be followed when assessing the suitability of dredged material for disposal in the ocean. That guidance is entitled: *Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual* (1991 Green Book) (56 Federal Register 13826, April 4, 1991) and requires the development of Regional Implementation Agreements for activities regulated under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 USC 1401 et seq.).

In March of 1993, the U.S. EPA Region 4 and the USACE South Atlantic Division (SAD) finalized a Regional Implementation Manual (RIM) that complied with the national guidance in the 1991 Green Book. This revision replaces and supersedes the 1993 RIM and has been approved by the following officials of EPA Region 4 and USACE SAD, and goes into effect upon the date of the last signature below:

J. I. Palmer Jr.
Regional Administrator
Region 4
U.S. Environmental Protection Agency

8/25/08

Date

Brigadier General Joseph Schroedel
Division Engineer
South Atlantic Division
U.S. Army Corps of Engineers

25 Aug 2008

Date

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# PREFACE

This *Southeast Regional Implementation Manual (SERIM) for Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coast Waters* was prepared cooperatively by the U.S. Environmental Protection Agency - Region 4 (EPA Region 4) and the U.S. Army Corps of Engineers – South Atlantic Division (SAD), and with the assistance of ANAMAR Environmental Consulting, Inc. in accordance with federal authorities per Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA) and the 1991 *Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual* (the 1991 Green Book). This SERIM supersedes previous editions of the USACE SAD/EPA Region 4 Regional Implementation Manual.

The purpose of this document is to provide guidance for applicants, permittees, and USACE SAD districts and EPA Region 4 staff evaluating ocean disposal of dredged material in southeastern U.S. coastal waters of the Atlantic Ocean and the Gulf of Mexico. Reflected herein are advances in scientific methodologies and environmental evaluation since publication of the May 1993 RIM. Important changes include:

- Clarification on permit application and coordination requirements,
- Reference site selection,
- Identification of contaminants of concern,
- Additional guidance on sampling and sample handling,
- Advances in chemical testing,
- Updated reporting limits,
- Species and test conditions for biological testing,
- Additional bioaccumulation interpretation guidance,
- Guidance on data reporting and statistical analysis, and
- Prior approval of SAPs and laboratory Quality Assurance Plans (QAPs) that meet rigorous quality assurance/quality control (QA/QC) requirements.

This document should be cited as:

USEPA/USACE. 2008. *Southeast Regional Implementation Manual (SERIM) for Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coast Waters*. EPA 904-B-08-001. U.S. Environmental Protection Agency Region 4 and U.S. Army Corps of Engineers, South Atlantic Division, Atlanta, GA.

# DISCLAIMER

This technical manual provides a compilation of current information and recommendations for collecting, handling, and manipulating sediment samples for physicochemical characterization and biological testing that are most likely to yield accurate, representative sediment quality data based on the experience of many monitoring programs and researchers. EPA and USACE may update this manual in the future as better information becomes available.

Mention of trade names, products, laboratories, or services does not convey and should not be interpreted as conveying, official USEPA or USACE approval, endorsement, or recommendation for use.

The policies set out in this document are not final agency action, but are intended solely as guidance. They are not intended, nor can they be relied upon, to create any right or benefit, substantive or procedural (including without limitation, that of judicial review), enforceable at law or equity against EPA or USACE, their officers or employees, or any other person. Nothing in this document is intended to alter any specific statutory and regulatory authorities or responsibilities assigned to EPA or USACE. EPA and USACE officials may decide to follow the guidance provided in this document, or to act at variance with the guidance, based on an analysis of specific site circumstances.

Reasonable efforts were made to provide accurate website links in this document. To our knowledge, these links were accurate as of April 2008.

# ACKNOWLEDGEMENTS

This document was produced with the assistance and attention to detail of many people working together. This manual was prepared by a joint EPA Region 4 and USACE South Atlantic Division work group consisting of the following members: Christopher McArthur, Doug Johnson, and Gary Collins, EPA Region 4; Daniel Small, South Atlantic Division; Philip Payonk, Wilmington District; Robin Socha, Charleston District; Steve Calver, Savannah District; Glenn Schuster, Jacksonville District; and Susan Rees and Jennifer Jacobson, Mobile District. Their considerable efforts in identifying and researching the changes that have occurred since the Region 4 – South Atlantic Division RIM was last produced in 1993 are appreciated.

The following people from the private sector were also contributors to this document: Nadia Lombardero of ANAMAR Environmental Consulting, Inc. (contractor to EPA) for her dedication and commitment to the project; Chris Osuch of Weston Solutions, Nancy Kohn of Battelle, and Wayne McCulloch of EA Engineering for their assistance to ANAMAR in responding to questions on Appendix L, Test Conditions; Jeff Christian of Columbia Analytical Services and Mark Coleman from Law Engineering and Environmental Services, Inc. for their assistance to ANAMAR in responding to questions on Appendix O, Quality Control Summary Tables. We would also like to thank the countless others who worked diligently on the document.

Much of the guidance in this manual was compiled from various EPA and USACE regional publications, such as the various San Francisco Bay Dredged Material Management Office guidance documents (guidance on sampling and analysis plans and Tier I reviews), the Dredged Material Evaluation Framework for the Lower Columbia River Management Area (guidance on sediment sampling and organic tin analysis), and the Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters (guidance on quality control). The contributions of the original authors are gratefully acknowledged.

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# ACRONYMS

*(To enable the reader to more easily consult this list of acronyms while reviewing a hard copy, it is repeated as an 11"x17" foldout on the last sheet in the document.)*

| | |
|---|---|
| 1991 Green Book | Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual (EPA and USACE, 1991) |
| APHA | American Public Health Association |
| ASTM | ASTM International (formerly American Society for Testing and Materials) |
| CCC | Criteria Continuous Concentration |
| CDD | Chlorinated dibenzo-p-dioxin(s) |
| CDF | Chlorinated dibenzofuran(s) |
| CFR | Code of Federal Regulations |
| CMC | Criterion Maximum Concentration |
| COC(s) | Contaminant(s) of Concern |
| CWA | Clean Water Act |
| DU | Dredging Unit |
| EPA (USEPA) | U.S. Environmental Protection Agency |
| FDA | Food and Drug Administration |
| GC/FPD | Gas Chromatograph/Flame Photometric Detection |
| HMW | High Molecular Weight (PAHs) |
| ITM | Inland Testing Manual (EPA, 1998) |
| LDC | London Dumping Convention |
| LMW | Low Molecular Weight (PAHs) |
| LPC | Limiting Permissible Concentration |
| LRL | Laboratory Reporting Limit |
| MPRSA | Marine Protection, Research, and Sanctuaries Act of 1972 |
| N/A | Not Applicable |
| NELAC | National Environmental Laboratory Association Conference |
| NEPA | National Environmental Policy Act |
| NOAA | National Oceanic and Atmospheric Administration |
| NPDES | National Pollutant Discharge Elimination System |
| O&M | Operation and Maintenance |
| ODMDS | Ocean Dredged Material Disposal Site |
| PAH | Polynuclear Aromatic Hydrocarbons |
| PCB | Polychlorinated Biphenyl |
| QA/QC | Quality Assurance/Quality Control |
| QAP | Quality Assurance Plan |
| QAPP | Quality Assurance Project Plan |
| RIM | Regional Implementation Manual |
| SAD | South Atlantic Division (USACE) |
| SAP | Sampling and Analysis Plan |
| SERIM | Southeast Regional Implementation Manual |
| SMMP | Site Management and Monitoring Plan |
| SOW | Scope of Work |
| TBD | To Be Determined |
| TBP | Theoretical Bioaccumulation Potential |
| TDL | Target Detection Limit |
| USACE | U.S. Army Corps of Engineers |
| USCS | Unified Soil Classification System |
| WQC | Federal Water Quality Criteria |
| WQS | State Water Quality Standards |

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# GLOSSARY

**Advance Maintenance:** Advance maintenance is dredging to a specified depth and/or width beyond the authorized channel dimensions in critical and fast-shoaling areas to avoid frequent re-dredging and ensure the reliability and least overall cost of operating and maintaining the project authorized dimensions.

**Criteria Continuous Concentration (CCC):** An estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

**Criterion Maximum Concentration (CMC):** An estimate of the highest concentration of a pollutant in saltwater, to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.

**$EC_{50}$:** $EC_{50}$ is the median effective concentration. The concentration of a substance that causes a specified effect (generally sublethal rather than acutely lethal) in 50% of the organisms tested in a laboratory toxicity test of specified duration.

**Effects Range-Low (ER-L):** Sediment screening values that represent the value at which toxicity may begin to be observed in sensitive species.

**Laboratory Reporting Limit (LRL):** Minimum level at which a lab will report analytical chemistry data with confidence in quantitative accuracy of that data. LRLs are adjusted for sample-specific parameters such as sample weight, percent solids, or dilution.

**$LC_{50}$:** $LC_{50}$ represents the median lethal concentration. The concentration of a substance that is lethal to 50% of the organisms tested in a laboratory toxicity of a specified duration.

**Method Detection Limit (MDL):** The minimum concentration of a substance that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero.

**Non-Pay Dredging:** Non-pay dredging is dredging outside the paid allowable overdepth that may and does occur due to such factors as unanticipated variations in the substrate, incidental removal of submerged obstructions, or wind or wave conditions. In environmental documentation non-pay dredging is normally recognized as a contingency allowance on dredging quantities and may and does occur in varying magnitude and locations during the construction and maintenance of a project.

**Paid Allowable Overdepth:** Paid allowable overdepth dredging (depth and/or width) is a construction design method for dredging that occurs outside the required authorized dimension and advance maintenance (as applicable) prism to compensate for physical conditions and inaccuracies in the dredging process and allow for efficient dredging practices. The term "allowable" must be understood in the contracting context of what dredging quantities are eligible for payment rather than in the regulatory context of what dredging quantities are reflected in environmental compliance documents or permits.

**Porewater:** Refers to water that fills the interstitial space between sediment grains in sedimentary deposits. Porewater may be displaced due to the activities of benthic fauna or by physical processes such as compaction.

**Quality Assurance (QA):** The total integrated program for assuring the reliability of data. A system for integrating the quality planning, quality control, quality assessment, and quality improvement efforts to meet user requirements and defined standards of quality with a stated level of confidence.

**Quality Assurance Project Plan (QAPP):** A Quality Assurance Project Plan documents the planning, implementation, and assessment procedures for a particular project, as well as any specific quality assurance and quality control activities. It integrates all the technical and quality aspects of the project in order to provide a "blueprint" for obtaining the type and quality of environmental data and information needed for a specific decision or use.

**Quality Control (QC):** The overall system of technical activities for obtaining prescribed standards of performance in the monitoring and measurement process to meet user requirements.

**Sampling and Analysis Plan (SAP):** A Sampling and Analysis Plan (SAP) expands upon the contents provided in the SOW and should include specific information regarding sampling sites, field sampling requirements, laboratory analyses and final report content.

**Scope of Work (SOW):** A contract addendum used as a legally binding agreement between the individual or organization requesting an analysis and the individual, laboratory, or organization performing the actual tasks.

**Standard Operating Procedure (SOP):** A written document that details an operation, analysis, or action whose mechanisms are thoroughly prescribed and that is commonly accepted as the method for performing certain routine or repetitive tasks.

**STFATE:** **S**hort **T**erm **Fate** of dredged material disposal in open water models, simulates the movement of the disposed material as it falls through a water column, spreads over the bottom and is transported and diffused as suspended sediment by the ambient current.

**STORET:** Short for **STO**rage and **RET**rieval, is a repository for water quality, biological, and physical data and is used by state environmental agencies, EPA and other federal agencies, universities, private citizens, and many others.

**Threshold Effect Level (TEL):** Sediment screening values that represent the concentration below which adverse effects are expected to occur only rarely.

**Target Detection Limit (TDL):** TDL is a performance goal set greater than the lowest, technically feasible detection limit for routine analytical methods and less than the available regulatory criteria or guidelines for evaluating dredged material

**Whole Sediment:** The sediment and interstitial waters of the proposed dredged material or reference sediment that have had minimal manipulation.

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# 1.0 INTRODUCTION

## 1.1 Overview

The potential adverse effects from the ocean disposal of dredged material in the marine environment can range from unmeasurable to significant. These effects may vary depending on many factors, including the composition of the proposed dredged material and the disposal site location. As a result, dredging and disposal operations are evaluated on a case-by-case basis. Federal regulations require such evaluations, with emphasis on potential biological impacts from the disposal of dredged material in the marine environment. According to Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA), any proposed disposal of dredged material in the ocean waters of the United States must be evaluated according to the criteria published by the U.S. Environmental Protection Agency (EPA) in Title 40 of the Code of Federal Regulations (CFR), Parts 220-228. The actual evaluation is conducted by the U.S. Army Corps of Engineers (USACE), which is the permitting agency for the transportation of dredged material to the ocean for the purpose of disposal, subject to EPA review and concurrence. MPRSA and Part 225 allow a waiver of the criteria, in extreme cases, if the proposed action is denied by EPA, but dredging is essential and feasible alternatives are unavailable. Only the Secretary of the Army may request a waiver and only the EPA Administrator may grant such waivers [40 CFR Part 225.4].

## 1.2 Federal Regulations and Guidance

The manual entitled *Evaluating Environmental Effects of Dredged Material Management Alternatives – A Technical Framework* (EPA and USACE, 2004) provides a consistent roadmap for the USACE and EPA personnel in evaluating the environmental acceptability of dredged material management alternatives. The major objectives of the document are to provide a general framework for evaluating dredged material management alternatives, supplement present implementation and testing manuals, and enhance consistency and coordination in USACE/EPA decision-making in accordance with federal environmental statutes regulating dredged material management. Additional national guidance for the evaluation of dredged material under the MPRSA Section 103 program is provided in the *Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual* (EPA and USACE, 1991). This manual, more commonly known as the "1991 Green Book," includes a description of the tiered approach to sediment testing. Included in the manual are methods and procedures for sediment sampling and testing, general guidance on bioassay and bioaccumulation testing, and an overview of data analyses and quality control/assurance procedures. The 1991 Green Book supersedes the 1977 Green Book (EPA and USACE, 1977).

The 1991 Green Book and ocean dumping regulations stress the use of effects-based-testing bioassays as evaluative tools necessary to determine suitability of material for ocean dumping. If the results of the appropriate tests/evaluations show that the proposed dredged material meets the criteria under 40 CFR 227, disposal of the material at an EPA-designated or USACE-selected ocean dredged material disposal site (ODMDS) is supported. Per 40 CFR 227.13(c), evaluation of dredged material focuses on biological effects rather than the concentration of contaminants. Bioassays are used to predict environmental effects because they are regarded as the best methods available for integrating the effects of multiple contaminants and for comparing the relative impacts of different dredged materials. Test organisms integrate and quantify the effects of chemical and physical constituents of a dredged material. Contaminant-based effects in the sediment can then be assessed in a holistic manner.

## 1.3 Regional Guidance

A Regional Implementation Manual (RIM) was developed in 1993 and represented an agreement between EPA Region 4 and USACE SAD districts within EPA Region 4 for the use of the 1991 Green Book. This document updates and supersedes the 1993 RIM. The SERIM documents testing and reporting guidance for the ocean disposal of dredged materials along the Atlantic and Gulf coasts of the southeastern United States. This agreement is based on USEPA regulations promulgated to implement Section 103 of the MPRSA of 1972. The guidance provided in this manual can be applied to all permit applicants and Federal Civil Works Projects (hereinafter referred to as Civil Works) that are subject to the criteria defined in EPA's Ocean Dumping Regulations in 40 CFR Parts 225 and 227.

> Additional information, beyond that called for in this SERIM, may be required for a proposed project depending on the nature and location of that project. In most cases, the project will also need to satisfy state regulatory requirements.

USACE SAD districts will provide a complete package, compiled from all available information, to EPA Region 4 and other pertinent regulatory agencies for review and comment. This is in addition to any required Public Notice. This information will serve as the basis for determination of permit issuance and/or subsequent enforcement, if necessary, under MPRSA Sections 105 and 107.

This SERIM provides EPA Region 4 and USACE SAD district personnel with guidance in carrying out their respective roles, and informs state regulatory agencies, permit applicants, and other interested parties, regarding federal regulatory requirements and coordination procedures for the ocean disposal of dredged material within the USACE SAD and EPA Region 4. Information in this SERIM includes the following:

A. Program Coordination
B. Administrative Requirements
C. Tiered Testing and the 1991 Green Book
D. Sediment Sampling
E. Physical and Chemical Testing
F. Bioassay and Bioaccumulation Testing
G. Statistical Analyses
H. Sediment Testing Report Format
I. Quality Control and Quality Assurance

New information is continually being developed by the Ocean Dredged Material Disposal Program. This information includes new regulations, national program guidance, dredging and disposal management operations, as well as scientific improvement in sediment testing procedures. When these new developments warrant changes in procedures, this SERIM will be updated. Clarifications and questions pertaining to this manual should be directed to EPA Region 4 or the appropriate USACE SAD district office (Appendix A).

Copies of the EPA/USACE 1991 Green Book and *Evaluating Environmental Effects of Dredged Material Management Alternatives - A Technical Framework* (EPA and USACE, 2004) are available at:

http://www.epa.gov/OWOW/oceans/gbook/index.html and

http://www.epa.gov/owow/oceans/regulatory/dumpdredged/evaluation.html, respectively.

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# 2.0 EPA REGION 4/USACE SAD OCEAN DISPOSAL PROGRAM COORDINATION

## 2.1 General Principles

USACE SAD districts and EPA Region 4 work cooperatively in the management of the Ocean Dredged Material Disposal Program to ensure that each agency's responsibilities are met. Coordination occurs through formal review processes and informal staff communications. The process will vary depending on whether the project is a USACE-sponsored Civil Works project or a project requiring a MPRSA 103 permit. In the case of Civil Works projects, USACE does not issue a permit [see MPRSA Section 103(e)]. In lieu of the permit procedure, USACE has issued regulations (see 33 CFR Parts 335-338) that require application of the same criteria, other factors to be evaluated, the same procedures, and the same requirements that apply to the issuance of permits.

Should concern arise during the process, EPA Region 4 and USACE SAD districts will resolve identified problems as early as possible to avoid potential project delays. Consequently, information critical to determinations regarding the suitability of dredged material for ocean disposal is required by USACE SAD districts and EPA Region 4 at the earliest reasonable time. Appendices C (MPRSA Ocean Disposal Evaluation Documentation), D (Sediment Testing Report Format) and J (Sampling and Analysis Plan and Testing Report Reviewer's Checklists) describe this information. All coordination with EPA Region 4 for activities involving ocean disposal of dredged material is the responsibility of the respective USACE SAD district office.

The initial step in the process is to determine the need for ocean disposal and evaluate alternatives to ocean disposal of dredged material (see 40 CFR Section 227.15). Under MPRSA Section 103, USACE is required to consider alternatives to ocean disposal. EPA Region 4 and USACE SAD districts, as well as any applicants or local sponsor, will work cooperatively to identify potential alternatives. No single alternative should initially be considered more desirable than another. Ocean disposal cannot automatically be considered the most desirable alternative, and each evaluation should be made on a case-by-case basis.

There are two points in the MPRSA Section 103 evaluation process where coordination and communication are important to project success: (1) the need for testing determinations (i.e., exclusionary criteria and test plan development), and (2) the MPRSA Section 103 evaluation determination. The following sections describe the needed information and timelines for EPA Region 4 and USACE SAD districts for these two coordination points. A coordination schedule is provided in Appendix B.

## 2.2 Exclusionary Criteria, Need for Testing, and Sampling and Analysis Plan Development

USACE SAD districts and EPA Region 4 should evaluate available information early in the review of proposed dredging projects to determine whether the dredged material needs testing and, if so, how the testing should be accomplished. Appendix C (Sections 1 and 2) describes the information that should be used by the USACE SAD district and EPA Region 4 to make these decisions and avoid delays in project implementation.

Information on the proposed dredging site, sediment grain size, and potential for contamination is used to determine whether the exclusion criteria are met [40 CFR 227.13 (b)]. Core boring logs; dredging design specifications; area hydrology; and locations, quantities, history, and types of pollutants discharged upstream of the proposed dredging are used for this determination. If the criteria are not met, additional information on previous testing (results and dates) and dredging (dates and extent of dredging) are used to determine the testing needs.

Should testing be required, the previously mentioned information should also be used in development of a sampling and analysis plan (SAP). This plan should include mutually agreed upon contaminants of concern (COCs), target detection limits, test organisms, number and location of samples, sampling procedures, and other plan components. Section 4.1 provides guidance on development of SAPs. Dredging projects are most likely to be approved and completed successfully with minimal delays when all parties agree beforehand on the scope and adequacy of necessary sediment technical evaluations, including sampling (i.e., number and location of stations, including the reference) and testing (i.e., appropriate COCs, test organisms). Therefore, USACE SAD districts (and applicants in the case of permitted projects) should provide draft SAPs, or their equivalent contained within draft testing contract Scope of Work (SOW), to EPA Region 4 for review. The SAPs should reflect the evaluation and testing framework contained within the 1991 Green Book or subsequent revisions, this document, and any current Site Management and Monitoring Plan for the ocean disposal site to be used. Approval of the SAP is required, as it is in the best interest of the applicant or the USACE SAD district in order to avoid requests from EPA Region 4 for additional information after sampling has been conducted. EPA Region 4 agrees to make every effort to provide comments on all draft SAPs within 15 to 30 days (2 to 4 weeks). Review time will depend on the level of EPA Region 4's prior involvement and familiarity with the project.

USACE SAD districts (and/or applicant) should immediately coordinate with and seek concurrence from EPA Region 4 (and the USACE SAD district if applicant) regarding any problems that arise during sampling and/or testing that may require modification of any substantive provision of the final SAP. These may include, but are not limited to: (1) adjustments to sample locations made in the field, (2) proposed changes in chemical analytical techniques or bioasssay test species, and (3) any proposal to retest if bioassay responses (including in control or reference exposures) are felt to be abnormal. Any such deviations from the final SAP must be fully documented in the project evaluation report(s) containing the results of the testing program carried out under the SAP.

The time frame to complete an assessment of the need for testing, developing a test plan, collecting and analyzing samples, running biotoxicity and bioaccumulation tests, performing appropriate statistical analyses, and preparing the sampling and testing report could take 8 months or longer (see Appendix B-Section 103 Coordination Schedule). To complete required evaluations, the process should be started at least 10 months prior to the intended dredging. If the project is likely to be more complex, additional time should be allowed.

## 2.3 Administrative Permit Requirements

MPRSA Section 103 permits for the transportation of dredged material for the purpose of disposal at an approved ODMDS are issued by USACE SAD district offices. MPRSA Section 103 applications should be consistent with USACE permitting regulations in 33 CFR Parts 320 to 330. All information submitted as part of the MPRSA application process should also comply with EPA Ocean Dumping Regulations in 40 CFR Parts 220 to 228.

USACE SAD districts will coordinate all sediment testing plans with EPA Region 4. Pre-application conferences to prepare appropriate sampling plans are encouraged for all MPRSA Section 103 permit applicants. Upon receiving all necessary information from the applicant, USACE SAD districts will provide for EPA Region 4 review the complete documentation of the project evaluation conducted under the SAP in the form of a Section 103 evaluation. This information can be provided prior to, with, or after the Public Notice. The evaluation reports will be consistent with the information provided in Appendix C and will be accompanied by a Section 103 Sediment Testing Report (Appendix D) and draft permit conditions necessary for implementation of the ODMDS Site Management and Monitoring Plan (SMMP).

USACE SAD districts are responsible for coordination of all federal actions, including EPA Region 4 concurrences, pertaining to MPRSA Section 103 applications. The applicant may also need to coordinate activities with the appropriate state regulatory agencies for compliance with Section 401 of the Clean Water Act and the State Coastal Management Program [Coastal Zone Management Act Section 307(c)]. A schedule for coordination is provided in Appendix B.

The permit process is outlined in Figure 2-1 and consists of 10 main steps:

1. **Pre-application Consultation**: Includes discussion of the need for the dredging project and a discussion of alternatives and the qualitative and quantitative information required by the District Engineer for use in evaluating the proposed dredged material.
2. **Evaluation of Dredged Material Proposed for Ocean Disposal**: Includes development, approval, and implementation of the SAP. This step should include close coordination between EPA Region 4, USACE SAD districts, and the applicant (see Section 2.2).
3. **Permit Application**: According to 33 CFR 325.1, a permit application must include the items listed in Table 2-1.
4. **Review of Application for Completeness**:
   a. Additional information is requested if the application is incomplete.
   b. Applicant is given the opportunity to respond according to each district's review schedule.
5. **Public Notice**: If the application is complete, USACE issues a Public Notice per 33 CFR 325.3. The notice must include all of the information required in 33 CFR 325.3(a), including the information required by 40 CFR 225.2(a) (see Table 2-2). A supplemental revised or corrected Public Notice will be issued if the District Engineer believes the new information affects the review of the proposal.

6. **USACE Section 103 Evaluation**: Either before, with, or after issuance of the Public Notice, USACE's District Engineer will submit to EPA Region 4 its determination of compliance with criteria (40 CFR 227 and 228) and the basis for that determination in the form of a Section 103 evaluation (see Appendix B). If the District Engineer or EPA Region 4 does not find the material to be in compliance, the project is modified or the waiver process is initiated (40 CFR 225.3 and 225.4):
   a. Economically feasible alternatives are reviewed. If an adequate alternative is identified, the decision to deny a permit is discussed in either a Statement of Findings or Record of Decision.
   b. If no alternatives are available, a request for waiver from the Chief of Engineers is applied for.
   c. The EPA Administrator reviews the waiver request and either denies or grants the waiver.
7. **EPA MPRSA Review**: Independent review of the information will be performed to determine whether the disposal activity complies with the criteria found in 40 CFR 227 and 228. This includes a review of all necessary physical, chemical, and biological tests. Refer to Table 2-3 for detailed explanations of EPA MPRSA review periods.
8. **USACE Public Interest Review**: USACE must consider all comments, suggestions, and concerns provided by all commenters and incorporate their comments into the administrative record of the application. If the permit is determined to be contrary to the public interest, the decision to deny a permit is discussed in either a Statement of Findings or a Record of Decision.
9. **Other Permits**: If the permit is not contrary to the public interest, review of other required permits needs to be addressed. If applicable, other application permits from federal and state agencies need to be obtained.
10. **Permit Issued**: A decision to issue a permit is discussed in either a Statement of Findings or a Record of Decision, and a Permit Public Notice with a list of permit decisions is published by USACE.

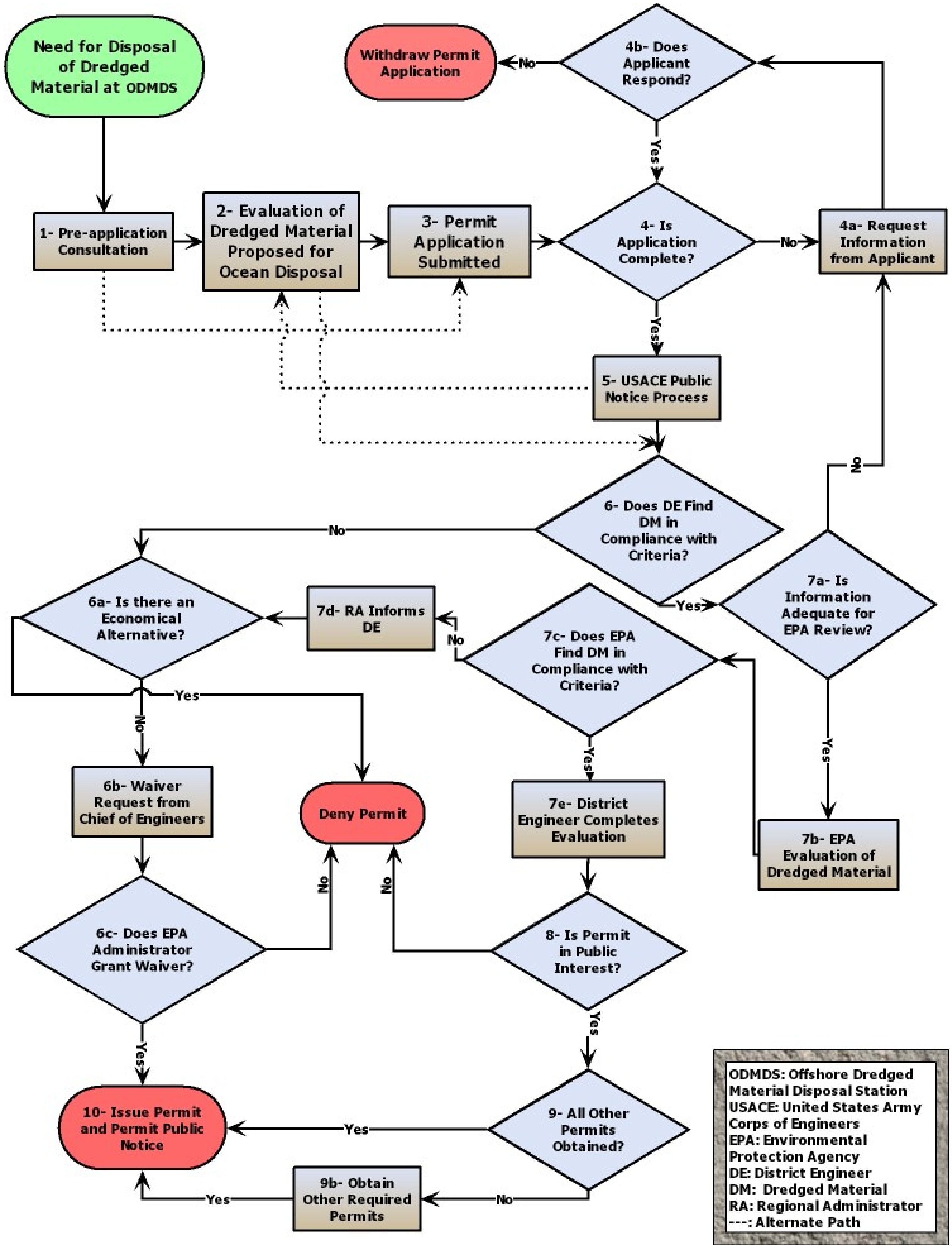


**Figure 2-1. Permit Application/Evaluation Procedure**

**Table 2-1. Permit Application Items [33 CFR 325.1]**

| | |
|---|---|
| a. | A complete description of the proposed activity, including necessary drawings, sketches, or plans. |
| b. | The location, purpose, and need for the proposed activity; scheduling of the activity; names and addresses of adjoining property owners; location and dimension of adjacent structures. |
| c. | A list of authorizations required by other federal, interstate, state, or local agencies for the work, including all approvals received or denials already made. |
| d. | The source of the material; the purpose of the disposal and a description of the type, composition, and quantity of the material (this ideally includes information necessary to determine if the material is in compliance with the criteria); the method of transportation and disposal of the material; and the location of the disposal site. |
| e. | The application should include: (1) an evaluation of dredged material disposal alternatives, including an examination of potential beneficial uses of the proposed dredged material and a consideration of alternative disposal options before selecting the ocean disposal option (40 CFR Sections 227.14 to 227.16), and (2) documentation of the criteria used as the basis upon which selections or rejections were made. If prior evaluations are current, reference to them is encouraged. |
| f. | Include written documentation of the site dredging history, including all results from previous sediment testing (both abiotic and biotic) and a general survey of other prior or current dredging activities at or near the site. If prior evaluations are current, reference to them is encouraged. |
| g. | If the ocean disposal application for re-certification of the proposed maintenance dredged material is currently covered or was previously covered under a MPRSA Section 103 disposal permit, the permit number (or Public Notice and date) should be provided. If more than 3 years have passed since the last evaluation was conducted for the dredge site, or if data are considered to be inadequate, the USACE SAD district, in consultation with EPA Region 4, will assess the need for additional evaluation. |
| h. | Give detailed information along with written documentation on known or suspected site contamination including oil, chemical, or waste spills and any other discharges that may cause contamination of the proposed dredging site. The local U.S. Coast Guard and Port Authority offices shall be consulted to obtain additional information on spills or suspected contamination. Results of the consultation shall be documented as part of the application. Any chemicals known to contaminate or suspected of contaminating the proposed dredging site must be added to the list of possible COCs (see Section 5.0 of this manual). |

### Table 2-2. Public Notice Information* Specific to MPRSA Section 103 Public Notices [33 CFR 325.3(a)(17) and 40 CFR 225.2(a)]

| | Regulatory Requirement | Examples/Guidance |
|---|---|---|
| 1. | The location of the proposed disposal site and its physical boundaries | Include the disposal site corner coordinates and center coordinates (latitude and longitude). Include distance from shore and water depth. Include disposal zone if applicable. |
| 2. | A statement about whether the disposal site has been designated pursuant to MPRSA Section 102(c) | Include date of designation and/or CFR citation. |
| 3. | If the proposed disposal site has not been designated by the Administrator, a statement of the basis for the proposed determination of why no previously designated site is feasible and a description of the characteristics of the proposed disposal site necessary for its designation pursuant to 40 CFR Part 228 | Include a statement as to why an EPA-designated ODMDS is not feasible. Address the 5 general (40CFR228.5) and 11 specific criteria (40CFR228.6) for the proposed site. Detailed information is typically provided in a supplemental document such as an Environmental Assessment. |
| 4. | The known historical uses of the proposed disposal site | Provide year site was first used. Provide volume of material disposed at site (see Ocean Disposal Database: http://el.erdc.usace.army.mil/odd/). Include details regarding most recent disposal project (volume, dates, physical characteristics, disposal zone if applicable). |
| 5. | Existence and documented effects of other authorized disposals that have been made in the disposal area (e.g., heavy metal background reading and organic carbon content) | Provide summary of monitoring (bathymetry, physical, chemical, biological) that has been conducted at the ODMDS and the conclusions of the monitoring. [For example: there has/has not been mounding at the site; there has been a change in the grain size to a siltier/sandier bottom; there has/has not been a significant change in the taxa/diversity/biomass of macro invertebrates at the site.] |
| 6. | An estimate of the length of time during which disposal would continue at the proposed site | Provide the anticipated date for initiation of disposal activities and the expected duration of disposal activities. |
| 7. | Information on the characteristics and composition of the dredged material | At a minimum, provide results of physical tests. Also provide results of chemical and biological tests on the dredged material if available. If EPA Region 4 has concurred on the suitability of the material for ocean disposal, this should be mentioned here. If additional tests will be conducted, this should be explained as well as how the results will be made available to the public. |
| 8. | A statement concerning a preliminary determination of the need for and/or availability of an Environmental Impact Statement | |

* Information provided for the Public Notice and other pertinent information will be used by USACE as an aid in determining the suitability of the proposed dredged material for ocean disposal under the criteria defined in 40 CFR Part 227 (see Appendix C for Section 103 Evaluation Report). If the data submitted by the applicant are insufficient to evaluate the proposed dredged material and prepare the Section 103 Evaluation Report (Appendix C), USACE SAD district, with the cooperation of EPA Region 4, will request additional information.

**Table 2-3. EPA MPRSA Review Periods**

| 30-Day Information Adequacy Review | 45- to 90-Day Dredged Material Review |
|---|---|
| The date on which the complete project description and evaluation documentation are transmitted to EPA starts the 30-day EPA review period for adequacy as described in MPRSA Section 103(c)(1). If EPA advises USACE in writing that the information is not complete, EPA will state the specific information that is needed and why it is necessary for decision-making. The subsequent 45- to 90-day evaluation period will not commence until EPA has received the requested additional information and notified USACE that it is complete. If EPA fails to advise USACE within 30 days of any such submittal whether more information is needed, USACE will assume the sediment evaluation documentation it provided to EPA is adequate. | The 45-day EPA evaluation period [MPRSA Section 103(c)(2)] begins as soon as EPA has received from USACE all information necessary to evaluate the material. EPA will make every effort to complete its evaluation of the project information and sediment testing data and provide written concurrence, concurrence with conditions, or non-concurrence within 45 days of transmission of the complete project information. However, in accordance with MPRSA Section 103(c)(2), EPA may request and USACE shall grant one 45-day extension, to a total of 90 calendar days. |

### 2.3.1 EPA Region 4 Concurrence

EPA agrees to provide a letter of concurrence in accordance with the timeframes outlined in Table 2-3. Except in cases of presumed concurrence pursuant to MPRSA Section 103(c)(4) due to lack of timely EPA Region 4 response, USACE SAD districts will not issue any MPRSA Section 103 ocean disposal permits without prior written concurrence from EPA Region 4. Even if EPA Region 4 provides full concurrence (or presumed concurrence) without additional special conditions, all relevant specifications of the disposal site's SMMP still apply and will be included directly as permit conditions. USACE SAD districts agree to provide a copy of relevant portions of the draft permit conditions to EPA at least 15 working days prior to issuance of the permit to confirm that all EPA Region 4 requirements (including SMMP requirements) are fully and accurately reflected therein. EPA agrees to submit in writing to the District any objections and justifications for such objection, including withdrawal of concurrence if necessary, within 10 working days from the date of receipt of such documents. Conditional concurrence is synonymous with non-concurrence if any of the conditions required by EPA Region 4 are not included in the permit. In the case of non-concurrence for ocean disposal of dredged material from a project or any portion thereof, USACE SAD districts will not permit any ocean disposal activity for that project except pursuant to the waiver provisions of MPRSA Section 103(d)..

### 2.3.2 Permit Modification

Should a project be modified following permit issuance or subsequent to EPA Region 4's concurrence on the Section 103 evaluation, the USACE SAD district agrees to consult with EPA Region 4 prior to modifying the permit. Modification could include, but is not limited to, the following: increase in the volume of material; a change in characteristics of the material; recent contamination of the material due to spills or discharges of pollutants; change in project limits, either in the dredging depth or width; or the addition of areas to be dredged. Consultation shall be in writing and shall include a detailed description of the modification, an addendum to the Section 103 evaluation (if needed), and a determination as to whether the modified project complies with the criteria. EPA Region 4 will follow the procedures and timeline outlined above and provide a letter of concurrence or non-concurrence with respect to the modification. If more information is needed, such as additional testing, EPA Region 4 will provide such notification within 30 days of receipt of the written description of the modification. As modifications typically occur during a project, and delays can result in substantial costs, EPA Region 4 should be consulted as early as possible. EPA Region 4 will make every effort to accelerate reviews of modifications.

## 2.4 Administrative Requirements for Federal Civil Works Projects

USACE does not issue permits for federal Civil Works projects. However, USACE regulation (33 CFR Part 335) and MPRSA Section 103(e) encourage that similar substantive requirements and procedures should apply to federal projects as are applied to non-federal projects for which a permit is issued. For new work Civil Works projects, EPA has two opportunities for formal coordination with USACE: the review under the National Environmental Policy Act (NEPA) and the review of the project Public Notice. The formal coordination under NEPA includes EPA's review of the draft, final, and supplemental Environmental Impact Statements (EIS) and Feasibility Report. The project Public Notice should contain the information defined by 33 CFR 337.1(a), including results of dredged material testing and evaluation. For Operation and Maintenance (O&M) projects, there are limited coordination opportunities under NEPA. Certain activities are excluded from NEPA, and Public Notices are normally issued for an indefinite period and are not reissued unless there are significant changes in the O&M activities of a project. O&M activities should be re-evaluated once every 3 years and this evaluation coordinated formally between the appropriate USACE SAD district and EPA Region 4's Water Management Division.

For Civil Works projects and O&M activities, USACE SAD districts will provide for EPA Region 4 review the complete documentation of the project evaluation conducted under the SAP in the form of a Section 103 Evaluation Report. This information can be provided with the Public Notice if applicable. The evaluation reports will be consistent with those provided in Appendix C and will be accompanied by a Sediment Testing Report (Appendix D). Refer to Table 2-3 for detailed explanations of EPA MPRSA review periods. The majority of the main steps involved in the process are similar to those in Section 2.3 of this report.

### 2.4.1 EPA Region 4 Concurrence

EPA agrees to provide a letter of concurrence in accordance with the timeframes outlined in Table 2-3. Except in cases of presumed concurrence pursuant to MPRSA Section 103(c)(4) due to lack of timely EPA Region 4 response, USACE SAD districts will not commence or authorize commencement of any ocean disposal activity without prior written concurrence from EPA Region 4. Even if EPA Region 4 provides full concurrence (or presumed concurrence) without additional special conditions, all relevant specifications of the disposal site's SMMP still apply and will be included directly as conditions to the USACE SAD district contracts and/or authorizations. USACE SAD districts agree to provide a copy of relevant portions of the draft authorizations and/or contract specifications to EPA at least 15 working days before advertising for bids to confirm that all EPA Region 4 requirements (including SMMP requirements) are fully and accurately reflected therein. EPA agrees to submit in writing to the District any objections and justifications for such objection, including withdrawal of concurrence if necessary, within 10 working days from the date of receipt of such documents. Conditional concurrence is synonymous with non-concurrence if any of the conditions required by EPA Region 4 are not included in the project's authorization and/or contracts. In the case of non-concurrence for ocean disposal of dredged material from a project or any portion thereof, USACE SAD districts will not commence or authorize to be commenced any ocean disposal activity for that project except pursuant to the waiver provisions of MPRSA Section 103(d).

### 2.4.2 Project Modification

Should a project be modified subsequent to EPA Region 4's concurrence on the Section 103 evaluation, USACE SAD districts agree to consult with EPA Region 4 prior to authorizing the commencement of the ocean disposal activity related to the modification. Modification could include, but is not limited to, the following: increase in the volume of material; a change in characteristics of the material; recent contamination of the material due to spills or discharges of pollutants; change in project limits, either in the dredging depth or width; or the addition of areas to be dredged. Consultation shall be in writing and shall include a detailed description of the modification, an addendum to the Section 103 evaluation (if needed), and a determination as to whether the modified project complies with the criteria. EPA Region 4 will follow the procedures and timeline outlined above and provide a letter of concurrence or non-concurrence with respect to the modification. If more information is needed, such as additional testing, EPA Region 4 will provide such notification within 30 days of receipt of the written description of the modification. As modifications typically occur during a project, and delays can result in substantial costs, EPA Region 4 should be consulted as early as possible. EPA Region 4 will make every effort to accelerate reviews of modifications.

# 3.0 TIERED TESTING

Under 40 CFR 227.27 of the ocean dumping regulations, the impact of the liquid, suspended-particulate, and solid phases of a material proposed for ocean disposal are evaluated. For most projects, the impact of the solid phase on the benthic environment deserves the most rigorous evaluation. Dredged material deposited on the seafloor usually has greater potential to cause impact to a smaller area for a longer period than the fraction of dredged material released to the water column. EPA and USACE have developed a tiered testing approach to evaluate the suitability of dredged material for ocean disposal. This approach is defined in detail in Chapters 1-4 of the 1991 Green Book. The initial tier uses readily available information or newly collected information that may be sufficient for evaluation (for those cases where this information shows that the proposed dredged material has not changed since previous testing and evaluation at Tier II and Tier III levels). Tier I also includes an assessment of when the regulatory exclusions from testing are applicable. Evaluation at successive tiers is based on more extensive and specific information that may be more time-consuming and expensive to generate, but that allows more comprehensive evaluations of the potential for environmental effects. Note that compliance with the ocean dumping regulations requires compliance with water quality criteria (WQC) (Tier II) and bioassays to assess (1) toxicity in the water column (both liquid phase and suspended phase) and sediment and (2) bioaccumulation in the sediment (Tier III). Therefore, a new project must proceed through Tiers I, II, and III in order for the dredged material to be determined suitable for ocean dumping (unless it meets the exclusionary criteria in Tier I).

## 3.1 Tier I

A Tier I decision based on Tier I testing is a recommendation on the suitability of dredged material for ocean disposal. This recommendation is based on review and analysis of existing data, although confirmatory physical and chemical analyses may be required to verify that site conditions have not changed since previous evaluations. If the information provided for the Tier I decision results in a determination that further testing is needed, this information will be used to supplement subsequent analyses. The information may be particularly useful in the identification of COCs during preparation of the SAP.

### 3.1.1 Exclusion from Testing

Tier I evaluations begin with a comparison of existing physical information on the proposed dredged material with the three exclusion criteria of 40 CFR Section 227.13(b). If the dredged material meets at least one of these criteria, additional testing is not required. The three exclusion criteria are indicated in the box below.

(1) The dredged material is composed predominately of sand, gravel, rock, or any other naturally occurring bottom material with particle sizes larger than silt, and the material is found in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels; or

(2) The dredged material is for beach nourishment or restoration and is composed predominately of sand, gravel, or shell with particle sizes compatible with material on the receiving beach; or

(3) When:

a. The material proposed for disposal is substantially the same as the substrate at the proposed dump site; and

b. The site from which the material proposed for disposal is to be taken is far removed from known sources of pollution so as to provide a reasonable assurance that such material has not been contaminated by such pollution.

As beach nourishment or restoration activities do not require a MPRSA Section 103 permit or authorization, criteria number 2 above is seldom, if ever, applicable. Conclusive written documentation should be provided showing that the proposed material meets one of the exclusion criteria. Physical data should be no more than 10 years old. The predominance of sand, gravel, or rock will be determined based on grain size analysis using the Unified Soil Classification System (USCS), which has been adopted by USACE. Predominately sand, gravel, or rock is generally interpreted to include the Clean Sands and Clean Gravel groups, including borderline (dual symbol) classifications (see Table 3-1). Areas of high current/wave energy should be documented with data from tide gauges or current meters. In general, high currents are considered to be in excess of 30 centimeters per second (EPA, 1989). To determine if material is substantially the same as the substrate at the proposed dump site, the physical properties (grain size distribution) need to be compared to the physical properties of samples collected at the proposed disposal site. Material will be considered substantially the same when the dredged material and the substrate at the proposed site fall within the same sediment group as defined by the USCS. To determine if the proposed dredging site is far removed from known sources of pollution, the sources in Table 3-2 should be considered. At a minimum, EPA's Envirofacts website (www.epa.gov/enviro/index.html) and the U.S. Coast Guard's National Response Center website (www.nrc.uscg.mil/index.htm) should be consulted.

**Table 3-1. Unified Soil Classification System Clean Sands and Gravel Groups**

| USCS Group Symbol | Description | Percent Fines[1] |
|---|---|---|
| GW | Well-graded gravels, gravel-sand mixtures. | <5% |
| GP | Poorly graded gravels or gravel-sand mixtures. | <5% |
| SW | Well-graded sands, gravelly sands. | <5% |
| SP | Poorly graded sands or gravelly sands. | <5% |
| Borderline (Dual Symbol) | Coarse-grained materials containing between 5% and 12% fines (e.g. GW-GM, SP-SC). | 5-12% |

[1] No. 200 (75-μm) sieve

**Table 3-2. Tier I Sources of Information**

| |
|---|
| Results from prior physical, chemical, and biological tests of the proposed material to be disposed or similar material from similar areas in the vicinity of the proposed dredging site. |
| Results of prior field monitoring studies of the material proposed to be dumped or similar material from similar areas in the vicinity of the proposed dredging site. |
| Existing data contained in other EPA Region 4 or USACE SAD district files or otherwise available from public or private sources. Examples include the following:<br>a. Selected Chemical Spill Listing (EPA)<br>b. Pesticide Spill Reporting System (EPA)<br>c. Pollution Incident Reporting System-National Response Center (U.S. Coast Guard)<br>d. Identification of In-Place Pollutants and Priorities for Removal (EPA)<br>e. Hazardous waste sites and management facilities reports (EPA)<br>f. USACE studies of sediment pollution and sediments<br>g. STORET(STOrage and RETrieval) database (EPA)<br>h. Water and sediment data on major tributaries (Geological Survey)<br>i. National Pollutant Discharge Elimination System (NPDES) permit records<br>j. CWA 404(b)(1) evaluations<br>k. Pertinent and applicable research reports<br>l. MPRSA 103 evaluations<br>m. Port authorities<br>n. Colleges/universities<br>o. State environmental agencies<br>p. Published scientific literature<br>q. On-line sources, e.g., Envirofacts at http://www.epa.gov/enviro/index.html (see Appendix E) |

### 3.1.2 Confirmatory Analysis

If no exclusionary criteria can be met, the limiting permissible concentration (LPC) is evaluated based on the collected information. This information must include data analyses of the toxicity and bioaccumulation potential of the dredged material as compared to the reference sediments. The information must also be sufficient to determine if the WQC, or 1% of the $LC_{50}/EC_{50}$, will be exceeded in the water column following the initial mixing period. In other words, the information should relate back to previous Tier II and III analyses at the same site. The information should also show that no new pollution sources have been introduced into the area since the previous Tier II and III testing was conducted, and that the material is essentially the same as it was when last sampled. If adequate information is not available for a Tier I LPC evaluation, the evaluation process moves to higher tiers.

Confirmatory physical or chemical tests will sometimes be required in order to finalize a Tier I decision. For instance, confirmatory testing may be required if information suggests that events such as oil or fuel spills have occurred that may have impacted the proposed dredging area. Confirmatory analyses would be used in this case to document that the event did not impact or change the proposed dredged material from when it was previously tested. In addition, confirmatory analyses may be required in cases when existing data are marginal (e.g., results were equivocal or borderline), or when data are relatively old (greater than 5 years) or incomplete. For maintenance projects, confirmatory analyses can be used to demonstrate that the characteristics of dredged material are relatively consistent from dredging cycle to dredging cycle, thereby validating the use of previous Tier II and III results. Confirmatory analyses can also be used to append relatively small additions to previously approved projects by showing that the new material is substantially the same as that already evaluated. In order to utilize confirmatory analyses to document compliance with the LPC, the following additional information is needed:

1. A regional map that clearly shows the project area in relation to other land and aquatic uses. Poor copies or illegible copies are not acceptable. Point out nearby land use, aquatic use, and development and present other pertinent information.

2. A site-specific map that indicates the areal extent of the proposed dredging project. This map should also show the locations of pertinent uses, such as fuel docks, storm drains, ship repair facilities, and other activities with the potential to affect the quality of the dredged material. At least one map should include the most recent available bathymetric information. Clearly indicate the approximate boundaries of the project area. If the project involves more than a single proposed depth, the limits of the different proposed depths should be clearly indicated on the project map.

3. A site history narrative, including all information pertinent to the request for a Tier I decision. This information should seek to identify any potential sources of contamination and pathways of contaminant transport (e.g., storm drains, agricultural runoff, industrial and municipal discharges)

4. A history of dredging at or near the site, including dates, areas, volumes, and depths previously dredged.

5. A table or description of the proposed dredging depths, permitted depths, and overdredge depth all expressed relative to Mean Lower Low Water (MLLW), and the associated volumes to be dredged.

6. A summary table of past physical and chemical tests. This table would include the date sampled, location, result of each chemical measurement, detection limits, units, and any information on the precision and accuracy of the values. An acceptable option would be to include properly identified tables and figures from past test results.

7. A table of past bioassay results. This table should include the date sampled, species tested, mean control survival, mean reference survival, and mean survival values in the dredged material.

8. Maps showing all past sampling stations for which results are included, with the currently proposed dredging area superimposed.

9. A narrative description of past suitability determinations for the project area. Provide specific information in the case of ambiguous data, negative decisions, or conditioned decisions. Note any unusual circumstances (e.g., poor control or reference sediment survival) in previous test results.

10. A description of any events that have occurred since the last sampling or dredging event that might influence sediment chemistry or bioassay results (e.g., oil or fuel spills). This shall include the query results from the U.S. Coast Guard Pollution Incident Reporting System or a certification that it was reviewed. Provide any other pertinent data and correspondence (or state that there were none).

11. Provide a Draft Sampling and Analysis Plan if additional confirmatory analyses are proposed for the project.

Confirmatory analyses cannot be used to document compliance with the LPC for new work projects where previous Tier II and Tier III studies do not exist. It also cannot be used for maintenance projects where Tier II and III results are more than 10 years old.

### 3.1.3 Contaminants of Concern

In the Tier I decision sequence, one possible outcome is that more information is required to determine compliance with the regulations. A critical prerequisite to generating this information is deciding, on a case-by-case basis, which contaminants are of concern in the particular dredged material being evaluated. In identifying possible COCs, those chemicals necessary to determine compliance with the requirements of Part 227.6 of the regulations must be included. Other possible contaminants that should be included are those that might be expected to cause unacceptable adverse impacts. The COCs in the dredged material should be identified based on:

- Presence in the dredged material
- Toxicological importance
- Propensity to bioaccumulate from sediments

Sources of potential information for determining the COCs are provided in Table 3-2. Some contaminants are always of interest because of the provisions of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter [London Dumping

Convention (LDC)] and the incorporation of these contaminants into the MPRSA and Sections 227.5 and 227.6 of the regulations. Chapters 6 and 7 of this SERIM provide a list of routine COCs for the southeastern U.S. that incorporates those contaminants required by the MPRSA and the regulations. This list should be reduced only when there is site-specific information indicating that the contaminants are not present in the project vicinity sediments (e.g., past or current sediment testing efforts). In addition, the list must be expanded when there are contaminant-specific industry or other pollution sources within a project watershed (e.g., pulp and paper mills).

## 3.2 Tier II

### 3.2.1 Water Column Evaluation

In Tier II, marine WQC compliance is determined using a numerical mixing model (e.g., STFATE). Mixing models are available at http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=drgmat. This determination provides a reliable, rapid screen for assessing potential impact and thereby reduces or eliminates the need for further testing under subsequent tiers if the dredged material is found to be out of compliance with WQC. If the dredged material is in compliance with marine WQC, it still must be assessed for toxicity and bioaccumulation under Tier III. Note that Tier III testing of water column toxicity cannot take the place of Tier II WQC compliance determinations. Detailed guidance for conducting Tier II evaluations is contained in Sections 5 and 10 of the 1991 Green Book.

In order to demonstrate compliance with the LPC, the ocean disposal of dredged material cannot exceed applicable EPA WQC or state water quality standards (WQS), if applicable, outside the disposal site boundaries at any time or within the disposal site boundaries 4 hours after initial mixing. WQS apply if a portion of the ODMDS is in state waters. For EPA's WQC, the acute concentrations [Criterion Maximum Concentration (CMC)] are used. EPA WQC are listed in Appendix F; updates are at http://www.epa.gov/waterscience/criteria/wqcriteria.html. State standards can be found at http://www.epa.gov/ost/standards/.

#### 3.2.1.1 Screen to Determine WQC Compliance

A screening method utilizing sediment chemistry can be used to determine compliance. The screen assumes that all of the contaminants in the dredged material are released into the water column during the disposal operation (see Section 10.1.1 of the 1991 Green Book). If the numerical model predicts that the concentration of all COCs released into the water column are less than the applicable WQC, the marine WQC LPC is satisfied.

The model needs to be run only for the COC that requires the greatest dilution. If the contaminant requiring the greatest dilution is shown to meet the LPC, all of the other contaminants that require less dilution will also meet the LPC. The contaminant that would require the greatest dilution is determined by calculating the dilution that would be required to meet the applicable marine WQC. To determine the required dilution ($D_r$), the following equation is solved for each COC:

$$D_r = (C_s - C_{wq}) / (C_{wq} - C_{ds}) \qquad \textbf{[Eq. 3-1]}$$

where

$C_s$ = concentration of the contaminant in the dredged material elutriate, expressed as micrograms per liter (µg/L) as determined by either equation 3-1 below or by elutriate chemical analytical results discussed in Section 3.2.1.2.

$C_{wq}$ = applicable marine WQC (EPA WQC or state WQS), in (µg/L)

$C_{ds}$ = background concentration of the constituent at the disposal site water column, in µg/L

NOTE: Dilution is defined as the volume of ambient water in the sample divided by the volume of elutriate water in the sample.

Note that most contaminant results are reported in micrograms per kilogram (µg/kg) dry weight. To convert the contaminant concentration reported on a dry-weight basis to the contaminant concentration in the dredged material, the dry-weight concentration must be multiplied by the mass of dredged-material solids per liter of dredged material:

$$C_s = C_{dw} \times \left[ \frac{n_s \times G}{G + n_s(1 - G)} \right] \qquad \textbf{[Eq. 3-2]}$$

where

$C_{dw}$ = contaminant concentration in dredged material, reported on a dry-weight basis (µg/kg)

$n_s$ = percent solids as a decimal

G = specific gravity of the solids. Use 2.65 if site-specific data are not available.

A table showing each contaminant and the dilution required to meet the WQC should be provided with the analysis. Alternatively, a module in the STFATE model can be used. The module requires the solids concentration (g/L), which is the term in brackets in Equation 3-2 above multiplied by 1000.

The concentration of the contaminant that would require the greatest dilution is then modeled using a numerical mixing model. Model input parameters are specific to each proposed dredging project and each ocean disposal site. Standard STFATE input parameters for each disposal site are being developed with each ODMDS-specific SMMP. They are included in Appendix G along with additional guidance on model usage. The key parameters derived from the dispersion model are the maximum concentration of the contaminant in the water column outside the boundary of the disposal site during the 4-hour initial-mixing period or anywhere in the marine environment after the 4-hour initial-mixing period. If both of these concentrations are below the applicable marine WQC, the WQC LPC is met and no additional testing is required to determine compliance with the WQC. If either of these concentrations exceeds the WQC, additional testing is necessary to determine compliance with the WQC, as described in the next section.

#### 3.2.1.2 Elutriate Analysis to Determine WQC Compliance

If the numerical mixing model applied above shows that the WQC cannot be met if all of the contaminants in the dredged material dissolve into the water column during disposal, an elutriate-chemical analysis is conducted. Following an elutriate procedure with the dredged material and the subsequent chemical analysis (see Section 10.1.2 of the 1991 Green Book), the model is run again with the elutriate-chemical analysis results. Elutriates are prepared using water from the proposed dredging site (see Section 5.5). A table should be provided showing each contaminant's elutriate concentration and the dilution required to meet the WQC using equation 3-1. This second model run predicts whether the COC that requires the greatest amount of dilution will meet or exceed the LPC for WQC. If the LPC is not met, disposal operations may be modified so the LPC is met (e.g., decrease barge size, change disposal method, limit disposal to certain oceanographic conditions).

### 3.2.2 Benthic Evaluation

Tier II tests for benthic-impact evaluation should be used only to screen out sediments that are not likely to meet the LPC or to assist in selecting a compositing or testing scheme under Tier III. Tier II tests cannot be used to pass the benthic evaluation. The only Tier II benthic-impact evaluation is the bioaccumulation analysis for non-polar organic compounds. The analysis uses a calculation for determining the theoretical bioaccumulation potential (TBP) in test organisms. The TBP calculation factors the concentration of the non-polar organic contaminant in the sediment, the total organic carbon (TOC) in the sediment, and the percent lipid concentration (%L) in the organism. The calculation is run for both the proposed dredged material and the reference material. Guidance for calculating the TBP of nonpolar organic chemicals is provided in Section 10.2 of the 1991 Green Book and Section 10.2 of *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.--Testing Manual* [Inland Testing Manual (ITM)] (EPA, 1998). When the results indicate high levels of contamination of non-polar organics in the dredged material, the applicant may choose not to continue on to Tier III but rather to seek other disposal options. In addition, dredging units with similar TBP can be composited for evaluation under Tier III, or dredging units with high TBP can be used as worst-case surrogates for the entire project in Tier III.

Unlike Tier II determination of compliance with WQC, the Tier II TBP calculation does not have to be performed in order to determine suitability for ocean dumping. Tier III bioassays are the decisive tests for making this determination.

## 3.3 Tier III

Tier III tests include (1) determination of water column toxicity and (2) assessment of contaminant toxicity and bioaccumulation from the material to be dredged. The evaluations in this tier are based on the output from Tiers I and II and comprise standardized bioassays. Detailed guidance for conducting Tier III evaluations is contained in Sections 6, 11, and 12 of the 1991 Green Book.

### 3.3.1 Water Column Bioassays

The Tier III water column evaluation considers the effects, after allowance for initial mixing, of dissolved contaminants plus those associated with suspended particulates on water column organisms. According to paragraph 227.13(c)(2)(ii) of the regulations, water column bioassays must be used when there are not applicable marine WQC for all the COCs or when there is reason to suspect the synergistic effects of certain contaminants. The LPC is defined in paragraph 227.27(a)(2) as

> *That concentration of waste or dredged material in the receiving water which, after allowance for initial mixing, as specified in §227.29, will not exceed a toxicity threshold defined as 0.01 of a concentration shown to be acutely toxic to appropriate sensitive marine organisms in a bioassay carried out in accordance with approved EPA procedures.*

Appropriate sensitive marine organisms are defined in paragraph 227.27(c) as

> *Appropriate sensitive marine organisms means at least one species each representative of phytoplankton or zooplankton, crustacean or mollusk, and fish species chosen from among the most sensitive species documented in the scientific literature or accepted by EPA as being reliable test organisms to determine the anticipated impact of the wastes on the ecosystem at the disposal site.*

Recommended species are presented in Chapter 7. A concentration shown to be acutely toxic is generally accepted to be equivalent to the $LC_{50}$ for tests with mortality as the endpoint and the $EC_{50}$ for development as the endpoint.

In evaluating the test results, the 100% dredged-material elutriate treatment is evaluated to determine if it is statistically significantly more toxic than either the control or the dilution water. If not, there is no indication of adverse effects attributable to the dredged material and further evaluation is not warranted. If the 100% dredged-material elutriate treatment is statistically significantly more toxic than either the control or dilution water, 0.01 of the $LC_{50}$ (or $EC_{50}$) is used in the mixing model (e.g., STFATE) to determine compliance with the LPC; i.e., the concentration of the dredged material must be less than 0.01 x $LC_{50}$ (or $EC_{50}$) at all times outside the disposal site and after 4 hours within the disposal site. If less than 50% mortality occurs in any of the elutriate treatments, it is not possible to calculate an $LC_{50}$. In such cases, the $LC_{50}$ used in the model to determine compliance should be the 100% elutriate treatment. If the conditions are highly toxic, such that the 10% elutriate treatment has greater than 50% mortality, further dilution must be made (new treatments of less than 10% dredged-material elutriate) to attain a survival of greater than 50% and determine the $LC_{50}$ by interpolation. Statistical procedures recommended for analyzing the test data are described in detail in Sections 13.2.1 and 13.2.2 of the 1991 Green Book. If the mixing model shows that the LPC is not met, disposal operations may be modified so the LPC is met (e.g., decrease barge size, change disposal method, limit disposal to certain oceanographic conditions). Additional model runs are then conducted to demonstrate that the modified disposal operations bring the project into compliance with the LPC.

### 3.3.2 Whole Sediment Bioassays

Evaluation of benthic bioassays in Tier III is based on data generated according to the guidance in Section 11.2 in both the 1991 Green Book and the 1998 ITM. For benthic-effects evaluation, the LPC of the solid phase of dredged material is applicable and is defined in paragraph 227.27(b) as *. . . that concentration which will not cause unreasonable acute or chronic toxicity or sublethal adverse effects based on bioassay results using . . . appropriate sensitive benthic* *marine organisms . . .* Appropriate sensitive benthic marine organisms are defined in paragraph 227.27(d) as . . . *two or more species that together represent filter-feeding, deposit feeding, and burrowing characteristics*. Lists of appropriately sensitive marine species for the southeastern U.S. are provided in Chapter 7 of this SERIM.

#### 3.3.2.1 Whole Sediment Toxicity Tests

Whole sediment bioassays (toxicity tests) evaluate the effects of the proposed dredged material disposal on benthic organisms. The bioassays use mortality data from the whole sediment treatments. A dilution series similar to the suspended phase tests is not used. Proposed dredged material does not meet the ocean dumping criteria for the whole sediment bioassay when mortality:

1. Is statistically significantly higher in the dredged material tests than the reference sediment tests (*statistically significant* is defined as statistical evidence that there is a difference between values or groups of values and does not necessarily indicate the difference is large, important, or significant in the common meaning of the word); and
2. Exceeds the reference sediment mortality by at least 10%; or
3. Exceeds the reference sediment mortality by at least 20% for the 10-day amphipod whole sediment bioassay test (1991 Green Book, Section 6-2).

#### 3.3.2.2 Sublethal Effects and Bioaccumulation Tests

Bioaccumulation tests evaluate the bioavailability of contaminants in the proposed dredged material. Guidance on bioaccumulation testing is provided in Chapter 12 of the 1991 Green Book or Chapter 12 of the ITM. Bioaccumulation tests are conducted for 28 days. Guidance on determining which contaminants to analyze for in the tissues is provided in Section 6.2 of this SERIM. Tissue contaminant concentrations should be multiplied by the appropriate steady-state factor. Contaminants requiring application of steady-state factors and the appropriate factors are provided in Appendix H.

The steady-state adjusted contaminant concentrations in the tissues of the test species are compared with:

- The Food and Drug Administration (FDA) published list of Action Levels for Poisonous or Deleterious Substances in Fish and Shellfish for Human Food (see Appendix H or the U.S. FDA Seafood Hazard Analysis and Critical Control Point website at http://www.cfsan.fda.gov/~comm/haccpsea.html for updates).
- Contaminant tissue concentrations that do not exceed the FDA action limits are also statistically compared to tissue concentrations from test species exposed to reference sediments. If the concentrations of the contaminant(s) statistically exceed those in the reference sediments, evaluations of LPC compliance for the proposed dredged material will require further analysis.

When bioaccumulation of contaminants in the proposed dredged material statistically exceeds those in the reference sediments, the 1991 Green Book (Section 6.3) recommends eight factors to be considered to evaluate LPC compliance. Based on these factors, EPA Region 4 has developed bioaccumulation screening levels (see Appendix H), below which LPC compliance is demonstrated. Tissue contaminant concentrations in excess of these values do not necessarily indicate LPC non-compliance but warrant further case-specific analysis utilizing the eight factors. The eighth factor is a consideration of background concentration in similar organisms. Appendix H provides background tissue levels specified by EPA Region 4. Additional guidance and reference material for further analysis are available at:

- *Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment Status and Needs* (EPA-823-R-00-001) February 2000. http://www.epa.gov/waterscience/cs/biotesting/
- USACE/USEPA *Environmental Residue-Effects Database (ERED)*. http://el.erdc.usace.army.mil/ered/
- USGS *Contaminant Hazard Review*: http://www.pwrc.usgs.gov/infobase/eisler/
- *National Sediment Bioaccumulation Conference Proceedings*, February 1998. (EPA 823-R-98-002) http://www.epa.gov/waterscience/cs/conftoc.html
- NOAA *Chemical Contaminants in Oysters and Mussels* (1998). NOAA's State of the Coast Report. http://oceanservice.noaa.gov/websites/retiredsites/sotc_pdf/CCOM.PDF
- *TrophicTrace: A Tool for Assessing Risks from Trophic Transfer of Sediment-Associated Contaminants*. http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=other

## 3.4 Tier IV

When a compliance determination cannot be made after completion of the first three tiers, further testing in Tier IV may be appropriate. However, Tier IV testing is intended for exceptional circumstances only and should not be routinely applied. Presently, Tier IV consists of bioassay and bioaccumulation tests to evaluate the long-term benthic impact of dredged material (no methods for Tier IV water column tests have yet been developed). Tests at this level should be selected to address specific project issues for a specific dredging operation that cannot be fully evaluated in the earlier tiers. Because these tests are case-specific and require significant time and money to complete, criteria for determining compliance with 40 CFR 227 should be agreed on in advance between EPA Region 4 and USACE SAD district staff.

Conducting Tier IV benthic testing is possible with current methods. However, because the evaluation consumes significant resources of the dredging applicant and of the regulatory authority, and a final noncompliance determination is still possible, all parties should weigh the options and decide whether to perform Tier IV testing or consider an alternative that does not involve ocean dumping, such as upland disposal.

Tier IV will likely be applied only to those few large projects in which non-ocean disposal options are unavailable or prohibitively expensive, and the project (or abandonment of the project) has significant economic or national defense implications.

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# 4.0 SEDIMENT SAMPLING

Accurate assessment of proposed dredged material for ocean disposal depends in large part on the accuracy and representativeness of sediment collection and analysis. Detailed information concerning appropriate sampling design, field and laboratory facilities needed, safety, sampling equipment, sample storage and transport procedures, and sample manipulation issues common to chemical or toxicological analyses is provided in the EPA technical manual *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses* (EPA, 2001b) [available from the EPA Office of Science and Technology's web site at http://www.epa.gov/waterscience/cs/collectionmanual.pdf] as well as the 1991 Green Book and the ITM. The following sections provide regional guidance on sediment sampling that should be used in addition to the guidance provided in the documents referenced above.

## 4.1 Sampling and Analysis Plan (SAP) / Quality Assurance Project Plan (QAPP)

The SAP is the main source of information about the proposed dredging project's sampling design/approach and quality assurance/quality control (QA/QC) measures associated with sample collection and dredged material analysis. The SAP is equivalent to the Draft QAPP and will be used in the development of the testing contract Scope of Work (SOW). The Draft QAPP or (SAP) should be coordinated with EPA prior to initiation of the SOW. It is EPA's policy that all environmental data used in decision-making be supported by a QAPP (EPA, 2000). Therefore, a final QAPP should also be coordinated with EPA prior to initiation of sampling. Sampling and testing should be coordinated far enough in advance of dredging to allow time for testing and data review (see Section 2.2). The following documents provide guidance on Draft QAPP (SAP) and final QAPP development:

- *Guidance for Quality Assurance Project Plans (G-5)* (PDF 401KB) - December 2002, EPA/240/R-02/009. Guidance on developing Quality Assurance Project Plans that meet EPA specifications. Note: This document replaces EPA/600/R-98/018 issued in February 1998. http://www.epa.gov/quality/qs-docs/g5-final.pdf (EPA, 2002).
- *EPA Requirements for Quality Assurance Project Plans* (QA/R-5) (PDF 120KB) - March 2001, EPA/240/B-01/003. Defines specifications for Quality Assurance Project Plans prepared for activities conducted by or funded by EPA. These specifications are equivalent to Chapter 5 of EPA Manual 5360. http://www.epa.gov/quality/qapps.html
- *Evaluation of Dredged Material Proposed for Ocean Disposal* (Ocean Testing Manual or Green Book), Chapter 8. EPA 503/8-91/001, February 1991. http://www.epa.gov/owow/oceans/gbook/gbook.pdf
- *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual* (Inland Testing Manual), Chapter 8. EPA-823-B-98-004, February 1998. http://www.epa.gov/waterscience/itm/ITM/
- *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations – Chemical Evaluations*. EPA-823-B-95-001, April 1995. http://www.epa.gov/waterscience/cs/library/evaluationguide.pdf

- *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual.* EPA -823-B-01-002, October 2001. http://www.epa.gov/waterscience/cs/collectionmanual.pdf

The SAP should be composed of standardized, recognizable elements covering the entire dredging project testing scheme from planning, through implementation, to assessment. The SAP elements and their intents are summarized as follows:

- Project Management - This group of SAP elements covers the basic area of dredging project management, including the project history and objectives, and roles and responsibilities of the participants. These elements ensure that the dredging project sediment testing program has a defined goal and that the participants understand the goal and approach to be used.
- Measurement/Data Acquisition - This group of SAP elements covers all aspects of measurement system design and implementation, ensuring that appropriate methods for sampling, analysis, data handling, and QC are employed and properly documented.
- Assessment/Oversight - This group of SAP elements addresses the activities for assessing the effectiveness of the implementation of the dredging project and associated QA and QC. The purpose of assessment is to ensure that the SAP is implemented as prescribed.
- Data Validation and Usability - This group of SAP elements covers QA activities that occur after the data collection phase of the dredging project is completed. Implementation of these elements ensures that data conform to the specified criteria, thus ensuring that the resulting data are adequate for agency decision-makers.

Table 4-1 contains the elements that should appear in the SAP. These elements are derived from the EPA QA documents listed above. Additional format and content for the elements are provided in Appendix I. Appendix J has a checklist for review of SAPs.

**Table 4-1. SAP/QAPP Elements**

| 1998 | 2002 | Group A: Project Management Elements |
|---|---|---|
| A1 | 2.1.1 | Title and Approval Sheet |
| A2 | 2.1.2 | Table of Contents |
| A3 | 2.1.3 | Distribution List |
| A4 | 2.1.4 | Project/Task Organization |
| A5 | 2.1.5 | Problem Definition/Background |
| A6 | 2.1.6 | Project/Task Description |
| A7 | 2.1.7 | Quality Objectives and Criteria for Measurement Data |
| A8 | 2.1.8 | Special Training Requirements/Certification |
| A9 | 2.1.9 | Documentation and Records |
| **1998** | **2001** | **Group B: Measurement/Data Acquisition Elements** |
| B1 | 2.2.1 | Sampling Process Design |
| B2 | 2.2.2 | Sampling Methods Requirements |
| B3 | 2.2.3 | Sample Handling and Custody Requirements |
| B4 | 2.2.4 | Analytical Methods Requirements |
| B5 | 2.2.5 | Quality Control Requirements |
| B6 | 2.2.6 | Instrument/Equipment Testing, Inspection, and Maintenance Requirements |
| B7 | 2.2.7 | Instrument Calibration and Frequency |
| B8 | 2.2.8 | Inspection/Acceptance Requirements for Supplies and Consumables |
| B9 | 2.2.9 | Data Acquisition Requirements (non-direct measurements) |
| B10 | 2.2.10 | Data Management |

| 1998 | 2001 | Group C: Assessment/Oversight Elements |
|---|---|---|
| C1 | 2.3.1 | Assessments and Response Action |
| C2 | 2.3.2 | Reports to Management |
| **1998** | **2001** | Group D: Data Validation and Usability |
| D1 | 2.4.1 | Data Review, Validation, and Verification Requirements |
| D2 | 2.4.2 | Validation and Verification Methods |
| D3 | 2.4.3 | Reconciliation with User Requirements |

## 4.2 Selection of Project Sample Stations

The selection of sampling stations at the proposed dredging site is a critical step in designing an acceptable sediment sampling plan. Selection involves both the location (horizontal and vertical) and the number of samples for a proposed project.

### 4.2.1 Dredging Units

Sediment characteristics are likely to vary within the limits of the area to be dredged as a result of geographic and hydrological features as well as proximity to direct contaminant input. The 1991 Green Book (Section 8.2.3) recommends that proposed areas to be dredged be subdivided into project segments or dredging units (DU) for sampling. Each DU is expected to have relatively consistent characteristics. In addition, dredged material from each DU, if warranted, could be managed in different manners during dredging and disposal to limit environmental impact. DUs can be selected based on historical data, sediment characteristics, geographic configuration, depth of cut, equipment limitations, known or suspected contaminant concentrations, etc. They can be defined by both horizontal and vertical limits, i.e., surface sediments might be considered separate from subsurface sediments at the same location. The 1991 Green Book (Section 8.2.3) recommends limiting vertical subdivisions to no smaller than 2 to 3 feet due to dredging equipment limitations. Typically, a DU can be characterized by a single sediment analysis. Thus, a separate decision can be made for a DU that can be characterized and dredged separately from other sediments in a project area.

For the purposes of this document, four possible rankings have been developed for dredging units: exclusionary, low, moderate, or high. In that order, these ranks represent a scale of increasing potential for significant concentrations of COCs and/or adverse biological effects. Table 4-2 identifies the parameters that better define these rankings.

The ranking system is based on two major factors:

1. The availability of historic information on the physical, chemical, and/or biological-response characteristics of the sediments from a reach or site; and

2. The number, kinds, and proximity of chemical sources (existing and historical) known to occur in or near a particular reach or site.

DUs and their respective rankings should be developed as part of the SAP and approved by the USACE SAD district and EPA Region 4 prior to sampling. An example of a maintenance project divided into DUs is provided in Figure 4-1.

**Table 4-2. Dredging Unit Ranking Definitions**

| Ranking | Parameters |
|---|---|
| Exclusionary | Material that has been shown to meet the exclusionary criteria in 40 CFR §227.13(b) are summarized below:<br>1. The material is predominately sand (see Section 3.1.1) <u>and</u> is found in areas of high current or wave energy, or<br>2. The material is substantially the same as the substrate at the ODMDS and the dredging site is far removed from known existing and historical sources of pollution. |
| Low | ▪ Available data indicate low concentrations of COCs and/or no significant response in biological tests;.<br>▪ Locations with higher percentages of finer-grained sediments and organic material but few sources of potential contamination;<br>▪ Typical locations include adjacent entrance channels, rural marinas, navigable side sloughs, and small community berthing facilities. |
| Moderate | ▪ Available data indicate moderate concentrations of COCs in sediments in a range known to cause adverse response in biological tests;<br>▪ Locations where sediments are subject to several sources of contamination, or where existing or historical use of the site has the potential to cause sediment contamination;<br>▪ Typical locations include urban marinas, fueling and ship-berthing facilities; areas downstream of major sewer or stormwater outfalls; and medium-sized urban areas with limited shoreline industrial development. |
| High | ▪ Available data indicate high concentrations of COCs in sediments and/or significant adverse responses;<br>▪ Locations where sediments are subject to numerous sources of sediment contamination, including industrial runoff and outfalls, or where existing or historical use of the site has the potential to cause sediment contamination;<br>▪ Typical locations include large urban areas and shoreline areas with major industrial development. |

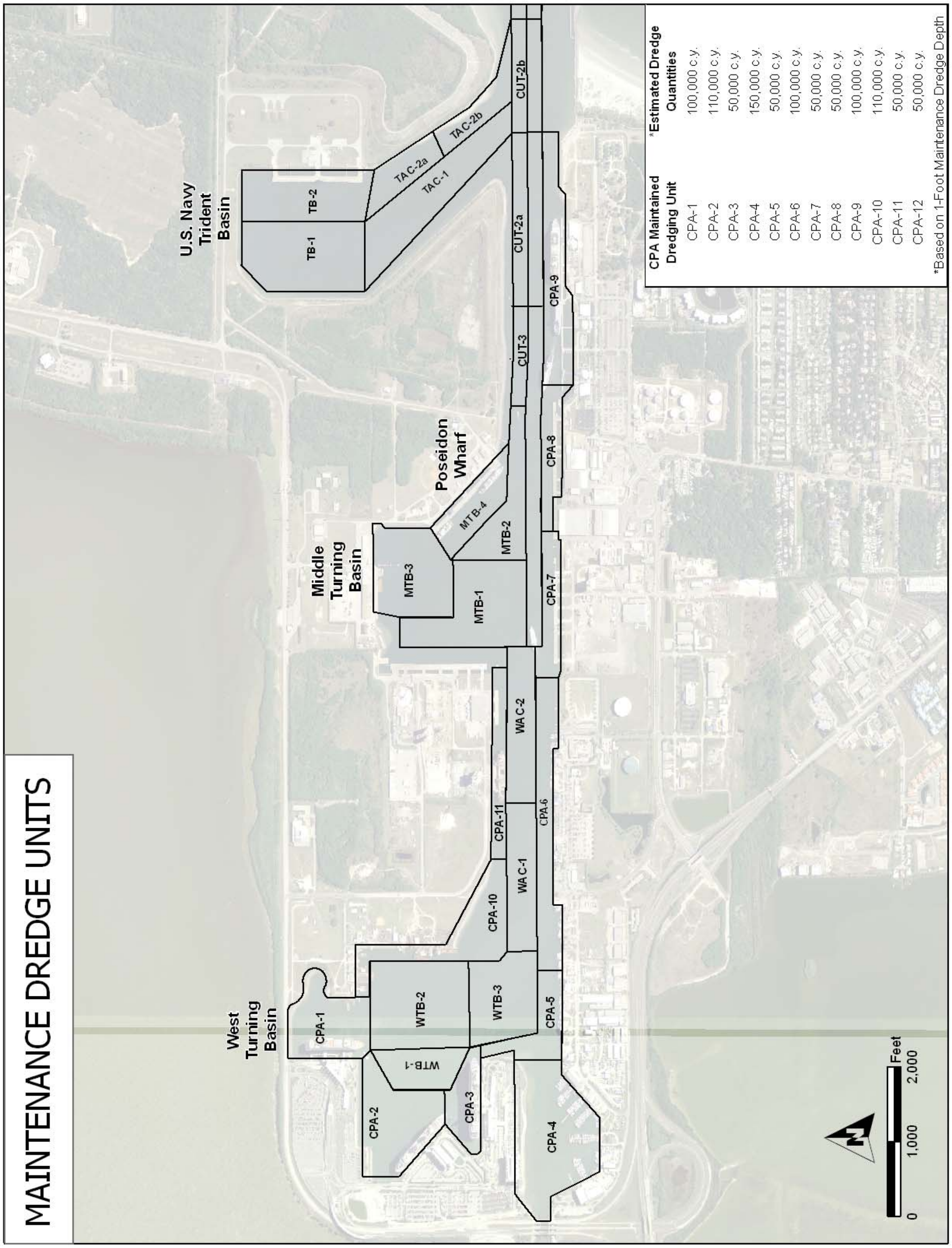


**Figure 4-1. Example of Dredging Units for Maintenance Dredging**

### 4.2.2 Recommended Sampling Requirements

As discussed above, each DU can be characterized by a single analysis. Therefore, the size of the DU will determine the number of analyses for a proposed project. Recommended volumes for the DU are provided in Table 4-3. These are recommended values and can be modified based on site-specific concerns. The presence of heterogeneous or discreet layers in the dredge cut may warrant further sub-sampling or assignment of a smaller DU. For example, if 25% of the sample volume is visually different from the rest of the sediment profile, and can be sampled and dredged separately, then an additional DU may be warranted.

**Table 4-3. Recommended Volumes for Dredging Units**

| Ranking | Volume (cubic yards) |
|---|---|
| Exclusionary | 300,000 |
| Low | 200,000 |
| Moderate | 100,000 |
| High | 50,000 |

The single sediment analysis for a DU will typically consist of a number of samples composited. The number of samples required of a proposed project, or that can be composited or combined for a single analysis, will be determined on a DU-by-DU basis. The number of samples and the compositing scheme will vary depending upon such factors as: (1) a reason to believe that contamination may exist, (2) the heterogeneity of the sediments, (3) the areal extent of the DU, and (4) the proposed depth of dredging. In general, sampling intensity increases with suspected contamination, higher ranking, greater areal extent, increasing depth, or the occurrence of stratification. In homogenous sediments, the requirement is a minimum of two samples, and in heterogeneous sediments, a minimum of three samples composited for one analysis is recommended to characterize a single DU.

### 4.2.3 Sample Replication for Quality Assurance

The number of sample replicates for quality assurance purposes should be determined in accordance with Section 8.0. Sample replicates should consist of a subsample of a well homogenized composite sample. Sediment testing should then be conducted on the replicate samples.

## 4.3 Sampling Reference Stations

For dredged material evaluations for ocean disposal, the test results from proposed dredging site samples are compared to test results from appropriate reference site sediments. Reference sediment is defined as*: "A sediment, substantially free of contaminants, that is as similar to the grain size of the dredged material and the sediment at the disposal site as practical, and reflects conditions that would exist in the vicinity of the disposal site had no dredged-material disposal ever occurred, but had all other influences on sediment condition taken place."* (1991 Green Book, Section 3.1.2). Reference sediment sampling stations are selected to simulate conditions at the proposed disposal site in the absence of past dredged material disposal. Reference sediments must be collected for each evaluation. Results from previous evaluations are not acceptable. Test organisms should be selected to minimize sensitivity to possible sediment grain size differences among the reference site, the control site, and the proposed dredging site.

Using historical reference sites and EPA Region 4 studies of reference areas, EPA Region 4 has identified preferred reference sites for each ODMDS for various grain size distributions. These sites are identified in Appendix K. One or more of these sites may be used and should be selected based on the grain size of the proposed dredged material. These reference areas shall be utilized. Alternative reference sites will be approved on a case-by-case basis. Reference sediments may be collected from: (1) a single reference-sediment sampling location; or (2) from a number of approved locations. Reference samples may be composited and tested according to guidance provided in Chapter 8 of the 1991 Green Book.

Replicate sediment samples should be collected at the reference site(s) using an appropriate collection device [see Table 5 for the EPA QA/QC Guidance (EPA, 1995)]. In most cases, a grab sample is adequate for reference sediment stations. Replicates may be composited into a single sample [see Chapter 8 of the 1991 Green Book or Chapter 4 of EPA (2001b) for guidance]. The collected sediment should be of sufficient quantity to conduct all required testing. A minimum of three replicate sediment samples from the reference site(s) should be collected for all testing [i.e., three grabs at one site or one grab at three sites or any other combination for a minimum of three grabs].

## 4.4 Sampling Control Site Stations

Control sediment should be used in all bioassay and bioaccumulation tests. Control sediment is distinguished from the reference sediment because it is selected to provide optimum conditions for the organisms. Control samples are used to determine the general health of the test organisms during the bioassay and bioaccumulation tests, and to evaluate test protocols as part of the laboratory QA/QC program. The coordinates of the control site or source of the control sediment should be documented in the SAP and approved by the appropriate USACE SAD district and EPA Region 4 prior to collection.

- Control sediment shall be defined as: "A natural sediment essentially free of contaminants and compatible with the biological needs of the test organisms such that the sediment has no discernible influences on responses being measured in the tests" (1991 Green Book, Section 1).
- Control sediment is used in the whole-sediment bioassay tests to assess the overall health of the test species. The average control test species mortality should not exceed 10% [30% for the zooplankton in the elutriate toxicity tests (see Appendix L)]. In the event these levels are exceeded, testing may need to be repeated.
- The control sediment tests are not usually compared to the proposed dredged material as part of the analysis to determine whether sediments are suitable for ocean disposal.

## 4.5 Sampling of Dredged Material at the Proposed Dredging Site

Sediment sampling at the selected stations in the proposed dredging site should be designed to ensure that the proposed dredged material will be adequately characterized. This sampling should include consideration of project design and survey/measurement considerations, the dredging history of the area (i.e., new vs. maintenance work), physical conditions, characteristics of the material being dredged (sedimentation rates), type of dredging equipment, and any previous sampling. It should also include a consideration of the actual potential dredging depth, which includes required project depth (authorized project depth and, if applicable, advanced maintenance), any paid allowable overdepth dredging, and non-pay overdepth dredging due to inaccuracies in the dredging technique and disturbances from the dredge. Guidance to assure that environmental compliance activities and environmental documentation associated with new and maintenance dredging adequately considers overdepth dredging has been prepared by USACE (2006). ER 1130-2-520 (USACE, 1996) provides that USACE may dredge a maximum of 2 feet of allowable overdepth in coastal regions and in inland navigation channels. This allowable overdepth is also referred to as paid allowable overdepth dredging. All material likely to be dredged, including material in the paid allowable overdepth and non-pay dredging areas, must be characterized and evaluated.

Table 4-4 provides general guidance on sampling depth based on dredging technique. Additional guidance can be found in "Overdepth Dredging and Characterization Depth Recommendations" (Tavolaro et al., 2007) and in the Memorandum for Commanders (USACE, 2006). The estimated dredging quantities, and therefore sampling depths, must be adequate to ensure achievement of the full dimensions of the project. They need to include estimates of the quantity that may be excavated due to the inherent imprecision of the dredging process while limiting dredging quantities in the interest of environmental protection and preservation of the disposal capacity. These estimates must be developed in a collaborative process that involves the USACE SAD district, EPA Region 4, and the applicant. The project's final sampling depth, including paid and non-pay dredging/disturbance depths, should be specified in the SAP.

**Table 4-4. General Guidance on Sampling Depth**

| Dredging Technique | General Paid Allowable Overdepth Dredging | Recommended Sampling Depth below Paid Allowable Overdepth Dredging | Recommended Sampling Depth below Project Required Depth with No Paid Allowable Overdepth |
|---|---|---|---|
| Cutterhead | 2 feet | 3 feet | 5 feet |
| Hopper | 2 feet | 1 foot | 1-2 feet |
| Mechanical | 2 feet | 2 feet | 4 feet |

Sample collection methods (e.g., grab, coring, etc.) can have an effect on sediment integrity. Therefore, it is important to understand the advantages and disadvantages of each sampling device for the type of testing that is to be done (ASTM, 2003; EPA, 2001b). Generally, coring should be used for new work material where the dredge depth exceeds the penetration of a grab sampler. Grab samplers can be used on maintenance material when the material has been documented to be homogeneous with depth. Explanations of appropriate sampling devices are provided in Table 5 of the EPA QA/QC Guidance (EPA, 1995). Appropriate core liners shall be used [Lexan®, cellulose acetate butyrate, or Teflon® (see also EPA, 2001b)]. Sediment sampling documentation should include:

- A description of the amount and extent of the proposed dredging as well as other factors previously described in Section 4.1. Sample location positioning should utilize Differential GPS or equivalent and be precise to ±3 meters (or DGPS equivalent precision);
- The amount of sediment to be collected to perform all physical, chemical, bioassay, and bioaccumulation sediment testing. Consideration of sample volume requirements for all analyses, acceptable storage, and holding times should be given depending on the tests to be conducted [EPA QA/QC Guidance Table 5 (EPA, 1995)]; and
- Sample log requirements that will document sediment sample handling procedures. Sample logs must specifically include:

  (a) sample date;
  (b) sample location (latitude and longitude);
  (c) sample identification code for chain-of-custody documentation, description of sediment odor and physical appearance;
  (d) sample depth and water depth;
  (e) sampling method (including sampling gear);
  (f) sample penetration depth;
  (g) number of samples taken; and
  (h) any problems encountered.

It is strongly recommended that samples be retained under proper storage conditions until acceptability of the data has been determined.

## 4.6 Water Sampling

Water samples are required for preparation of the elutriate sample and dilution water. In accordance with Sections 10.1.2 and 11.1.4 of the 1991 Green Book, elutriate samples are prepared using unfiltered water from the dredging site. The sample(s) should be collected within 1 meter of the bottom, but entrainment of material to be dredged should be avoided. The water sample should be collected with equipment and materials suitable for the type of analytical parameters that are being tested for (i.e., peristaltic pump, Van Dorn, etc). The location(s) of the elutriate sample water should be included in the SAP and approved by the USACE SAD district and EPA Region 4. In accordance with Section 11.1.4 of the 1991 Green Book, disposal-site water, clean seawater, or artificial sea/salt mixtures should be used as dilution water for the tests. If disposal site water is to be used, the sample should be collected from at least one meter below surface and within the disposal site boundaries.

## 4.7 Sample Handling

Guidance on sample handling can be found in Section 8.2.6.1 of the 1991 Green Book and Chapters 4 and 5 of *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual* (EPA, 2001b). Sediment samples for biological testing should have all living organisms removed from the sediment prior to handling. This can best be accomplished by press-sieving the sediments through a 1-mm-mesh screen. Other matter retained on the screen with the organisms, such as shell fragments, gravel, and debris, should be recorded and discarded. Sediments for physical and chemical analysis should not undergo such treatment. All sediments should be thoroughly homogenized.

# 5.0 PHYSICAL AND CHEMICAL TESTING OF DREDGED MATERIAL

Testing is frequently required to characterize the physical and chemical properties of sediments proposed for dredging and disposal. The following information supplements Section 9.0 of the 1991 Green Book and Section 2.8.1 of the QA/QC Manual (EPA, 1995). Strict adherence to established testing protocols and detection limits while conducting all analyses will aid in expediting review and concurrence for projects. Any deviation from these protocols should be approved by the USACE SAD district and EPA Region 4 prior to analysis. Such deviation should be clearly defined in the SAP (see Sections 2.2 and 4.1). Established QA/QC procedures must be followed (see Section 8.0).

## 5.1 Physical Analysis

Sediment proposed for dredging and disposal and reference sediments should be analyzed for grain size distribution, TOC, and total solids/percent moisture (Table 5-1). In addition, specific gravity, bulk density, and Atterberg limits may be required on a case-by-case basis. Atterberg limits should be determined when clumping of dredged material is expected during disposal (e.g., new work projects in cohesive clays). The grain size analysis should be conducted according to the methods described in Plumb (1981) or ASTM (2002) and reported as percentages retained by weight in the following size classes, at a minimum:

- Gravel
- Coarse Sand
- Medium Sand
- Fine Sand
- Silt/Clay (expressed as "Fines")

Gravel and sand fractions should be separated using the standard sieve sizes indicated in Table 5-1 and reported as cumulative frequency percentages (Section 7.1). The USCS should be utilized and each sample assigned the appropriate two-letter group (see ASTM, 2006). There may be cases where silt and clay fractions will need to be distinguished. USACE SAD districts and EPA Region 4 will provide guidance on a case-by-case basis on whether it is needed. Silt and clay fractions should be quantified by hydrometer (ASTM, 2002), pipette, or Coulter Counter (Plumb, 1981). Use of a laser diffraction grain size analyzer is also acceptable (Loizeau et al., 1994). Total solids and percent moisture should be measured as described by Plumb (1981) or APHA (1995).

It should be noted that the results of the above physical analyses may be used to support compliance with one or more of the three exclusionary criteria in 40 CFR 227.13(b) for ocean disposal (see Section 3.1.1).

**Table 5-1. Parameters Used for the Physical Characterization of Sediments**

| Parameter | Method | Measure/Quantitation Limit |
|---|---|---|
| Grain Size Distribution | Plumb, 1981; ASTM, 2002 | |
| Gravel (>4.75mm) | | Retained on No. 4 sieve |
| Coarse Sand (2.0-4.75mm) | | Passing through No. 4 sieve and retained on No. 10 sieve |
| Medium Sand (0.425-2.0mm) | | Passing through No. 10 sieve and retained on No. 40 sieve |
| Fine Sand (0.075-0.425mm) | | Passing through No. 40 sieve and retained on No. 200 sieve |
| Silt (0.005-0.075mm) | | As determined by hydrometer, pipette or Coulter counter/laser particle size analyzer |
| Clay (<0.005mm) | | As determined by hydrometer, pipette or Coulter counter/laser particle size analyzer |
| Total (percent) Solids | Plumb, 1981 | Value based on mass. 1.0% |
| Total Organic Carbon | 9060 (SW846) | 0.1% |
| Specific Gravity | Plumb, 1981 | |
| Atterberg Limits* | ASTM 4318D | |

*Not needed in all cases. Consult your USACE district and EPA prior to analysis.

## 5.2 Chemical Analysis of Sediments

As discussed in Section 3.2.1.1, chemical analysis of sediments can be used to document compliance with applicable EPA WQC or state WQS. However, it cannot be used for determination of water column toxicity or the assessment of contaminant toxicity and bioaccumulation from the material to be dredged. As discussed in Section 3.2.2, sediment chemistry can be used to screen out sediments that are not likely to meet the LPC or to assist in selecting a compositing or testing scheme under Tier III. It can also be used in Tier I as part of confirmatory analysis (see Section 3.1.2). It should be noted that chemical analysis of sediments is not required to document compliance with the ocean dumping criteria, but can be a beneficial tool in evaluating current and future projects.

There are three reasons for analyzing the sediments – none required under ocean dumping criteria:

(1) Elutriate screen (Appendix F and Table 5-1),

(2) Establish contaminants,

(3) Determine chemical dredging characterization of dredge material to establish future confirmatory analyses.

The COCs that should be analyzed on a routine basis are listed in Tables 5-3 through 5-7. The routine metals, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and pesticides listed in these tables were chosen based on the requirements of 40 CFR 227.6, their toxicity, their persistence in the environment, their ability to bioaccumulate, and their widespread and consistence occurrence in the estuarine, marine, and freshwater sediments and organisms of the southeastern United States. These lists can be reduced or expanded based on site-specific knowledge of pollution sources or historical testing showing the presence or lack of presence of specific contaminants. Table 3-2 provides a list of resources for determining COCs. It should be explicitly stated in the SAP when listed contaminants will not be analyzed. One of the primary sources of dioxin-like compounds [chlorinated dibenzo-p-dioxins (CDDs), chlorinated dibenzofurans (CDFs), and certain PCBs] in surface water is bleached pulp and paper mills (EPA, 2001c). Dioxin-like compounds will be added to the analyte list when pulp and paper mills are or were present upstream in the watershed of the proposed dredging area unless it has been previously documented that these compounds are not present within the sediments in the vicinity of the project. Other major sources of dioxin-like substances to the air and land that could deposit in sediments include solid and medical waste incineration, secondary copper smelting, and cement kilns (EPA, 2001c). If any of these activities are present in the project vicinity, dioxin-like compounds should be considered. Appropriate methods and target detection limits for the dioxin-like compounds and any other supplemental COCs can be found in Appendix M of this document, the EPA QA/QC Guidance (EPA, 1995), the Inland Testing Manual, or the 1991 Green Book. If sediment chemistry is to be used in the screening method (Section 3.2.1.1) to document compliance with the WQC, analyses must be performed for all analytes listed in Appendix F.

The target detection limits (TDLs) listed in the tables are performance goals (EPA, 1995). Laboratory reporting limits (LRL) for each project should be at or below these values (Jones and Clarke, 2005). LRLs are the minimum levels at which a lab will report analytical chemistry data with confidence in the quantitative accuracy of that data. LRLs are adjusted for sample-specific parameters such as sample weight, percent solids, or dilution. As routine data acceptance criteria, the LRLs for each analyte should be below the listed TDL, with the caveat that some sediments with higher percent moisture content may have LRLs above the TDLs. It is the applicant's (USACE SAD district for Civil Works projects) responsibility to meet the TDLs. Some laboratories have had difficulties in the past meeting the required TDLs because of inappropriate sample preparation and clean-up procedures to remove interfering substances typically found in marine sediments (e.g., elemental sulfur). If the TDLs cannot be attained, a detailed explanation should accompany the data providing the reasons for not attaining the required TDLs. Re-analysis may be necessary or the contaminant may have to be assumed to be present at the reported LRL. Appropriate sample preparation, clean-up, and analytical methods have been developed for estuarine/marine sediments by the National Oceanic and Atmospheric Administration (NOAA) (1993) and the EPA research laboratory at Narragansett, RI (EPA, 1993a). Established sample and clean-up procedures are presented in Table 5-2.

**Table 5-2. Sample and Clean-up Procedures Generally Used for Marine Sediments**

| Parameter | Methods |
|---|---|
| Pesticides | EPA 3640 (GPC), 3660 (Sulfur), 3620 (Florisil) |
| PCBs | EPA 3640 (GPC), 3660 (Sulfur), 3620 (Florisil), 3665 (Sulfuric Acid) |
| PAHs | EPA 3640 (GPC), 3630 (Silica Gel) |

**Table 5-3. Standard Contaminants of Concern to Be Analyzed from Sediment Samples: Metals**

| Metal | Analytical Method[1] | Target Detection Limit[2] |
|---|---|---|
| Arsenic | 6020 | 1 |
| Cadmium | 6020 | 0.1 |
| Chromium | 6020 | 1 |
| Copper | 6020 | 1 |
| Lead | 6020 | 0.5 |
| Mercury | 7471 | 0.05 |
| Nickel | 6020 | 1 |
| Selenium | 6020 | 1 |
| Silver | 6020 | 0.2 |
| Zinc | 6020 | 1 |

1 The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

2 Dry weight: mg/kg or ppm

**Table 5-4. Standard Contaminants of Concern to Be Analyzed from Sediment Samples: Pesticides and Semi-Volatiles**

| Contaminant of Concern | Analytical Method[1] | Target Detection Limit[2] |
|---|---|---|
| **Pesticides** | | |
| Aldrin | 8081 | 10 |
| Chlordane & Derivatives | 8081 | 10 |
| Dieldrin | 8081 | 10 |
| 4,4'-DDD | 8081 | 10 |
| 4,4'-DDE | 8081 | 10 |
| 4,4-DDT | 8081 | 10 |
| Endosulfan & Derivatives | 8081 | 10 |
| Endrin & Derivatives | 8081 | 10 |
| Heptachlor & Derivatives | 8081 | 10 |
| Hexachlorocyclohexane (Lindane) & Derivatives | 8081 | 10 |
| Methoxychlor | 8081 | 10 |
| Toxaphene | 8081 | 50 |
| **Semi-Volatiles** | | |
| Pentachlorophenol | 8151 Modified or 8270C SIM | 100 |

1 The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

2 Dry weight: µg/kg or ppb

**Table 5-5. Standard Contaminants of Concern to Be Analyzed from Sediment Samples: PAHs**

| PAH | Analytical Method[1] | Target Detection Limit[2] |
|---|---|---|
| Acenaphthene* | 8270 | 20 |
| Acenaphthylene | 8270 | 20 |
| Anthracene* | 8270 | 20 |
| Benzo(a)Anthracene** | 8270 | 20 |
| Benzo(a)Pyrene** | 8270 | 20 |
| Benzo(g,h,i)Perylene | 8270 | 20 |
| Benzo(k)Fluoranthene | 8270 | 20 |
| Benzo(b)Fluoranthene | 8270 | 20 |
| Chrysene** | 8270 | 20 |
| Dibenzo(a,h)Anthracene** | 8270 | 20 |
| Fluoranthene** | 8270 | 20 |
| Fluorene* | 8270 | 20 |
| Indeno(1,2,3-c,d)Pyrene | 8270 | 20 |
| 1- & 2-Methylnaphthalene* | 8270 | 20 |
| Naphthalene* | 8270 | 20 |
| Phenanthrene* | 8270 | 20 |
| Pyrene** | 8270 | 20 |

The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

Dry weight: µg/kg or ppb

* Low molecular weight (LMW) PAHs (NOAA, 1989)

** High molecular weight (HMW) PAHs (NOAA, 1989)

**Table 5-6. Standard Contaminants of Concern to Be Analyzed from Sediment Samples: PCBs**

| PCB Congener | Congener Number | Analytical Method[1] | Target Detection Limit[2] |
|---|---|---|---|
| 2,4' diCB | 8* | 8082 | 1.0 |
| 2,2',5 triCB | 18* | 8082 | 1.0 |
| 2,4,4' triCB | 28* | 8082 | 1.0 |
| 2,2',3,5' tetraCB | 44* | 8082 | 1.0 |
| 2,2',4,5' tetraCB | 49 | 8082 | 1.0 |
| 2,2'5,5' tetraCB | 52* | 8082 | 1.0 |
| 2,3',4,4' tetraCB | 66* | 8082 | 1.0 |
| 3,3',4,4' tetraCB | 77 | 8082 | 1.0 |
| 2,2',3,4,5' pentaCB | 87 | 8082 | 1.0 |
| 2,2',4,5,5' pentaCB | 101* | 8082 | 1.0 |
| 2,3,3'4,4' pentaCB | 105* | 8082 | 1.0 |
| 2,3',4,4',5 pentaCB | 118* | 8082 | 1.0 |
| 3,3',4,4',5 pentaCB | 126 | 8082 | 1.0 |
| 2,2',3,3',4,4' hexaCB | 128* | 8082 | 1.0 |
| 2,2',3,4,4',5' hexaCB | 138* | 8082 | 1.0 |
| 2,2',4,4',5,5' hexaCB | 153* | 8082 | 1.0 |
| 2,3,3',4,4',5 hexaCB | 156 | 8082 | 1.0 |
| 3,3',4,4',5,5' hexaCB | 169 | 8082 | 1.0 |
| 2,2',3,3',4,4'5 heptaCB | 170* | 8082 | 1.0 |
| 2,2',3,4,4',5,5' heptaCB | 180* | 8082 | 1.0 |
| 2,2',3,4,4',5',6 heptaCB | 183 | 8082 | 1.0 |
| 2,2',3,4,4',6,6' heptaCB | 184 | 8082 | 1.0 |
| 2,2',3,4',5,5',6 heptaCB | 187* | 8082 | 1.0 |
| 2,2',3,3',4,4',5,6 octaCB | 195* | 8082 | 1.0 |
| 2,2',3,3',4,4',5,5',6 nonaCB | 206* | 8082 | 1.0 |
| 2,2',3,3',4,4',5,5',6,6' decaCB | 209* | 8082 | 1.0 |

[1] The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

[2] Dry weight: µg/kg or ppb

* PCB congeners to be used in summation for comparison to NOAA data (see Section 7.3)

**Table 5-7. Standard Contaminants of Concern to Be Analyzed from Sediment Samples: Organotin**

| Compound | Analytical Method[1] | Target Detection Limit[2] |
|---|---|---|
| Monobutyltin | Krone et al., 1989* | 10 |
| Dibutyltin | Krone et al., 1989* | 10 |
| Tributyltin | Krone et al., 1989* | 10 |

1 The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

2 Dry weight: µg/kg or ppb

* Grignard reaction and gas chromatograph/flame photometric detection (GC/FPD)

## 5.3 Chemical Analysis of Elutriates

Elutriates must be analyzed if the screening method (Section 3.2.1.1) does not demonstrate compliance with the WQC (Appendix F). The dredged-material elutriate preparation is conducted according to the methods presented in the 1991 Green Book, Section 10.1.2.1. The elutriate must be prepared using water from the dredging site (see Section 4.6). Samples for the elutriate and the water column toxicity test can be prepared from the same sediment-water mixture. To evaluate water quality criteria in the liquid phase, the elutriate water must be centrifuged to remove particulates in accordance with the guidelines in Section 10.1.2.1 of the 1991 Green Book. (Note: The sample is not centrifuged in the case of water column toxicity test).

The recommended methods and required TDLs for each COC are listed in Tables 5-9 through 5-11. If the disposal site or a portion of the disposal site lies within state waters, additional analytes may need to be added to document compliance with state WQCs. At a minimum, chemical analyses must be conducted on all analytes in Tables 5-9 through 5-11 unless the screening method (Section 3.2.1.1) has already demonstrated compliance. Disposal site water should also be evaluated for these analytes for use in the mixing model unless existing data are available.

Additional information, beyond that called for in this SERIM, may be required for a proposed project depending on the nature and location of that project. In most cases, the project will also need to satisfy state regulatory requirements.

Some laboratories have had difficulties in the past meeting the required TDLs because of inappropriate sample preparation and clean-up procedures to remove interfering substances typically found in marine water and elutriates derived from marine sediments (e.g., sodium chloride). Appropriate sample preparation and clean-up procedures for applicable chemical parameters are presented in Table 5-8.

**Table 5-8. Sample and Clean-up Procedures Generally Used for Marine Waters and Elutriates**

| Parameter | Methods |
|---|---|
| Metals | EPA 1640 (reductive precipitation chemical separation for some elements: As, Cd, Cu, Pb, Ni, Ag, Zn) |
| PCBs | EPA 3665 (sulfuric acid) |

**Table 5-9. Standard Contaminants of Concern to Be Analyzed from Elutriate Samples: Metals**

| Contaminant of Concern | Method[1] | Target Detection Limit (µg/L) |
|---|---|---|
| Arsenic | 200.8 or 6020 | 1 |
| Cadmium | 200.8 or 6020 | 1 |
| Chromium, Total [2] | 200.8 or 6020 | 1 |
| Chromium, Hexavalent (Cr+6) | 7196A | 1 |
| Copper | 200.8 or 6020 | 1 |
| Lead | 200.8 or 6020 | 1 |
| Mercury | 245.1 or 7470 | 0.2 |
| Nickel | 200.8 or 6020 | 1 |
| Selenium | 270.2, 270.3, 7740, 7741, or 7742 | 2 |
| Silver | 200.8 or 6020 | 1 |
| Zinc | 200.8 or 6020 | 1 |

[1] The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

[2] If hexavalent chromium (Cr+6) cannot be run within holding time, total chromium could be run in its place; if the resulting data meet the hexavalent chromium criteria, the sample will pass.

**Table 5-10. Standard Contaminants of Concern to Be Analyzed from Elutriate Samples: Nonmetals**

| Contaminant of Concern | Method[1] | Target Detection Limit (µg/L) |
|---|---|---|
| Ammonia | 350.1 | 30 |
| Cyanide | 335.2 | 10 |
| Tributyltin (TBT) | Krone et al. 1989* | 0.01 |

[1] The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

* Grignard reaction and GC/FPD

**Table 5-11. Standard Contaminants of Concern to Be Analyzed from Elutriate Samples: Pesticides and Semi-Volatiles**

| Contaminant of Concern | Method[1] | Target Detection Limit (µg/L) |
|---|---|---|
| **Pesticides** | | |
| Aldrin | 8081 | 0.5 |
| Chlordane | 8081 | 0.05 |
| DDT | 8081 | 0.1 |
| Dieldrin | 8081 | 0.5 |
| alpha – Endosulfan | 8081 | 0.03 |
| beta – Endosulfan | 8081 | 0.03 |
| Endrin | 8081 | 0.03 |
| gamma-BHC (Lindane) | 8081 | 0.1 |
| Heptachlor | 8081 | 0.05 |
| Heptachlor Epoxide | 8081 | 0.05 |
| Toxaphene | 8081 | 0.2 |
| **Semi Volatiles** | | |
| Pentachlorophenol | 8151 Modified or 8270C SIM | 10 |

[1] The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

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# 6.0 BIOASSAY AND BIOACCUMULATION TESTING OF DREDGED MATERIAL

Bioassay tests (in Tier III) must be conducted on all proposed dredging, reference, and control site samples according to the protocol outlined in the 1991 Green Book. Strict adherence to the 1991 Green Book bioassay procedures including nationally approved and recognized updates, will aid in expediting review and concurrence for projects. Any deviations from the procedures should be approved by the appropriate USACE SAD district and EPA Region 4 prior to testing. Bioassay and bioaccumulation testing will be conducted according to test conditions listed in Appendix L. It is recommended that the table format presented in Appendix L be used to report each testing parameter. Additionally, a section including any deviations from these testing conditions should be included in the sediment report.

## 6.1 Water Column Effects: Acute Toxicity Tests

The water column evaluation considers the effects, after allowance for initial mixing, of dissolved contaminants plus those associated with suspended particulates on water column organisms (see Section 3.3.1). Technical guidance on performing water column bioassays is provided in the Section 11.1 of the 1991 Green Book (or Section 11.1 of the ITM). Paragraph 227.27(c) of the regulations defines appropriate sensitive water column marine organism to mean at least one species each representative of phytoplankton or zooplankton, crustacean or mollusk, and fish. Therefore, a minimum of three series of tests using three species is required for each dredged material sample, a control, and the dilution water. It is recommended that the test organisms be fish, crustaceans, and zooplankton. Table 6-1 lists recommended tests species for the southeastern United States.

Test duration is 96 hours except for planktonic larvae. The procedure for preparing the water column test samples is given in Section 11.4.1 of the 1991 Green Book. Note that, contrary to the elutriate preparation method for chemical analysis, the sample is not filtered or centrifuged unless necessary to observe test organisms in the chamber. Also note that the control and dilution water may be one and the same. A minimum of five replicates per treatment is required. A minimum of 10 organisms per replicate is required except for larvae, which are measured by concentration of egg suspension (ASTM, 2004). Refer to Appendix L for specific species information. The measured endpoint is mortality ($LC_{50}$) or development ($EC_{50}$) in the case of larval test. At least three concentrations of the dredged-material elutriate should be tested (100%, 50%, and 10% of the dredged-material elutriate.). If the conditions are highly toxic, such that the 10% elutriate treatment has greater than 50% mortality/abnormality, further dilution must be made (new treatments of less than 10% dredged-material elutriate) to attain a survival of greater than 50% and determine the $LC_{50}$ by interpolation. If mortality is greater than 10% (30% mortality/abnormality for zooplankton tests) in the control treatment or in the dilution-water treatment for a particular test species, the test should be rejected and the bioassay repeated.

## Table 6-1. Recommended Test Species for Water Column Toxicity Testing of Dredged Material

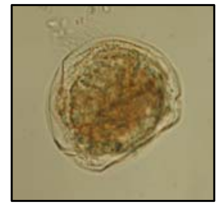
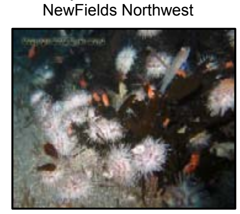
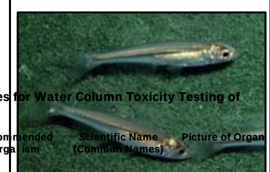
| Group | Endpoint Measured | Test Duration | Recommended Organism | Scientific Name (Common Names) | Picture of Organism |
|---|---|---|---|---|---|
| Phytoplankton or Zooplankton | Abnormal development | 46-72 hrs | Oyster Larvae | *Crassostrea virginica* (eastern oyster) | <br>Courtesy of: William Gardiner, NewFields Northwest |
| | Abnormal development | 46-72 hrs | Mussel Larvae | *Mytilus edulis* (common bay mussel, blue mussel) | <br>Courtesy of: William Gardiner, NewFields Northwest |
| | Abnormal development | 46-72 hrs | Clam Larvae* | *Mercenaria mercenaria* (hard clam, quahog, cherrystone) | <br>Photo by: Randy Newman Courtesy of Food and Agricultural Organization (FAO) |
| | Abnormal development | 46-72 hrs | Sea Urchin Larvae | *Arbacia punctulata*<br><br>*Strongylocentrotus* sp. (purple-spined sea urchin)<br><br>*Lytechinus pictus* (white sea urchin) | <br>Photo by: Randy Newman Courtesy of: North Carolina Division of Parks and Recreation<br><br>Courtesy of William Gardiner, NewFields Northwest<br><br>Courtesy of Owen Lloyd, www.OwenLloyd com |

**Table 6-1. Recommended Test Species for Water Column Toxicity Testing of Dredged Material**

| Group | Endpoint Measured | Test Duration | Recommended Organism | Scientific Name (Common Names) | Picture of Organism |
|---|---|---|---|---|---|
| * Pictures of organisms in adult stage were used. | | | | | |
| Crustacean or Mollusk | Mortality | 96 hrs | Shrimp | *Americamysis bahia*<br>*Americamysis bigelowi*<br>*Americamysis almyra* (opossum or mysid shrimp) | <br><br>Courtesy of: Alan Ken d ERDC |
| Fish | Mortality | 96 hrs | Silverside | *Menidia menidia* (Atlantic silverside)<br>*Menidia beryllina* (inland silverside)<br>*Menidia peninsulae* (tidewater silverside) | <br><br>Courtesy of Weston Solutions, Inc<br>Courtesy of: MBL Aqua t e |
| | Mortality | 96 hrs | Sheepshead Minnow | *Cyprinodon variegatus* (sheepshead minnow) | <br>Copyright George Burgess Florida Museum of Natural History |

## 6.2 Benthic Effects Evaluation

The benthic effects evaluation involves whole sediment toxicity and bioaccumulation testing. The general procedures for Tier III toxicity tests are described in Section 11 of the 1991 Green Book. Tier III bioaccumulation procedures are described in Section 12 of the 1991 Green Book.

### 6.2.1 Whole Sediment Toxicity Tests

The purpose of sediment toxicity tests is to determine whether the sum of the sediment contaminants in combination with the physical characteristics will elicit a toxic response to exposed organisms after the material is deposited into the marine environment. The regulations require that benthic bioassays be conducted with species that together represent filter-feeding, deposit-feeding, and burrowing characteristics [40 CFR 227.27(d)]. For ocean disposal, two test species (an amphipod being one of the required organisms) that represent the three categories of organisms specified in the regulations are required (see Table 6-2). Species-specific test conditions are provided in Appendix L. The duration of the toxicity tests is 10 days. General guidance for the collection, handling, and storage of sediments for biological testing may be found in Section 8 of the 1991 Green Book.

> As a general rule, approval from EPA and USACE (in the case of applicants) on project-specific procedures is required for any sediments requiring treatment for ammonia. Ammonia is not a contaminant of concern for benthic assessments as it is typically stripped from the dredged material during disposal. However, amphipods and shrimp are generally sensitive to sediment ammonia and excessive ammonia concentrations may cause mortalities in these species, resulting in false positives confounding the mortality endpoint of interest (more persistent toxics).

To account for this potential false positive, EPA and USACE have devised methods to reduce ammonia toxicity <u>before</u> any test begins (see Section 11.2.2 of the Inland Testing Manual and/or Appendix N of this document). To avoid toxicity from ammonia, the sediment porewater total ammonia and un-ionized ammonia concentrations must be below the values shown in Table 6-2 before any test organism is added to a test chamber. If porewater concentrations exceed these values, the procedures in Appendix N should be followed.

As indicated in the 1991 Green Book, all control survivorship must be at least 90% for the test to be valid. <u>Tests with less than 90% survival in the control will have to be rerun</u>. Mean survivorship in the reference should be greater than the reference survival criteria stated in Table 6-2. When the mean reference survival is less than the minimum reference survival criteria from Table 6-2 the following options are available:

1. The test results for dredged material should be compared to the control instead of the reference; or
2. Data should be reviewed for possible outliers (see Section 7.4.1); or
3. The test should be repeated

**Table 6-2. Recommended Test Species and Environmental Parameters for Benthic Effects Toxicity Testing of Dredged Material**

| Group | Scientific Name | Minimum Reference Survival Criteria[3] | Grain Size (% silt/clay) | Ammonia Unionized (mg/L) | Ammonia Total (mg/L) | Picture of Organism |
|---|---|---|---|---|---|---|
| Amphipod | *Ampelisca abdita* | 73% | >10[1] | <0.4[1] (porewater @ pH=7.7) | <30[1] (porewater @ pH=7.7) |  Courtesy of: Alan Kennedy, ERDC |
| | *Leptocheirus plumulosus* | 73% | full range | <0.8[1] (porewater @ pH=7.7) | <60[1] (porewater @ pH=7.7) |  Courtesy of: Alan Kennedy, ERDC |
| Shrimp | *Americamysis bahia** | 82% | full range | <0.6[2] (Overlying water @ pH=7.9) <0.3[2] (Overlying water @ pH=7.5) | not available |  Courtesy of: Alan Kennedy, ERDC |
| Polychaetes | *Neanthes arenaceodentata* | TBD | full range | N/A | N/A |  Courtesy of: Alan Kennedy, ERDC |

1 EPA, 1993b

2 EPA, 1994

3 These numbers were generated from past reference performance in EPA Region 4 and represent the 95% lower confidence limit for mean survival.

* Formerly called *Mysidopsis bahia*

TBD = to be determined; N/A = not applicable

### 6.2.2 Whole Sediment Bioaccumulation Tests

Bioaccumulation refers to the accumulation of contaminants in the tissues of organisms through any route, including respiration, ingestion, or direct contact with contaminated sediment or water. The regulations require that bioaccumulation be considered as part of the environmental evaluation of dredged material proposed for ocean dumping [40 CFR 227.6(c)(3)]. Bioaccumulation tests must be conducted with appropriate benthic marine organisms. Paragraph 227.27(d) of the regulations defines this to mean species that together represent filter-feeding, deposit-feeding, and burrowing characteristics must be submitted to tests that evaluate the bioaccumulation potential of contaminants in the proposed dredged material. These categories of species are broad and overlapping. The present recommendation is that a burrowing polychaete and a deposit-feeding bivalve mollusk be tested. These two organisms satisfy the requirements specified in paragraph 227.27(d) and are relevant to evaluating contaminant bioavailability at disposal sites. Acceptable species are listed in Table 6-3. *Mercenaria mercenaria* is not an acceptable bioaccumulation organism because it feeds from the water column and not the sediment.

To clarify recommendations in the 1991 Green Book (Section 12.1), the 28-day exposure test is required for organic COCs as well as for metals instead of 28 days for organics and 10 days for metals. At least 20 specimens of each species are recommended in each test replicate, although more may be necessary to conduct the prescribed tissue analyses at the end of the test exposure. It is the applicant's (USACE SAD districts for federal projects) responsibility to ensure that the laboratory provides enough tissue to run subsequent chemical analyses which may include analysis for both metals and organic COCs. Animals used as the test control organisms should be archived at the end of bioaccumulation tests in case the tissues require testing for comparison to the test organisms from the study tanks.

All test organisms should be depurated at the end of the study according to Section 12.1.2 of the 1991 Green Book. Additionally, it is highly recommended that a sufficient amount of "pre-exposure" sample organisms (to analyze for the same COC list as the rest of the test organisms and compare pre-exposure tissue results to post-exposure results if necessary) be depurated and frozen at the beginning of the study.

Animals used as the test control organisms should be archived at the end of bioaccumulation tests in case the tissues require testing for comparison to the test organisms from the study tanks.

Five replicates are required for the reference and treatment samples in order to conduct statistical comparisons. Five (minimum of three) replicates are also recommended for the control. Those constituents that are recommended to be analyzed for in the tissue on a routine basis are listed in Tables 6-4 to 6-8, but may include other contaminants as determined by the Tier I review and/or chemical testing of the sediments. The routine metals, PCBs, PAHs, and pesticides listed in these tables were chosen based on the requirements of 40 CFR 227.6, their toxicity, their persistence in the environment, their ability to bioaccumulate, and their widespread and consistence occurrence in the estuarine, marine, and freshwater sediments and organisms of the southeastern United States. These lists will be reduced or expanded based on site-specific knowledge of pollution sources or historical testing showing the presence or lack of presence of specific contaminants.

**Table 6-3. Recommended Test Species and Environmental Parameters for Bioaccumulation Testing of Dredged Material**

| Group | Scientific Name | Picture of Organism |
|---|---|---|
| Bivalve | *Macoma nasuta* (preferred) |  Courtesy of: Alan Kennedy, ERDC |
| | *Yoldia limatula* |  Courtesy of: www.Jakshells.org Joel Wooster |
| Polychaetes | *Neries virens* (preferred) |  Courtesy of: Alan Kennedy, ERDC |
| | *Arenicola* sp. |  Copyrighted photo, obtained from BIOPIX com |

When sediment chemistry is used to determine COCs, those contaminants listed in 40 CFR 227.6 shall be included when present. Contaminants in concentrations above the LRL in sediments will be considered present and should be tested for in tissues. The final decision on which project-specific contaminants are required to be tested for in the tissue is made by the USACE SAD district in consultation with EPA Region 4 after the physical and sediment chemistry data (if available) are reviewed. The applicant (USACE SAD district for federal projects) must ensure that the contracted laboratory can reasonably achieve the required TDLs listed in Tables 6-4 to 6-8. A discussion of LRLs and TDLs can be found in Section 5.2 of this document. Dioxins, phenols, and phthalate esters tests are to be conducted on a project-specific basis (refer to Appendix M, QA/QC Manual, ITM, or 1991 Green Book for methods and TDLs).

**Table 6-4. Standard Contaminants of Concern to Be Analyzed from Tissue Samples: Metals**

| Metal | Analytical Method[1] | Target Detection Limit[2] |
|---|---|---|
| Arsenic | 200.8 | 0.2 |
| Cadmium | 200.8 | 0.1 |
| Chromium | 6010 | 1 |
| Copper | 200.8 | 1 |
| Lead | 200.8 | 0.2 |
| Mercury | 7471 | 0.02 |
| Nickel | 200.8 | 1 |
| Silver | 200.8 | 0.2 |
| Zinc | 200.8 | 1 |

1 The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided that the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

2 Wet weight: mg/kg or ppm

**Table 6-5. Standard Contaminants of Concern to Be Analyzed from Tissue Samples: Pesticides and Semi-Volatiles**

| Contaminant of Concern | Analytical Method[1] | Target Detection Limit[2] |
|---|---|---|
| **Pesticides** | | |
| Aldrin | 8081 | 2 |
| Chlordane & Derivatives | 8081 | 2 |
| Dieldrin | 8081 | 2 |
| 4,4'-DDD | 8081 | 2 |
| 4,4'-DDE | 8081 | 2 |
| 4,4-DDT | 8081 | 2 |
| Endosulfan & Derivatives | 8081 | 2 |
| Endrin & Derivatives | 8081 | 2 |
| Heptachlor & Derivatives | 8081 | 2 |
| Hexachlorocyclohexane (Lindane) & Derivatives | 8081 | 2 |
| Methoxychlor | 8081 | 2 |
| Toxaphene | 8081 | 50 |
| **Semi-Volatiles** | 8151 Modified or | 100 |
| Pentachlorophenol | 8270C SIM | - |

1 The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided that the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

2 Wet weight: µg/kg or ppb

**Table 6-6. Standard Contaminants of Concern to Be Analyzed from Tissue Samples: PAHs**

| PAH | Analytical Method[1] | Target Detection Limit[2] |
|---|---|---|
| Acenaphthene* | 8270C SIM | 20 |
| Acenaphthylene | 8270C SIM | 20 |
| Anthracene* | 8270C SIM | 20 |
| Benzo(a)Anthracene** | 8270C SIM | 20 |
| Benzo(a,e)Pyrene** | 8270C SIM | 20 |
| Benzo(g,h,i)Perylene | 8270C SIM | 20 |
| Benzo(k)Fluoranthene | 8270C SIM | 20 |
| Benzo(b)Fluoranthene | 8270C SIM | 20 |
| Chrysene** | 8270C SIM | 20 |
| Dibenzo(a,h)Anthracene** | 8270C SIM | 20 |
| Fluoranthene** | 8270C SIM | 20 |
| Fluorene* | 8270C SIM | 20 |
| Indeno(1,2,3,4,-c,-d) Pyrene | 8270C SIM | 20 |
| 1- & 2-Methylnaphthalene* | 8270C SIM | 20 |
| Naphthalene* | 8270C SIM | 20 |
| Phenanthrene* | 8270C SIM | 20 |
| Pyrene** | 8270C SIM | 20 |

[1] The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided that the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

[2] Wet weight: µg/kg or ppb

* LMW PAH (NOAA, 1989)

** HMW PAH (NOAA, 1989)

## Table 6-7. Standard Contaminants of Concern to Be Analyzed from Tissue Samples: PCBs

| PCB Congener | Congener Number | Analytical Method[1] | Target Detection Limit[2] |
|---|---|---|---|
| 2,4' diCB | 8* | 8082 | 1.0 |
| 2,2',5 triCB | 18* | 8082 | 1.0 |
| 2,4,4' triCB | 28* | 8082 | 1.0 |
| 2,2',3,5' tetraCB | 44* | 8082 | 1.0 |
| 2,2',4,5' tetraCB | 49 | 8082 | 1.0 |
| 2,2'5,5' tetraCB | 52* | 8082 | 1.0 |
| 2,3',4,4' tetraCB | 66* | 8082 | 1.0 |
| 3,3',4,4' tetraCB | 77 | 8082 | 1.0 |
| 2,2',3,4,5' pentaCB | 87 | 8082 | 1.0 |
| 2,2',4,5,5' pentaCB | 101* | 8082 | 1.0 |
| 2,3,3'4,4' pentaCB | 105* | 8082 | 1.0 |
| 2,3',4,4',5 pentaCB | 118* | 8082 | 1.0 |
| 3,3',4,4',5 pentaCB | 126 | 8082 | 1.0 |
| 2, 2',3,3',4,4' hexaCB | 128* | 8082 | 1.0 |
| 2,2',3,4,4',5' hexaCB | 138* | 8082 | 1.0 |
| 2,2',4,4',5,5' hexaCB | 153* | 8082 | 1.0 |
| 3,3',4,4',5,5' hexaCB | 169 | 8082 | 1.0 |
| 2,2',3,3',4,4'5 heptaCB | 170* | 8082 | 1.0 |
| 2,2',3,4,4',5,5' heptaCB | 180* | 8082 | 1.0 |
| 2,2',3,4,4',5',6 heptaCB | 183 | 8082 | 1.0 |
| 2,2',3,4,4',6,6' heptaCB | 184 | 8082 | 1.0 |
| 2,2',3,4',5,5',6 heptaCB | 187* | 8082 | 1.0 |
| 2,2',3,3',4,4',5,6 octaCB | 195* | 8082 | 1.0 |
| 2,2',3,3',4,4',5,5',6 nonaCB | 206* | 8082 | 1.0 |
| 2,2',3,3',4,4',5,5',6,6' decaCB | 209* | 8082 | 1.0 |

1 The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided that the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

2 Wet weight: µg/kg or ppb

* PCB congeners to be used in summation for comparison to NOAA data (see Section 7.3)

**Table 6-8. Standard Contaminants of Concern to Be Analyzed from Tissue Samples: Organotin**

| Compound | Analytical Method[1] | Target Detection Limit[2] |
|---|---|---|
| Monobutyltin | Krone et al., 1989* | 10 |
| Dibutyltin | Krone et al., 1989* | 10 |
| Tributyltin | Krone et al., 1989* | 10 |

1 The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided that the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

2 Wet weight: µg/kg or ppb

* Grignard reaction and GC/FPD

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# 7.0 DATA REPORTING AND STATISTICS

Following sampling and testing, data reporting and statistical analysis of the results are necessary to determine the suitability of the proposed dredged material for ocean disposal. Coordination with the USACE SAD district and EPA Region 4 while analyzing the samples and reviewing the test data is recommended. Complete documentation of all laboratory data and statistical analyses must be supplied to the USACE SAD district. The following information supplements Section 13.0 of the 1991 Green Book.

## 7.1 Data Reporting for Field Collection Activities

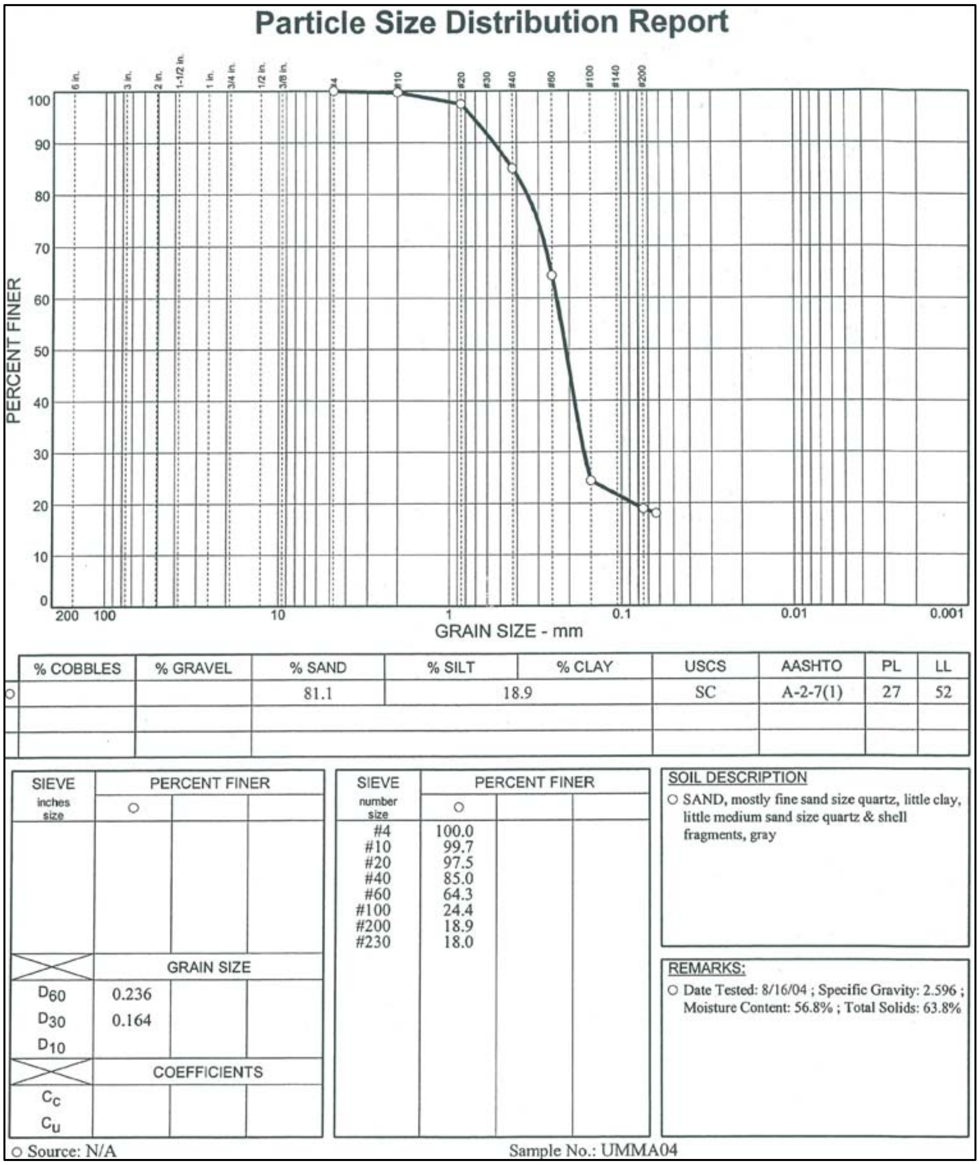
General sample collection techniques for sediment and water collection must be documented. The report should include descriptions of positioning equipment, decontamination procedures, *in situ* measurements, sample processing procedures, compositing schemes, and any problems encountered during field collection activities. Dredged material management units should be provided on a map along with all sediment and water sampling locations. All original field sheets and core logs (if applicable) must be included as an appendix. Photographic documentation of sediment samples is recommended.

A table summarizing all sample collection information should be provided with the following information: sample ID, sampling date and time, coordinates (NAD 83), water depth, depth of water sample(s) collected, core depth (if used), identification of any compositing of samples, *in situ* measurements, sample description, general observations, tide cycle, and analyses to be conducted.

## 7.2 Data Reporting for Physical Testing

All physical data should be summarized and presented in tabular format with the following column headings, at a minimum, for each analyzed sample: soil description, % grain size information, % solids, soil classification, and specific gravity.

For physical data, the percentages of each size class (Table 5-1) should be reported as well as the USCS classification. In addition to reporting the percentages of each size class, the applicant must graph the cumulative frequency percentages using the USACE Engineering (ENG) Form 2087 or a similar form (Figure 7-1). These forms should be included in the report or as a report appendix.




| | % COBBLES | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | | | 81.1 | 18.9 | | SC | A-2-7(1) | 27 | 52 |

| SIEVE inches size | PERCENT FINER ○ | | |
|---|---|---|---|
| | GRAIN SIZE | | |
| $D_{60}$ | 0.236 | | |
| $D_{30}$ | 0.164 | | |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | | |
|---|---|---|---|
| #4 | 100.0 | | |
| #10 | 99.7 | | |
| #20 | 97.5 | | |
| #40 | 85.0 | | |
| #60 | 64.3 | | |
| #100 | 24.4 | | |
| #200 | 18.9 | | |
| #230 | 18.0 | | |

SOIL DESCRIPTION
○ SAND, mostly fine sand size quartz, little clay, little medium sand size quartz & shell fragments, gray

REMARKS:
○ Date Tested: 8/16/04 ; Specific Gravity: 2.596 ; Moisture Content: 56.8% ; Total Solids: 63.8%

○ Source: N/A Sample No.: UMMA04

**Figure 7-1. Sediment Grain Size Gradation Graph/Form**

## 7.3 Data Reporting for Chemical Testing

All chemical data should be summarized and presented in tabular format. Additionally, all laboratory data should be provided in the Testing Report (see Appendix D) and in electronic tabular format (e.g., spreadsheet, delineated text file). Analytical data reported by the laboratories [with National Environmental Laboratory Association Conference (NELAC) standard qualifiers] must be included in the appendix section of the report.

PCB congeners should be reported as individual congeners as well as total PCBs. Total PCBs should be reported as EPA Region 4 PCBs and as NOAA PCBs. EPA Region 4 PCBs represents the sum of all the PCBs listed in Table 5-6. NOAA PCBs represents the sum of the PCB congeners identified by an asterisk in Table 5-6 and are calculated by the following equation:

$$[Total\_NOAA\_PCBs] \cong 2 * \sum (18 congeners)$$ (NOAA, 1989) **[Eq. 7-1]**

In addition to the individual PAHs, total PAHs should also be provided as total low molecular weight (LMW) PAHs and total high molecular weight (HMW) PAHs, as described in Table 5-5.

Organotin must be reported as the individual compounds and total organotin. Total organotin should be reported on a tin basis as follows:

$$[Total\_Organotin\_as\_Sn] = \sum \left[ \frac{TBT}{2.44} + \frac{DBT}{1.96} + \frac{MBT}{1.48} \right]$$ **[Eq. 7-2]**

Refer to Section 5.2 for information on reporting data to the TDLs and LRLs. All data should be certified to be accurate by the analytical laboratory or by a third-party data validator.

### 7.3.1 Sediment Chemistry Reporting

All sediment chemical data reported should be summarized and presented in tabular format and, at a minimum, include the following information for each analyzed sample: type of test performed, sample ID, units, qualifiers with description, and source of data (analysis performed by).

Sediment chemistry data should be reported on a dry weight basis and reported as mg/kg for metals, µg/kg for organics, and ng/kg for dioxins/furans and dioxin-like PCBs. Percent solids, used to calculate dry weight concentrations, also must be reported. If analyte concentrations are below the LRL, they should be reported in the summary tables as <###.##, where ###.## is the LRL. Additionally, all NELAC-flagged data reported by the laboratories should be included in the appendix section.

When performing the calculations for PCB congeners and total organotins (Eq. 7-1 and Eq. 7-2), if an analyte concentration is below the LRL, one-half of the LRL should be used in the calculation. If the LRL exceeds the TDL, the LRL should be used (no half substitutions allowed).

When using sediment chemistry data in the WQC compliance screen (Eq. 3-2), the data should also be provided in tabular format with the following column headings for each analyzed sample: sediment concentration, percent solids, estimated elutriate concentration (Cs, µg/L), federal WQC and/or state WQS, background concentration, and dilution necessary to meet the WQC or WQS. If an analyte concentration is below the LRL, one-half of the LRL should be used in the calculation. If the LRL exceeds the TDL, the LRL should be used (no half substitutions allowed). When the disposal site is in federal jurisdiction, the WQC is used for comparison. If the site overlaps with both state and federal waters, the data should be compared to the lowest number from either the WQC or the WQS. When comparing results to WQC, the Criterion Maximum Concentration (CMC) and not the Criteria Continuous Concentration (CCC) should be used (EPA, 2006).

It should be noted that, although comparison to sediment quality guidelines (USACE, 1998a; USACE, 1998b) may be a beneficial guideline for determining sediment quality, it is not required or used for documenting compliance with the ocean dumping criteria.

### 7.3.2 Water and Elutriate Chemistry Reporting

All chemical data should be summarized and presented in tabular format with the following column headings, at a minimum, for each analyzed sample: type of test performed, sample ID, units, qualifiers with description, and source of data (analysis performed by).

> Water and elutriate chemistry data should be reported as µg/L. If analyte concentrations are below the LRL, they should be reported in the summary tables and flagged according to NELAC standards.

To determine WQC compliance, the following information should be included in the summary tables: federal WQC and/or state WQS, and dilution necessary to meet the WQC or WQS. When the disposal site is in Federal jurisdiction, the WQC is used for comparison. If the site overlaps with both State and Federal waters, the data should be compared to the lowest number from either the WQC or the WQS. When comparing results to WQC, the CMC and not the CCC should be used (EPA, 2002b).

In the WQC and WQS calculations (total PCBs, total PAHs, water quality screen, elutriate chemistry comparison to WQC criteria), if an analyte concentration is below the LRL, one-half of the LRL or the estimated (J-flagged) value (whichever is greater) should be used in the calculation. In some cases, the MDL can be used if it has been adequately verified through the analysis of the appropriate MDL check samples and has been sample-corrected. USACE SAD districts and EPA Region 4 should be consulted before substituting the MDL. For the above calculations, if the LRL exceeds the TDL, then the LRL should be used (no half substitutions allowed).

### 7.3.3 Water Quality Criteria Mixing Model (STFATE)

Running the Water Quality Criteria Mixing Model (STFATE) for documenting compliance with the ocean dumping criteria is based on comparison of WQC compliance screen values or elutriate concentrations to the CMC (i.e., if any analytical results are above the CMC, the mixing model should be run for that particular parameter). Mixing model results should be summarized as the minimum dilution (and corresponding concentration) achieved outside the site boundaries and within the site boundaries after 4 hours. Examples of the summary results obtained for initial mixing computation of water quality are presented in Tables 7-1 and 7-2.

**Table 7-1. Example of WQC Initial Mixing Computation Results: 4-Hour Criteria**

| Time (hours)* | Depth (feet)*[1] | Maximum Contaminant Concentration ($C_{max}$) on Grid* | Dilution on Grid ($D_{a\text{-}wq}$)[2] |
|---|---|---|---|
| 4.0 | X (1st Depth) | 0.0350 | 25 |
| 4.0 | Y (2nd Depth) | 0.0351 | 25 |
| 4.0 | Z (3rd Depth) | 0.0135 | 66 |

* Information obtained from computer output

1 Depths should correspond to the depths for which initial mixing computation results are provided by the model.

2 $D_{a\text{-}wq} = (C_s - C_{max})/(C_{max} - C_{ds})$; where $C_s$ and $C_{DS}$ are defined in Eq 3-1

NOTE: In the above calculations, a $C_s$ of 0.90 and a $C_{ds}$ of 0.0 were used for demonstration.

**Table 7-2. Example of WQC Initial Mixing Computation Results: Disposal Site Boundary Criteria**

| Depth (feet)*[1] | Time Corresponding to $C_{max}$ Outside Disposal Site (hours)* | Maximum Contaminant Concentration ($C_{max}$) Outside Disposal Site * | Dilution Outside Disposal Site ($D_{a\text{-}wq}$)[2] |
|---|---|---|---|
| X (1st Depth) | 3.5 | 0.0188 | 47 |
| Y (2nd Depth) | 3.67 | 0.0094 | 95 |
| Z (3rd Depth) | 3.83 | 0.00721 | 124 |

* Information obtained from computer output

1 Depths should correspond to the depths for which initial mixing computation results are provided by the model.

2 $D_{a\text{-}wq} = (C_s - C_{max})/(C_{max} - C_{ds})$; where $C_s$ and $C_{DS}$ are defined in Eq 3-1

NOTE: In the above calculations, a $C_s$ of 0.90 and a $C_{ds}$ of 0.0 were used for demonstration.

The dredged material characteristics (% solids, % sand, % clay, % silt, percent solids, water density) and operational parameters (barge characteristics, disposal method, etc.) used for the model runs should be provided. If non-standard input parameters (Appendix G - STFATE Input Parameters or ODMDS SMMP) are used, they should be summarized and a rationale for their use provided. EPA Region 4 and USACE SAD districts should be consulted prior to using non-standard input parameters. Model output files (*.DUO) should be provided with the 103 evaluation or the sediment testing report. Additionally, an electronic copy *.DUI file should be provided to expedite data review.

## 7.4 Data Reporting and Statistics for Bioassay and Bioaccumulation Testing

### 7.4.1 Definition and Treatment of Outliers

In most biological testing, some data points will be either much smaller or much larger then would be reasonably expected. Intuitively, outliers can be thought of as individual observations that are "far away" from the rest of the data. Outliers can be the result of faulty data, erroneous procedures, or invalid assumptions regarding the underlying distribution of all the data points that could potentially be sampled. In practice, a small number of outliers can be expected from a large number of samples including those that follow a normal distribution. Several techniques are available for outlier detection. Tests that involve hypothesis testing on data assumed to be normally distributed include Grubb's test, Rosner's test, and Dixon's test. The main advantage of using one of these formal statistical procedures is the ability to limit the risk of falsely flagging a valid data point as an "outlier".

When suspecting that a data point might be an outlier during the statistical analysis of bioassay and bioaccumulation data, the analysis should be performed twice, once with the suspected outlier and again without it. Both results should be reported and an explanation of why the outlier is believed to deserve exclusion or inclusion with the analysis should be presented. Such an explanation should not rely solely on the fact that some statistical test detected the outlier. In general, the more environmentally conservative approach should be utilized.

### 7.4.2 Water Column Bioassay Reporting and Statistics

Water column toxicity test results should be reported and statistically analyzed in accordance with Sections 11.1.6 and 13.2.3 of the 1991 Green Book. Data summaries should show the statistical comparison of dredged material treatments to the control and dilution waters. $LC_{50}$/$EC_{50}$ calculations (when required) shall be provided and summarized in a table.

#### 7.4.2.1 Water Column Toxicity Mixing Models (STFATE)

Section 3.3.1 discusses when the mixing model must be run to determine compliance with the toxicity LPC. Mixing model results are compared to 1% (0.01) of the $LC_{50}$ (or $EC_{50}$), whichever applies. Mixing model results should be summarized as the minimum dilution (and corresponding concentration) achieved outside the site boundaries and within the site boundaries after 4 hours. Examples of summary results obtained for initial mixing computation of water column toxicity are presented in Tables 7-3 and 7-4.

**Table 7-3. Example of Toxicity Initial Mixing Computation Results: 4-Hour Criteria**

| Time (hours)* | Depth (feet)*[1] | Maximum Concentration Above Background ($C_{tox}$) on Grid* (percent) | Dilution on Grid ($D_{a\text{-}tox}$)[2] |
|---|---|---|---|
| 4.0 | X (1st Depth) | 0.0242 | 4,130 |
| 4.0 | Y (2nd Depth) | 0.0400 | 2,500 |
| 4.0 | Z (3rd Depth) | 0.0243 | 4,114 |

* Information obtained from computer output

1 Depths should correspond to the depths for which initial mixing computation results are provided by the model.

2 $D_{a\text{-}tox}=(100- C_{tox})/ C_{tox}$;

NOTE: In the above calculations, a $C_s$ of 0.90 and a $C_{ds}$ of 0.0 were used for demonstration.

**Table 7-4. Example of Toxicity Initial Mixing Computation Results: Disposal Site Boundary Criteria**

| Depth (feet)*[1] | Time Corresponding to $C_{tox}$ Outside Disposal Site (hours)* | Maximum Concentration Above Background ($C_{tox}$) Outside Disposal Site * (percent) | Dilution Outside Disposal Site ($D_{a\text{-}tox}$)[2] |
|---|---|---|---|
| X (1st Depth) | 2.75 | 0.0085 | 11,764 |
| Y (2nd Depth) | 3.00 | 0.0141 | 7,091 |
| Z (3rd Depth) | 3.25 | 0.00856 | 11,681 |

* Information obtained from computer output

1 Depths should correspond to the depths for which initial mixing computation results are provided by the model.

2 $D_{a\text{-}tox}=(100- C_{tox})/ C_{tox}$;

The model input parameters discussed in Section 7.3.3 above should also be provided if not previously done so.

### 7.4.3 Whole Sediment Bioassay Reporting and Statistics

Whole sediment toxicity test results should be reported and statistically analyzed in accordance with Sections 11.2.3 and 13.2.3 of the 1991 Green Book. Data summaries should show the number of surviving organisms for each replicate for each treatment as well as the average percent survival for each treatment (inclusive of reference and control). In addition, a statistical comparison of each dredged material treatment to the reference and control should be provided.

### 7.4.4 Bioaccumulation Reporting and Statistics

For bioaccumulation tests, data summaries should show the number of surviving organisms for each replicate for each treatment as well as the average percent survival for each treatment (inclusive of reference and control). Guidelines to report and analyze bioaccumulation data are presented in Sections 12.2 and 13.3 of the 1991 Green Book.

## 7.5 Bioaccumulation Tissue Chemistry Reporting and Statistics

Results for tissue bioaccumulation data should be presented in tables containing the tissue chemistry results for all replicates within each treatment (site), replicate averages, comparison to FDA levels, and statistical comparisons to the replicates obtained from the reference site.

### 7.5.1 Tissue Chemistry Reporting

Tissue chemistry data should be reported as dry and wet weights and reported as: mg/kg for metals, µg/kg for organics, and ng/kg for dioxins/furans and dioxin-like PCBs. If analyte concentrations are below the LRL, they should be reported in the summary tables and flagged according to NELAC standards.

PCB congeners should be reported as individual congeners as well as total PCBs. Total PCBs should be reported as EPA Region 4 PCBs and NOAA PCBs. "EPA Region 4 PCBs" represents the sum of all the PCBs in Table 6-6. "NOAA PCBs" represents the sum of the PCB congeners identified by an asterisk in Table 6-6 and is calculated using Equation 7-1. A comparison of individual PCBs or NOAA PCBs is not needed. NOAA PCBs should only be compared to data collected by NOAA under the Mussel Watch and Status and Trends Programs.

In addition to the individual PAHs, total PAHs should be provided as total LMW PAH and total HMW PAH, as described in Table 6-5.

Organotin should be reported as the individual compounds and total organotin. Total organotin should be reported on a tin basis as described in Section 7.0 (Eq. 7-2). FDA Action Level and statistical comparisons of each dredged material treatments to the reference and control should be provided for TBT and total organotin.

All analytical data reported by the laboratories according to NELAC standards should be included in the appendix section of the report.

In the above calculations (total PCBs, total PAHs, total organic tin) and the statistical comparisons discussed below, if an analyte concentration is below the LRL, one-half of the LRL or estimated (J-flagged) value (whichever is greater) should be used in the calculation. In some cases, the MDL can be used if it has been adequately verified through the analysis of the appropriate MDL check samples and sample-corrected. USACE SAD districts and EPA Region 4 should be consulted before substituting the MDL. In conducting statistical comparisons, the 1991 Green Book, the Inland Testing Manual, or Jones et al. (2005) should be consulted. In general, if two or less of the treatment replicates are below the LRL, then the LRL should be substituted. If three of the replicates are below the LRL, one-half of the LRL or estimated (J-flagged) value (whichever is greater) should be substituted, and if more than three replicates are below the LRL, no comparison should be made. Reference replicates below the LRL should always be substituted with one-half of the LRL or the estimated value (whichever is less). For the above calculations, if the LRL exceeds the TDL, the LRL should be used (no half substitutions allowed) except for the reference.

### 7.5.2 Comparison to FDA Action Levels

A data summary table shall be included that compares the tissue concentrations to the FDA action levels (Appendix H and USFDA, 2001). The bioaccumulation tissue results for the sample station average concentration should be presented in the table. If the sample tissue results are statistically greater than the FDA action level (meaning that the 95% upper confidence limit is above the FDA action level), it should be somehow identified (e.g., in bold, with an asterisk, underlined). Statistical comparisons should be done using wet weight values. A comparison of total EPA Region 4 PCBs corrected for steady state, and not individual PCBs or NOAA PCBs, is needed.

### 7.5.3 Statistical Comparison to Reference

A data summary table should be included that compiles all chemistry data by a statistical comparison of tissue concentration of the test analyte from the sample stations relative to the field reference tissue concentrations using ANOVA and Dunnett's multiple comparisons procedures. Data should first be checked for normality and homogeneity of variance. If either of these assumptions is not met and a suitable transformation is not found, the data should be analyzed using Steel's Many One Rank Test. Because the objective of this analysis is to determine if organisms exposed to the dredge materials have a greater bioaccumulation of analytes than organisms exposed to the reference sediments, it is appropriate to use a "one-sided" test distribution. In other words, the analysis is testing for significant differences among samples only for tissue concentrations greater than, not less than, the reference tissue concentration. The sample station average concentration should also be presented in the table.

If the sample is statistically greater than the reference, it should be somehow identified (e.g., in bold, with an asterisk, underlined). If the statistical difference is due to concentrations less than the LRL in the reference exposed tissues, it should be somehow identified (e.g., in bold, with an asterisk, underlined). Statistical comparisons should be done using wet weight values.

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# 8.0 QUALITY CONTROL AND ASSURANCE

Quality Assurance/Quality Control (QA/QC) planning is necessary to ensure that the physical, chemical, and biological data generated during dredged material evaluations meet overall program and specific project needs. Establishing QA/QC procedures is fundamental to meeting project data quality criteria and to providing a basis for good decision-making.

QA activities provide a formalized system for evaluating the technical adequacy of sample collection and laboratory analysis activities. These QA activities begin before samples are collected and continue after laboratory analyses are completed.

For a better understanding of the QA/QC process as it relates to sediment sampling and analysis, refer to the *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations* manual (EPA, 1995).

A NELAC-accredited laboratory should be used to perform the physical and chemical analyses of tissues, sediments, waters, and elutriates. The national accreditation program ensures that standardized procedures and training of personnel are being used across laboratories. Laboratories are required under NELAC to develop Quality Manuals and Standard Operating Procedures (SOPs) that can become addendums or be referred to in the project SAP/QAPP.

Due to the wide-ranging nature of sediment bioassay and bioaccumulation testing, it is highly recommended that the laboratory prepare and provide to EPA Region 4 and the USACE district a Sediment Bioassay and Bioaccumulation Quality Assurance Manual (R4-SBBQAM) to be approved and kept on file. Preparation and approval of this manual prior to project involvement will help expedite revisions and approvals of the project SAP/QAPP.

As part of Quality Assurance, all activities should be monitored throughout the duration of the project and any deviations from the SAP/QAPP, methods, analytical anomalies, etc., should be communicated to the USACE district office and EPA Region 4 as soon as possible.

As part of Quality Control, the applicant must submit documentation of all QC measures performed during analysis of the samples using the Quality Control Summary Tables in Appendix O. These tables contain the acceptance criteria for analytical physical, chemical, and bioassay/bioaccumulation tests. These tables should be included as an appendix to the Sediment Testing Report. The experimental design and water quality measurements for bioassay and bioaccumulation tests should be reported in the format presented in Appendix P.

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# 9.0 REFERENCES


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### Credits for Photos Used in Section 6 Tables

| Group | Scientific Name | Courtesy of | Association | Location |
|---|---|---|---|---|
| Phytoplankton or Zooplankton | *Crassostrea virginica* | William Gardiner | NewFields Northwest | Port Gamble, WA |
| | *Mytilus edulis* | William Gardiner | NewFields Northwest | Port Gamble, WA |
| | *Mercenaria mercenaria* | Randy Newman | Food and Agriculture Organization (FAO) | www.fao.org |
| | *Arbacia punctulata* | Randy Newman | North Carolina Division of Parks and Recreation | Raleigh, NC |
| | *Strongylocentrotus* sp. | William Gardiner | NewFields Northwest | Port Gamble, WA |
| | *Lytechinus pictus* | Owen Lloyd | http://www.owenlloyd.com/scuba/pictures/index.asp?species_id=43 | |
| | *Americamysis* sp. | Alan Kennedy | US Army Engineer R&D Center CEERD-EP-R | Vicksburg, MS |
| | *Menidia beryllina* | Jason Weeks | MBL Aquaculture | Sarasota, FL |
| | *Menidia peninsulae* | George Burgess | Florida Museum of Natural History | Gainesville, FL |
| | *Cyprinodon variegatus* | George Burgess | Florida Museum of Natural History | Gainesville, FL |
| Amphipod | *Ampelisca abdita* | Alan Kennedy | US Army Engineer R&D Center CEERD-EP-R | Vicksburg, MS |
| | *Leptocheirus plumulosus* | Alan Kennedy | US Army Engineer R&D Center CEERD-EP-R | Vicksburg, MS |
| Shrimp | *Americamysis bahia* | Alan Kennedy | US Army Engineer R&D Center CEERD-EP-R | Vicksburg, MS |
| Bivalve | *Macoma nasuta* | Alan Kennedy | US Army Engineer R&D Center CEERD-EP-R | Vicksburg, MS |
| | *Yoldia limatula* | Joel Wooster | www.jaxshells.org | Jacksonville, FL |
| Polychaete | *Nereis virens* | Alan Kennedy | US Army Engineer R&D Center CEERD-EP-R | Vicksburg, MS |
| | *Neanthes arenaceodentata* | Alan Kennedy | US Army Engineer R&D Center CEERD-EP-R | Vicksburg, MS |
| | *Arenicola* sp. | | Copyrighted photo, obtained from http://www.biopix.com/ | |

# Appendix A

# KEY PERSONNEL

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# Appendix A

## KEY PERSONNEL

(* denotes primary contact for interagency coordination within that office)

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## ODMDS Contacts

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| Morehead City | Gary Collins | Phil Payonk |
| New Wilmington | Gary Collins | Phil Payonk |
| Wilmington | Gary Collins | Phil Payonk |
| Georgetown Harbor | Gary Collins | Phil Wolf |
| Charleston | Gary Collins | Phil Wolf |
| Port Royal | Gary Collins | Phil Wolf |
| Savannah | Doug Johnson | Steve Calver |
| Brunswick Harbor | Doug Johnson | Steve Calver |
| Fernandina Beach | Chris McArthur | Glenn Schuster |
| Jacksonville | Chris McArthur | Glenn Schuster |
| Canaveral Harbor | Chris McArthur | Glenn Schuster |
| Fort Pierce Harbor | Chris McArthur | Glenn Schuster |
| Palm Beach Harbor | Chris McArthur | Glenn Schuster |
| Port Everglades Harbor | Chris McArthur | Glenn Schuster |
| Miami | Chris McArthur | Glenn Schuster |
| Tampa | Gary Collins | Glenn Schuster |
| Pensacola Nearshore | Gary Collins | Jennifer Jacobson |
| Pensacola Offshore | Gary Collins | Jennifer Jacobson |
| Mobile | Doug Johnson | Jennifer Jacobson |
| Pascagoula | Doug Johnson | Jennifer Jacobson |
| Gulfport East | Doug Johnson | Jennifer Jacobson |
| Gulfport West | Doug Johnson | Jennifer Jacobson |

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# Appendix B

# MPRSA SECTION 103 COORDINATION SCHEDULE

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# Appendix B

## MPRSA SECTION 103 COORDINATION SCHEDULE

| ACTIVITY | RESPONSIBLE PARTY | TIME FRAME |
|---|---|---|
| Action Required | | Day 0 |
| Notify EPA of Proposed Action | USACE | Day 1-2 |
| Pre-project/Pre-application Meeting[1] | USACE/EPA | Day 7 |
| Sampling and Analysis Plan[2] | USACE | Day 37[3] |
| Review and Approval of SAP[4] | EPA/USACE | Day 51 |
| Analysis Period[5] (Contractor/Applicant to notify USACE of any problems as they occur. USACE will then notify EPA) | USACE | 2 - 8 months |
| Preliminary Data Review | USACE/EPA | 14 days (during analysis period) |
| Application Complete | USACE | AP[7] + Day 0 |
| Public Notice Issued[6] | USACE | AP + 15 days |
| 103 Evaluation/Request for Concurrence Letter to EPA[8,9,10] | USACE | AP + 15 days |
| Public Review Complete (30 days) | USACE | AP + 45 days |
| EPA Concurrence (45-90 days) | EPA | AP + 60 days |
| Notify EPA of Permit Issuance or Contract Award for Federal Project | USACE | 15 days from permit issuance or contract award |
| Notify EPA When Dredging Initiated | USACE/applicant | 15 days before dredging initiated |
| Notify EPA When Dredging Completed (disposal report) | USACE/applicant | 45 days after dredging completed |

Notes:

1. Meeting by teleconference is acceptable. Topics of discussion to include project specifics, need for ocean disposal, evaluation requirements, sampling and analysis plan submittal.

2. Sampling and analysis plan to include contaminants of concern, area to be dredged, dredging unit delineation, sample locations, depth of samples and sampling devices, types of analysis, species requirements, QA/QC procedure, following format and example outlined in the Regional Implementation Manual.

3. Date for submittal of sampling and analysis plan may change. If so, the appropriate number of days will be added or subtracted from the schedule.

4. Review and approval of sampling and analysis plan will be jointly made by EPA and USACE in the case of permit applicants, and by EPA in the case of federal projects. Failure to obtain EPA approval on sampling and analysis plans may result in delays in review and concurrence by EPA, and possible requests for additional sampling and testing.

5. USACE will notify EPA when sampling begins.

6. A Public Notice (PN) will sometimes be issued prior to the availability of test results. The PN should indicate what testing will done and how the public can obtain the results. In such cases. a supplemental PN will be issued at this point in the process.

7. The date that the application is considered complete by USACE will begin a subsequent schedule, referred to as Analysis Period (AP) + Day 0, which includes all the time to completion of the analysis period.

8. For "Permitted Projects," the USACE point of contact will be the Regulatory Branch/Division and all official correspondence, transmittal of documents, and requests for concurrence to EPA will be the responsibility of the Regulatory Branch/Division.

9. For "Federal Projects," the USACE point of contact will be the Planning Division and all official correspondence, transmittal of documents, and requests for concurrence to EPA will be the responsibility of the Planning Division.

10. The Request for Concurrence letter will include the following items:

    a. Section 103 Evaluation in the required format (see RIM Appendix C).

    b. Sediment Report prepared according to the RIM outline and including all the required elements described in the RIM.

    c. QA/QC package including lab data sheets and exception narratives (usually an appendix to the sediment report).

    d. ADDAMS STFATE Model Report (if required) including input data. Input data are available for most ODMDSs in the Site Management and Monitoring Plan or in Appendix G of the RIM.

# Appendix C

# MPRSA OCEAN DISPOSAL EVALUATION DOCUMENTATION

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## Appendix C

## MPRSA OCEAN DISPOSAL EVALUATION DOCUMENTATION

The following information is required for completion of the MPRSA Section 103 evaluation. Information should not be repeated, but referenced where material is needed for more than one part of the evaluation documentation.

1. Dredging and Disposal Project Information
   a. A map showing dredging locations/boundaries and delineating dredging units. Shall include range stations to adequately delineate project limits
   b. Core boring logs (if available) and other historical and current sampling stations keyed to the map
   c. Volume of material to be dredged by dredging unit
   d. Percentage of fine-, medium-, and coarse-grained material by dredging unit
   e. Bathymetric information for the channel to be dredged with the project dredging depth contour highlighted
   f. Design depth (including overdredge depth or advance maintenance) and width for each dredging unit or project reach
   g. Expected method(s) of dredging, transport, and disposal of material
   h. Expected start, duration and end of dredging, transport, and disposal of material
   i. Proposed disposal location (or zone) within the ODMDS
   j. Historical compliance with ODMDS site designation and SMMP conditions
2. Exclusionary Criteria - 40CFR §227.13(b) [Tier I]
   a. Rationale for meeting the exclusionary criteria (choose one):
      i. The dredged material is composed predominately of sand, gravel, rock, or any other naturally occurring bottom material with particle sizes larger than silt, and the material is found in areas of high current or wave energy
         (1) Grain sizes of the dredged material (from 1d above)
         (2) Current data from current meters or tide gauges (if available)
      ii. The material is substantially the same as the substrate at the disposal site and the dredging site is far removed from sources of pollution so as to provide a reasonable assurance that such material has not been contaminated by such pollution.
         (1) Grain sizes of the dredged material (from 1d above)
         (2) Grain sizes of the material at the disposal site
         (3) Locations (keyed to map), quantities, and types of pollutants discharged upstream of the dredging area (see Section 3.1.1 of the RIM for data sources)
         (4) Results of previous testing in the area demonstrating lack of contamination
   b. If one of the exclusionary criteria is met, items 3 through 6 below need not be addressed.

3. Need for Testing (Tier I)
   a. Site history narrative including potential sources of contamination
   b. Locations (keyed to map), quantities, and types of pollutants discharged upstream of the dredging area (see Section 3.1.1 of the RIM for data sources)
   c. History of dredging in area
   d. Summary of the past physical, chemical, and biological tests including a narrative description of past suitability determinations
   e. Maps showing all past sampling stations (from 1b above)
   f. Description of any events that have occurred since the last sampling or dredging event that might influence sediment chemistry or bioassay results
4. Water Column Determinations - 40CFR §227.6(c)(1) and 227.27(a) and Suspended Particulate Phase Determination - 40 CFR §227.6(c)(2) and 227.27(b) [Tiers II-III]
   a. Evaluation of the Liquid Phase - Water Quality Criteria

      Choose one of the following:

      i. Sediment Chemistry Screen
         (1) Table showing for each station and analyte: sediment chemistry value, estimated elutriate concentration, background concentration, applicable marine water quality criteria or standard, and the required dilution to achieve the criteria/standard
         (2) ADDAMS STFATE result (if required) for the contaminate requiring the most dilution
         (3) Sediment testing report

      (or)

      ii. Elutriate Analysis
         (1) Table showing for each station and analyte: elutriate concentration, background concentration, applicable marine water quality criteria or standard, and the required dilution to achieve the criteria/standard
         (2) ADDAMS STFATE result (if required) for the contaminate requiring the most dilution. Include any special disposal practices (e.g., minimum distances from site boundaries, tidal state, current magnitude/direction) that must be instituted to assure compliance.
         (3) Elutriate chemistry testing report
   b. Liquid and Suspended Phase Bioassays
      i. Comparison of 100% dredged material elutriate control and dilution water (if not significantly more toxic, items ii and iii below are not required)
      ii. LC50/EC50 for each station where 100% elutriate is toxic
      iii. ADDAMS STFATE results for station with lowest LC50/EC50. Include any special disposal practices (e.g., minimum distances from site boundaries, tidal state, current magnitude/direction) that must be instituted to assure compliance
      iv. Elutriate bioassay testing report

5. Benthic Screen (optional) [Tier II]
   a. Tier II tests for benthic impact evaluation should be used only to screen out sediments that are not likely to meet the criteria or to assist in selecting a compositing or testing scheme under Tier III.
      i. Theoretical Bioaccumulation Potential (TBP) calculation
      ii. Sediment testing report
6. Benthic Determinations - 40 CFR§227.6(c)(3) and 227.27(b) [Tier III]
   a. Benthic Toxicity Evaluation
   b. Benthic Bioavailability Evaluation
      i. 28-day bioaccumulation exposure
      ii. Tissue chemical analysis
      iii. Comparison with FDA Action Levels and tissues exposed to the reference and risk-based analysis as required
      iv. Sediment testing report
7. Non-Testing Related Regulatory Issues: Subparts B,C,D and E of 40CFR§227
   a. Subpart B - Environmental Impact
      i. §227.4 Criteria for Evaluating Environmental Impact
      ii. §227.5 Prohibited Materials
      iii. §227.7 Limits established for specific wastes or waste constituents

         - address presence of pathogens, biological pests, non-indigenous species
      iv. §227.8 Limitations on the Disposal Rates of Toxic Wastes; §227.11 Containerized Wastes; and §227.12 Insoluble Wastes
      v. §227.9 Limitations on Quantities of Waste Materials

         - include project volumes
         - provide site capacity if determined
      vi. §227.10 Hazards to Fishing, Navigation, Shorelines, or Beaches

         - reference appropriate section(s) of the site designation EIS/EA if necessary
   b. Subpart C - Need for Ocean Dumping
      i. For federal projects, provide authorization and reference Feasibility Study or other NEPA document providing assessment of disposal alternatives.
      ii. For non-federal projects, the alternative disposal alternatives should be summarized and assessed. The final determination is made in the USACE Statement of Findings on whether or not to grant the permit.
   c. Subpart D - Impact of the Proposed Dumping on Aesthetic, Recreational, and Economic Values
      i. Reference appropriate section(s) of the site designation EIS/EA to address potential impacts of disposal at the site on recreational fisheries, commercial fisheries, shore recreation, and cultural resources with regard to disposal of dredged material at the site.

ii. Address visible characteristics.
iii. Address presence of toxics and bioaccumulative chemicals (reference 6 above).
iv. Address pathogens (reference 7.a.iii above).

d. Subpart E - Impact of the Proposed Dumping on other Uses of the Ocean
- reference appropriate section(s) of the site designation EIS/EA

8. MPRSA Section 103 Conditions

a. Requirements (management options) to meet the Ocean Disposal Criteria
   i. Disposal zones or minimum distances from the disposal site boundaries
   ii. Ambient disposal conditions (e.g., current or tidal conditions)
   iii. Limits on disposal vessel size or discharge rates
b. Requirements necessary to meet site designation conditions
   i. Grain size limitations
   ii. See 40CFR Section 228.15(h)
c. Requirements necessary to meet the requirements of the disposal site SMMP.
   i. Disposal zones
   ii. Limits on oceanographic conditions for disposal
   iii. Disposal monitoring requirements
   iv. Reporting requirements
d. All conditions must be implemented through permit conditions or contract specifications for federal projects. The draft permit conditions/contract specification must be included as part of the MPRSA Ocean Disposal Evaluation Documentation. These are typically available from the SMMP.

# Appendix D

# SEDIMENT TESTING REPORT FORMAT

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# Appendix D

## SEDIMENT TESTING REPORT FORMAT

The preferred format for the sediment testing report, including physical, chemical, bioassay, and bioaccumulation data, is provided below.

1. Introduction
   a. Project Description – The project description should include the following information:
      i) A general location map showing the proposed dredging location and disposal site.
      ii) A plan view map showing the project dredging limits. The map should identify project depth (including advance maintenance and any allowable overdepth) and indicate the extent of side-slopes.
      iii) Dredged material quantities proposed for ocean disposal. Quantities for other disposal alternatives should also be provided if known.
   b. Description of the Testing Approach – The objective of the testing should be provided (e.g., ocean disposal, inland disposal, upland disposal) and include a summary of the experimental design and tests conducted. The rationale for performing specific types of tests (e.g., chemical analysis of elutriate samples for comparison to water quality criteria) should be presented in writing. All contractors involved in the sampling and analysis should be identified.
2. Materials and Methods
   a. Sample Collection Techniques – Field sediment and water collection methods and locations should be described, including but not limited to:
      i) Positioning equipment,
      ii) Decontamination procedures,
      iii) *In situ* measurements,
      iv) Sample processing procedures,
      v) Compositing schemes,
      vi) Types of analyses to be conducted for each station,
      vii) Sediment sampling equipment (grab sampler, vibracore, split spoon, etc.),
      viii) Water sampling equipment (Van Dorn, peristaltic pump, etc.),
      ix) Dredged material management units should be provided on a map along with all sediment and water sampling locations.
   b. Physical and Chemical Analytical Procedures – References for laboratory protocols for physical and chemical analysis should be included. Tables summarizing analytical methods (EPA method number or other EPA-approved method) and target detection limits should be provided.
   c. Bioaccumulation and Toxicology Procedures – The following information should be provided for each test:
      i) Test species used and the supplier or collection site for the test species,

ii) Source of control sediment samples,

iii) Source of water used,

iv) Test experimental design and endpoint,

v) Any deviations from test protocol,

vi) Statistical analysis procedures,

vii) Summary of QA/QC information on maintaining the test species. Details should be provided in the appendix.

3. Results and Discussion

a. Field Data and *In Situ* Measurements – The following should be summarized in a table for each sample:

i) Sample I.D.,

ii) Actual sample location (Lat/Long or State Plane coordinates in NAD83),

iii) Sample date and time,

iv) Tide cycle and tide height at sample collection,

v) Water depth at sample location,

vi) Depth at which any water samples were collected,

vii) Required and actual core depth (if coring is used); any problems in collecting sediment from the required depth should be discussed,

viii) Weather,

ix) Sample description.

b. Physical Testing Data – The following should be summarized in a table for each sample:

i) Description,

ii) Percent gravel, sand and silt/clay,

iii) Percent solids,

iv) USCS classification,

v) Total organic carbon.

c. Sediment Chemistry (if conducted)

i) Chemical results should be summarized in a table. Comparison to published screening values (e.g., TEL, ERL) and previous results can be made where appropriate. When conducting confirmatory analysis, results statistically significantly higher than previous results should be identified in the summary table (e.g., in bold or italics).

ii) Estimated elutriate concentrations should be presented in a summary table along with the applicable marine water quality criteria or state water quality standards, background concentration, and required dilution (if performing water quality compliance screen).

d. Elutriate Chemistry (if conducted) - Elutriate concentrations should be presented in a summary table along with the applicable marine water quality criteria or state water quality standards, background concentration, and required dilution.

e. Suspended Particulate and Elutriate Phase Bioassay Data

i) Results should be summarized in a table. Results for each concentration and replicate should be included.

ii) Statistical comparisons of results for the 100% elutriate to the reference and control should be presented.

iii) $LC_{50}$/$EC_{50}$ results should be presented.

f. Liquid Phase Limiting Permissible Concentration (although required as part of a dredged material evaluation, this may or may not be included in the sediment testing report) – STFATE dilution modeling results for both the sample requiring the most dilution to meet the WQC and the sample with the lowest $LC_{50}$/$EC_{50}$ should be summarized with the following information:

i) Disposal site input parameters (if these have been previously developed and published by EPA Region 4, they can be referenced);

ii) Dredged material specific input parameters (e.g., grain size, percent solids);

iii) Greatest concentration and corresponding dilution within the disposal site after 4 hours (include depth at which this occurs);

iv) Greatest concentration and corresponding dilution outside of the disposal site during the simulation (include depth at which this occurs).

g. Solid Phase Bioassay Data

i) Results should be summarized in tabular form. Survival in each replicate should be presented.

ii) Results of statistical comparisons should be provided and samples with statistically significant differences from the reference identified.

h. Bioaccumulation Data

i) Mean survival should be summarized in a table for each organism.

ii) Tissue chemistry results should be summarized in tabular format. Average concentrations for each sample should be presented in the summary. Results should be presented in wet and dry weights. The table(s) should also include a comparison to the reference sample results. The concentration as a percent of reference should be provided. Where the concentration is greater or equal to 100%, samples that were statistically higher than the reference should be identified in the table (e.g., in bold or italics).

4. Quality Assurance/Quality Control (QA/QC) – A comprehensive review of all laboratory, toxicological, and field data should be provided. Any deviations from the Sampling and Analysis Plan should be identified. The following should be available as appendices:

a. Field paperwork including field sheets, calibration and temperature logs, daily QC reports, and chain-of-custody records;

b. Particle size distribution report (graphs);

c. Raw chemistry data and MDL studies;

d. Data validation, reduction, and reporting, including any necessary case narratives;

e. Internal QC checks (refer to Section 8.0);

f. Calculation of data quality indicators;

g. Corrective actions;

h. STFATE model output (if included, see paragraph 3f above);
i. Sampling and Analysis Plan;
j. Quality Assurance Plan;
k. Applicable correspondence.

5. References – This list should include all references used in the field sampling program, laboratory and statistical data analyses, and historical data used to compare the dredging to the reference site.

# Appendix E

# ON-LINE TIER I DATA RESOURCES

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# Appendix E

## ON-LINE TIER I DATA RESOURCES

### Tier I Data Search

Existing data may be contained in any number of USEPA, USACE, state, or other government files. Below is a list of Web sites that may be used to obtain information on the potential contaminants of concern in the proposed dredged material. This is only a partial list of internet sites; further searches will locate other sources of information such as colleges and universities, published scientific literature, and studies of sediment pollution and sediments.

Reasonable efforts were made to provide accurate website links. To our knowledge, these links were accurate as of April 2008.

#### *EPA Web Sites*

| | |
|---|---|
| USEPA, Office of Science and Technology, Contaminated Sediments | www.epa.gov/waterscience/cs/ |
| USEPA, Emergency Response Notification System | |
| Further information on specific spills may be obtained by contacting the USEPA, Region 4, Emergency Response and Removal Branch (404/562-8705). National Response Center tracking number is recommended to expedite any requests. | |
| Superfund Sites includes information about Superfund sites, which are uncontrolled or abandoned places where hazardous waste is located, possibly affecting local ecosystems or people. | www.adem.state.al.us |
| RCRA Corrective Action | www.epa.gov/epaoswer/hazwaste/ca/facility.htm |
| A single point of access to select USEPA environmental data, including: Toxic Release Inventory, Hazardous Waste (RCRA information), Superfund, Enviromapper, Chemicals. | www.epa.gov/enviro/index_java.html |
| STORET. Currently STORET combines the functions of the original STORET with that of the Biological Information System (BIOS) and the Ocean Data Evaluation System (ODES). | www.epa.gov/storet/ |
| National Pollution Discharge Elimination System (NPDES) | cfpub.epa.gov/npdes/ |

#### *Coast Guard Web Sites*

| | |
|---|---|
| National Response Center: Maintains the national database for spills (including hazardous waste, petroleum, pesticides) | www.nrc.uscg.mil/index.htm |

#### *NOAA Web Sites*

| | |
|---|---|
| Office of Response and Restoration, Toxic Chemicals | response.restoration.noaa.gov/cpr/cpr.html |
| Coastal Zone Management Program | www.ocrm.nos.noaa.gov/czm/welcome.html |

## *Port Authorities*

| U.S. SOUTH ATLANTIC PORTS | |
|---|---|
| Canaveral Port Authority | www.portcanaveral.org |
| Georgia Ports Authority | www.gaports.com |
| Jacksonville Port Authority | www.jaxport.com |
| North Carolina State Ports Authority | www.ncports.com |
| Port Everglades | www.broward.org/port |
| Port of Miami | www.miamidade.gov/portofmiami/ |
| Port of Palm Beach District | www.portofpalmbeach.com |
| South Carolina State Ports Authority | www.port-of-charleston.com |
| **U.S. GULF PORTS** | |
| Alabama State Port Authority | www.asdd.com |
| Jackson County Port Authority - Port of Pascagoula | www.portofpascagoula.com |
| Mississippi State Port Authority At Gulfport | www.shipmspa.com |
| Panama City Port Authority | www.portpanamacityusa.com |
| Port Manatee/Tampa Bay | www.portmanatee.com |
| Port of Pensacola | www.portofpensacola.com |
| Port of St. Petersburg | www.stpete.org/port/index.htm |
| Tampa Port Authority | www.tampaport.com/ |

## *State Environmental Agencies*

| | |
|---|---|
| Alabama Department of Environmental Management | www.adem.state.al.us |
| Florida Department of Environmental Protection | www.dep.state.fl.us/default.htm |
| Georgia Environmental Protection Division, Department of Natural Resources | www.ganet.org/dnr/naturalresources.aspx |
| Mississippi Department of Environmental Quality | www.deq.state.ms.us |
| Mississippi Department of Marine Resources | www.dmr.state.ms.us |
| North Carolina Department of Environment and Natural Resources (DENR) | www.enr.state.nc.us |
| NC DENR, Division of Coastal Management | dcm2.enr.state.nc.us/ |
| South Carolina Department of Natural Resources | dnr.sc.gov |
| South Carolina Department of Health and Environmental Control | www.scdhec.net |

## USACE Web Sites

| | |
|---|---|
| USACE Center for Contaminated Sediments | www.wes.army.mil/el/dots/ccs/ |
| Dredging Operations and Environmental Research, USACE | www.wes.army.mil/el/dots/doer/doer.html |
| USACE, Jacksonville District, Clean Water Act 404(b)(1) evaluations | www.saj.usace.army.mil/regulatory/what/rpe/regs-policy-eforcment.htm |
| USACE, Jacksonville District, Nationwide Permits Information | www.saj.usace.army.mil/regulatory/permitting/nwp/nwp.htm |
| USACE, Memphis District | www.mvm.usace.army.mil/regulatory/memphis.htm |
| USACE HQ, Regulatory Branch | www.usace.army.mil/cw/cecwo/reg/index.html |
| USACE, Engineer Development and Research Center, Contaminated Sediments | el.ersdc.usace.army.mil/dots/ccs |

## US Geological Survey (USGS)

| | |
|---|---|
| Sediment Effects Concentrations and Contaminated Sediments | www.cerc.usgs.gov/pubs/sedtox/sediment.htm |
| USGS, National Streamflow Information Program | water.usgs.gov/nsip/ |
| USGS, Water Resources | Water.usgs.gov |
| USGS, Toxic Substances Hydrology Program | Toxics.usgs.gov |
| USGS, Coastal and Marine Geology Program | Marine.usgs.gov |

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# Appendix F

## EPA WATER QUALITY CRITERIA FOR CONTAMINANTS OF CONCERN IN MARINE WATERS

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# Appendix F

## EPA WATER QUALITY CRITERIA FOR CONTAMINANTS OF CONCERN IN MARINE WATERS

This table summary has been provided as an example of the 2006 WQC values. The latest EPA WQC should always be used for compliance comparison.

| EPA Water Quality Criteria[1] (WQC) for Chemicals of Concern in Marine Waters | |
|---|---|
| **Chemicals of Concern** | **Acute Concentration Levels (µg/l)[2]** |
| **Metals** | |
| Arsenic | 69 |
| Cadmium | 40 |
| Chromium (VI) | 1100 |
| Copper | 4.8 |
| Lead | 210 |
| Mercury | 1.8 |
| Nickel | 74 |
| Selenium | 290 |
| Silver | 1.9 |
| Zinc | 90 |
| **Nonmetals** | |
| Ammonia | pH- and temperature-dependent |
| Cyanide | 1 |
| Tributyltin (TBT) | 0.42 |
| **Pesticides** | |
| Aldrin | 1.3 |
| Chlordane | 0.09 |
| DDT | 0.13 |
| Dieldrin | 0.71 |
| alpha - Endosulfan | 0.034 |
| beta - Endosulfan | 0.034 |
| Endrin | 0.037 |
| gamma-BHC (Lindane) | 0.16 |
| Heptachlor | 0.053 |
| Heptachlor Epoxide | 0.053 |
| Toxaphene | 0.21 |
| Pentachlorophenol | 13 |

1 Reference: U.S. Environmental Protection Agency. National Water Quality Criteria: 2006. EPA-822-R-02-047. http:www.epa.gov/waterscience/criteria/nrwqc-2006.pdf

2 Concentrations in µg/l unless otherwise stated.

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# Appendix G

# STFATE GUIDANCE AND STANDARD INPUT PARAMETERS

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## Appendix G

## STFATE GUIDANCE AND STANDARD INPUT PARAMETERS

TABLE OF CONTENTS

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## STFATE GENERAL GUIDANCE

Guidance on the use of the STFATE can be found in Appendix C of the Inland Testing Manual. Some additional "hints" on model input are provided below:

1) Volume Concentrations: The volume concentrations for sand, clay, silt etc. are of the total dredged material, not just the solids portion. For example, if the solids are 64% sand, but dredged material is only 43% solids, then the volume fraction for sand is .64*0.43 = 0.28. If you look at the Water Quality Analysis Data in the output, and it shows the volume fraction of water as being zero, this is obviously incorrect. It should be the same as your percent moisture number.

2) Type of Analysis: Select "Section 103 Regulatory Analysis for Ocean Waters"

3) Determining Contaminant of Concern from Whole Sediment Chemistry Screen
   a. Requires concentration of the contaminant in the dredged material expressed as µg/L, Cs
   b. To convert the contaminant concentration reported on a dry-weight basis to the contaminant concentration in the dredged material, the dry-weight concentration must be multiplied by the mass of dredged-material solids per liter of dredged material:

$$C_s = C_{dw} \times \left[ \frac{n_s \times G}{G + n_s(1 - G)} \right]$$

   where:

   $C_{dw}$ = contaminant concentration in dredged material, reported on a dry-weight basis (µg/kg)

   $n_s$ = percent solids as a decimal

   G = specific gravity of the solids. Use 2.65 if site-specific data are not available.

4) Velocity Profile Type: If "single depth average profile" option is selected, be sure that the depth at location is equal to the water depth of the disposal site. If not, the velocity will be adjusted for the water depth at the disposal site in accordance with the continuity principle ($V_1$x$D_1$)=($V_2$x$D_2$), where $V_1$ and $D_1$ are the velocity and depth, respectively, specified in the input and $V_2$ and $D_2$ are the velocity and depth, respectively, at the disposal site.

5) STFATE Input Parameters: The following input parameters are current as of the date of this appendix. ODMDS SMMPs should be consulted for updates.

## STFATE INPUT PARAMETERS

### JACKSONVILLE DISTRICT

Water Column Evaluations
Numerical Model (STFATE) Input Parameters
**Fernandina Beach ODMDS**

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 350 | ft |
| Spacing Between Grid Points (top to bottom) | 350 | ft |
| Constant Water Depth | 50 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 0 ft | 1.0190 | g/cc |
| Ambient Density at Depth = 50 ft | 1.0250 | g/cc |

**AMBIENT VELOCITY DATA**

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity (depth=8.2 feet) | -0.50[3] | ft/sec |
| Z-Direction Velocity (depth=8.2 feet) | -0.20[3] | ft/sec |
| X-Direction Velocity (depth=42.3 feet) | -0.32[3] | ft/sec |
| Z-Direction Velocity (depth=42.3 feet) | -0.13[3] | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 7,875 | ft |
| Location of Disposal Point from Left Edge of Grid | 7,875 | ft |
| Dumping Over Depression | 0 | |

**INPUT, EXECUTION AND OUTPUT**

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 1,800 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 1,800 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 13,950 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 13,950 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

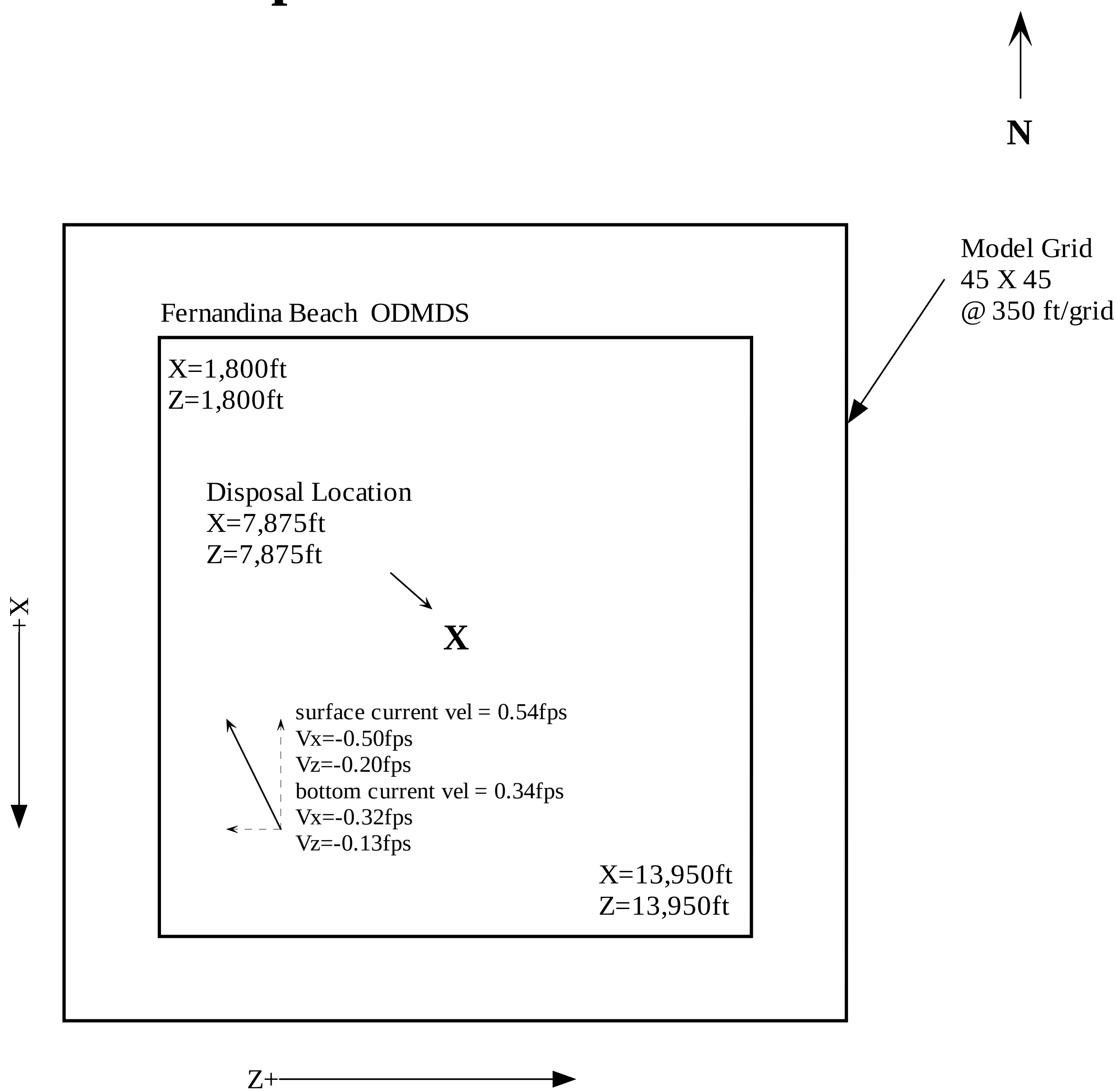
**COEFFICIENTS**

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.0225[2] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Calculated from NOAA field work at Fort Pierce, FL (1994)

# Fernandina Beach ODMDS STFATE Input Parameters



Water Column Evaluations
Numerical Model (STFATE) Input Parameters
**Jacksonville ODMDS**

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 350 | ft |
| Spacing Between Grid Points (top to bottom) | 350 | ft |
| Constant Water Depth | 46 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 0 ft | 1.0221[2] | g/cc |
| Ambient Density at Depth = 46 ft | 1.0236[2] | g/cc |

**AMBIENT VELOCITY DATA**

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity (depth=8.2 feet) | 0.52[3] | ft/sec |
| Z-Direction Velocity (depth=8.2 feet) | 0.21[3] | ft/sec |
| X-Direction Velocity (depth=40.0 feet) | 0.31[3] | ft/sec |
| Z-Direction Velocity (depth=40.0 feet) | 0.12[3] | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 5,700 | ft |
| Location of Disposal Point from Left Edge of Grid | 7,700 | ft |
| Dumping Over Depression | 0 | |

**INPUT, EXECUTION AND OUTPUT**

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 2,660 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 4,660 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 8,740 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 10,740 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

**COEFFICIENTS**

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.001 |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] From surveys in July 1995 and July 1998 (EPA)

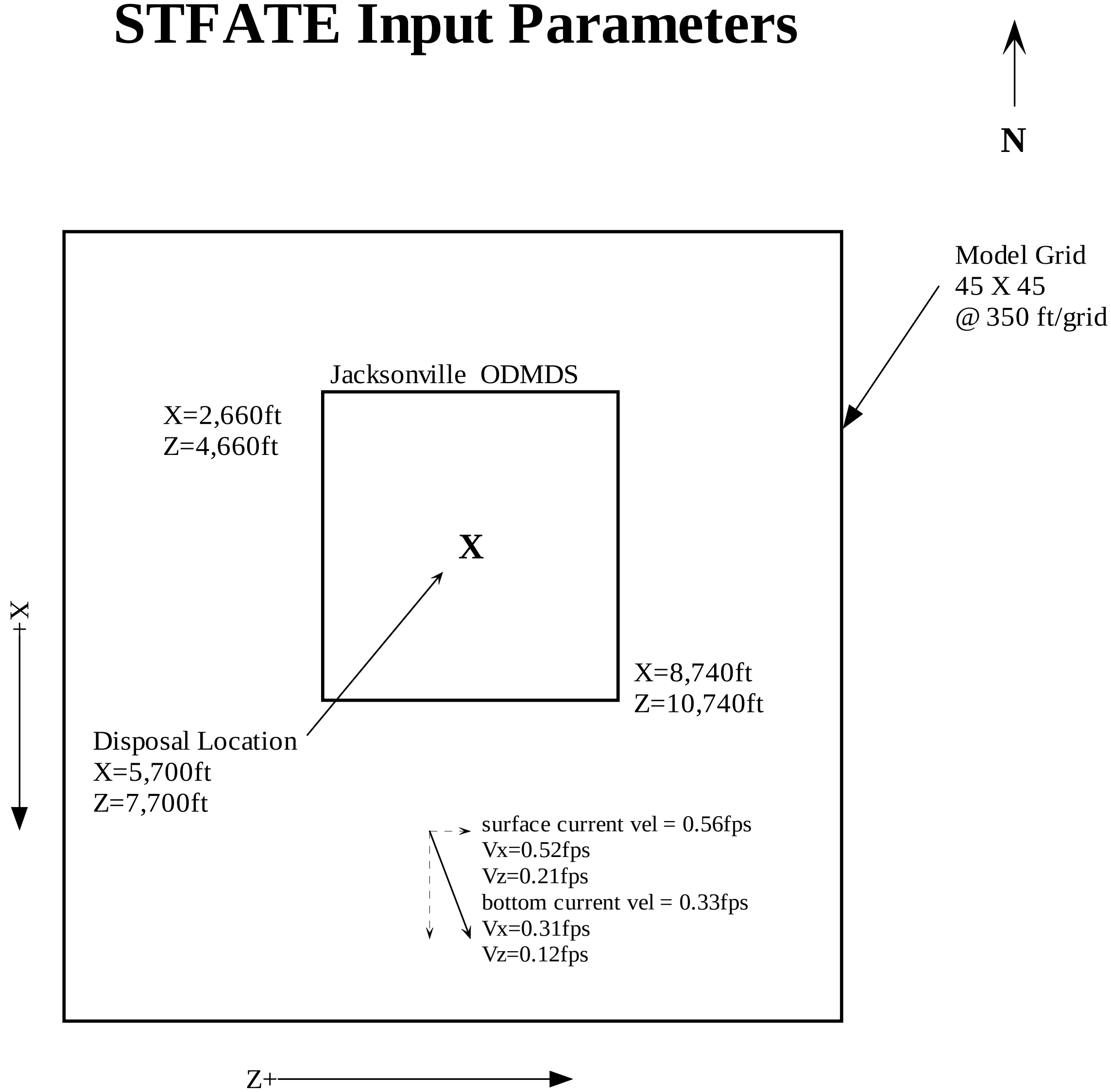
[3] From EPA current measurements, August 2006-September 2008

<u>Dilution Rates for Generic Material (4,000cy):</u>
Minimum dilution outside disposal site: 350 to 1; Minimum dilution after 4 hours: 1000 to 1

| Jacksonville ODMDS Background Water Concentration | |
|---|---|
| **Contaminants of Concern** | **Background Concentration Levels (µg/L)** |
| Arsenic | 1.36 [1] |
| Cadmium | 0.008 [1] |
| Chromium (VI) | 0.025 [2,3,4] |
| Copper | 0.34[1] |
| Lead | 0.5 [3,4] |
| Mercury | 0.1 [2,3,4] |
| Nickel | 0.57 [2] |
| Selenium | No Data |
| Silver | 0.009[1] |
| Zinc | 2.33[1] |
| Ammonia | 25 [5] |
| Cyanide | 1.0 [3,4] |
| Tributyltin (TBT) | 0.01 [3,4] |
| Aldrin | 0.01 [2,4] |
| Chlordane | 0.015 [2,3,4] |
| DDT | 0.01 [2,4] |
| Dieldrin | 0.01 [2,4] |
| alpha - Endosulfan | 0.01 [2,4] |
| beta - Endosulfan | 0.01 [2,4] |
| Endrin | 0.01 [2,4] |
| gamma-BHC (Lindane) | 0.01 [2,4] |
| Heptachlor | 0.01 [2,4] |
| Heptachlor Epoxide | 0.01 [2,4] |
| Toxaphene | .015 [2,4] |
| Parathion | No Data |
| Pentachlorophenol | No Data |

[1] 2007 EPA Status and Trends Survey at the Canaveral ODMDS
[2] Reference station water from the 2004 Jacksonville Harbor 103 Evaluation
[3] Reference station water from the 2006 Mayport Harbor 103 Evaluation
[4] Analyte not detected. Value based on one half the reporting limit.

# Jacksonville ODMDS
# STFATE Input Parameters



Water Column Evaluations
Numerical Model (STFATE) Input Parameters

## Canaveral ODMDS

### SITE DESCRIPTION

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 350 | ft |
| Spacing Between Grid Points (top to bottom) | 350 | ft |
| Constant Water Depth | 45 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 0 ft | 1.0237 | g/cc |
| Ambient Density at Depth = 45 ft | 1.0240 | g/cc |

### AMBIENT VELOCITY DATA

| Parameter | Value | Units |
|---|---|---|
| Water Depth | 45 | ft |
| Profile | Logarithmic | |
| Vertically Averaged X-Direction Velocity | 0.0 | ft/sec |
| Vertically Averaged Z-Direction Velocity | 0.33 | ft/sec |

### DISPOSAL OPERATION DATA

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 7,875 | ft |
| Location of Disposal Point from Left Edge of Grid | 7,875 | ft |
| Dumping Over Depression | 0 | |

##### INPUT, EXECUTION AND OUTPUT

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 1,800 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 1,800 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 13,950 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 13,950 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

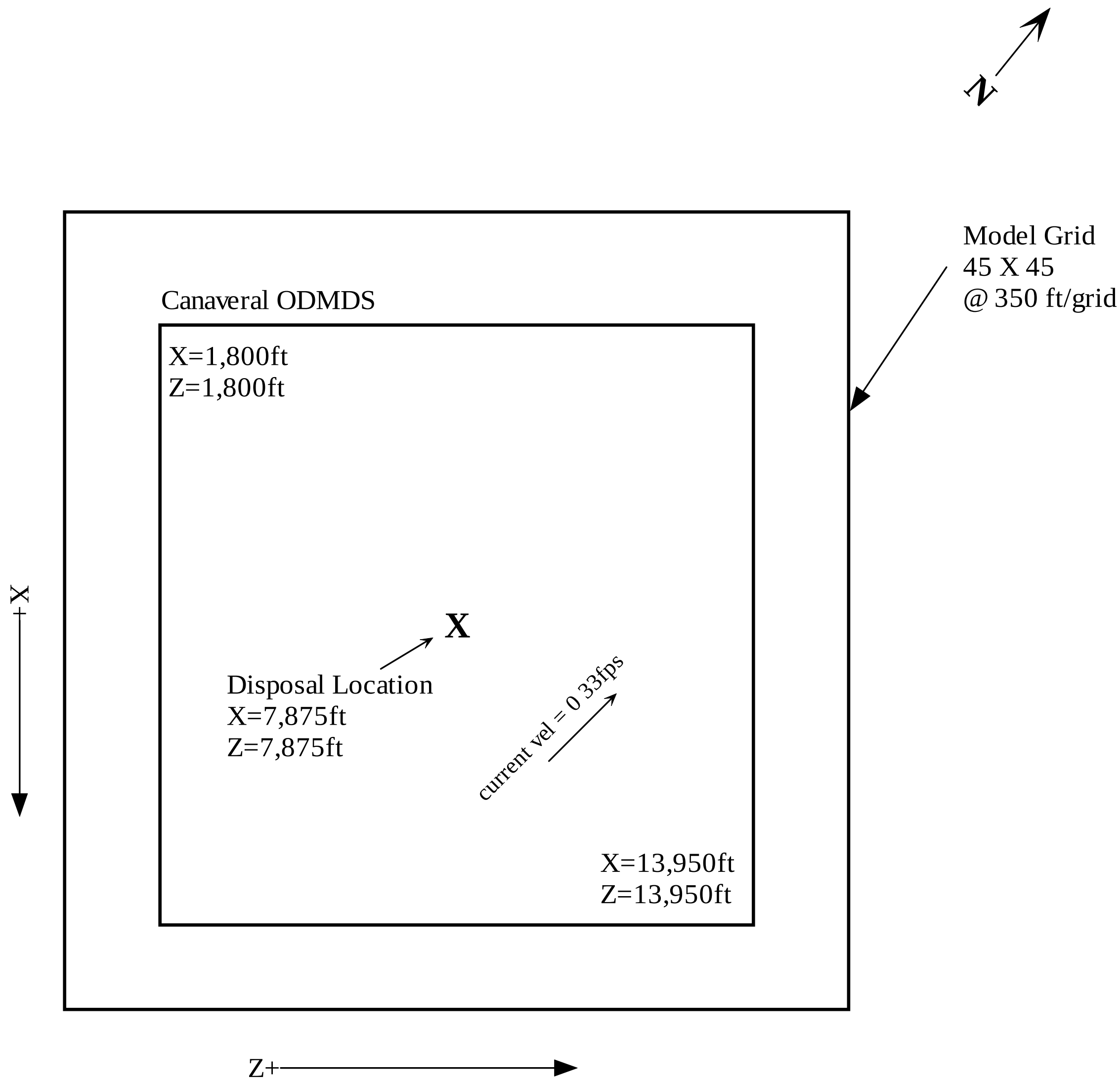
##### COEFFICIENTS

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.0225[2] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Calculated from NOAA field work at Fort Pierce (1994)

# Canaveral ODMDS STFATE Input Parameters



Water Column Evaluations
Numerical Model (STFATE) Input Parameters

## Fort Pierce ODMDS

### SITE DESCRIPTION

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 32 | |
| Number of Grid Points (top to bottom) | 32 | |
| Spacing Between Grid Points (left to right) | 250 | ft |
| Spacing Between Grid Points (top to bottom) | 250 | ft |
| Constant Water Depth | 45 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 0 ft | 1.0256 | g/cc |
| Ambient Density at Depth = 45 ft | 1.0257 | g/cc |

### AMBIENT VELOCITY DATA

| Parameter | Value | Units |
|---|---|---|
| Water Depth | 45 | ft |
| Profile | Logarithmic | |
| Vertically Averaged X-Direction Velocity | -0.10 | ft/sec |
| Vertically Averaged Z-Direction Velocity | 0.0 | ft/sec |

### INPUT, EXECUTION AND OUTPUT

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 1,000 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 1,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 7,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 7,000 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

**DISPOSAL OPERATION DATA - RESTRICTED AREA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 4,000 | ft |
| Location of Disposal Point from Left Edge of Grid | 4,000 | ft |
| Dumping Over Depression | 0 | |

**DISPOSAL OPERATION DATA - FINE GRAINED MATERIAL AREA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 5,000 | ft |
| Location of Disposal Point from Left Edge of Grid | 4,000 | ft |
| Dumping Over Depression | 0 | |

**COEFFICIENTS**

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.0225[2] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Calculated from NOAA field work (1994)

Water Column Evaluations
Numerical Model (STFATE) Input Parameters
**Palm Beach Harbor ODMDS**

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 40 | |
| Number of Grid Points (top to bottom) | 40 | |
| Spacing Between Grid Points (left to right) | 500 | ft |
| Spacing Between Grid Points (top to bottom) | 500 | ft |
| Constant Water Depth | 558 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 1 | deg. |
| Number of Points in Ambient Density Profile[2] Point | 4 | |
| Ambient Density at Depth = 0 ft | 1.0247 | g/cc |
| Ambient Density at Depth = 82 ft | 1.0249 | g/cc |
| Ambient Density at Depth = 164 ft | 1.0259 | g/cc |
| Ambient Density at Depth = 558 ft | 1.0279 | g/cc |

**AMBIENT VELOCITY DATA[3]**

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity at Depth = 33 feet | -2.7 | ft/sec |
| Z-Direction Velocity at Depth = 33 feet | +1.1 | ft/sec |
| X-Direction Velocity at Depth = 197 feet | -2.2 | ft/sec |
| Z-Direction Velocity at Depth = 197 feet | +0.9 | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 14,000 | ft |
| Location of Disposal Point from Left Edge of Grid | 10,000 | ft |
| Dumping Over Depression | 0 | |

#### INPUT, EXECUTION AND OUTPUT

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 11,000 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 7,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 17,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 13,000 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

#### COEFFICIENTS

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.001[1] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.390[4] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Profiles from EPA 1998 measurements

[3] Velocity data represents average conditions. Determined from WES 1998 analysis of ADCP data offshore Ft. Lauderdale, FL.

[4] Calculated from NOAA field work at Miami (1991)

Dilution Rates for Generic Material:
Minimum dilution outside disposal site: 15,000 to 1; minimum dilution after 4 hours: 36,000 to 1

Water Column Evaluations
Numerical Model (STFATE) Input Parameters

**Port Everglades Harbor ODMDS**

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 40 | |
| Number of Grid Points (top to bottom) | 40 | |
| Spacing Between Grid Points (left to right) | 500 | ft |
| Spacing Between Grid Points (top to bottom) | 500 | ft |
| Constant Water Depth | 645 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0.0 | deg. |
| Slope of Bottom in Z-Direction | 1.0 | deg. |
| Number of Points in Ambient Density Profile[2] Point | 5 | |
| Ambient Density at Depth = 0 ft | 1.0246 | g/cc |
| Ambient Density at Depth = 65 ft | 1.0248 | g/cc |
| Ambient Density at Depth = 328 ft | 1.0272 | g/cc |
| Ambient Density at Depth = 492 ft | 1.0280 | g/cc |
| Ambient Density at Depth = 645 ft | 1.0282 | g/cc |

**AMBIENT VELOCITY DATA**[3]

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity at Depth = 33 feet | -2.7 | ft/sec |
| Z-Direction Velocity at Depth = 33 feet | +1.1 | ft/sec |
| X-Direction Velocity at Depth = 197 feet | -2.2 | ft/sec |
| Z-Direction Velocity at Depth = 197 feet | +0.9 | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 14,000 | ft |
| Location of Disposal Point from Left Edge of Grid | 10,000 | ft |
| Dumping Over Depression | 0 | |

**INPUT, EXECUTION AND OUTPUT**

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 11,000 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 7,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 17,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 13,000 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

**COEFFICIENTS**

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.001[1] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.39[4] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Profiles from EPA 1998 measurements

[3] Velocity data represents average conditions. Determined from WES 1998 analysis of ADCP data offshore Ft. Lauderdale, FL.

[4] Calculated from NOAA field work at Miami (1991)

Dilution Rates for Generic Material:
Minimum dilution outside disposal site: 6,600 to 1; minimum dilution after 4 hours: 15,700 to 1

Water Column Evaluations
Numerical Model (STFATE) Input Parameters

**Miami ODMDS**

[In Development]

Water Column Evaluations
Numerical Model (STFATE) Input Parameters
**Tampa ODMDS**

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 60 | |
| Spacing Between Grid Points (left to right) | 350 | ft |
| Spacing Between Grid Points (top to bottom) | 350 | ft |
| Constant Water Depth | 70 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 0 ft | 1.0222 | g/cc |
| Ambient Density at Depth = 70 ft | 1.0241 | g/cc |

**AMBIENT VELOCITY DATA**

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity at Depth = 0 ft | 0.46 | ft/sec |
| Z-Direction Velocity at Depth = 0 ft | 0.46 | ft/sec |
| X-Direction Velocity at Depth = 60 ft | 0.35 | ft/sec |
| Z-Direction Velocity at Depth = 60 ft | 0.35 | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | Zone A=4,000<br>Zone B=TBD<br>Zone C=12,400 | ft |
| Location of Disposal Point from Left Edge of Grid | 7,875 | ft |
| Dumping Over Depression | 0 | |

#### INPUT, EXECUTION AND OUTPUT

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 1,800 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 1,800 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 13,950 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 13,950 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

#### COEFFICIENTS

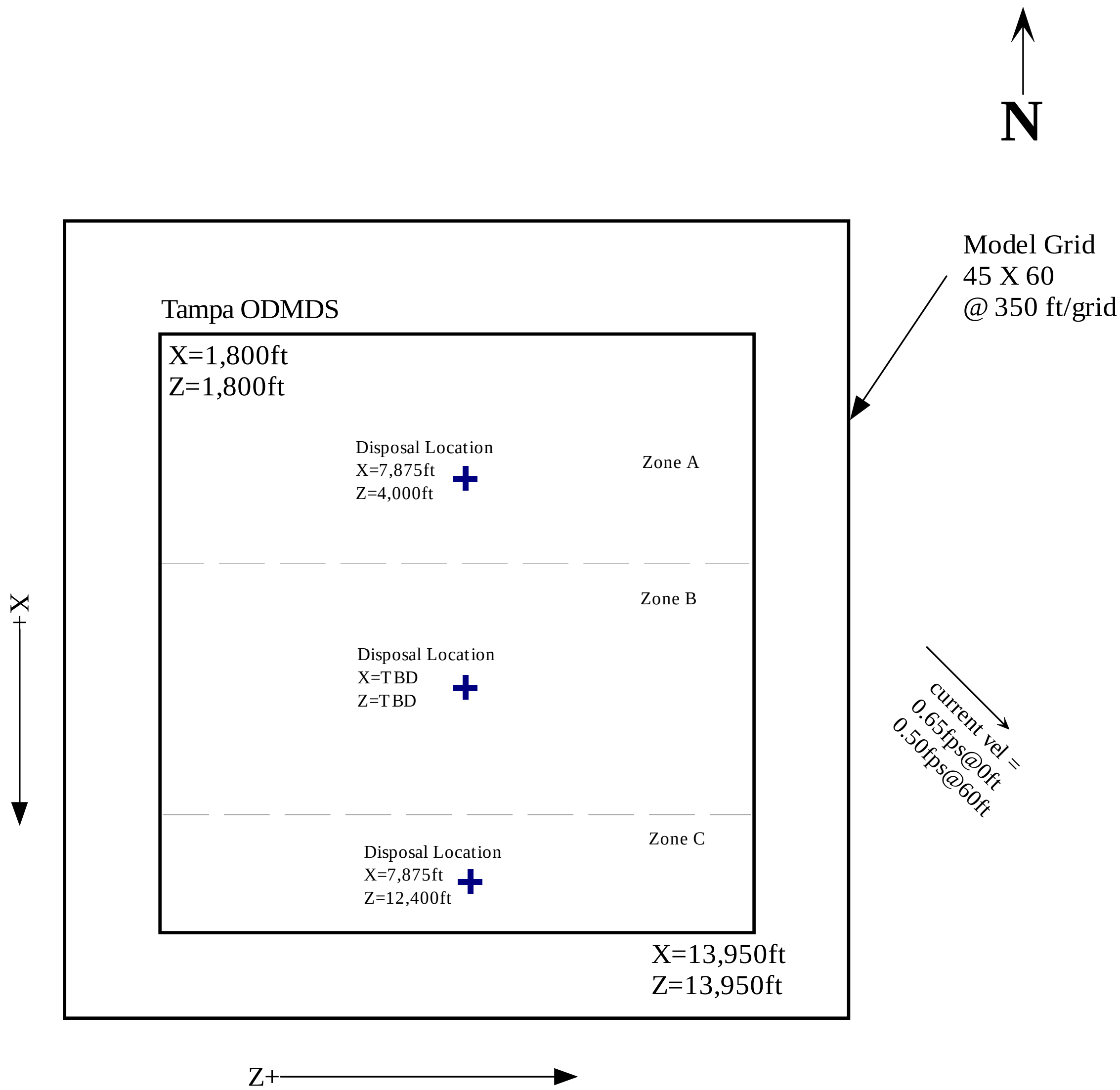
| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.0225 |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1]Model default value

#### TYPICAL DILUTION RATES

| Zone | Dilution at 4 Hours | Minimum Dilution Outside of ODMDS at All Times |
|---|---|---|
| A | 1,435:1 | >100,000:1 |
| C | TBD | N/A |

# Tampa ODMDS STFATE Input Parameters



## MOBILE DISTRICT

Water Column Evaluations
Numerical Model (STFATE) Input Parameters
**Pensacola ODMDS**

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 500 | ft |
| Spacing Between Grid Points (top to bottom) | 500 | ft |
| Constant Water Depth | 75 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 3 | |
| Ambient Density at Depth = 1 ft | 1.0248 | g/cc |
| Ambient Density at Depth = 36 ft | 1.0267 | g/cc |
| Ambient Density at Depth = 75 ft | 1.0271 | g/cc |

**AMBIENT VELOCITY DATA**

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity at Depth = 30 ft | 0.0 | ft/sec |
| Z-Direction Velocity at Depth = 30 ft | -0.750 | ft/sec |
| X-Direction Velocity at Depth = 56 ft | 0.0 | ft/sec |
| Z-Direction Velocity at Depth = 56 ft | -0.530 | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 11,250[2] | ft |
| Location of Disposal Point from Left Edge of Grid | 16,875[2] | ft |
| Dumping Over Depression | 0 | |

**INPUT, EXECUTION AND OUTPUT**

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 6,000 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 4,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 16,500 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 19,500 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

**COEFFICIENTS**

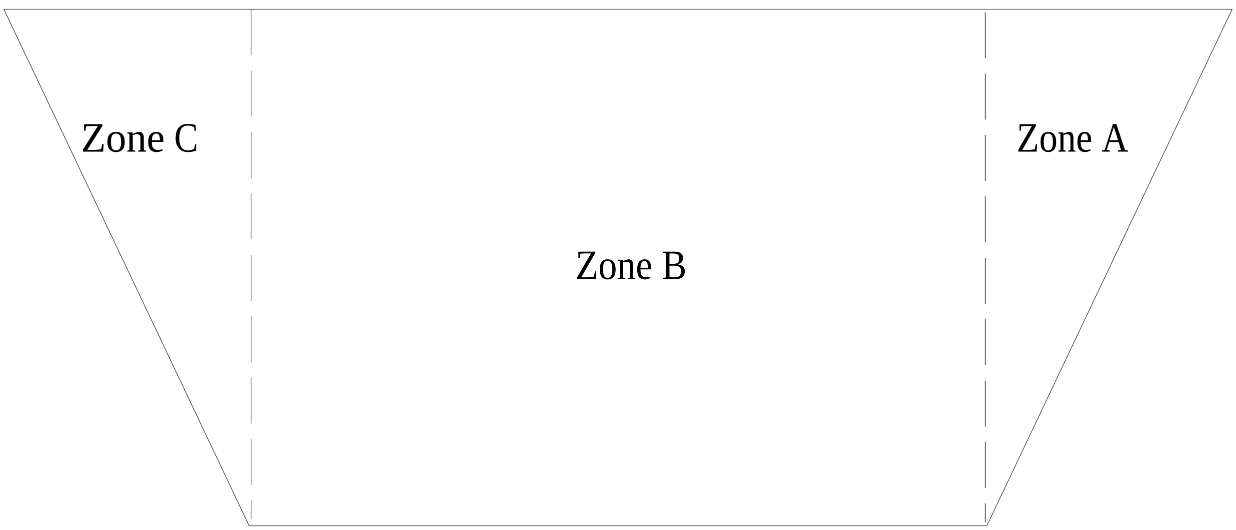
| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.001[1] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Represents center of disposal site. Dredged material requiring disposal in another location in order to meet the dilution criteria must be brought to the attention of EPA and USACE.

Typical dilution achieved after 4 hours = 2,415:1
Typical dilution achieved at all times outside disposal site = $1.5 \times 10^6$:1

# Pascagoula ODMDS
# STFATE Modeling Zones



Water Column Evaluations
Numerical Model (STFATE) Input Parameters

## Pascagoula ODMDS Zone A

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 500 | ft |
| Spacing Between Grid Points (top to bottom) | 500 | ft |
| Constant Water Depth | 44 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 5 ft | 1.0174 | g/cc |
| Ambient Density at Depth = 44 ft | 1.0230 | g/cc |

**AMBIENT VELOCITY DATA**

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity at Depth = 10 ft | -0.232 | ft/sec |
| Z-Direction Velocity at Depth = 10 ft | -0.232 | ft/sec |
| X-Direction Velocity at Depth = 40 ft | -0.116 | ft/sec |
| Z-Direction Velocity at Depth = 40 ft | +0.116 | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 8,500[2] | ft |
| Location of Disposal Point from Left Edge of Grid | 8,200[2] | ft |
| Dumping Over Depression | 0 | |

INPUT, EXECUTION AND OUTPUT

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 2,000 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 2,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 21,500 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 20,500 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

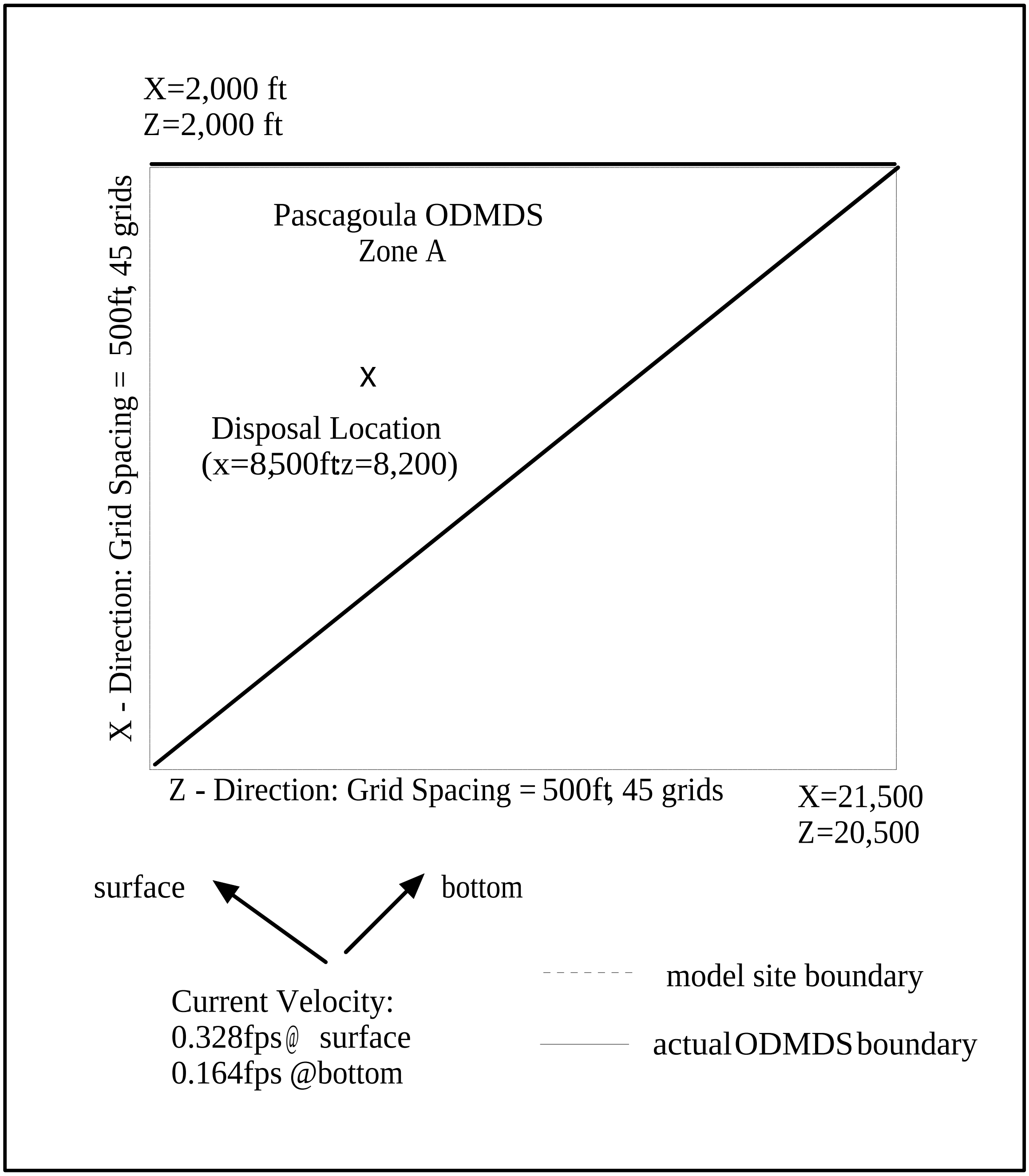
COEFFICIENTS

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.001[1] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Represents center of zone A. Dredged material requiring disposal in another location in order to meet the dilution criteria must be brought to the attention of EPA and USACE.

Typical dilution achieved after 4 hours = 500:1
Plume does not reach site boundaries within 4 hours


X=2,000 ft
Z=2,000 ft
Pascagoula ODMDS
Zone A
X
Disposal Location
(x=8,500ft, z=8,200)
X - Direction: Grid Spacing = 500ft, 45 grids
Z - Direction: Grid Spacing = 500ft, 45 grids
X=21,500
Z=20,500
surface
bottom
Current Velocity:
0.328fps @ surface
0.164fps @bottom
model site boundary
actual ODMDS boundary

Water Column Evaluations
Numerical Model (STFATE) Input Parameters

## Pascagoula ODMDS Zone B

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 600 | ft |
| Spacing Between Grid Points (top to bottom) | 600 | ft |
| Constant Water Depth | 46 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 5 ft | 1.0174 | g/cc |
| Ambient Density at Depth = 46 ft | 1.0230 | g/cc |

**AMBIENT VELOCITY DATA**

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity at Depth = 10 ft | -0.232 | ft/sec |
| Z-Direction Velocity at Depth = 10 ft | -0.232 | ft/sec |
| X-Direction Velocity at Depth = 40 ft | -0.116 | ft/sec |
| Z-Direction Velocity at Depth = 40 ft | +0.116 | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 13,500[2] | ft |
| Location of Disposal Point from Left Edge of Grid | 14,500[2] | ft |
| Dumping Over Depression | 0 | |

**INPUT, EXECUTION AND OUTPUT**

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 2,000 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 2,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 25,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 27,000 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

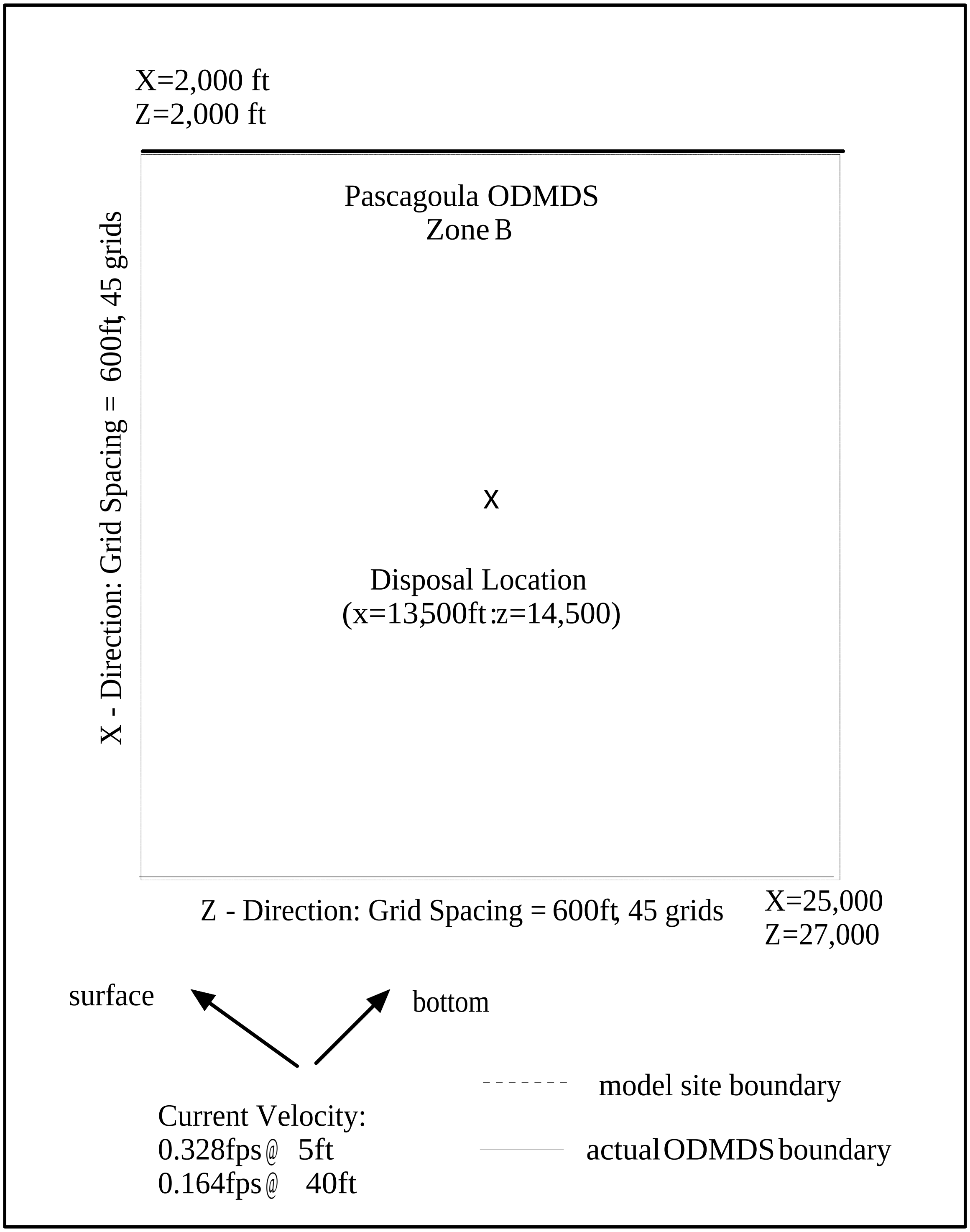
**COEFFICIENTS**

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.001[1] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Represents center of zone A. Dredged material requiring disposal in another location in order to meet the dilution criteria must be brought to the attention of EPA and USACE.

Typical dilution achieved after 4 hours = 500:1
Plume does not reach site boundaries within 4 hours



X=2,000 ft
Z=2,000 ft
Pascagoula ODMDS
Zone B
X - Direction: Grid Spacing = 600ft, 45 grids
X
Disposal Location
(x=13,500ft:z=14,500)
Z - Direction: Grid Spacing = 600ft, 45 grids
X=25,000
Z=27,000
surface
bottom
model site boundary
Current Velocity:
0.328fps @ 5ft
0.164fps @ 40ft
actual ODMDS boundary

Water Column Evaluations
Numerical Model (STFATE) Input Parameters

## Pascagoula ODMDS Zone C

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 400 | ft |
| Spacing Between Grid Points (top to bottom) | 600 | ft |
| Constant Water Depth | 47 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 5 ft | 1.0174 | g/cc |
| Ambient Density at Depth = 47 ft | 1.0230 | g/cc |

**AMBIENT VELOCITY DATA**

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity at Depth = 10 ft | -0.232 | ft/sec |
| Z-Direction Velocity at Depth = 10 ft | -0.232 | ft/sec |
| X-Direction Velocity at Depth = 40 ft | -0.116 | ft/sec |
| Z-Direction Velocity at Depth = 40 ft | +0.116 | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 9,660[2] | ft |
| Location of Disposal Point from Left Edge of Grid | 11,200[2] | ft |
| Dumping Over Depression | 0 | |

**INPUT, EXECUTION AND OUTPUT**

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 2,000 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 2,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 25,000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 15,800 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

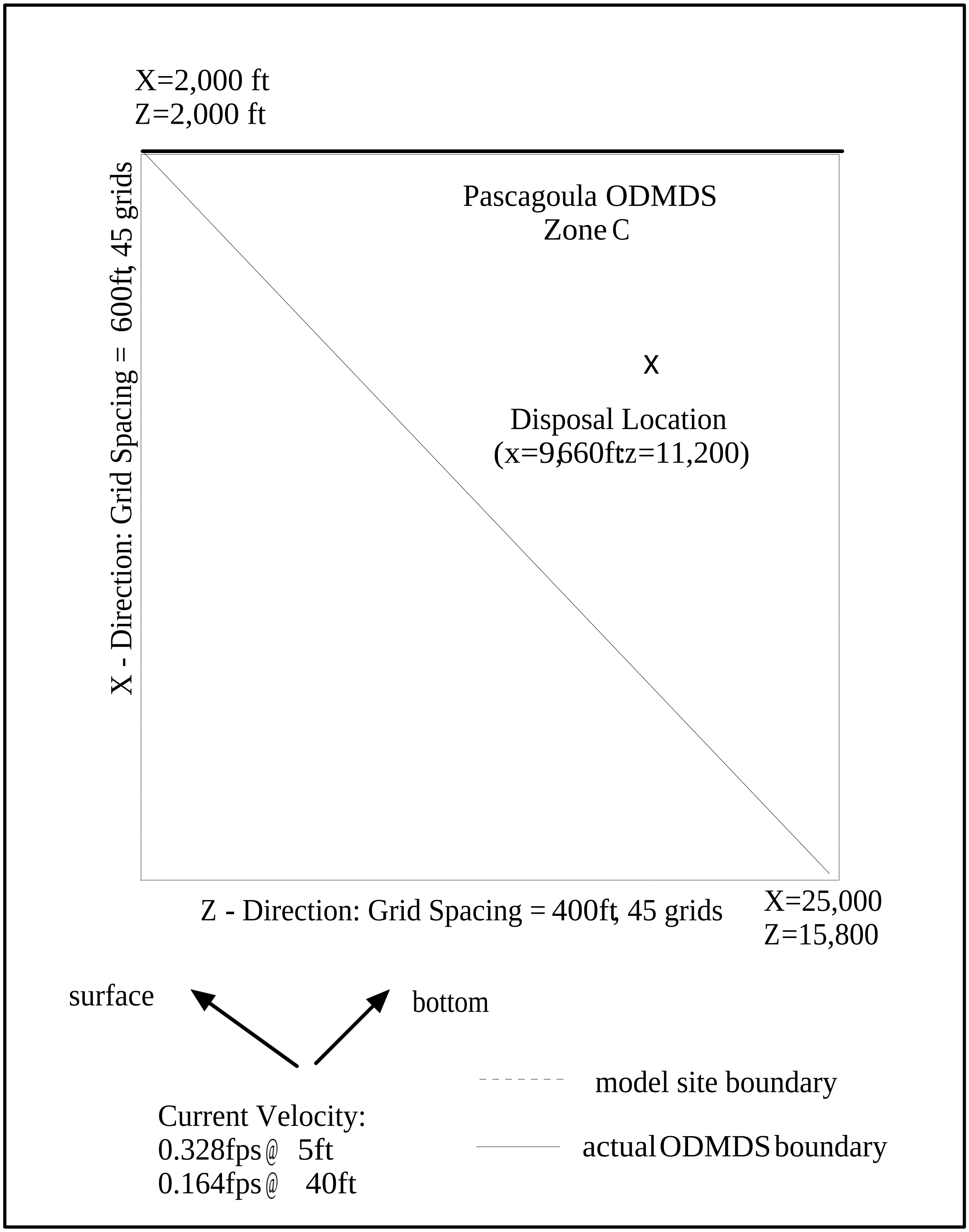
**COEFFICIENTS**

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.001[1] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Represents center of zone A.  Dredged material requiring disposal in another location in order to meet the dilution criteria must be brought to the attention of EPA and USACE.

Typical dilution achieved after 4 hours = 500:1
Plume does not reach site boundaries within 4 hours


X=2,000 ft
Z=2,000 ft
X - Direction: Grid Spacing = 600ft, 45 grids
Pascagoula ODMDS
Zone C
X
Disposal Location
(x=9,660ft, z=11,200)
Z - Direction: Grid Spacing = 400ft, 45 grids
X=25,000
Z=15,800
surface
bottom
Current Velocity:
0.328fps @ 5ft
0.164fps @ 40ft
model site boundary
actual ODMDS boundary

Water Column Evaluations
Numerical Model (STFATE) Input Parameters

## Mobile ODMDS

[In Development]

Water Column Evaluations
Numerical Model (STFATE) Input Parameters

## Gulfport East ODMDS

### SITE DESCRIPTION

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 300 | ft |
| Spacing Between Grid Points (top to bottom) | 750 | ft |
| Constant Water Depth | 26 | ft |
| Roughness Height at Bottom of Disposal Site | 0.005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 6 ft | 1.0175 | g/cc |
| Ambient Density at Depth = 26 ft | 1.0205 | g/cc |

### AMBIENT VELOCITY DATA

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity at Depth = 10 ft | 0.422 | ft/sec |
| Z-Direction Velocity at Depth = 10 ft | 0.503 | ft/sec |
| X-Direction Velocity at Depth = 20 ft | 0.316 | ft/sec |
| Z-Direction Velocity at Depth = 20 ft | 0.377 | ft/sec |

### DISPOSAL OPERATION DATA

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 14100[2] | ft |
| Location of Disposal Point from Left Edge of Grid | 2100[2] | ft |
| Dumping Over Depression | 0 | |

INPUT, EXCECUTION AND OUTPUT

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 600 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 900 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 27,650 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 3,300 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

COEFFICIENTS

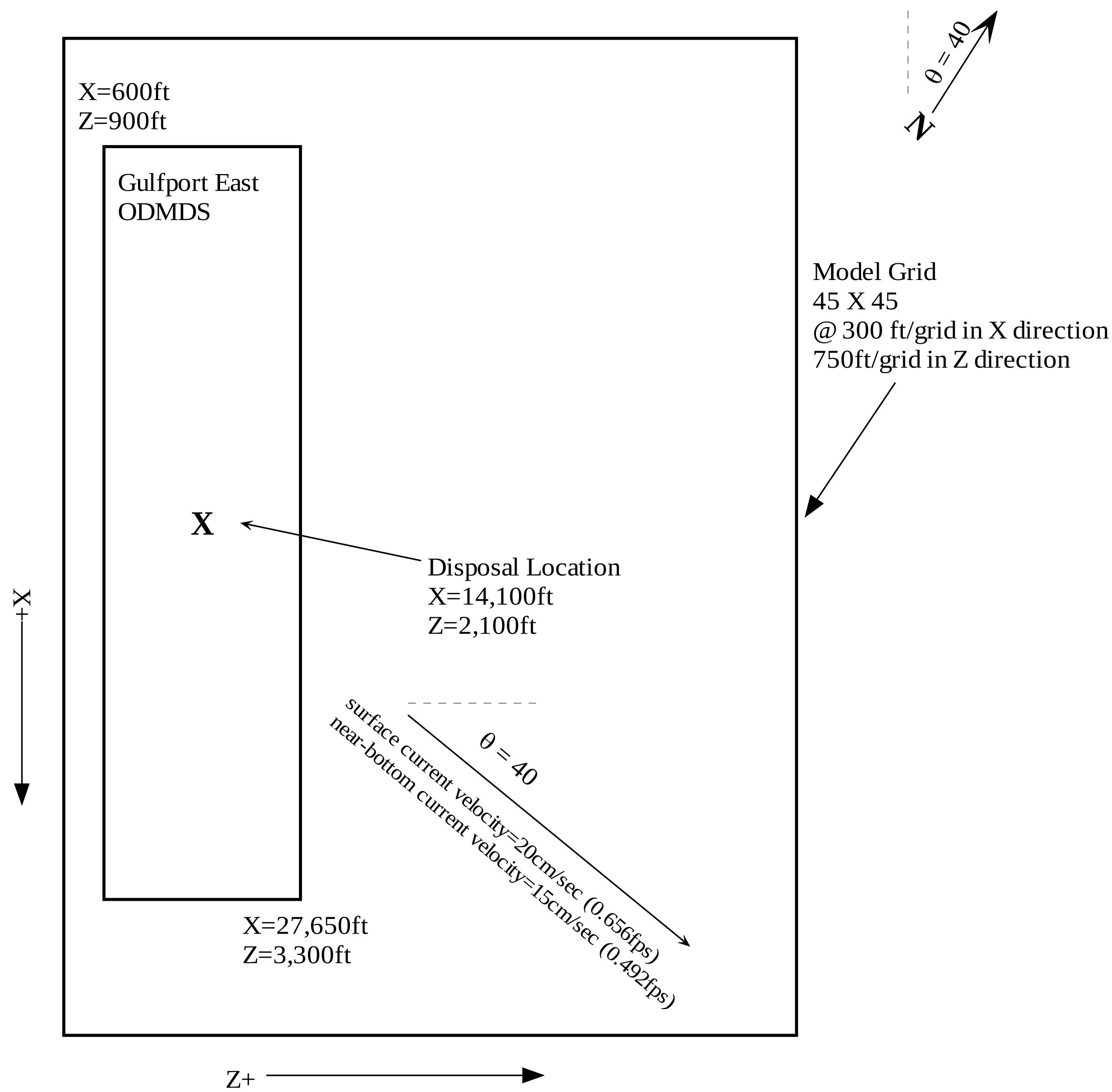
| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.001[1] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Represents center of disposal site. Dredged material requiring disposal in another location in order to meet the dilution criteria must be brought to the attention of EPA and USACE.

Typical dilution achieved after 4 hours = 1,700:1
Typical dilution achieved at all times outside disposal site = 100:1

# Gulfport East ODMDS STFATE Input Parameters



Water Column Evaluations
Numerical Model (STFATE) Input Parameters

## Gulfport West ODMDS

### Site Description

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 300 | ft |
| Spacing Between Grid Points (top to bottom) | 600 | ft |
| Constant Water Depth | 25 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 6 ft | 1.0175 | g/cc |
| Ambient Density at Depth = 25 ft | 1.0205 | g/cc |

### Ambient Velocity Data

| Parameter | Value | Units |
|---|---|---|
| Profile | 2-Point at constant depth | |
| X-Direction Velocity at Depth = 10 feet | 0.303 | ft/sec |
| Z-Direction Velocity at Depth = 10 feet | 0.582 | ft/sec |
| X-Direction Velocity at Depth = 19 feet | 0.227 | ft/sec |
| Z-Direction Velocity at Depth = 19 feet | 0.436 | ft/sec |

### Disposal Operation Data

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 13,800[2] | ft |
| Location of Disposal Point from Left Edge of Grid | 2,700[2] | ft |
| Dumping Over Depression | 0 | |

**INPUT, EXCECUTION AND OUTPUT**

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site<br>- Distance from Top Edge | 600 | ft |
| Location of the Upper Left Corner of the Disposal Site<br>- Distance from Left Edge | 900 | ft |
| Location of the Lower Right Corner of the Disposal Site<br>- Distance from Top Edge | 27,000 | ft |
| Location of the Lower Right Corner of the Disposal Site<br>- Distance from Left Edge | 4,500 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

**COEFFICIENTS**

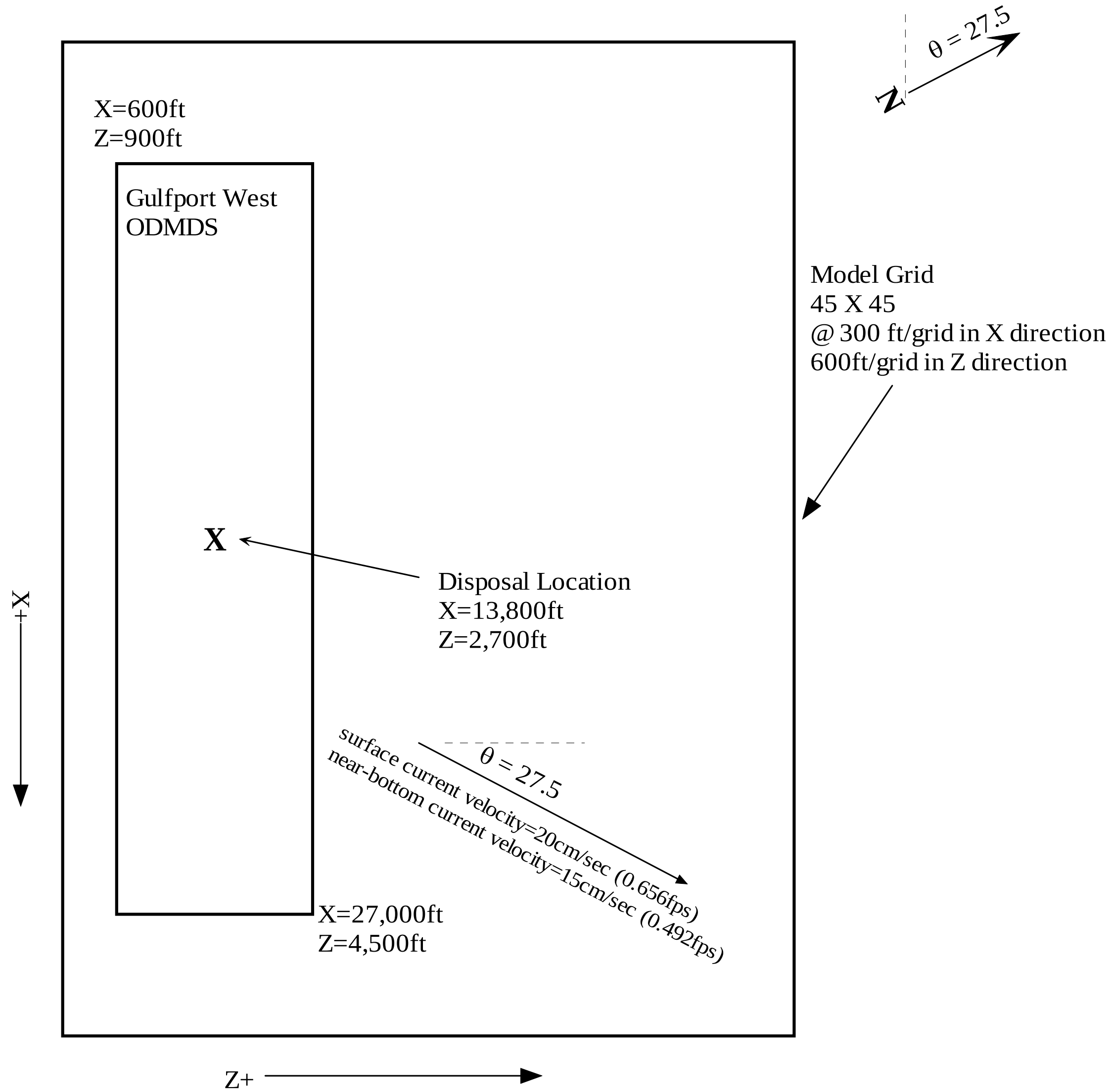
| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.001[1] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

[2] Represents center of disposal site. Dredged material requiring disposal in another location in order to meet the dilution criteria must be brought to the attention of EPA and USACE.

Typical dilution achieved after 4 hours = 1,200:1
Typical dilution achieved at all times outside disposal site = 170:1

# Gulfport West ODMDS STFATE Input Parameters



## WILMINGTON DISTRICT

Water Column Evaluations
Numerical Model (STFATE) Input Parameters
**New Wilmington ODMDS**

### SITE DESCRIPTION

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 700 | ft |
| Spacing Between Grid Points (top to bottom) | 700 | ft |
| Constant Water Depth | 45 | ft |
| Roughness Height at Bottom of Disposal Site | 0.005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 3 | |
| Ambient Density at Depth = 0 ft | 1.0241 | g/cc |
| Ambient Density at Depth = 22.5 ft | 1.0241 | g/cc |
| Ambient Density at Depth = 45 ft | 1.0248 | g/cc |

### AMBIENT VELOCITY DATA

| Parameter | Value | Units |
|---|---|---|
| Water Depth | 45 | ft |
| Profile | Logarithmic | |
| X-Direction Velocity | 0 | ft/sec |
| Z-Direction Velocity | 0.65 | ft/sec |

### DISPOSAL OPERATION DATA

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 15,750 | ft |
| Location of Disposal Point from Left Edge of Grid | 7,875 | ft |
| Dumping Over Depression | 0 | |

INPUT, EXECUTION AND OUTPUT

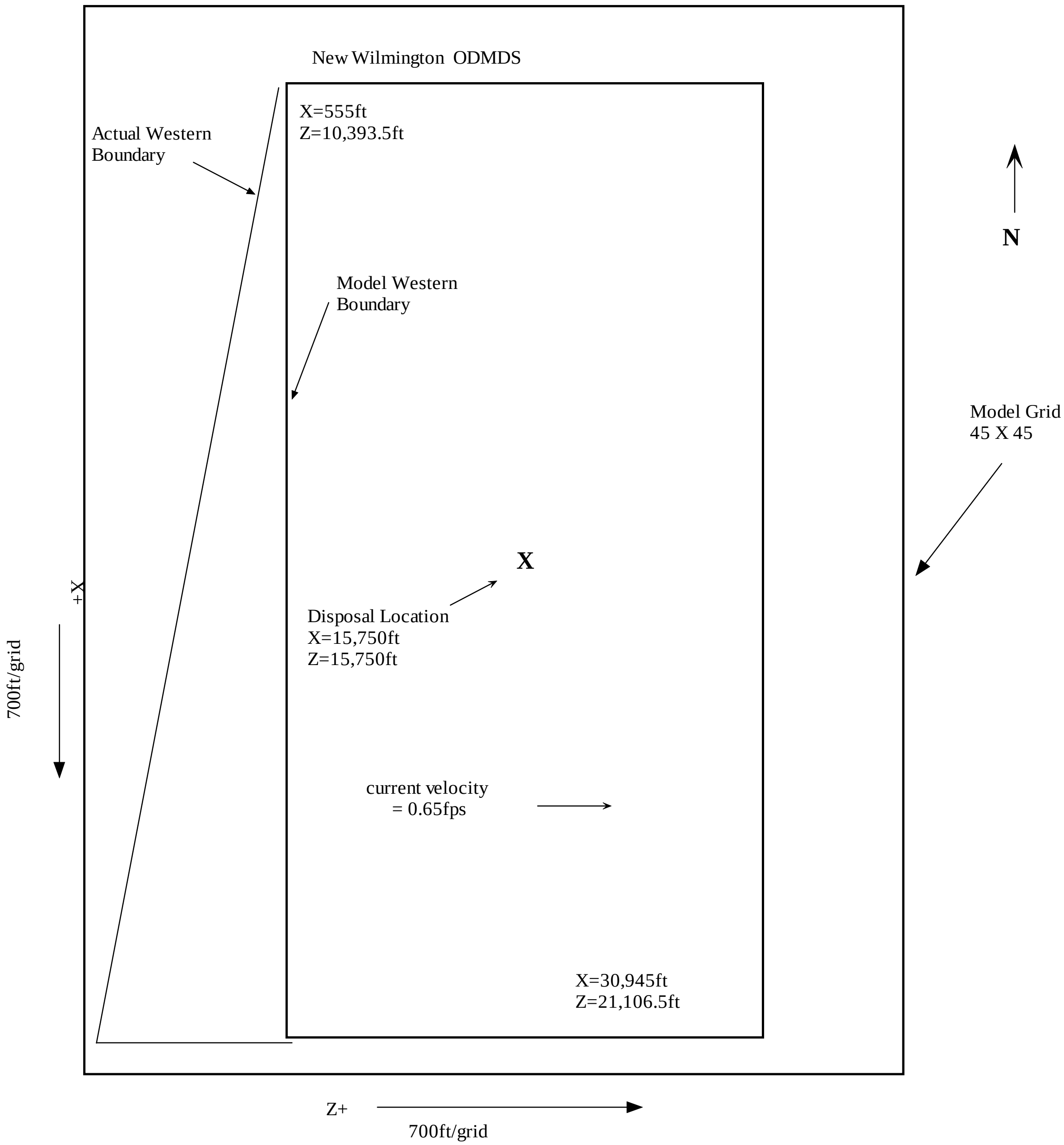
| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 555 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 10,393.5 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 30,945 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 21,106.5 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

COEFFICIENTS

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.0010[1] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1] Model default value

# New Wilmington ODMDS STFATE Input Parameters



## Morehead City ODMDS

### SITE DESCRIPTION

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 50 | |
| Number of Grid Points (top to bottom) | 50 | |
| Spacing Between Grid Points (left to right) | 250 | ft |
| Spacing Between Grid Points (top to bottom) | 250 | ft |
| Constant Water Depth | **52** | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 0 ft | **1.0325** | g/cc |
| Ambient Density at Depth = **52** ft | **1.0325** | g/cc |

### AMBIENT VELOCITY DATA

| Parameter | Value | Units |
|---|---|---|
| Velocity Profile | 2-Point at constant depth | |
| X-Direction Velocity (3 feet) | 0.29 | ft/sec |
| Z-Direction Velocity (3 feet) | 0 | ft/sec |
| X-Direction Velocity (31.2 ft.) | 0.11 | ft/sec |
| Z-Direction Velocity (31.2 ft) | 0 | ft/sec |

### DISPOSAL OPERATION DATA

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 5000 | ft |
| Location of Disposal Point from Left Edge of Grid | 5000 | ft |
| Dumping Over Depression | 0 | |

##### INPUT, EXECUTION AND OUTPUT

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 2000 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 2000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 8000 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 8000 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

##### COEFFICIENTS

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.0010 |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1]Model default value

[2]Calculated from NOAA field work at Fort Pierce (1994)

## SAVANNAH DISTRICT

Water Column Evaluations
Numerical Model (STFATE) Input Parameters
**Brunswick Harbor ODMDS**

[In development]

Water Column Evaluations
Numerical Model (STFATE) Input Parameters

## Savannah Harbor ODMDS

[In development]

## CHARLESTON DISTRICT

Water Column Evaluations
Numerical Model (STFATE) Input Parameters
**Port Royal ODMDS**

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 350 | ft |
| Spacing Between Grid Points (top to bottom) | 350 | ft |
| Constant Water Depth | 36 | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 0 ft | 1.0215 | g/cc |
| Ambient Density at Depth = 36 ft | 1.0220 | g/cc |

**AMBIENT VELOCITY DATA**

| Parameter | Value | Units |
|---|---|---|
| Water Depth | 36 | ft |
| Profile | Logarithmic | |
| Vertically Averaged X-Direction Velocity | 0.0 | ft/sec |
| Vertically Averaged Z-Direction Velocity | 0.33 | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 7,875 | ft |
| Location of Disposal Point from Left Edge of Grid | 7,875 | ft |
| Dumping Over Depression | 0 | |

##### INPUT, EXECUTION AND OUTPUT

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 1,800 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 1,800 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 13,950 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 13,950 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

##### COEFFICIENTS

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.0225[2] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1]Model default value

[2]Calculated from NOAA field work at Fort Pierce (1994)

Water Column Evaluations
Numerical Model (STFATE) Input Parameters
**Charleston ODMDS**

**SITE DESCRIPTION**

| Parameter | Value | Units |
|---|---|---|
| Number of Grid Points (left to right) | 45 | |
| Number of Grid Points (top to bottom) | 45 | |
| Spacing Between Grid Points (left to right) | 350 | ft |
| Spacing Between Grid Points (top to bottom) | 350 | ft |
| Constant Water Depth | **36** | ft |
| Roughness Height at Bottom of Disposal Site | .005[1] | ft |
| Slope of Bottom in X-Direction | 0 | deg. |
| Slope of Bottom in Z-Direction | 0 | deg. |
| Number of Points in Ambient Density Profile Point | 2 | |
| Ambient Density at Depth = 0 ft | **1.0215** | g/cc |
| Ambient Density at Depth = **36** ft | **1.0220** | g/cc |

**AMBIENT VELOCITY DATA**

| Parameter | Value | Units |
|---|---|---|
| Water Depth | **36** | ft |
| Profile | Logarithmic | |
| Vertically Averaged X-Direction Velocity | 0.0 | ft/sec |
| Vertically Averaged Z-Direction Velocity | 0.33 | ft/sec |

**DISPOSAL OPERATION DATA**

| Parameter | Value | Units |
|---|---|---|
| Location of Disposal Point from Top of Grid | 7,875 | ft |
| Location of Disposal Point from Left Edge of Grid | 7,875 | ft |
| Dumping Over Depression | 0 | |

**INPUT, EXECUTION AND OUTPUT**

| Parameter | Value | Units |
|---|---|---|
| Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge | 1,800 | ft |
| Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge | 1,800 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge | 13,950 | ft |
| Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge | 13,950 | ft |
| Duration of Simulation | 14,400 | sec |
| Long Term Time Step | 600 | sec |

**COEFFICIENTS**

| Parameter | Keyword | Value |
|---|---|---|
| Settling Coefficient | BETA | 0.000[1] |
| Apparent Mass Coefficient | CM | 1.000[1] |
| Drag Coefficient | CD | 0.500[1] |
| Form Drag for Collapsing Cloud | CDRAG | 1.000[1] |
| Skin Friction for Collapsing Cloud | CFRIC | 0.010[1] |
| Drag for an Ellipsoidal Wedge | CD3 | 0.100[1] |
| Drag for a Plate | CD4 | 1.000[1] |
| Friction Between Cloud and Bottom | FRICTN | 0.010[1] |
| 4/3 Law Horizontal Diffusion Dissipation Factor | ALAMDA | 0.0225[2] |
| Unstratified Water Vertical Diffusion Coefficient | AKYO | Pritchard Expression |
| Cloud/Ambient Density Gradient Ratio | GAMA | 0.250[1] |
| Turbulent Thermal Entrainment | ALPHAO | 0.235[1] |
| Entrainment in Collapse | ALPHAC | 0.100[1] |
| Stripping Factor | CSTRIP | 0.003[1] |

[1]Model default value
[2]Calculated from NOAA field work at Fort Pierce (1994)

Water Column Evaluations
Numerical Model (STFATE) Input Parameters

## Georgetown ODMDS

[In development]

# Appendix H

# BIOACCUMULATION REFERENCE TABLE

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# Appendix H

## BIOACCUMULATION REFERENCE TABLE

### Table 1. Bioaccumulation Reference Table*

| Compound | Steady State Factor (bivalve/ polychaete) (see Note 3) | FDA Limits | | Ecological Non-Specific Effects Threshold (see Note 1 below) | | EPA Region 4 Background Concentration (see Note 2 below): South Atlantic Bight Background Concentration | | North Gulf of Mexico Background Concentration | | Eastern Florida Background Concentration | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | bivalve | polychaete/ crustacea | bivalve | polychaete | bivalve | polychaete | bivalve | polychaete | bivalve | polychaete |
| **Metals** | | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Antimony | 1.0/1.0 | — | — | — | — | <0.16 | <0.22 | 0.22-0.47 | <0.31 | — | — |
| Arsenic | 1.0/1.0 | 86.0 | 76.0 | 12.6 | 12.6 | 4.4-8.6 | 6.2-46 | 3.4-5.4 | 7.4-37.0 | 2.9-4.4 | 11-47 |
| Beryllium | 1.0/1.0 | — | — | — | — | <0.19 | <0.22 | <0.14 | <0.09 | — | — |
| Cadmium | 1.0/1.0 | 3.0 | 4.0 | 1.0 | 27.8 | 0.68-2.7 | 0.26-1.8 | 0.15-0.83 | 0.34-1.4 | 0.90-2.0 | 1.0-1.20 |
| Chromium | 1.0/1.0 | 13.0 | 12.0 | 6.3 | 10.0 | 0.4-4.6 | 2.8-7.1 | 0.49-5.2 | 0.89-4.6 | 1.0-2.3 | 1.0-2.2 |
| Copper | 1.0/1.0 | — | — | 0.2 | 0.4 | 1.2-2.9 | 2.5-3.5 | 0.58-2.8 | 2.3-5.3 | 1.2-1.4 | 3.5-3.9 |
| Lead | 1.0/1.0 | 1.7 | 1.5 | 0.1 | 0.1 | 0.05-0.77 | 0.36-0.60 | <0.47 | 0.31-1.2 | 0.10-0.21 | 0.73-1.3 |
| Mercury | 1.0/1.0 | 1.0 | 1.0 | 0.3 | 0.3 | <0.02 | 0.02-0.05 | <0.028 | 0.03-0.04 | <0.04 | 0.02-0.05 |
| Nickel | 1.0/1.0 | 80.0 | 70.0 | 2.2 | 2.2 | 0.9-3.7 | 1.6-3.5 | 0.7-3.1 | 0.53-3.5 | 0.61-2.1 | 0.89-3.4 |
| Selenium | 1.0/1.0 | — | — | 14.2 | 14.2 | 0.70-1.4 | 1.2-1.9 | 0.5-1.5 | 0.61-0.99 | — | — |
| Silver | 1.0/1.0 | — | — | 1.0 | 1.0 | <0.96 | <0.95 | 0.11-0.56 | <0.15 | <0.24 | <0.25 |
| Thallium | 1.0/1.0 | — | — | 0.3 | 0.3 | <0.10 | <0.22 | <0.47 | <0.31 | — | — |
| Zinc | 1.0/1.0 | — | — | 11.6 | 0.3 | 10-20 | 20-27 | 7.0-30.0 | 14-16 | 7.4-15 | 18-23 |
| | | | | | | | | | | | |
| **Pesticides** | | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** |
| Aldrin | 2.7/2.7 | 300.0 | 300.0 | 560.0 | 160.0 | < 6.6 | <8.9 | <4.2 | <7.3 | <0.7 | <0.7 |
| Chlordane & Derivatives | 1.9/1.9 | 300.0 | 300.0 | 64.0 | 64.0 | <6.7 | <6.8 | <4.4 | <11.0 | <0.7 | <0.7 |
| Dieldrin | 1.7/1.7 | 300.0 | 300.0 | 15.2 | 4.4 | < 6.6 | <12 | <4.4 | <5.0 | <0.7 | <0.7 |
| 4,4'-DDT | 2.9/2.9 | 5000.0 | 5000.0 | 42.2 | 1.2 | <17 | <17 | <11.0 | <13.0 | <1.7 | <5.7 |
| 4,4' DDE | 2.4/2.4 | — | — | — | — | <6.7 | <6.8 | <4.4 | <5.0 | <0.7 | <0.7 |
| 4,4' DDD | 2.6/2.6 | — | — | — | — | <17 | <87 | <8.6 | <9.6 | <1.3 | <1.3 |

## Table 1. Bioaccumulation Reference Table* (continued)

| Compound | Steady State Factor (bivalve/ polychaete) (see Note 3) | FDA Limits | | Ecological Non-Specific Effects Threshold (see Note 1 below) | | EPA Region 4 Background Concentration (see Note 2 below): South Atlantic Bight Background Concentration | | North Gulf of Mexico Background Concentration | | Eastern Florida Background Concentration | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | bivalve | polychaete/ crustacea | bivalve | polychaete | bivalve | polychaete | bivalve | polychaete | bivalve | polychaete |
| Endosulfan & Derivatives | 1.0/1.0 | — | — | 2.9 | 2.9 | <17 | <17 | <24.0 | <27.6 | <2.0 | <2.0 |
| Endrin & Derivatives | 1.0/1.3 | — | — | 3.8 | 3.7 | <17 | <17 | <19.6 | <22.6 | <2.0 | <2.0 |
| Heptachlor | 1.0/1.0 | 300.0 | 300.0 | 11.5 | 11.5 | <8.0 | <49 | <3.3 | <3.7 | <0.5 | <0.5 |
| Heptachlor Epoxide | 1.0/1.0 | 300.0 | 300.0 | — | — | < 6.7 | < 6.6 | <4.4 | <5.0 | <0.7 | <0.7 |
| Hexachlorocyclohexane & Derivatives | 1.0/1.0 | — | — | 74.1 | — | < 29.1 | < 79.3 | — | — | — | — |
| Methoxychlor | 1.1/1.1 | — | — | 5.9 | 5.9 | <34 | <33 | <33 | <24 | <3.3 | <3.3 |
| Toxaphene | 1.0/1.0 | — | — | 2.7 | 2.7 | <670 | <660 | <650 | <500 | <67 | <67 |
| | | | | | | | | | | | |
| **PAHs** | | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** |
| Acenaphthene | 1.0/1.0 | — | — | 7.3 | 1.2 | <20 | <20 | <20 | <20 | <20 | <20 |
| Acenaphthylene | 1.0/1.0 | — | — | — | — | <20 | <20 | <20 | <20 | <20 | <20 |
| Anthracene | 1.0/1.0 | — | — | — | — | <20 | <20 | <20 | <20 | <20 | <20 |
| Benzo(a)Anthracene | 1.7/1.7 | — | — | — | — | <20 | <20 | <20 | <20 | <20 | <20 |
| Benzo(a)Pyrene | 2.1/2.1 | — | — | — | — | <20 | <20 | <20 | <20 | <20 | <20 |
| Benzo(g,h,i)Perylene | 2.9/2.9 | — | — | — | — | <20 | <20 | <20 | <20 | <20 | <20 |
| Benzo(k)Fluoranthene | 2.3/2.3 | — | — | — | — | <20 | <20 | 13.00 | 11.00 | <20 | <20 |
| Benzo(b)Fluoranthene | 2.3/2.3 | — | — | — | — | <20 | <20 | 11.00 | 16.00 | <20 | <20 |
| Chrysene | 1.4/1.4 | — | — | — | — | <20 | <20 | 10.00 | <20 | <20 | <20 |
| Dibenzo(a,h)Anthracene | 2.0/2.0 | — | — | — | — | <20 | <20 | 14.00 | <20 | <20 | <20 |
| Fluoranthene | 1.1/1.1 | — | — | 8.8 | 12.8 | <20 | <20 | <20 | <20 | <20 | <20 |
| Fluorene | 1.0/1.0 | — | — | — | — | <20 | <20 | <20 | <20 | <20 | <20 |
| Indeno(1,2,3,4,-c,-d)Pyrene | 3.0/3.0 | — | — | — | — | <20 | <20 | <20 | <20 | <20 | <20 |
| Pyrene | 1.1/1.1 | — | — | — | — | <20 | <20 | <20 | <20 | <20 | <20 |
| Methylnaphthalene | 1.0/1.0 | — | — | — | — | <20 | <20 | <20 | <20 | <20 | <20 |
| Naphthalene | 1.0/1.0 | — | — | — | — | <20 | <20 | <20 | <20 | <20 | <20 |
| Phenanthrene | 1.0/1.0 | — | — | — | — | <20 | <20 | <20 | 14-17 | <20 | <20 |

**Table 1. Bioaccumulation Reference Table*** (continued)

| | | | | | | EPA Region 4 Background Concentration (see Note 2) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Steady State Factor (bivalve/ polychaete) (see Note 3) | FDA Limits | | Ecological Non-Specific Effects Threshold (see Note 1) | | South Atlantic Bight Background Concentration | | North Gulf of Mexico Background Concentration | | Eastern Florida Background Concentration | |
| Compound | | bivalve | polychaete/ crustacea | bivalve | polychaete | bivalve | polychaete | bivalve | polychaete | bivalve | polychaete |
| LMWpah | — | — | — | — | — | 60 | 60 | 60.00 | 64-67 | 60.0 | 60.0 |
| HMWpah | — | — | — | — | — | 60 | 60 | 64.00 | 60.0 | 60.0 | 60.0 |
| Total PAHs | — | — | — | 40000.0 | 40000.0 | 170 | 170 | 178 | 181-184 | 170 | 170 |
| | | | | | | | | | | | |
| **PCBs** | | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** |
| Total Region 4 PCBs | 1.0/1.7 | 2000.0 | 2000.0 | 390.0 | 390.0 | 11.4-100.8 | 20.4-121 | 10.0-19.1 | 13.4-17.5 | 0.25-0.33 | 0.60 |
| | | | | | | | | | | | |
| **Organotins** | | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** |
| Monobutyltin | — | — | — | — | — | — | — | — | — | <1.0 | <1.3 |
| Dibutyltin | — | — | — | — | — | — | — | — | — | 0.5-0.6 | <1.3 |
| Tributyltin | 1.0/1.0 | — | — | 114.4 | 52.4 | — | — | — | — | <1.0 | <1.3 |
| Total (as Sn) | — | — | — | — | — | — | — | — | — | 0.8-0.9 | 0.6-1.0 |
| | | | | | | | | | | | |
| **Other Organics** | | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** | **(µg/kg)** |
| (3-and/or 4-)Methylphenol | — | — | — | — | — | <80 | <80 | — | — | — | — |
| 1,2,4-Trichlorobenzene | — | — | — | — | — | <160 | <160 | — | — | — | — |
| 2,4-Dimethylphenol | — | — | — | — | — | <20 | <20 | — | — | — | — |
| 2-Methylphenol | — | — | — | — | — | 64.70 | <40 | — | — | — | — |
| Benzyl Butyl Phthalate | — | — | — | — | — | 177.50 | <170 | — | — | — | — |
| bis(2-Ethylhexyl)Phthalate | 2.8/2.8 | — | — | 847.0 | — | <170 | <170 | — | — | — | — |
| Dibenzofuran | — | — | — | — | — | <170 | <170 | — | — | — | — |
| Diethyl Phthalate | 1.0/1.0 | — | — | — | — | <170 | <170 | — | — | — | — |
| Dimethyl Phthalate | — | — | — | — | — | <170 | <170 | — | — | — | — |
| Di-n-Butylphthalate | 1.0/1.0 | — | — | — | — | <170 | <170 | — | — | — | — |
| Di-n-Octylphthalate | 1.2/1.2 | — | — | — | — | <170 | <170 | — | — | — | — |
| Hexachlorobenzene | — | — | — | — | — | <170 | <170 | — | — | — | — |
| Hexachlorobutadiene | — | — | — | — | — | <170 | <170 | — | — | — | — |
| Hexachlorocyclopentadiene | — | — | — | — | — | <170 | <170 | — | — | — | — |
| Hexachloroethane | — | — | — | — | — | <170 | <170 | — | — | — | — |

## Table 1. Bioaccumulation Reference Table* (continued)

| Compound | Steady State Factor (bivalve/ polychaete) (see Note 3) | FDA Limits | | Ecological Non-Specific Effects Threshold (see Note 1) | | EPA Region 4 Background Concentration (see Note 2): South Atlantic Bight Background Concentration | | North Gulf of Mexico Background Concentration | | Eastern Florida Background Concentration | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | bivalve | polychaete/ crustacea | bivalve | polychaete | bivalve | polychaete | bivalve | polychaete | bivalve | polychaete |
| n-Nitrosodiphenylamine/ Diphenylamine | — | — | — | — | — | <170 | <170 | — | — | — | — |
| Phenol | 1.0/1.0 | — | — | — | — | 101.70 | <80 | — | — | — | — |
| Pentachlorophenol | 1.1/1.1 | — | — | 269.0 | 85.1 | <80 | <80 | — | — | — | — |
| | | | | | | | | | | | |
| **Dioxins** | | | | **(ng/kg)** | **(ng/kg)** | **(ng/kg)** | **(ng/kg)** | **(ng/kg)** | **(ng/kg)** | **(ng/kg)** | **(ng/kg)** |
| Dioxin/Furan TEQ | — | — | — | — | — | 0.32-0.36 | 0.18-0.44 | 0.16-0.19 | 0.31-0.63 | — | — |
| PCB TEQ | — | — | — | — | — | 2.00-2.23 | 2.57 | 1.97-5.62 | 2.39-3.00 | — | — |
| Total TEQ | — | — | — | — | — | 2.36-2.58 | 3.01 | 2.12-5.78 | 2.70-3.63 | — | — |

*All data are wet weights and represent steady state concentrations

—= No data available

**NOTE 1. Description of the Calculation of the Non-Specific Ecological Effects Thresholds**

The thresholds have been formulated to evaluate potential bioaccumulation-related adverse effects of dredged sediments proposed for disposal in offshore locations. The thresholds are tissue concentrations of given compounds that are not expected to have unacceptable effects in marine organisms. They have been calculated based on (1) Water Quality Criteria (WQC) for chronic effects in saltwater organisms and (2) the potential of the given compounds to accumulate in tissues of marine organisms once equilibrium is established between the concentration of the compound in water and the concentration of the compound in given species' tissues. Ambient WQC for chronic effects on saltwater organisms are concentrations in water that are not expected to lead to adverse effects with long-term exposure. Most values are based on water concentrations with no adverse chronic effects on 95% of saltwater organisms. However, criteria occasionally are set lower based on FDA Action Limits (for safe concentrations in species consumed by humans), accumulated tissue concentrations associated with adverse effects, or because of potential effects on species of commercial or recreational value. The criteria have been developed by EPA since the 1970s, but are not available for all compounds of concern in the Ocean Dumping Program. Where a criterion was not available, but an indication was given of concentrations relevant to chronic effects, this value was used instead.

Bioconcentration and bioaccumulation factors were also taken primarily from the Ambient Water Quality Criteria documents, although others were also obtained from EPA document #823-R-00-002. Most studies included in these documents were subject to requirements for demonstration of steady-state equilibrium, or else noted exposure durations. A Bioconcentration Factor (BCF) is a ratio of the concentration of a given compound in water to the concentration of the compound in an organism's tissues. These are typically derived in laboratory studies in which water is the only possible exposure medium (i.e., sediment and food are absent). Bioaccumulation Factors (BAFs) are similar, but do account for exposure via food and sediment. These are typically derived from field exposures and are more indicative of true bioaccumulation potential if derived appropriately, but few such values were available. BCFs are used here with sediment exposures (1) because organisms in the Ocean Dumping Program's 28-day tests are not generally provided food, (2) because of the lack of BAFs, and (3) to allow calculations with WQC. Both BCFs and BAFs are chemical- and species-specific.

Multiplying the WQC by the BCF gives a steady-state (equilibrium) estimate of the chemical concentration a species would eventually accumulate in its tissues if it were exposed to the chemical at the saltwater chronic WQC concentration. The chronic WQC concentrations are designed as maximum allowable concentrations that would not result in adverse chronic effects in most marine species. Thus, it is expected that tissue concentrations resulting from bioaccumulation in an organism exposed to the chronic WQC concentration would not have adverse effects in most marine species. Calculations are shown in Table 2, below.

**NOTE 2. Region 4 Background Concentrations**

It is often useful to compare tissue concentrations from bioaccumulation studies to background tissue concentrations from organisms collected in the vicinity of the proposed disposal site (see Section 6.3 of the Green Book). When bioaccumulation in organisms exposed to project dredged material is not greater than tissue concentrations in organisms from the vicinity of the disposal site (the background levels), it means that placement of the material would not result in bioaccumulation above existing ambient levels in the general area and thus does not have a potential to cause undesirable effects. When bioaccumulation in organisms exposed to project dredged materials is greater than these levels, it may or may not be predictive of adverse effects (e.g., it may reflect extremely low “background” levels).

During the period from 2002 until 2007, EPA Region 4 conducted field surveys to collect bivalves and polychaetes from coastal waters of the southeastern U.S. Organisms were collected along the South Atlantic Bight (northeast Florida to southern North Carolina), the northern Gulf of Mexico (Pensacola, Florida to Gulfport, Mississippi) and east Florida (Cape Canaveral, Florida to Fort Pierce, Florida). Organisms were collected using a dredge (e.g., Fall River dredge, clam dredge) in water depths of approximately 20 meters. Tissue samples were analyzed by the EPA Region 4 Science and Ecosystem Support Division laboratory. Less-than values indicate that the analyte was not detected below the stated concentration. Other concentrations represent the high-end or range of background concentration detected. Total PCBs were calculated using the method described in Chapter 7 of this Southeast Regional Implementation Manual. Many of the congeners were not detected.

**NOTE 3. Steady State Factors**

In some cases, contaminant concentrations are not expected to reach steady-state within the 28-day exposure duration of a standard bioaccumulation test. Steady-state factors represent the factor that must be applied (multiplied) to the 28-day bioaccumulation tissue concentration to estimate the contaminant concentration that would be reached if sufficient exposure time was allowed to the tissue concentrations to reach steady-state (i.e., the bioaccumulation levels that could be expected to occur in the field after disposal). Various studies have developed methods for calculating what proportion of the steady-state tissue concentration is expected at 28 days. These are based on $K_{ow}$, a value representing how a given chemical will partition between water and lipid in an organism. All concentrations in this table represent steady-state values.

## Table 2: Tissue Threshold Calculations Based on Water Quality Criteria

| Compound | Saltwater Chronic Water Quality Criterion (µg/L) | BCF (bivalve/ polychaete) | Tissue Conc. (mg/kg) (bivalve/ polychaete) | Remarks |
|---|---|---|---|---|
| Arsenic | 36 | 350/350 | 12.6/12.6 | Ambient concentration is based on arsenic (III); BCF is based on the eastern oyster (*Crassostrea virginica*) |
| Cadmium | 8.8 | 113/3160 | 1.0/27.8 | BCFs are based on blue mussel (*Mytilus edulis*) and polychaete (*Ophryotrocha diadema*) |
| Chromium | 50 | 125/200 | 6.3/10.0 | Ambient concentration is based on chromium (VI) since it is substantially more toxic than chromium (III); BCFs are based on eastern oyster (*Crassostrea virginica)* and polychaete ( *Neanthes arenaceodentata)* |
| Copper | 1.9[1] | 88/203 | 0.2/0.4 | BCFs are based on quahog clam (*Mercenaria mercenaria*) and polychaete (*Nereis diversicolor)* |
| Lead | 5.6 | 17.5/17.5 | 0.1/0.1 | BCFs are based on quahog clam (*Mercenaria mercenaria*) |
| Mercury | 0.025[2] | 10000/10000 | 0.3/0.3 | BCFs are based on eastern oyster (*Crassostrea virginica)* |
| Nickel | 8.3 | 262/262 | 2.2/2.2 | BCFs are based on eastern oyster (*Crassostrea virginica)* |
| Selenium | 71 | 200/200 | 14.2/14.2 | BCFs are based on euphausiid (adult) Meganyctiphanes |
| Silver | 0.92[3] | 1056/1056 | 1.0/1.0 | BCFs are based on blue mussel (*Mytilus edulis)* |
| Thallium | 31 | 11/11 | 0.3/0.3 | BCFs are based on blue mussel (*Mytilus edulis)* |
| Zinc | 86 | 135/3.7 | 11.6/0.3 | BCFs are based on soft shell clam (*Mya arenaria)* and shrimp (*Pandalus montagui)* |
| Aldrin | 0.07[4] | 8000/2300 | 0.56/0.16 | BCF estimate is based on dieldrin since aldrin rapidly transforms to dieldrin in the environment; BCF is based on eastern oyster (*Crassostrea virginica)* and marine fish, spot (*Leiostomus xanthurus*) |
| Chlordane & Derivatives | 0.004[2] | 6600/6600 | 0.026/0.026 | BCF is based on sheepshead minnow (*Cyprinodon variegatus*) |
| Dieldrin | 0.0019[2] | 8000/2300 | 0.015/0.004 | BCF is based on eastern oyster (*Crassostrea virginica)* and marine fish, spot (*Leiostomus xanthurus*) |

## Table 2: Tissue Threshold Calculations Based on Water Quality Criteria (continued)

| Compound | Saltwater Chronic Water Quality Criterion (µg/L) | BCF (bivalve/ polychaete) | Tissue Conc. (mg/kg) (bivalve/ polychaete) | Remarks |
|---|---|---|---|---|
| DDT | 0.001[2] | 42400/1200 | 0.042/0.001 | BCF is based on eastern oyster (*Crassostrea virginica)* and pink shrimp (*Penaeus duorarum*) |
| Endosulfans | 0.0087[2] | 328/328 | 0.003/0.003 | BCF is based on sheepshead minnow |
| Endrin | 0.0023[2] | 1670/1600 | 0.004/0.004 | BCF is based on eastern oyster (*Crassostrea virginica)* and grass shrimp (*Palaemonetes pugio*) |
| Heptachlor | 0.0036[2] | 3181/3181 | 0.01/0.01 | BCF is based on marine fish, spot (*Leiostomus xanthurus*) |
| Methoxychlor | 0.013[5] | 450/450 | 0.006/0.006 | BCFs are based on quahog clam (*Mercenaria mercenaria*) |
| Toxaphene | 0.0002[2] | 13350/13350 | 0.003/0.003 | BCF is based on eastern oyster (*Crassostrea virginica)* |
| Acenaphthene | 20 | 0.36/0.06 | 0.007/0.001 | BCFs are based on quahog clam (*Mercenaria mercenaria*) and cunner (*Tautogolabrus adspersus*) |
| Fluoranthene | 16 | 0.55/0.80 | 0.009/0.013 | BCFs are based on clam (*Macoma nasuta*) and sand worm (*Nereis virens*) |
| TBT | 0.0074 | 114.4/52.39 | 0.001/0.0004 | BCF are based on eastern oyster (*Crassostrea virginica)* and polychaete (*Nereis diversicolor*) |
| Pentachlorophenol | 7.9 | 34/11 | 0.269/0.087 | BCF is based on eastern oyster (*Crassostrea virginica)* and sheepshead minnow (*Cyprinodon variegatus*) |
| Total PCBs | 0.03 | 13000/1300 | 0.39/0.39 | BCF is based on eastern oyster (*Crassostrea virginica)* |

1 From draft WQC issued for review and comment in 2003
2 Based on more protective Final Residual Value
3 From 1987 Draft WQC. No saltwater chronic value is listed for silver in the 1980 WQC.
4 Acute WQC was reduced by 20 to estimate chronic value
5 0.01*LC50

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# Appendix I

# SAMPLING AND ANALYSIS PLAN / QUALITY ASSURANCE PROJECT PLAN (SAP/QAPP) GUIDANCE AND EXAMPLE ON FORMAT AND CONTENT

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# Sampling and Analysis Plan (SAP) [Quality Assurance Project Plan (QAPP)] Guidance on Format and Content

## INSTRUCTIONS

The SAP is equivalent to the draft QAPP and will be used in the development of the testing contract scope of work (SOW). The draft QAPP (or SAP) should be coordinated with EPA prior to initiation of the SOW. A final QAPP also should be coordinated with EPA prior to initiation of sampling. This document contains the key elements you will need for your SAP/QAPP and is designed for you to begin adding your own project-specific information. Bear in mind that you will have "gaps" for information that is not known or available at the time the draft is submitted and which will be added upon finalization of the document.

NOTE: Begin creating your actual project-specific SAP/QAPP using EPA's *Guidance for Quality Assurance Project Plans* (G-5) for guidance on format and content. Remember: Too much information is better than too little, and repetition will likely make the review process more efficient than having the reviewers constantly refer back to previous entries. The blue explanatory text boxes in the template can (and should) remain in-place for all versions. It is recommended that you use the existing formatting and fonts whenever possible. However, you may adjust them if necessary to fit tables and figures.

Have the following publications readily available while you are preparing your Sampling and Analysis Plan/Quality Assurance Project Plan (QAPP):

a. USEPA and USACE. 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual* (**Green Book**). EPA-503/8-91-001. February 1991. http://www.epa.gov/owow/oceans/gbook/gbook.pdf

b. USEPA and USACE. 2008. *Southeast Regional Implementation Manual (SERIM) - Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coast Waters* (**SERIM**). U.S. Environmental Protection Agency Region 4 and U.S. Army Corps of Engineers, South Atlantic Division, Atlanta, GA. http://www.epa.gov/region4/water/oceans/documents/Regional_Implementation_Manual.pdf

c. USEPA. 1995. *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations – Chemical Evaluations*. EPA-823-B 95 001. http://www.epa.gov/waterscience/library/sediment/evaluationguide.pdf

d. USEPA. 2001. *Requirements for Quality Assurance Project Plans* (QA/R-5) (PDF 120KB) - March 2001, EPA/240/B-01/003. These specifications are equivalent to Chapter 5 of EPA Manual 5360. http://www.epa.gov/quality/qs-docs/r5-final.pdf

e. USEPA. 2001. *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual.* EPA 823-B-01-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC. http://www.epa.gov/waterscience/cs/collectionmanual.pdf

f. USEPA. 2002. *Guidance for Quality Assurance Project Plans* (G-5) [G-5 publication] (PDF 401KB) - December 2002, EPA/240/R-02/009. (Note: This document replaces EPA/600/R-98/018 issued in February 1998.) http://www.epa.gov/quality/qs-docs/g5-final.pdf

# GROUP A. PROJECT MANAGEMENT

## 1.0 ELEMENT A1 - TITLE AND APPROVAL SHEET

For instructions on preparing the title and approval sheets, see *Guidance for Quality Assurance Project Plans* (G-5), Section 2.1.1 and *Requirements for Quality Assurance Project Plans* (QA/R-5), Section 3.2.1.

**Title: {ADD YOUR PROJECT'S FULL TITLE HERE}**

**Organization/Applicant: U.S. Army Corps of Engineers (USACE), Wilmington District**

Technical Manager:

Signature:______________________________ Date:______________________

QA Manager (if applicable):

Signature:______________________________ Date:______________________

**Regulatory Agency: USEPA Region 4**

Project Manager:

Signature:______________________________ Date:______________________

QA Manager:

Signature:______________________________ Date:______________________

**Regulatory Agency: USACE District Regulatory Division (where applicable)**

Regulatory Project Manager:

Signature:______________________________ Date:______________________

Sediment Testing Specialist:

Signature:______________________________ Date:______________________

QA Manager:

Signature:______________________________ Date:______________________

***Contractor 1:***

*Project Manager:*

*Signature:*______________________________ *Date:*______________________

*QA Officer:*

Signature:______________________________ Date:______________________

{if necessary, add more contacts and signatures in accordance with your SAP/QAPP}

## 2.0 ELEMENT A2 - TABLE OF CONTENTS

For guidance on preparing a Table of Contents, see *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.2 and *Requirements for Quality Assurance Project Plans* (QA/R-5) Section 3.2.2. A document control format or component is not required.

**This Table of Contents is a "field" that will self-update when you right click in it and choose "Update Field."** (If you have added/deleted numbered headings, update the entire table and not just the page numbers.)

**TABLE OF CONTENTS**

**Attachments**

## 3.0 ELEMENT A3 - DISTRIBUTION LIST

For help preparing a distribution list, see *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.3 and *Requirements for Quality Assurance Project Plans* (QA/R-5) Section 3.2.3.

This document is to be distributed to the following individuals for review and approval prior to commencement of sampling activities:

1. USACE Technical Manager:
2. USACE QA/QC Manager:
3. USEPA Project Manager:
4. USEPA QA/QC Manager:
5. Contractor Project Manager:
6. Contractor QA/QC Manager:

## 4.0 ELEMENT A4 - PROJECT/TASK ORGANIZATION

Provide the information as described in *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.4 and *Requirements for Quality Assurance Project Plans* (QA/R-5) Section 3.2.4.

{Begin adding your project-specific information here.}

### 4.1 List of Acronyms

A list and definitions of all acronyms used in the SAP should be provided in the document.

{Begin adding your project-specific information here.}

### 4.2 Dredging Project Proponent

Be sure to identify the applicant(s), including name, address, phone, fax, and email address. If Civil Works or O&M project, include the Project Manager or O&M contact.

**Applicant:**

**Regulatory:**

## 4.3 Dredging Project Team and Responsibilities

This section should give the names, affiliations, address, phone, fax, and e-mail address and a list of responsibilities of the principle contact(s) responsible for the following elements of the proposed testing program:

- Dredging project planning and coordination
- Field sample collection and transport, including chain of custody
- Sample holding and archiving
- Laboratory preparation and analysis for physical, chemical, and bioassay testing. Contacts should be given for all laboratories involved in sediment testing.
- Quality Assurance (QA) management
- Final data reporting

**Organization:**
Project Manager:
Address:
Phone:
Fax:
email:
Responsibilities:

**EPA Project Manager:**
Address:
Phone:
Fax:
email:
Responsibilities:

**Contractor 1:**
Project Manager:
Address:
Phone:
Fax:
email:
Responsibilities:

**Subcontractor 1:**
Project Manager
Address:
Phone:
Fax:
email:
Responsibilities:

**Chemistry Laboratory 1:**
Project Manager
Address:
Phone:
Fax:
email:
Responsibilities:

**Chemistry Laboratory 2:**
Project Manager
Address:
Phone:
Fax:
email:
Responsibilities:

**Toxicology Laboratory 1:**
Project Manager
Address:
Phone:
Fax:
email:
Responsibilities:

**Geotechnical Laboratory:**
Project Manager
Address:
Phone:
Fax:
email:
Responsibilities:

## PROJECT ORGANIZATION CHART

{Insert your project's organizational chart here (change the page orientation if you need to)}

## 5.0 ELEMENT A5 - PROBLEM DEFINITION/BACKGROUND

This section should provide sufficient project background as described in *EPA Guidance for Quality Assurance Project Plans* (G-5) and *EPA Requirements for Quality Assurance Project Plans* (QA/R-5).

{Begin adding your project-specific information here.}

### 5.1 Background/Site History

This section should provide the background behind the dredging project (purpose and need) and summarize all available site use, dredging and testing information that could have a bearing on sampling or testing decisions for the proposed dredging project. It is suggested that the following information from at least the **last three** dredging episodes be provided (if available):

- Date and location of dredging, volume removed, general characteristics of the dredged material (sand vs. silt/clay) and disposal site used.
- Summary of past testing results (physical, chemical, and biological) and associated suitability determinations. It would be helpful to include figures of the area dredged, sampling locations and summary data tables from earlier reports.
- Summary of testing results from adjacent or nearby areas, if available. These data, obtained from other dredging projects or monitoring programs, are particularly useful for dredging projects with little or no previous dredged material testing information.
- Identification and description of site-specific and nearby land- and water-based activities that may affect sediment quality in the proposed dredging area (e.g., fuel docks, outfalls, industrial uses).

{Begin adding your project-specific information here.}

### 5.2 Identification of Principal Data Users and Decision Makers

This section should identify the regulating agencies and other data users (e.g., USACE, EPA, state and local governments).

| Agency-Organization | Location | Area(s) of Responsibility |
|---|---|---|
| | | |
| | | |

{Add rows as necessary}

## 6.0 ELEMENT A6 - DREDGING PROJECT/TASK DESCRIPTION

{Begin adding your project-specific information here.}

### 6.1 Purpose/Background

#### 6.1.1 General Background

This section should provide a comprehensive description of the proposed dredging project including the following information:

- Location (city and county) of the dredging project (include the vicinity and dredging site maps with scale)
- Type of facility involved (e.g., oil refinery, recreational harbor, dry dock, military terminal, etc.)
- Type of activity supported by dredging project (e.g., navigation channel, recreational harbor, military, etc.)
- Purpose of the proposed dredging (e.g., maintenance dredging of berths or channels, channel or berth deepening, etc.)
- The area(s), depth(s), overdredge depth(s), and estimated in-place volume of dredged material associated with the proposed dredging project. Indicate whether side slopes and overdredge are included in the volume calculations and the acreage of the dredging project based on the top of the side slope.
- Existing/pre-dredging conditions and depth(s). This may be accomplished by cross referencing the bathymetric data required by Section 10.4 of this appendix.
- Physical characteristics of the dredged material (if known).
- The proposed dredging method (e.g., clam shell, hydraulic, hopper).

{Begin adding your project-specific information here.}

### 6.1.2 Permitting

This section should indicate whether the proposed dredging will require a MPRSA 103 permit or whether it is a Civil Works project. For permitted projects, this section should indicate whether the proposed dredging is for a new permit or an extension or re-issuance of an existing permit. For projects where permits have been in place, include a discussion of any special permit conditions or related actions that may have bearing on SAP/QAPP approval. This section should also briefly summarize the status of any applications for the proposed dredging project. This information should include, but is not limited to, the following items. A table may be useful in presenting this information.

- Date of MPRSA 103 application to CE District
- Date of Public Notice if already issued
- Proposed date of Public Notice if not already issued
- Existing and previous permit numbers associated with dredging projects in the area (include all permits, not just MPRSA 103). For each permit, indicate agency, issuance and expiration dates, permitted volume(s), and any limitations.

{Begin adding your project-specific information here.}

## 6.2 Description of the Sampling and Analysis

### 6.2.1. Measurements That Are Expected During the Course of the Sediment Sampling

This section should cite the list of physical properties, chemicals of concern, and bioassay tests to be undertaken. Also, identify the methods and reporting limits that will be used in making these measurements. The use of tables is strongly recommended. This section should be consistent with Section 13.3.

{Begin adding your project-specific information here.}

### 6.2.2. Applicable Technical Quality Standards or Criteria

This section should address any relevant State Water Quality Standards or Federal Water Quality Criteria, if applicable.

{Begin adding your project-specific information here.}

### 6.2.3. Special Personnel or Equipment Requirements That May Indicate the Complexity of the Dredging Project

Indicate "Not Applicable" if there are no personnel or equipment needs beyond those required for normal sampling and testing for a dredging project. Examples may include drill rigs for land-based sampling.

{Begin adding your project-specific information here.}

### 6.2.4. Assessment Techniques Needed for the Dredging Project

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.6. Use of cross-reference to Section 20 of this SAP would be appropriate.

{Begin adding your project-specific information here.}

### 6.2.5. Schedule for the Work Performed

This section should give an estimated schedule for the testing program including:

- Commencement of field sampling
- Completion of field sampling
- Completion of chemical and physical testing
- Completion of biological testing
- Delivery of final testing report
- Expected or proposed dredging and disposal timeframes (i.e., include consideration of any relevant dredging or disposal timing restrictions).

{Begin adding your project-specific information here.}

### 6.2.6. Dredging Project and Quality Records Required, Including the Types of Reports Needed

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.6. Use of cross-reference to Section 20 of this SAP would be appropriate.

{Begin adding your project-specific information here.}

## 7.0 ELEMENT A7 - QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.7 and *Requirements for Quality Assurance Project Plans* (QA/R-5) Section 3.1.7. Appendix D of *Guidance for Quality Assurance Project Plans* (G-5) has a good discussion of the difference between Data Quality Objectives (DQO) and Data Quality Indicators (DQI).

{Begin adding your project-specific information here.}

## 8.0 ELEMENT A8 - SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

Applicants and consultants may use this section to document any state, local government, or project-specific training or certification requirements such as laboratory certification. Indicate "Not Applicable" if there are no personnel training or certification requirements beyond those required for normal sampling and testing for a dredging project. (Refer to *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.8.)

{Begin adding your project-specific information here.}

## 9.0 ELEMENT A9 - DOCUMENTATION AND RECORDS

Refer to *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.9.

{Begin adding your project-specific information here.}

### 9.1 Reporting of Results

{Begin adding your project-specific information here.}

### 9.2 Report Format

This section should indicate the format for the final reporting of data (e.g., hard copy, electronic) and the software that will be used for data files and test documents. [See SERIM Appendix C.]

{Begin adding your project-specific information here.}

### Data Reporting Package Archiving and Retrieval

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.9 and *Requirements for Quality Assurance Project Plans* (QA/R-5).

{Begin adding your project-specific information here.}

# GROUP B. PROJECT MANAGEMENT

## 10.0 ELEMENT B1 - SAMPLING PROCESS DESIGN

| |
|---|
| Refer to *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.1. |

{Begin adding your project-specific information here.}

### 10.1 Scheduled Dredging Project Activities, Including Measurement Activities

| |
|---|
| Describe schedule of proposed sampling relative to dredging schedule. This is especially important for projects involving routine maintenance. |

{Begin adding your project-specific information here.}

### 10.2 Rationale for the Design

{Begin adding your project-specific information here.}

## 10.3 Design Assumptions

| |
|---|
| Be sure to address contingency plans to account for changes or modifications to the proposed sampling plan. |

{Begin adding your project-specific information here.}

## 10.4 Procedures for Locating and Selecting Environmental Samples

This section should provide all information describing and justifying the proposed location, depth, and compositing plan for each sediment sample. The text of this section should provide a brief explanation of and justification for the proposed sampling locations representative of the material within each dredging unit to be dredged (e.g., based on grid, shoaling patterns, pollution sources, or ship interference or movement) and compositing (e.g., based on location, geological, or physical/chemical considerations). Sampling depths should be equal to the proposed dredging depth (authorized depth and advance maintenance), full overdredge depth, and expected sediment disturbance depth (see SERIM Section 4.5). A pre-sampling hydrographic survey should be taken prior to SAP submission to get the best possible bathymetric data for volume estimates and sample positioning. The following information should be superimposed on or included with the survey map(s).

- Date when the hydrographic survey was conducted
- Scale
- Proposed Dredging Units
- Proposed sediment sampling locations and composite boundaries if applicable
- Proposed dredging site water sample location
- Large scale features (e.g., piers, berthing areas, boat ramps)
- Dredging project boundaries (include boundaries delineating different project depths)
- Contour lines depicting areas that will actually be dredged (i.e., showing areas that are less than project depth, and that are less than the proposed overdepth).
- Potential sources of sediment contamination (e.g., fuel docks and storage facilities, culverts/outfalls, dry docks, RCRA/Superfund sites).

It is suggested that the following information be presented in tabular form:

- Nomenclature planned to identify field and laboratory samples/composites: To facilitate review of analytical and QA documentation, cross reference all proposed sample identification numbers to a unified system. Field sampling identification should correspond to sites indicated on the survey map and core logs.
- Compositing Plan: Rationale for the proposed compositing. Address why sediment throughout the area or layer to be composted is expected to be relatively homogeneous physically and chemically (refer to past test results for the area, if available).
- Dredging Volume: Estimate of the in-place volume of material to be dredged (including the full overdepth, even if this differs from the pay-depth in a dredging contract) that is represented by each station, sample and composite.
- Sampling Depths: Include the proposed depth of each core sample. Depths should be equal to the proposed dredging depth plus the full overdredge depth.
- Sample Analysis: Identify which tests will be run on core samples or composites of samples (e.g., physical tests, chemical tests, water column toxicity tests, benthic toxicity tests, or bioaccumulation tests).
- Field Parameters: Describe how samples will be evaluated in the field. Field staff members typically make observations of visible layers in the core samples, odor, color, consistency, and texture of the sediment. Measurements are also frequently collected in the field (e.g., temperature, salinity, etc. of the water column, tidal state, etc.)

{Begin adding your project-specific information here.}

The following section should provide information on the reference site(s) and control site(s) that will be used for comparison with sediments from the proposed dredging location(s). Reference sediment must be collected from the approved reference location associated with the proposed disposal site. The following information should be provided for the reference samples:

- Map identifying reference site locations with coordinates
- Number of samples making up reference composite.

{Begin adding your project-specific information here.}

### 10.5 Classification of Measurements as Critical or Noncritical

{Begin adding your project-specific information here.}

### 10.6 Validation of Any Nonstandard Methods

Any method modification must be fully documented.

{Begin adding your project-specific information here.}

## 11.0 ELEMENT B2 – SAMPLING AND METHODS REQUIREMENTS

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.2.

{Begin adding your project-specific information here.}

### 11.1 Describe the Sample Collection, Preparation, and Decontamination Procedures

This section of the SAP should provide a full and detailed description of the procedures for water, sediment, and tissue sample collection; equipment decontamination; sample logging; sample packaging; and storage. This section should include discussion of the following elements:

- Proposed field sampling schedule.
- Proposed field sampling procedures/equipment (e.g., coring device) and rationale, sample containers (e.g., type of buckets, glass jars), and storage equipment (e.g., cooler).
- Proposed navigation and positioning methods.

{Begin adding your project-specific information here.}

### 11.2 Identify Support Facilities for Sampling Methods

This should include a brief description of the equipment and vessel (s) used in the sampling operation.

{Begin adding your project-specific information here.}

### 11.3 Describe Sampling/Measurement System Failure Response and Corrective Action Process

{Begin adding your project-specific information here.}

### 11.4 Describe Sampling Equipment, Sample Preservation, and Holding Times

{Begin adding your project-specific information here.}

## 12.0 ELEMENT B3 – SAMPLE HANDLING AND CUSTODY REQUIREMENTS

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.3. This section should include discussions of the following elements:

- Proposed sample preservation, transport and chain-of-custody procedures.
- Proposed sample storage and archiving procedures (e.g., temperatures and holding times, cross referencing is encouraged).

{Begin adding your project-specific information here.}

## 13.0 ELEMENT B4 – ANALYTICAL METHODS REQUIREMENTS

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.2.

Element B4 encompasses the information indicated in Sections 13.1 through 13.3, below.

### 13.1 Subsampling

{Begin adding your project-specific information here.}

### 13.2 Preparation of the Samples

This information may be combined in a table with the requirement of 13.3, below.

{Begin adding your project-specific information here.}

### 13.3 Analytical Methods

This information may be combined in a table with the requirement of 13.2. Laboratories are allowed to use professional judgment in modifying and developing alternatives to approved test methods to take advantage of emerging technologies that reduce costs, overcome analytical difficulties, and enhance data quality. A necessary condition of method flexibility is the requirement that modified method produce results equivalent or superior to results produced by the approved reference method. The flexibility to select more appropriate methods provides an opportunity to use new technologies to overcome matrix interference problems, lower detection limits, improve laboratory productivity, or reduce the amount of hazardous wastes in the laboratory.

{Begin adding your project-specific information here.}

#### 13.3.1 Physical and Chemical Analysis

This section should present the following information in tabular format:

- Characteristics to be measured (e.g., conventional physical measurements, metals, PAHs, polychlorinated biphenyls, organotins, and pesticides),
- Proposed preparation/extraction and cleanup methods,
- Proposed analytical methods,
- Target Detection Limits (TDL) of elutriate, sediment (dry weight basis) and tissue (wet weight basis). TDLs should meet those specified in the SERIM Tables 5-3 to 5-7, 5-9 to 5-11, and 6-4 to 6-8.

Discussion of the proposed methods should be included to clarify any study-specific or lab-specific modifications or additions, or to justify substantive deviations from the methods in Tables 5-2 to 5-11 and 6-4 to 6-8 of the SERIM.

{Begin adding your project-specific information here.}

### 13.3.2 Biological Analysis

{Begin adding your project-specific information here.}

[1]In some circumstances, EPA/USACE may agree to review draft data in order to expedite tiered testing (e.g., to decide on an appropriate compositing scheme, whether addition bioaccumulation testing is necessary, or a reduced list of analytes for bioaccumulation analysis). Any SAP proposing review of draft data should provide a full justification for the request being made.

**Bioassay Protocols**

Generally, the SAP should reference recommended protocols for conducting bioassays (e.g., ASTM or EPA standard methods). The following project-specific information should be included, as well as discussion of any proposed deviations from or clarifications of the recommended protocols:

- Species proposed for use and rationale for their selection (e.g., seasonal availability, substrate preference/tolerances), if necessary,
- Source of test organisms, and collection and handling procedure (including acclimation procedures),
- Control sediment source,
- Reference sediment source,
- Number of laboratory replicates proposed,
- Reference toxicant(s),
- Performance standards for control and reference samples,
- Performance standards for reference toxicant testing (e.g., laboratory mean and standard deviation on LC50/EC50 data for each species proposed for testing),
- Water quality parameters (e.g., salinity, temperature, pH, ammonia, and dissolved oxygen) to be measured in overlying water/elutriate, including measurement procedures and frequency,
- Proposed bioassay sediment interstitial water monitoring parameters (e.g., salinity, pH, ammonia, and sulfides), including measurement procedures and frequency. This should include any procedures for compensating for elevated interstitial concentrations.

{Begin adding your project-specific information here.}

## 14.0 ELEMENT B5 - QUALITY CONTROL REQUIREMENTS

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.5.

Field and laboratory QC procedures should follow recommended minimum laboratory QC outline in the SERIM, as well as standard industry practices for environmental samples. All QC in a cited method must be performed. This section should reference the guidance used or discuss the following QC components as they relate to the proposed sampling and analysis:

- Field cross-contamination and filter blanks
- Method blanks
- Duplicates (reported as relative standard deviation)
- Ongoing Precision and Recovery (OPR) [sometimes referred to as a laboratory control samples, quality control check sample, laboratory-fortified blank, or blank spike]
- Matrix spikes
- Spike duplicates
- Surrogate spikes
- QC batch size

{Begin adding your project-specific information here.}

## 15.0 ELEMENT B6 – INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

| |
|---|
| See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.6. |

{Begin adding your project-specific information here.}

## 16.0 ELEMENT B7 – INSTRUMENT CALIBRATION AND FREQUENCY

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.7.

{Begin adding your project-specific information here.}

## 17.0 ELEMENT B8 – INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

| |
|---|
| See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.8. |

{Begin adding your project-specific information here.}

## 18.0 ELEMENT B9 – DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.9.

{Begin adding your project-specific information here.}

## 19.0 ELEMENT B10 – DATA MANAGEMENT, INTERPRETATION, AND REDUCTION

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.10.

{Begin adding your project-specific information here.}

### 19.1 Data Management

{Begin adding your project-specific information here.}

### 19.2 Data Interpretation and Reduction

{Begin adding your project-specific information here.}

# GROUP C. ASSESSMENT AND OVERSIGHT

## 20.0 ELEMENT C1 – ASSESSMENTS AND RESPONSE ACTIONS

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.3.1.

{Begin adding your project-specific information here.}

## 21.0 ELEMENT C2 – REPORTS TO MANAGEMENT

| |
|---|
| See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.3.2. |

{Begin adding your project-specific information here.}

# GROUP D. DATA VALIDATION AND USABILITY

## 22.0 ELEMENT D1 – DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

| |
|---|
| See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.4.1. |

{Begin adding your project-specific information here.}

## 23.0 ELEMENT D2 – VALIDATION AND VERIFICATIONS METHODS

| |
|---|
| See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.4.2. |

{Begin adding your project-specific information here.}

## 24.0 ELEMENT D3 – RECONCILIATION WITH DATA QUALITY OBJECTIVES

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.4.3.

{Begin adding your project-specific information here.}

## 25.0 REFERENCES

| List the references you used to compile your QAPP. |
|---|

{Begin adding your project-specific information here.}

# EXAMPLE OF A COMPLETED SAP / QAPP

The following document is an EXAMPLE of a completed SAP/QAPP for a project sponsored by the U.S. Army Corps of Engineers, Wilmington District. It is provided as a guide for you to refer to so you can see the extent of information you will need to provide for YOUR project-specific SAP/QAPP.

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# Sampling and Analysis Plan (SAP) [Quality Assurance Project Plan (QAPP)] Guidance on Format and Content

## INSTRUCTIONS

The SAP is equivalent to the draft QAPP and will be used in the development of the testing contract scope of work (SOW). The draft QAPP (or SAP) should be coordinated with EPA prior to initiation of the SOW. A final QAPP also should be coordinated with EPA prior to initiation of sampling. This document is an example of a completed SAP/QAPP. Information that is needed in the draft QAPP (or SAP) is identified in this example with black text. Information that is not yet determined at the time the draft is submitted and which will be added upon finalization of the QAPP is identified in this example with *green italicized text* to make it stand out whether printed or viewed in color or in black and white (do not confuse with document titles, also in italics).

NOTE: Begin creating your actual project-specific SAP/QAPP using EPA's *Guidance for Quality Assurance Project Plans* (G-5) for guidance on format and content. Remember: Too much information is better than too little, and repetition will likely make the review process more efficient than having the reviewers constantly refer back to previous entries. The blue explanatory text boxes in the template can (and should) remain in-place for all versions.

Have the following publications readily available while you are preparing your Sampling and Analysis Plan/Quality Assurance Project Plan (QAPP):

a. USEPA and USACE. 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual* (**Green Book**). EPA-503/8-91-001. February 1991. http://www.epa.gov/owow/oceans/gbook/gbook.pdf

b. USEPA and USACE. 2008. *Regional Implementation Manual - Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coast Waters* (**SERIM**). U.S. Environmental Protection Agency Region 4 and U.S. Army Corps of Engineers, South Atlantic Division, Atlanta, GA. http://www.epa.gov/region4/water/oceans/documents/Regional_Implementation_Manual.pdf

c. USEPA. 1995. *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations – Chemical Evaluations*. EPA-823-B 95 001. http://www.epa.gov/waterscience/library/sediment/evaluationguide.pdf

d. USEPA. 2001. *Requirements for Quality Assurance Project Plans* (QA/R-5) (PDF 120KB) - March 2001, EPA/240/B-01/003. These specifications are equivalent to Chapter 5 of EPA Manual 5360. http://www.epa.gov/quality/qs-docs/r5-final.pdf

e. USEPA. 2001. *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual.* EPA 823-B-01-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC. http://www.epa.gov/waterscience/cs/collectionmanual.pdf

f. USEPA. 2002. *Guidance for Quality Assurance Project Plans* (G-5) [G-5 publication] (PDF 401KB) - December 2002, EPA/240/R-02/009. (Note: This document replaces EPA/600/R-98/018 issued in February 1998.) http://www.epa.gov/quality/qs-docs/g5-final.pdf

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# GROUP A. PROJECT MANAGEMENT

## 1.0 ELEMENT A1 - TITLE AND APPROVAL SHEET

For instructions on preparing the title and approval sheets, see *Guidance for Quality Assurance Project Plans* (G-5), Section 2.1.1 and *Requirements for Quality Assurance Project Plans* (QA/R-5), Section 3.2.1.

**Title: EVALUATION OF DREDGED MATERIAL PROPOSED FOR OCEAN DISPOSAL: RELOCATED TURNING BASIN, NORTHEAST CAPE FEAR RIVER, WILMINGTON, NORTH CAROLINA**

**Organization/Applicant: U.S. Army Corps of Engineers (USACE), Wilmington District**

Technical Manager: Phil Wolf

Signature:________________________________________ Date:______________________________

QA Manager (if applicable): Phil Payonk

Signature:________________________________________ Date:______________________________

**Regulatory Agency: USEPA Region 4**

Project Manager: Gary Collins

Signature:________________________________________ Date:______________________________

QA Manager: William Bokey

Signature:________________________________________ Date:______________________________

**Regulatory Agency: USACE District Regulatory Division (where applicable)**

Regulatory Project Manager: N/A

Signature:________________________________________ Date:______________________________

Sediment Testing Specialist:

Signature:________________________________________ Date:______________________________

QA Manager:

Signature:________________________________________ Date:______________________________

**Contractor 1:** *ANAMAR Environmental Consulting, Inc.*

Project Manager: *Nadia Lombardero*

Signature:_______________________________________________ Date:________________________

QA Officer: *Paul Berman*

Signature:________________________________________ Date:______________________________

## 2.0 ELEMENT A2 - TABLE OF CONTENTS

For guidance on preparing a Table of Contents, see *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.2 and *Requirements for Quality Assurance Project Plans* (QA/R-5) Section 3.2.2. A document control format or component is not required.

**This Table of Contents is a "field" that will self-update when you right click in it and choose "Update Field."** (If you have added/deleted numbered headings, update the entire table and not just the page numbers.)

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## Attachments

## 3.0 ELEMENT A3 - DISTRIBUTION LIST

For help preparing a distribution list, see *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.3 and *Requirements for Quality Assurance Project Plans* (QA/R-5) Section 3.2.3.

This document is to be distributed to the following individuals for review and approval prior to commencement of sampling activities:

1. USACE Technical Manager: Phil Wolf
2. USACE QA/QC Manager: Phil Payonk
3. USEPA Project Manager: Gary Collins
4. USEPA QA/QC Manager: William Bokey
5. Contractor Project Manager: *Nadia Lombardero*
6. Contractor QA/QC Manager: *Paul Berman*

## 4.0 ELEMENT A4 - PROJECT/TASK ORGANIZATION

Provide the information as described in *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.4 and *Requirements for Quality Assurance Project Plans* (QA/R-5) Section 3.2.4.

Element A4 encompasses the information indicated in Sections 4.1 through 4.3, below.

### 4.1 List of Acronyms

A list and definitions of all acronyms used in the SAP should be provided in the document.

| | |
|---|---|
| ASTM | ASTM International (formerly American Society for Testing and Materials) |
| APP | Accident Prevention Plan |
| CCC | Criteria Continuous Concentration |
| CMC | Criterion Maximum Concentration |
| COC | Contaminant(s) of Concern |
| CQAR | Chemical Quality Assurance Report |
| CY | Cubic Yards |
| DQCR | Daily Quality Control Report |
| DQI | Data Quality Indicators |
| DQO | Data Quality Objectives |
| DU | Dredging Unit |
| EDD | Electronic Data Deliverable |
| EPA (USEPA) | U.S. Environmental Protection Agency |
| FDA (USFDA) | Food and Drug Administration |
| HSP | Health and Safety Plan |
| ITM | Inland Testing Manual (EPA, 1998) |
| LPC | Limiting Permissible Concentration |
| LRL | Laboratory Reporting Limit |
| LIMS | Laboratory Information Management System |
| MDL | Method Detection Limit |
| MLLW | Mean Lower Low Water |
| MLW | Mean Low Water |
| MRL | Method Reporting Limit |
| MPRSA | Marine Protection, Research, and Sanctuaries Act of 1972 |
| NECFR | Northeast Cape Fear River |
| NELAC | National Environmental Laboratory Association Conference |
| NOAA | National Oceanic and Atmospheric Administration |
| O&M | Operation and Maintenance |
| ODMDS | Ocean Dredged Material Disposal Site |

| | |
|---|---|
| PAH | Polynuclear Aromatic Hydrocarbons |
| PCB | Polychlorinated Biphenyl |
| QA/QC | Quality Assurance/Quality Control |
| QAM | Quality Assurance Manual |
| QAP | Quality Assurance Plan |
| QAPP | Quality Assurance Project Plan |
| SAD | South Atlantic Division (USACE) |
| SAP | Sampling and Analysis Plan |
| SERIM | Southeast Regional Implementation Manual |
| TB | Turning Basin |
| TDL | Target Detection Limit |
| TBD | To Be Determined |
| USACE | U.S. Army Corps of Engineers |

## 4.2 Dredging Project Proponent

Be sure to identify the applicant(s), including name, address, phone, fax, and email address. If Civil Works or O&M project, include the Project Manager or O&M contact.

**Applicant:** US Army Corps of Engineers (USACE) - Wilmington District

**Regulatory:** USEPA Region 4

See below for contact information.

## 4.3 Dredging Project Team and Responsibilities

This section should give the names, affiliations, address, phone, fax, and e-mail address and a list of responsibilities of the principle contact(s) responsible for the following elements of the proposed testing program:

- Dredging project planning and coordination
- Field sample collection and transport, including chain of custody
- Sample holding and archiving
- Laboratory preparation and analysis for physical, chemical, and bioassay testing. Contacts should be given for all laboratories involved in sediment testing.
- Quality Assurance (QA) management
- Final data reporting

**Organization:** US Army Corps of Engineers, Wilmington District
Project Manager: Phil Wolf
USACE, Charleston District:
69A Hagood Ave.
Charleston, SC 29403
Phone: (843) 329-8069
Fax: (843) 329-2331
email: Philip.M.Wolf@sac.usace.army.mil
Responsibilities: Design, permit, construct, and maintain the relocated NECFR turning basin

**EPA Project Manager:** Gary Collins
Coastal Section
61 Forsyth Street, SW
Atlanta, GA 30303
Phone: (404) 562-9395
Fax: (404) 562-9343
email: collins.garyw@epa.gov
Responsibilities: Give concurrence to environmental requirements of dredged sediment for approval for offshore disposal per the Green Book (USEPA 1991), SERIM (USEPA/USACE 1993), and the ITM (USEPA 1998)

**Contractor 1:** *ANAMAR Environmental Consulting, Inc.*
Project Manager: *Nadia Lombardero*
*2106 NW 67th Place, Suite 5*
*Phone: (352) 377-5770*
*Fax: (352) 378-7620*
*email: nlombardero@anamarinc.com*
Responsibilities: Field logistics planning, sample collection and transport, chains of custody, quality assurance management, final data reporting

**Subcontractor 1:** *University of North Carolina Wilmington*
*Project Manager: Captain Jerry Compeau*
*5600 Marvin K. Moss Lane*
*Wilmington, N.C. 28409*
*Phone: (910) 962-2301*
*Fax: N/A*
*email: compeaug@uncw.edu*
*Responsibilities: Vessel support for field collections*

**Chemistry Laboratory 1:** *Columbia Analytical Services, Inc.*
*Project Manager: Jeff Christian*
*1317 S. 13th Avenue*
*Kelso WA, 98626*
*Phone: (360) 501-3316*
*Fax: (360) 636-1068*
*email: jchristian@kelso.caslab.com*
*Responsibilities: Sample holding and archiving, laboratory preparation and analysis for sediment, elutriate, and tissues.*

**Chemistry Laboratory 2:** *Columbia Analytical Services, Inc*
*Project Manager: Sam (Xiang Qiu) Liang*
*10655 Richmond Ave., Ste. 130A*
*Houston, TX 77042*
*Phone: (713) 266-1599*
*Fax: (713) 266-0130*
*email: XLiang@houston.caslab.com*
*Responsibilities: Sample holding and archiving, laboratory preparation and analysis for sediment dioxin analyses.*

**Toxicology Laboratory 1:** *Weston Solutions Inc.*
*Project Manager: David Moore*
*2433 Impala Drive*
*Carlsbad, CA 92009*
*Phone: (760) 931-8081*
*Fax: (760) 931-1580*
*email: David.Moore@WestonSolutions.com*
*Responsibilities: Sample holding and archiving, laboratory preparation and analysis for Suspended Phase, Solid Phase, and Bioaccumulation Potential analyses.*

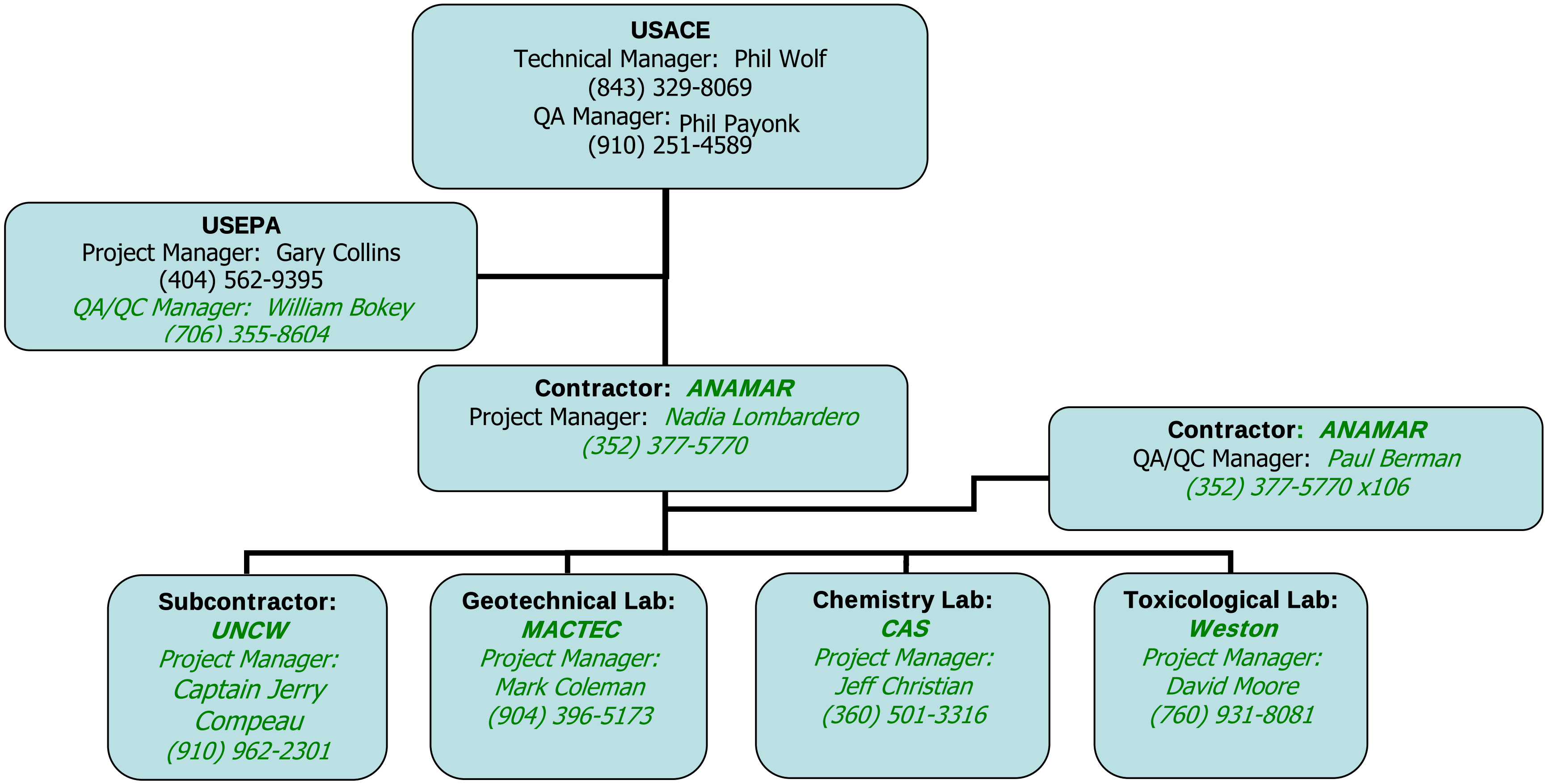
**Geotechnical Laboratory:** *MACTEC*

*Project Manager: Mark Coleman*
*3901 Carmichael Avenue*
*Jacksonville, FL 32207*
*Phone: (904) 396-5173*
*Fax: (904) 396-5703*
*email: MAColeman@mactec.com*
*Responsibilities: Sample holding and archiving, laboratory preparation and analysis for physical analyses.*

*The successful completion of this project relies on open lines of communication between the client, contractor, regulatory agencies, laboratories, and subcontractors. This communication and successful completion of the project is ANAMAR's utmost goal. Contact information will be readily available throughout the life of this project, from pre-planning to field work, data analysis, data reduction, and reporting. Any questions, clarifications, suggestions, and/or problems will be addressed in a timely manner.*

*See Project Organization Chart on next page.*

## PROJECT ORGANIZATION CHART



## 5.0 ELEMENT A5 - PROBLEM DEFINITION/BACKGROUND

> This section should provide sufficient project background as described in *EPA Guidance for Quality Assurance Project Plans* (G-5) and *EPA Requirements for Quality Assurance Project Plans* (QA/R-5).

Element A5 encompasses the information indicated in Sections 5.1 and 5.2, below.

### 5.1 Background/Site History

> This section should provide the background behind the dredging project (purpose and need) and summarize all available site use, dredging and testing information that could have a bearing on sampling or testing decisions for the proposed dredging project. It is suggested that the following information from at least the **last three** dredging episodes be provided (if available):
>
> - Date and location of dredging, volume removed, general characteristics of the dredged material (sand vs. silt/clay) and disposal site used.
> - Summary of past testing results (physical, chemical, and biological) and associated suitability determinations. It would be helpful to include figures of the area dredged, sampling locations and summary data tables from earlier reports.
> - Summary of testing results from adjacent or nearby areas, if available. These data, obtained from other dredging projects or monitoring programs, are particularly useful for dredging projects with little or no previous dredged material testing information.
> - Identification and description of site-specific and nearby land- and water-based activities that may affect sediment quality in the proposed dredging area (e.g., fuel docks, outfalls, industrial uses).

Information in this section is from the report *Wilmington Harbor Cape Fear River, NC General Re-evaluation Report (GRR), Alternative Formulation Briefing Preconference Materials, July 2007.* See Attachment 1.

This project requires the relocation of a ship turning basin in the Northeast Cape Fear River (NECFR). Existing conditions require that ships docking above the Isabelle Holmes Bridge must back through one or two bridges on the return route downstream. For navigation safety and operability, a turning basin needs to be established above the Hilton Railroad Bridge to allow ships to return downstream bow-first.

The relocation of the turning basin is part of the deepening project that has been previously tested.

This is new-work requiring the area to be excavated; therefore, no previous sediment, elutriate, or toxicological testing has been done on the proposed dredge material. Numerous studies have been performed in the past along the Cape Fear and the Northeast Cape Fear Rivers. Historically, dredged material from the rivers has been disposed of either offshore in the

Wilmington ODMDS or the New Wilmington ODMDS, or in disposal islands located adjacent to the Cape Fear River and/or the Northeast Cape Fear River.

**No Action**. The No Action alternative would maintain the existing ship turning basin at Almont. Ships would continue to be required to back through the Hilton Railroad and Isabelle Holmes Bridges stern-first. Turning would continue to pose hazards to yacht moorings in the vicinity.

**Relocation of Ship Turning Basin in Northeast Cape Fear River.** The Almont turning basin has been the only turning basin available in the NECF 32-foot authorized project. As the deepening studies progressed, discussions began with the river pilots regarding alternative locations for turning basins.

The preferred choice by the pilots was based upon their current needs in the river. The Chemserve terminal became the preferred location for a turning basin since it has the highest current use. Four alternatives emerged, all of which would serve the needs of the pilots. All alternatives would have construction methods of some combination of rock blasting, mechanical excavating, and cutter/suction hydraulic dredging.

Upon getting input from local river pilots and the users of the turning basin, Alternative 2(A) was determined to be the best and most effective alternative.

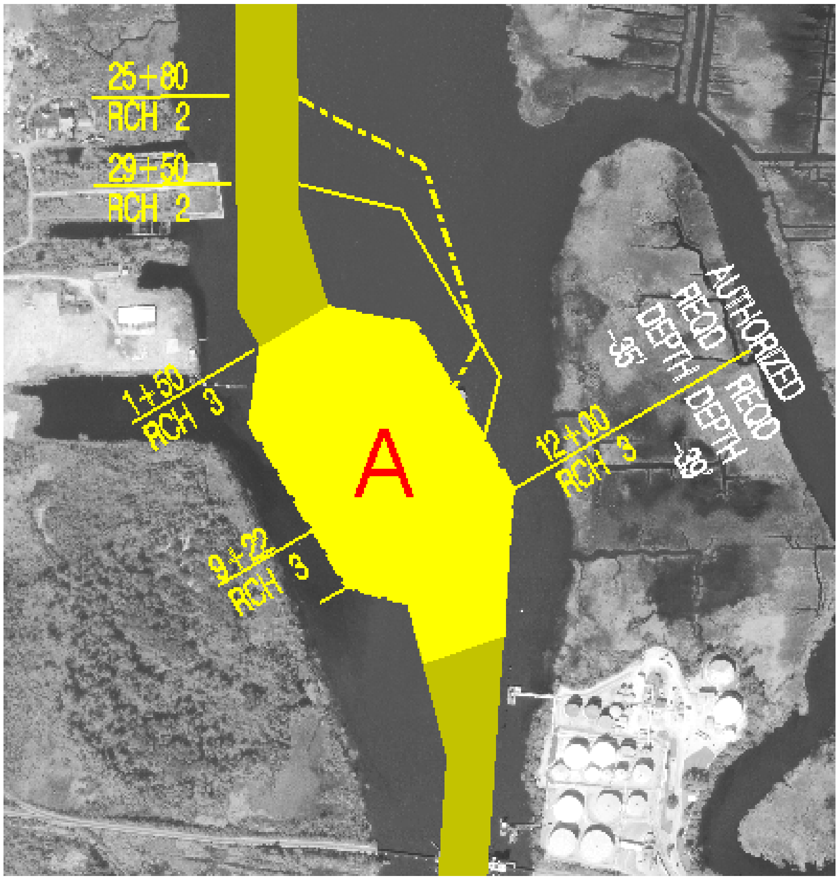
### Alternative Options for Relocation of Turning Basin

### Alternative 1: Enlarging of turning basin at upper terminus. NOT SELECTED

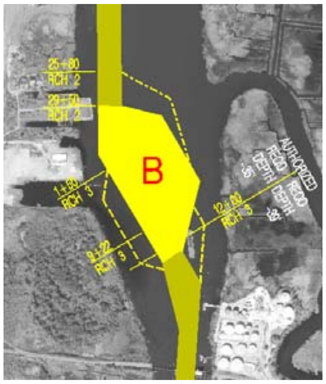
**Alternative 2(A): Creation of middle turning basin A, south.**

**THIS IS THE ALTERNATIVE BEING CONSIDERED FOR THIS SAP/QAPP**

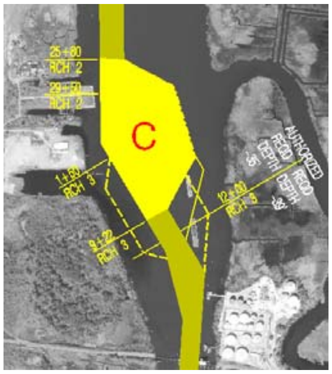
The entire turning basin and channel are to be deepened to -39 feet (+2 paid overdredege). Currently, the channel is maintained at -32 feet. Please note that the map below is to show the general configuration of the turning basin and is not for planning; specifically, the "REQD DEPTH" listed on this map is not factual for this project.




**Alternative 3(B): Creation of middle turning basin B, middle. NOT SELECTED**



### Alternative 4(C): creation of middle turning basin C, north. NOT SELECTED




### Previous Studies and Projects

U.S. Army Corps of Engineers, Wilmington District, *Final Feasibility Report and Environmental Impact Statement on Improvement of Navigation, Cape Fear – Northeast Cape Fear Rivers Comprehensive Study*, Wilmington, North Carolina, June 1996. This report was prepared in final response to a resolution adopted 8 September 1988 by the United States House of Representatives, which directed that the existing Federal project for Wilmington Harbor be reviewed and improvements considered. Recommendations included improvements to Wilmington Harbor by deepening the channels from the Atlantic Ocean to Wilmington from 38 feet to 42 feet; deepening the 25-foot channel in the up-river portion of the harbor to 34 feet, and widening the channel from 200 feet to 250 feet; and enlarging two anchorage/turning basins.

US Army Corps of Engineers, Wilmington District, *Environmental Assessment, Preconstruction Modifications of Authorized Improvements, Wilmington Harbor, North Carolina*, February 2000. This environmental assessment addressed preconstruction modifications to harbor improvements including Ocean Bar Channel realignment, beach placement of dredged sand, rock blasting without air curtains, and a comprehensive dredging and disposal plan.

Wilmington Harbor and the Cape Fear and Northeast Cape Fear Rivers are periodically maintenance dredged with the material being placed either in the Wilmington ODMDS, the New Wilmington ODMDS, or in a disposal island adjacent to the Cape Fear River. Each past dredging project has gone through the appropriate environmental review process with supporting documentation and studies.

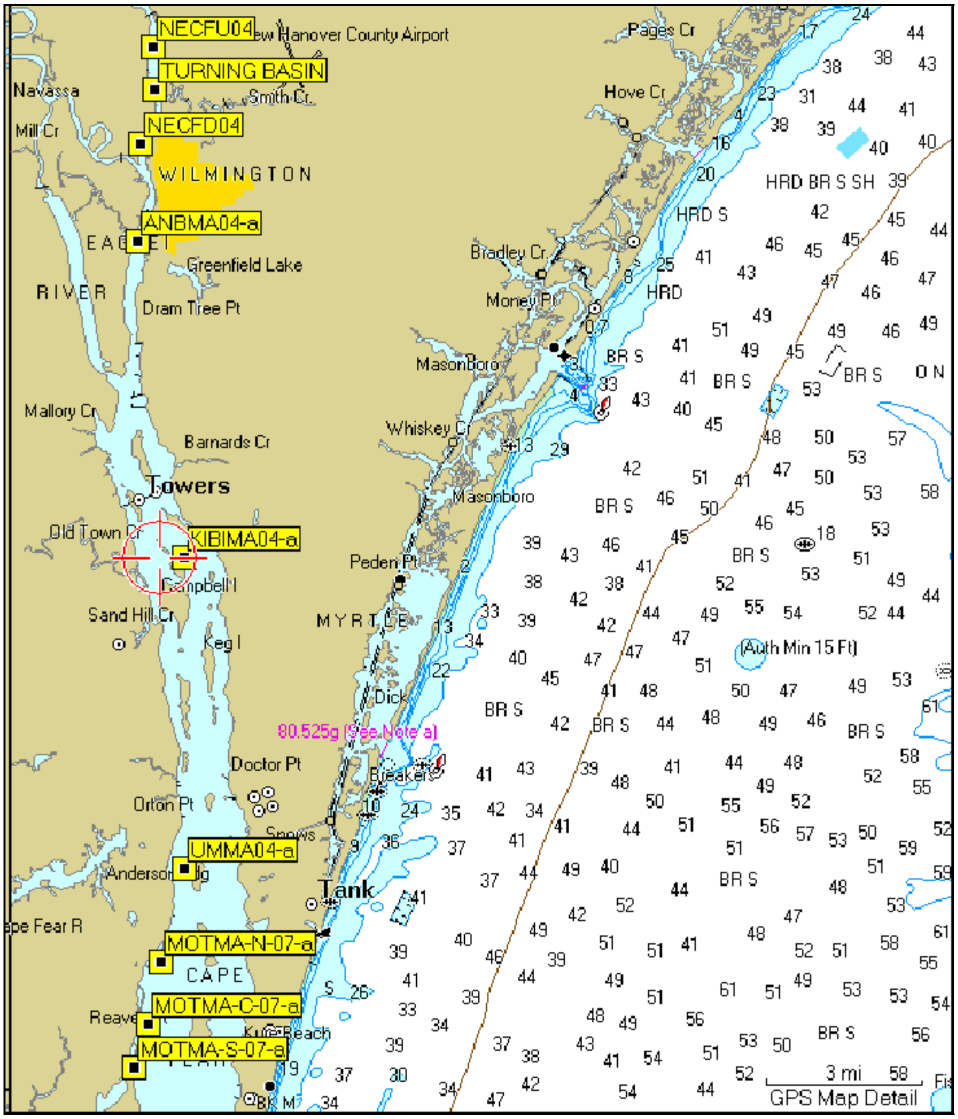
Alternative 1 in Section 5.1, enlarging of turning basin at upper terminus, has been approved for ocean disposal; it was included in a sampling event for maintenance/deepening of Wilmington Harbor. Sampling and testing took place in 2004.

This is new-work requiring the area to be excavated, therefore no previous sediment, elutriate, or toxicological testing has been done on the proposed dredge material.

The last dredging event in the area was performed in October 2005. It is believed that Chemserve, a company that has a facility in the immediate area has actually dredged the

Federal Channel themselves more recently. This is being confirmed and will be updated in the Final SAP/QAP.

Recent studies have been performed in adjacent areas of the Cape Fear and Northeast Cape Fear Rivers in conjunction with the maintenance dredging and deepening projects.




Even though this exact area has not been tested, results from previous studies in the region showed no significant mortality of bioassay or bioaccumulation organisms and no significantly elevated sediment or elutriate results. The most recent 103 sediment evaluation was performed in 2004, and complete results are documented in the report *Evaluation of Dredged Material Proposed for Ocean Disposal: Wilmington Harbor, Wilmington, North Carolina* (ANAMAR 2005). Core samples were taken approximately 0.6 miles upstream and 1 mile downstream of the proposed turning basin (Samples NECFU04 and NECFD04 on map above). Core logs and grain size data of these two samples are located in Attachment 3. This report was submitted to USACE-Wilmington District and concurrence was given by USEPA Region 4.

## 5.2 Identification of Principal Data Users and Decision Makers

This section should identify the regulating agencies and other data users (e.g., USACE, EPA, state and local governments).

| Agency-Organization | Location | Area(s) of Responsibility |
|---|---|---|
| USACE | Wilmington, NC | Design, permit, construct, and maintain the relocated NECFR turning basin, and manage the New Wilmington ODMDS |
| USEPA | Region 4, Atlanta, GA | Give concurrence to environmental requirements of dredged sediment for approval for offshore disposal per the Green Book (USEPA 1991), SERIM (USEPA/USACE 1993), and the ITM (USEPA 1998), and manage the New Wilmington ODMDS |

## 6.0 ELEMENT A6 - DREDGING PROJECT/TASK DESCRIPTION

Element A6 encompasses the information indicated in Sections 6.1 and 6.2, below.

### 6.1 Purpose/Background

#### 6.1.1 General Background

This section should provide a comprehensive description of the proposed dredging project including the following information:

- Location (city and county) of the dredging project (include the vicinity and dredging site maps with scale)
- Type of facility involved (e.g., oil refinery, recreational harbor, dry dock, military terminal, etc.)
- Type of activity supported by dredging project (e.g., navigation channel, recreational harbor, military, etc.)
- Purpose of the proposed dredging (e.g., maintenance dredging of berths or channels, channel or berth deepening, etc.)
- The area(s), depth(s), overdredge depth(s), and estimated in-place volume of dredged material associated with the proposed dredging project. Indicate whether side slopes and overdredge are included in the volume calculations and the acreage of the dredging project based on the top of the side slope.
- Existing/pre-dredging conditions and depth(s). This may be accomplished by cross referencing the bathymetric data required by Section 10.4 of this appendix.
- Physical characteristics of the dredged material (if known).
- The proposed dredging method (e.g., clam shell, hydraulic, hopper).
- Proposed dredged material disposal site and disposal zone if appropriate.

Information in this section is taken from the report *Wilmington Harbor Cape Fear River, NC General Re-evaluation Report (GPR), Alternative Formulation Briefing Preconference Materials, July 2007.* See Attachment 1.

**Creation of Turning Basin**

The purpose of this project is to determine if the sediment proposed to be dredged from the relocated NECFR turning basin is acceptable for disposal in the New Wilmington ODMDS. The turning basin will be located just north of Chemserve in Reach 3 – this is the southernmost of the three options in this area. This has been described as the “pilots preferred alternative” because of its proximity to the Chemserve terminal and its functional geometry relating to adjacent reaches. The turning basin at Reach 7 (Almont) and at Reach 2 (Southern States) will be abandoned upon completion of construction.

Refer to the maps in Attachment 2.

Assumptions:
For the purposes of quantity estimates shown below, the NECFR project is complete with -35' required (-37' allowable) in the channel only from Reach 3, station 12+00, northward to Reach 1, station 3+00. The existing turning basin remains at its current depth.

Description:
Channel would be deepened to -39' required (-41' allowable) from Reach 3, station 12+00, northward to station 1+50 to accommodate a new 800' by 800' turning basin. Basin corners will be chamfered into the existing channel geometry. The 250' wide channel above Reach 3 , station 1+50 would be a -35' required project.

Quantity Summary:
Note: These quantities are estimates and reflect the difference between the assumed condition and the proposed alternative. Based on surveys conducted June 23, 2005 [Formula: proposed channel and turning basin volumes – (minus) assumed condition channel volumes]

| Design Volume | Advance Maintenance | Paid Allowable Overdredge | Unpaid Allowable Overdredge | TOTAL |
|---|---|---|---|---|
| 633,800 | 0 | 64,000 | 0 | 697,800 |

Bedrock occurs in the TB at approximately 30-35 feet MLLW, as such the total volumes listed above combine the sediment and rock expected to be encountered. See Section 10 for a breakdown of sediment vs. rock volumes.

## Location

The project location is Northeast Cape Fear River, Wilmington, New Hanover County, North Carolina. See the maps in Attachment 2.

## Type of Facility Involved

New-work, relocated turning basin spanning the existing channel just north of the Chemserve Terminal located at 2005 North 6th Street, Wilmington, NC 28401-2843

## Type of Activity Supported

The activity involves a turning basin in support of commercial navigation.

## Purpose of the Proposed Dredging

Relocation of the turning basin to improve navigation, operability of the channel, and river safety. See Section 5.1.

## Area, Depths, Volume

Refer to the maps in Section 5.1, in Attachment 1 pages D-28 and G-120, and in Attachment 2.

**Area:** (approx) 1,020,000 $ft^2$, or 23.4 acres

**Depths:** The channel would be deepened to -39′ required (-41′ allowable) from Reach 3, station 12+00, northward to station 1+50 to accommodate the turning basin. Basin corners will be chamfered into the existing channel geometry.

**Allowable Paid Overdredge:** 2 feet

**Allowable Non-Paid Overdredge:** Zero (0) feet based on the assumption that rock will be encountered below approximately 30 to 35 feet. See core logs from adjacent areas, Attachment 3.

**Existing Conditions and Depth(s)**

Depths currently range from approximately 23 to 36 feet in the channel and from 16 to 26 feet in the turning basin area. The depths vary widely due to shoaling and other natural processes. The sediment in the area is expected to be similar to nearby areas of the river for which testing has taken place. Approximately the first foot is likely to be fine sandy silt, under that it is expected to be fine sand mixed with layers of mud and silt, at approximately 30-35 feet will be cemented limestone of the bedrock. See bathymetry maps in Attachment 2 and corelogs/grain size data from 2004 in Attatchment 3.

**Proposed Dredging Method**

Combination of rock blasting, mechanical excavating, and cutter-suction hydraulic dredging.

**Proposed Disposal Site / Zone**

New Wilmington ODMDS for sediment, any rock removed may be disposed of in the decommissioned turning basin(s)

### 6.1.2 Permitting

This section should indicate whether the proposed dredging will require a MPRSA 103 permit or whether it is a Civil Works project. For permitted projects, this section should indicate whether the proposed dredging is for a new permit or an extension or re-issuance of an existing permit. For projects where permits have been in place, include a discussion of any special permit conditions or related actions that may have bearing on SAP/QAPP approval. This section should also briefly summarize the status of any applications for the proposed dredging project. This information should include, but is not limited to, the following items. A table may be useful in presenting this information.

- Date of MPRSA 103 application to CE District
- Date of Public Notice if already issued
- Proposed date of Public Notice if not already issued
- Existing and previous permit numbers associated with dredging projects in the area (include all permits, not just MPRSA 103). For each permit, indicate agency, issuance and expiration dates, permitted volume(s), and any limitations.

The dredge material from Alternative 1 (in Section 5.1), Enlarging of turning basin at upper terminus, has been approved for ocean disposal. It was included in a sampling event for maintenance/deepening of Wilmington Harbor. Sampling and testing took place in 2004.

This project is a civil works project, therefore a permit will not be required.

## 6.2 Description of the Sampling and Analysis

### 6.2.1. Measurements That Are Expected During the Course of the Sediment Sampling

This section should cite the list of physical properties, chemicals of concern, and bioassay tests to be undertaken. Also, identify the methods and reporting limits that will be used in making these measurements. The use of tables is strongly recommended. This section should be consistent with Section 13.3.

See Section 13.3 for proposed analytical methods and target detection limits.

| |
|---|
| **PHYSICAL ANALYSIS (Sediments)**<br>Grain Size<br>Specific Gravity<br>Total Solids |
| **CHEMICAL ANALYSIS (Sediments, Elutriates, and Site Water)**<br>Metals<br>Polynuclear Aromatic Hydrocarbons (PAHs)<br>Polychlorinated Biphenyls (PCBs)<br>Total Petroleum Hydrocarbons (TPH)<br>Dioxins (sediments only – not elutriates or site water)<br>Total Organic Carbon (TOC) (sediments only – not elutriates or site water) |
| **BIOASSAY AND BIOACCUMULATION TESTS:**<br>**Suspended Particulate Phase** toxicity tests using three species: the Inland Silverside, *Menidia beryllina;* the mysid, *Americamysis bahia;* and larvae of the bivalve oyster, *Crassostrea virginica*. Test duration will be 96 hours.<br>**Solid Phase** toxicity tests using two species: the amphipod, *Leptocheirus plumulosus;* and the polychaete, *Nereis arenaceodentata*.<br>**Whole Sediment Bioaccumulation** 28-day exposure bioaccumulation testing. Test organisms: the polychaete, *Nereis virens;* and the bentnose clam, *Macoma nasuta.* |
| **CHEMICAL ANALYSIS OF TISSUES:**<br>Analyze bioaccumulation test organism tissues for selected contaminants of concern (COCs). Tissues will be analyzed for percent moisture, percent lipids, and contaminants detected in the chemical analysis of sediment (metals and PAHs). Direction on target analytes for tissue analysis will be provided before the end of the 28-day exposure period. |

#### 6.2.2. Applicable Technical Quality Standards or Criteria

This section should address any relevant State Water Quality Standards or Federal Water Quality Criteria, if applicable.

Sediment results will be compared to published sediment screening values where appropriate. These levels are the Threshold Effects Level (TEL) and the Effects Range-Low (ERL). The TEL represents the concentration below which adverse effects are expected to occur only rarely, and the ERL is the value at which toxicity may begin to be observed in sensitive species (Buchman 1999). Comparisons will be used for reference only, not for any regulatory decisions.

Elutriate and Site Water results will be compared to the Federal Water Quality Criteria - Criterion Maximum Concentration (CMC). The CMC is an estimate of the highest concentration of a pollutant in saltwater to which an aquatic community can be exposed briefly without resulting in an unacceptable effect (EPA 2002).

Tissue chemistry results will be compared to U.S. Food and Drug Administration (USFDA) Action Levels (USFDA 2003) for those analytes that have a published limit, reference station levels, and Region 4 bioaccumulation table values in Appendix H of the SERIM. Results may also be used in a risk-based evaluation if they exceed reference concentrations and Region 4 bioaccumulation table values

#### 6.2.3. Special Personnel or Equipment Requirements That May Indicate the Complexity of the Dredging Project

Indicate "Not Applicable" if there are no personnel or equipment needs beyond those required for normal sampling and testing for a dredging project. Examples may include drill rigs for land-based sampling.

Sampling in the turning basin will be done using a vibratory type core sampler. Samples will be taken to project depth +2 feet paid allowable over-depth or to refusal, whichever is encountered first.

#### 6.2.4. Assessment Techniques Needed for the Dredging Project

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.6. Use of cross-reference to Section 20 of this SAP would be appropriate.

This project is not overly complex; it is fairly straightforward in that it is for collection of samples in a small extent of the waterway, it is a one-time sampling event (i.e., no long-term maintenance or measurements), and that the field work can be accomplished in a span of 2 to 3 days. As such, the assessment techniques stated in Section 20 are adequate to provide sufficient assurance that the quality objectives of the project will be met.

### 6.2.5. Schedule for the Work Performed

This section should give an estimated schedule for the testing program including:

- Commencement of field sampling
- Completion of field sampling
- Completion of chemical and physical testing
- Completion of biological testing
- Delivery of final testing report
- Expected or proposed dredging and disposal timeframes (i.e., include consideration of any relevant dredging or disposal timing restrictions).

It is anticipated that sampling will be performed December 2007-January 2008.

Dredging is expected to begin in August 2009 (at the earliest), with a reasonable chance that it will be August 2010 due to funding constraints.

| Responsibility | Estimated Schedule for Sampling/Testing/Reporting Schedule | Calendar Days after Contract Award |
|---|---|---|
| USACE | Prepare a Scope & Internal Government Estimate from SAP | 7 |
| USACE | Contracting | 21 |
| Contractor | Price Quote | 30 |
| USACE | Contracting and Environmental Evaluate Proposal | 37 |
| USACE | Negotiate, Award, and Notice to Proceed | 44 |
| Contractor | Prepare QAPP | 58 |
| USACE/EPA | Coordinate/Approve QAPP | 86 |
| Contractor | Simultaneously Preparing and Coordinating for Sampling and Analysis<br>Commence Field Sampling (20 Workdays after Approved QAPP)<br>Completion of Field Sampling | 128 |
| Contractor | Completion of Chemical and Physical Sampling | 191 |
| Contractor | Completion of Biological Testing | 317 |
| Contractor | Delivery of Final Testing Report | 380 |
| USACE | Prepare 103 Report/Concurrence | 422 |
| EPA | EPA Review of 103 | 471 |

### 6.2.6. Dredging Project and Quality Records Required, Including the Types of Reports Needed

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.6. Use of cross-reference to Section 20 of this SAP would be appropriate.

The following reports must be submitted:

1. Sampling and Analysis/draft Quality Assurance Project Plan (SAP/QAPP) submitted for review and comment. USACE will submit to EPA for final approval.
2. Final Quality Assurance Project Plan (SAP/QAPP), following update from comments for final approval prior to sampling. USACE will submit to EPA for final approval.
3. Site-Specific Safety and Health Plan – Accident Prevention Plan
4. Preliminary Sediment Chemistry Data Report
5. The Marine, Protection, Research and Sanctuaries Act of 1972 (MPRSA) Section 103 Sediment Evaluation Testing Report
6. Chemical Quality Assurance Report (CQAR). The CQAR is to evaluate all of the representative data from the project field sampling and laboratory analyses. For each group of data, a data review checklist is completed that assesses daily field QC reports and specific QC chemical data quality indicators, and it enables the reviewer to identify potential data problem areas that may require additional data validation. The Quality Assurance Report identifies non-conformances, QC deficiencies, or other problems that would impact the data quality objectives as specified in the work plan and the QAPP. The Chemical Data Quality Assessment Report summarizes the overall usability of the data for the intended purposes. This report will be an appendix to the Final Sediment Testing Report (see Section 5, above).
7. Daily Quality Control Reports (DQCR). A DQCR will be prepared by the Field Team Leader or Project Manager for each day sampling is conducted. This report will contain a description of the work performed, samples collected, general conditions, corrective actions taken, departures from the sampling plans, and any other notes or comments needed that will document the day's activities. This report will be an appendix to the Final Sediment Testing Report (see item 5, above).

## 7.0 ELEMENT A7 - QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

### Data Quality Objectives for Sediment and Tissue Chemical Analyses

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding Times |
|---|---|---|---|---|
| **PAHs and Pesticides** | MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | 14 days until extraction, 40 days thereafter |
| | MS/MSD | 1 set per 20 samples or 1 set per batch up to 20 samples | 70 - 130% for spike limits<br><br>30% RSD for precision | |
| | Duplicate | 1 per 20 samples or 1 per batch up to 20 samples | 30% RSD for precision (Evaluated for analytes >3x RL) | |
| | SRM** | 1 per 20 samples or 1 per batch up to 20 samples | Within limits specified by provider (Evaluated for analytes >3x RL) | |
| | ICV | Immediately following calibration curve | 80 - 120% Recovery | |
| | CCV | Minimum - one per 10 samples and at the end of each batch whenever batch is greater than 10 or for GC/MS at the beginning of every 12 hours | RRF or RF ≤25% for GC/MS methods and ≤15 for all other methods | |
| | Surrogates | Every sample | 30 - 150% Recovery | |
| | Internal Standard | Every sample | 50 - 200% Recovery | |
| | IC | Verify after each initial calibration | <20% RSD for each analyte or RF ≤30% for GC/MS | |
| | MDL | Verify MDL study once per year for each analyte of interest | Updated annually | |

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding Times |
|---|---|---|---|---|
| **Dioxins** | MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | 14 days until extraction, 40 days thereafter |
| | LCS | 1 per 20 samples or 1 per batch up to 20 samples | 70-130% for spike limits | |
| | MS/MSD or LCS/LCSD^ | 1 set per 20 samples or 1 set per batch up to 20 samples | 70-130% recovery for accuracy and ≤20 % difference for precision | |
| | ICV | Immediately following calibration curve | 50 - 150% recovery | |
| | CCV° | At the beginning of every 12 hours of analysis | 80 - 120% Native standards 65 - 135% Labeled standards | |
| | Initial Calibration Standards | Once per run | 80 - 120% Native standards 65 - 135% Labeled standards | |
| **Metals** | MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | 180 Days |
| | MS/MSD | 1 set per 20 samples or 1 set per batch up to 20 samples | 70 - 130% for spike limits | |
| | Duplicate | 1 per 20 samples or 1 per batch up to 20 samples | 30% RSD (Evaluated for analytes >3x RL) | |
| | SRM | 1 per 20 samples or 1 per batch up to 20 samples | 70 - 130% Recovery (Evaluated for analytes >3x RL) | |
| | LCS/LFB | 1 per 20 samples or 1 per batch up to 20 samples | 70 - 130% Recovery | |
| | ICV | Immediately following calibration curve | 90 - 110% Recovery | |

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding Times |
|---|---|---|---|---|
| | CCV | Minimum - one per 10 samples and at the end of each batch whenever batch is greater than 10 | 90 - 110% Recovery | |
| | LDR | Verify LDR once per quarter for ICP analysis and one time for mercury analysis | Refer to frequency | |
| | Initial Calibration for AA, Hg | Performed daily | Correlation coefficient ≥ 0.995 | |
| | MDL | Verify MDL study once per year for each analyte of interest | Updated annually | |
| | ICB | Immediately after initial calibration | No analyte should be detected > RL | |
| **TOC** | MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | 28 Days |
| | MS/MSD | 1 set per 20 samples or 1 set per batch up to 20 samples | 75 - 125% for spike limits<br><br>20% RSD for precision (Evaluated for analytes >3x RL) | |
| | Triplicate | 1 per 20 samples or 1 per batch up to 20 samples | 20% RSD for precision (Evaluated for analytes >3x RL) | |
| | SRM** | 1 per 20 samples or 1 per batch up to 20 samples | Within limits specified by provider (Evaluated for analytes >3x RL) | |
| | ICV | Immediately following calibration curve | 80 - 120% Recovery | |
| | CCV | At the beginning of every 12 hours of analysis | 90 - 110% Recovery | |
| | IC | Verify after each initial calibration | cc > 0.9950 for all calibrations | |

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding Times |
|---|---|---|---|---|
| | MDL | Verify MDL study once per year for each analyte of interest | Updated annually | |
| **Grain Size** | Triplicate | 1 set per 20 samples or per batch | <20% RSD | Undetermined |
| **% Solids and Specific Gravity** | Duplicate | 1 set per 10 samples or per batch | Within 20% Relative % Difference | Undetermined |

** If SRMs are not available, use laboratory control samples

## 8.0 ELEMENT A8 - SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

> Applicants and consultants may use this section to document any state, local government, or project-specific training or certification requirements such as laboratory certification. Indicate “Not Applicable” if there are no personnel training or certification requirements beyond those required for normal sampling and testing for a dredging project. (Refer to *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.8.)

It is strongly recommended that all field personnel have at a minimum: 24-hour HAZWOPER training and certification in first aid and CPR. All sampling and field work must conform to the USACE Safety Manual EM 385-1-1 (USACE 2003).

## 9.0 ELEMENT A9 - DOCUMENTATION AND RECORDS

| Refer to *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.9. |
|---|

Element A9 encompasses the information indicated in Sections 9.1 through 9.3, below.

### 9.1 Reporting of Results

The data obtained will be presented in graphical, tabular, and written text as appropriate. The draft and final testing reports will undergo internal technical review and quality assurance review by persons with appropriate technical qualifications to ensure that the report meets the project requirements specified in the technical work plan and the QA goals. The draft and final reports shall present all aspects of evaluations of the dredged material required under Section 103 of the Marine, Protection, Research and Sanctuaries Act of 1972 (MPRSA) as described in *Evaluation of Dredged Material Proposed for Ocean Disposal Testing Manual* (USACE/EPA 1991) and shall present the results of field sampling, physical/chemical analyses of sediment, toxicological testing, and bioaccumulation exposures as outlined in Appendix D of the SERIM.

The reports will consist of 8½" by 11" pages with drawings or oversized tables folded, if necessary, to this size. The report margins shall be suitable for use in a durable 3-ring binder. A decimal numbering system will be used, with each section having a unique decimal designation. Reports that require extensive editing, have extensive errors, or are not in the required formats will be rejected and re-submittal will be required. All submittals under shall be sent to USACE-Wilmington District. Any maps, drawings, figures, sketches, databases, spreadsheets, or text files prepared for this report shall be provided in both hard copy and digital form.

The digital copies of reports and other text documents shall be provided in Microsoft Word 2000 (or higher version). Spreadsheet files and data files shall be provided in Microsoft Excel 2000 (or higher version) format. All text, spreadsheet, and database files shall be delivered compact disk read-only memory (CD-ROM) with ISO-9660 format. Level IV laboratory data should be provided as Adobe Acrobat PDF files.

Geographic data shall be provided in feet and projected into the North Carolina State Plane coordinate system.

Five copies of the final report (hard copies and CD) shall be submitted to USACE-Wilmington District. Only one copy of Level IV laboratory reporting data is required.

## 9.2 Report Format

This section should indicate the format for the final reporting of data (e.g., hard copy, electronic) and the software that will be used for data files and test documents. [See SERIM Appendix C.]

**Standard Formats and Requirements for Digital Data Provided to the Wilmington District U.S. Army Corps of Engineers under Contract (CESAW-TS-PE March 2002)**

The following paragraphs represent the format for electronic files being delivered as part of any contract. These paragraphs do not specify content or what the electronic files should contain. The content or data represented should be specified in the basic Scope of Work.

1. Specifications for Digital Data. Any maps, drawings, figures, sketches, databases, spreadsheets, or text files prepared under the terms of this contract shall be provided in both hard copy and digital form, unless otherwise specified in the Scope of Work. The hard copy deliverables shall be defined in the body of the basic Scope of Work.

2. Text, Spreadsheet, and Database Files: The U.S. Army Corps of Engineers, Wilmington District standard computing software is Microsoft Office. Reports and other text documents shall be provided in Microsoft Word 2000 (or higher version) format and Adobe Portable Document Format (PDF). Spreadsheet files shall be provided in Microsoft Excel 2000 (or higher version) format. Databases shall be provided in Microsoft Access format, unless otherwise specified in the basic Scope of Work. Prior to database development, the contractor shall provide the Government with a Technical Approach Document and Entity Relationship Diagram for approval which describes the contractor's technical approach to designing and developing the database. All text, spreadsheet, and database files shall be delivered on compact disk read-only memory (CD-ROM) with ISO-9660 format.

3. Digital Mapping and Data Standards: The U.S. Army Corps of Engineers, Wilmington District utilizes Microstation for Computer Assisted Drafting and Design CADD. Data provided must be readable by Microstation SE or higher to provide design drawings, sketches, or figures. All digital files provided in Microstation shall be provided in feet and projected into the North Carolina State Plane coordinate system. The maps shall use the GRS 1980 spheroid and the North American Datum 1983 (WGS-84, and shall be provided on CD-ROMs

4. Geographic Information System (GIS) Data Delivery Format

    a. Digital geographic maps and the related digital information shall be developed using double precision and delivered in uncompressed ARC/INFO export file format (.e00) using ARC/INFO Release 8.0 or higher. The Wilmington District will also accept ARC/View Shapefiles. These file formats are geographic information system software applications produced by the Environmental Systems Research Institute of Redlands, California, and are in the GIS software suite used by U.S. Army Corps of Engineers, Wilmington District.

b. Digital geographic maps and the related digital information shall be usable on an IBM-compatible personal computer system using the Windows NT 4.0 or Windows 2000 operating systems. This data shall be provided on compact disk read-only memory (CD-ROM) with ISO-9660 format.

5. General Digital Standard for CADD and GIS Files

a. Geographic data shall be provided in feet and projected into the North Carolina State Plane coordinate system. The maps shall use the GRS 1980 spheroid and the North American Datum 1983 (WGS-84). Vertical upland topographic surveys shall use NGVD 1929. Hydrographic survey will reference the local dredging datum which will be provided in the project scope of services. No offsets shall be used. Each map layer or coverage shall have a projection file. Map or drawing scales will be determined by the Contracting Officer's Representative for the contract. Mapping accuracy for the agreed scales will conform to the American Society for Photogrammetry and Remote Sensing (ASPRS), "Accuracy Standards for Large-Scale Maps" and "Interim Accuracy Standards for Large-Scale Maps" (ASPRS, 1991). Copies of the ASPRS Accuracy Standards can be obtained by contacting:

American Society for Photogrammetry and Remote Sensing
5410 Grosvenor Lane, Suite 210
Bethesda, MD 20814-2160

b. Geographic data must be provided in a form that does not require translation, preprocessing, or post processing before being used in the U.S. Army Corps of Engineer's System. However, the Contractor shall consult with the Government (specifically the Geographic Information Systems Coordinator) concerning the use of alternative delivery formats such as MicroStation SE or higher to provide design drawings, sketches, or figures. All digital files provided in Microstation shall be in the same projection and use the same coordinate system, datum, and units as stated above, and shall be provided on CD-ROMs.

c. Geographic Data Structure: All geographic information shall be developed in a structure consistent with the Spatial Data Standards (SDS), Version 1.9, released in December 1999, or a higher version if available at the time of this project. The Contractor shall consult with the Government concerning modifications or additions to the SDS. The Government may approve modifications to the Standard if it is determined that SDS does not adequately address subject data sets. Copies of the SDS may be obtained by contacting:

Director, U.S. Army Engineer Waterways Experiment Station
Tri-Service CADD/GIS Technology Center
Attn: CEWES-IM-DA/Smith
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

d. Geographic Data Documentation: For each digital file delivered containing geographic information (regardless of format), the Contractor shall provide documentation consistent with the "Content Standards for Digital Geospatial

Metadata, June 1998" published by the Federal Geographic Data Committee. The documentation shall include but is not limited to the following: the name and description of the map layer or coverage, the source of the data and any related data quality information such as accuracy and time period of content, the type of data coverage (point, line, polygon, etc.), the field names of all attribute data and a description of each field name, the definition of all codes used in the data fields, the ranges of numeric fields and the meaning of these numeric ranges, the creation date of the map layer and the name of the person who created it. A point of contact shall be provided to answer technical questions. A metadata generation software, called Document.aml, is available from ESRI for use with ARC/INFO to help in the production of the required metadata. Corpsmet 95 metadata software is available from the U.S. Army Geospatial Clearinghouse at http://corpsgeo1.usace.army.mil/. Copies of the FGDC metadata standard can be obtained by contacting:

FGDC Secretariat
c/o U.S. Geological Survey
590 National Center
Reston, Virginia 22092
(703) 648-5514

FGDC metadata standards can also be found on the Internet at
http://www.fgdc.gov

e. Geographic Data Review: The digital geographic maps, related data, and text documents shall be included for review in the draft and final contract submittals. The reviews may include a visual demonstration of the geographic data on the Windows NT computer system in the Environmental Resources Section GIS Unit's. Actual installation of the digital data from the CD-ROM onto the computer will be conducted by GIS Unit personnel. However, the Contractor shall have a technical consultant available at each review to assist with any digital data discrepancies. The data will be analyzed for subject content and system compatibility. Review comments to data and text shall be incorporated by the Contractor prior to approval of the final submittal.

f. Ownership: All digital files, final hard-copy products, source data acquired for this project, and related materials, including that furnished by the Government, shall become the property of U.S. Army Corps of Engineers, Wilmington District and will not be issued, distributed, or published by the Contractor.

## 9.3 Data Reporting Package Archiving and Retrieval

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.1.9 and *Requirements for Quality Assurance Project Plans* (QA/R-5).

All reports, data, field sheets, correspondence, notes, field books, and any other documents associated with this project will be archived by the contractor for a minimum of 5 years from the date of the final report. Prior to disposal of any records, the contractor must contact the client (USACE-Wilmington) for authorization and direction in the disposal of said documents.

# GROUP B. PROJECT MANAGEMENT

## 10.0 ELEMENT B1 - SAMPLING PROCESS DESIGN

| |
|---|
| Refer to *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.1. |

Element B1 encompasses the information indicated in Sections 10.1 through 10.6, below.

### 10.1 Scheduled Dredging Project Activities, Including Measurement Activities

| |
|---|
| Describe schedule of proposed sampling relative to dredging schedule. This is especially important for projects involving routine maintenance. |

Sampling, analysis, and reporting will take place prior to dredging. Due to the nature of this new-work project, the material is highly unlikely to change between sampling and dredging.

Additional sampling will be conducted prior to any maintenance dredging of this area.

### 10.2 Rationale for the Design

| |
|---|
| This section should give a brief overview description of the type and extent (i.e., number of samples and composites) of testing being proposed. Justification for the proposed testing program should be made by explicit reference to the dredging project description and site history information presented in earlier sections, as well as to any existing guidance on sampling design (e.g., Green Book, SERIM). It is particularly important to clearly explain the rationale for any proposed sampling and compositing approach that differs from existing agency guidelines. |

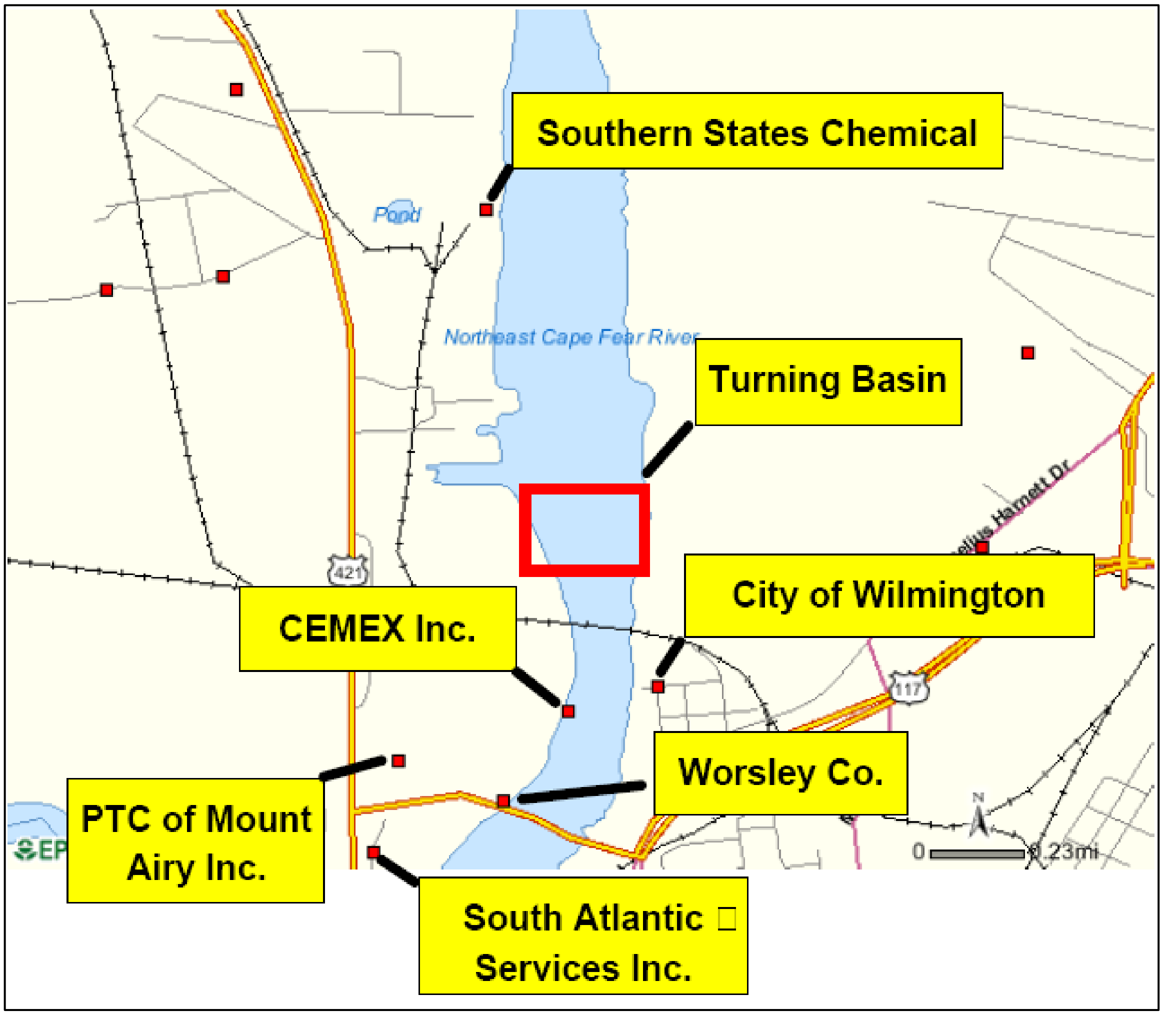
As the proposed project constitutes a new-work project, and no previous data exist, analysis will consist of all three analytical tiers, including bioaccumulation bioassays.

Review of the EPA Envirofacts database indicates the following permitted discharges in the immediate vicinity of the proposed project:

#NC0065307, Worsley Companies - exp 12/31/06

#NCG080598, Ptc of Mount Airy Inc.-exp 8/31/07

#NCG500162, CEMEX Inc., exp 7/31/07)




Previous testing discussed in Section 5.1 indicates that there are low concentrations of COCs and no significant adverse response in biological tests conducted on sediments from nearby areas. The proposed project is not located adjacent to shoreline areas or berthing facilities and is therefore not likely subject to contamination. Based on this analysis, the proposed project sediments have been given a ranking of 'low' (refer to Table 4-2, SERIM) relative to the potential for significant concentrations of COCs and adverse biological effects.

Estimated volumes for the project are 454,800 cubic yards of sediment and 179,000 cubic yards of rock down to the design depth. Considering the paid allowable overdepth of 2 feet, there is a potential additional volume of approximately 75,500 cubic yards of material. However, the overdepth material is likely to be rock. Rock material will consist of one dredging unit (DU) and will not require sampling or testing. For the remaining material, based on the estimated volume (454,800 CY) and the guidance provided in the SERIM for low ranked materials, the remaining sediments have been divided into two DUs for a total of three DUs. One DU represents the upper sediments (down to -28 feet MLLW) most likely to be subject to any contamination. The second DU represents the lower sediments less likely to be subject to any contamination. One set of analyses will be conducted for each DU except for the rock DU. Each of the DUs being tested will be represented by five subsamples. This exceeds that recommended in the SERIM, but is necessary due to the possible variability within the dredging area. The five subsamples from each DU will be composited and collected at the same location for both the turning basis (TB) surface and TB subsurface DUs. Two of the subsamples will be located within the footprint of the existing channel, and the remaining three will be distributed through the remaining portion of the turning basin with at least one sampling point located on either side of the existing channel. The DUs are summarized in the table below:

| Dredging Unit | | Depth (feet MLLW) | Estimated Volume (cubic yards) | Number of Subsamples |
|---|---|---|---|---|
| 1 | TB Surface | Surface to -28 | 158,400 | 5 |
| 2 | TB Subsurface | -28 to point of refusal or -41 | 296,400 | 5 |
| 3 | TB Rock | Point of refusal to -41 | 179,000 to 254,500 | N/A |

One field replicate will be collected as described in the EPA document *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations* (EPA 1995). The field replicate will be collected at the same location and time as one project sample, and will be analyzed for sediment chemistry, elutriate chemistry and physical parameters, but not for toxicological testing.

Reference Sample: For dredged material evaluations for ocean disposal, the test results from proposed dredging site samples are compared to test results from appropriate reference site sediments. Reference sediment is defined as, "A sediment, substantially free of contaminants, that is as similar to the grain size of the dredged material and the sediment at the disposal site as practical, and reflects conditions that would exist in the vicinity of the disposal site had no dredged-material disposal ever occurred, but had all other influences on sediment condition taken place" (1991 Green Book, Section 3.1.2).

The reference station was sampled in 2004 as part of 103 evaluation in Wilmington Harbor. Grain size data revealed that it contained 81.1% sand and 18.9% silt/clay.

## 10.3 Design Assumptions

Assumptions used for the creation of this SAP include the following:

1. The contractor will have access to each sampling site. Some ports, marinas, military facilities, etc., have limited access due to security concerns, ship berthing, and other factors.
2. If a sampling point needs to be relocated based on logistical concerns, including but not limited to the below-mentioned scenarios, the relocated sampling point will be recorded

with a GPS unit capable of sub-meter accuracy. The relocated point will coincide with depths and locations of the dredging prism. Every effort will be taken to inform the USACE Technical Manager, the QA Manager, or the USEPA Project Manager prior to any deviations from this sampling plan. In all likelihood, the USACE Technical Manager will be present during sampling. Any deviation will be explained in the DQCR, the field sheet(s), and the testing report.

3. The surveys (bathymetry data) are current, accurate, and the most recent available.

Possible foreseen problems and solutions include the following:

Problem: Rock at a depth not allowing sample collection. Solution: Relocate sample location or sample using a different technique.

Problem: Mooring of a ship or barge at a sampling location. Solution: Relocate sample location or attempt to get ship moved to provide access.

Problem: Heavy traffic in the channel or turning basin area limiting sample collection. Solution: Relocate sample location(s), postpone sampling, or sample around traffic (safety dependent).

Problem: Weather (hurricane, lightning, etc.) or rough seas. Solution: Postpone sampling until the situation clears.

Note that there is no way to accurately predict every problem that may arise when in the field. Every effort will be taken to inform the USACE Technical Manager or the QA Manager of any changes in the sampling scheme prior to the change taking place. The contractor Project Manager and the Field Team Leader will be familiar with the project and project goals and make an educated, scientifically based decision on the change if the USACE Technical Manager, QA Manager or the USEPA Project Manager cannot be contacted. Any deviation will be explained in the DQCR, the field sheet(s), and in the testing report.

## 10.4 Procedures for Locating and Selecting Environmental Samples

This section should provide all information describing and justifying the proposed location, depth, and compositing plan for each sediment sample. The text of this section should provide a brief explanation of and justification for the proposed sampling locations representative of the material within each dredging unit to be dredged (e.g., based on grid, shoaling patterns, pollution sources, or ship interference or movement) and compositing (e.g., based on location, geological, or physical/chemical considerations). Sampling depths should be equal to the proposed dredging depth (authorized depth and advance maintenance), full overdredge depth, and expected sediment disturbance depth (see SERIM Section 4.5). A pre-sampling hydrographic survey should be taken prior to SAP submission to get the best possible bathymetric data for volume estimates and sample positioning. The following information should be superimposed on or included with the survey map(s).

- Date when the hydrographic survey was conducted
- Scale
- Proposed Dredging Units
- Proposed sediment sampling locations and composite boundaries if applicable
- Proposed dredging site water sample location
- Large scale features (e.g., piers, berthing areas, boat ramps)
- Dredging project boundaries (include boundaries delineating different project depths)
- Contour lines depicting areas that will actually be dredged (i.e., showing areas that are less than project depth, and that are less than the proposed overdepth).
- Potential sources of sediment contamination (e.g., fuel docks and storage facilities, culverts/outfalls, dry docks, RCRA/Superfund sites).

It is suggested that the following information be presented in tabular form:

- Nomenclature planned to identify field and laboratory samples/composites: To facilitate review of analytical and QA documentation, cross reference all proposed sample identification numbers to a unified system. Field sampling identification should correspond to sites indicated on the survey map and core logs.
- Compositing Plan: Rationale for the proposed compositing. Address why sediment throughout the area or layer to be composted is expected to be relatively homogeneous physically and chemically (refer to past test results for the area, if available).
- Dredging Volume: Estimate of the in-place volume of material to be dredged (including the full overdepth, even if this differs from the pay-depth in a dredging contract) that is represented by each station, sample and composite.
- Sampling Depths: Include the proposed depth of each core sample. Depths should be equal to the proposed dredging depth plus the full overdredge depth.
- Sample Analysis: Identify which tests will be run on core samples or composites of samples (e.g., physical tests, chemical tests, water column toxicity tests, benthic toxicity tests, or bioaccumulation tests).
- Field Parameters: Describe how samples will be evaluated in the field. Field staff members typically make observations of visible layers in the core samples, odor, color, consistency, and texture of the sediment. Measurements are also frequently collected in the field (e.g., temperature, salinity, etc. of the water column, tidal state, etc.)

Sample stations for the collection of sediment and water-column samples are listed below. Sediment samples were chosen and are to be collected from locations and depths coinciding with the dredging prism. The selected reference station is located in the Atlantic Ocean and corresponds to reference station RS-NW-D in Appendix K of the SERIM. The five subsamples from the proposed turning basin (NECFTB07-a through -e) will be collected and composited as described in Section 10.2. Site water for background chemical analysis and for the generation of elutriates will be taken from the approximate center of the proposed turning basin.

Cores will be taken to project depth (+2-foot paid allowable overdredge) or to refusal, whichever is encountered first.

Sampling locations were selected randomly to best represent the dredging area meeting the criteria discussed in Section 10.2.

See maps and bathymetry in Attachment 2 and geotechnical data in Attachment 3.

**Nomenclature:**
Sample IDs to be collected are listed below:

| Sample ID | Sub Sample | Coordinates, WGS84 | | Sample Type | Depth of Core | |
|---|---|---|---|---|---|---|
| | | | | | from | to |
| NECFTB07-Upper | a | N 34.263805206 | W 77.95097332 | Core | sed surface | -28 |
| | b | N 34.262355163 | W 77.94996459 | Core | | |
| | c | N 34.264452627 | W 77.95021267 | Core | | |
| | d | N 34.262096391 | W 77.94864564 | Core | | |
| | e | N 34.263927756 | W 77.94870635 | Core | | |
| NECFTB07-Lower | a | N 34.263805206 | W 77.95097332 | Core | -28 | -41 or refusal |
| | b | N 34.262355163 | W 77.94996459 | Core | | |
| | c | N 34.264452627 | W 77.95021267 | Core | | |
| | d | N 34.262096391 | W 77.94864564 | Core | | |
| | e | N 34.263927756 | W 77.94870635 | Core | | |
| Reference NECFTB07-REF | a-e | N 33.78687 | W 77.98934 | Grab | -- | -- |
| NECFTB07-Site Water* | -- | N 34.26255 | W 77.94919 | Grab | Collected at 1 meter above bottom | |

* Sample NECFTB07-Site Water will be collected from the approximate center of the turning basin and will be used for background chemical analysis and to generate elutriates.

**Compositing Plan:**
The subsamples NECFTB07-UPPER-a through -e will be composited to make one sample for analysis, NECFTB07-Upper.

The subsamples NECFTB07-LOWER-a through -e will be composited to make one sample for analysis, NECFTB07-Lower.

The subsamples NECFTB07-REF-a through -e will be composited to make one sample for analysis, NECFTB07-REF.

**Estimated Dredge Volume:**

<table>
<tr><th>Sample/<br>Dredge Unit ID</th><th>Sub Sample</th><th>Subsample Representative Volume (est.)</th><th>Sample Representative Volume (est.)</th><th>Total Volume (est.)</th><th>Grand Total to be Dredged (est.)</th></tr>
<tr><td rowspan="5">NECFTB07-Upper<br>TB Surface</td><td>a</td><td>31,680</td><td rowspan="5">158,400</td><td rowspan="10">454,800</td><td rowspan="11">633,800-<br>709,300</td></tr>
<tr><td>b</td><td>31,680</td></tr>
<tr><td>c</td><td>40,000</td></tr>
<tr><td>d</td><td>40,000</td></tr>
<tr><td>e</td><td>15,040</td></tr>
<tr><td rowspan="5">NECFTB07-Lower<br>TB Subsurface</td><td>a</td><td>60,000</td><td rowspan="5">296,400</td></tr>
<tr><td>b</td><td>60,000</td></tr>
<tr><td>c</td><td>50,000</td></tr>
<tr><td>d</td><td>70,000</td></tr>
<tr><td>e</td><td>56,400</td></tr>
<tr><td>No Sample<br>TB Rock</td><td>N/A</td><td>N/A</td><td>N/A</td><td>179,000-<br>254,500</td></tr>
</table>

**Sampling Depths:**
Samples will be taken to project depth +2 feet paid allowable overdredge or to refusal, whichever is encountered first.

**Sample Analysis:**

All analyses will be conducted on the composite samples made from the appropriate subsamples as noted in the Compositing Plan above. Below are the analyte groups to be tested for this project, a complete list of analyses and methods is listed in Section 13.3.1.

| Test | Sample: | NECFTB07-Upper | NECFTB07-Lower | NECFTB07-Replicate | NECFTB07-REF | NECFTB07-Site Water | Pretest Tissues |
|---|---|---|---|---|---|---|---|
| Physicals | Grain Size | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | Atterburg Limits | **--** | **--** | **--** | **--** | -- | -- |
| | Total Solids | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | Settling Rates | **--** | **--** | **--** | **--** | -- | -- |
| | Specific Gravity | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | Bulk Density | **--** | **--** | **--** | **--** | -- | -- |
| | TOC | **Y** | **Y** | **Y** | **Y** | -- | -- |
| Sediment Chemistry | Metals | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | Organotins | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | TPH | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | Pesticides | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | Herbicides | -- | -- | -- | -- | -- | -- |
| | PCB Congeners | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | PCB Aroclors | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | PAHs | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | Dioxins | **Y** | **Y** | **Y** | **Y** | -- | -- |
| | Semi-Volatiles | -- | -- | -- | -- | -- | -- |
| | Biphenyl | -- | -- | -- | -- | -- | -- |
| | VOAs | -- | -- | -- | -- | -- | -- |
| Elutriate/Water Chemistry | Metals | **Y** | **Y** | **Y** | **Y** | **Y** | **--** |
| | Organotins | **Y** | **Y** | **Y** | **Y** | **Y** | **--** |
| | TPH | -- | -- | -- | -- | -- | -- |
| | Pesticides | **Y** | **Y** | **Y** | **Y** | **Y** | -- |
| | Herbicides | -- | -- | -- | -- | -- | -- |
| | PCB Congeners | **Y** | **Y** | **Y** | **Y** | **Y** | -- |
| | PCB Aroclors | **Y** | **Y** | **Y** | **Y** | **Y** | -- |
| | PAHs | **Y** | **Y** | **Y** | **Y** | **Y** | -- |
| | Dioxins | -- | -- | -- | -- | -- | -- |
| | Semi-Volatiles | -- | -- | -- | -- | -- | -- |
| | Biphenyl | -- | -- | -- | -- | | -- |
| | VOAs | -- | -- | -- | -- | -- | -- |
| | Ammonia | -- | -- | -- | -- | -- | -- |
| | Cyanide | -- | -- | -- | -- | -- | -- |
| Tissue Chemistry* | Metals | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** |
| | Organotins | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** |
| | TPH | -- | -- | -- | -- | -- | -- |
| | Pesticides | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** |
| | Herbicides | -- | -- | -- | -- | -- | -- |
| | PCB Congeners | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** |
| | PCB Aroclors | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** |
| | PAHs | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** |
| | Dioxins | -- | -- | -- | -- | -- | -- |

| Test | Sample: | NECFTB07-Upper | NECFTB07-Lower | NECFTB07-Replicate | NECFTB07-REF | NECFTB07-Site Water | Pretest Tissues |
|---|---|---|---|---|---|---|---|
| | Semi-Volatiles | -- | -- | -- | -- | -- | -- |
| | Biphenyl | -- | -- | -- | -- | -- | -- |
| | VOAs | **--** | **--** | -- | -- | -- | -- |
| | % Lipids | -- | -- | -- | -- | -- | **Y** |
| Toxicology | Suspended Phase Bioassay | **Y** | **Y** | -- | -- | -- | -- |
| | Solid Phase Bioassay | **Y** | **Y** | -- | **Y** | -- | -- |
| | Bioaccumulation Potential | **Y** | **Y** | -- | **Y** | -- | -- |

**Y** = analysis will be performed

-- = analysis will not be performed/not required or not applicable

* Parameters for tissue analysis may be adjusted upon review of the sediment chemistry results; a final decision will be made after negotiations between ANAMAR, USACE, and USEPA.

**Field Parameters:**
Site conditions such as prevailing weather, wind direction, air temperature, and tidal cycle will be documented at each sampling site. *In situ* measurements, depth, date and time, coordinates, current conditions, sediment descriptions, number of containers, and team members will be recorded on project-specific field sheets. When sampling the inshore site water sample, *in situ* hydrographic measurements for water temperature, pH, water depth, dissolved oxygen, salinity, and conductivity will be collected at the surface of the water column using either a YSI 650MDS or a Hydrolab Multi Probe Datasonde®. Turbidity will be measured using a Hach 2100P® Turbidimeter. All instruments will be calibrated at the beginning and end of the sampling day according to the manufacturers' specifications.

> The following section should provide information on the reference site(s) and control site(s) that will be used for comparison with sediments from the proposed dredging location(s). Reference sediment must be collected from the approved reference location associated with the proposed disposal site. The following information should be provided for the reference samples:
>
> - Map identifying reference site locations with coordinates
> - Number of samples making up reference composite.

The Reference Station (NECFTB07-REF) is located in an area used in previous 103 evaluation studies in the Wilmington Harbor-Cape Fear River area. It corresponds to station RS-NW-D recommended in Appendix K of the SERIM. The reference sediment is natural sediment that is:

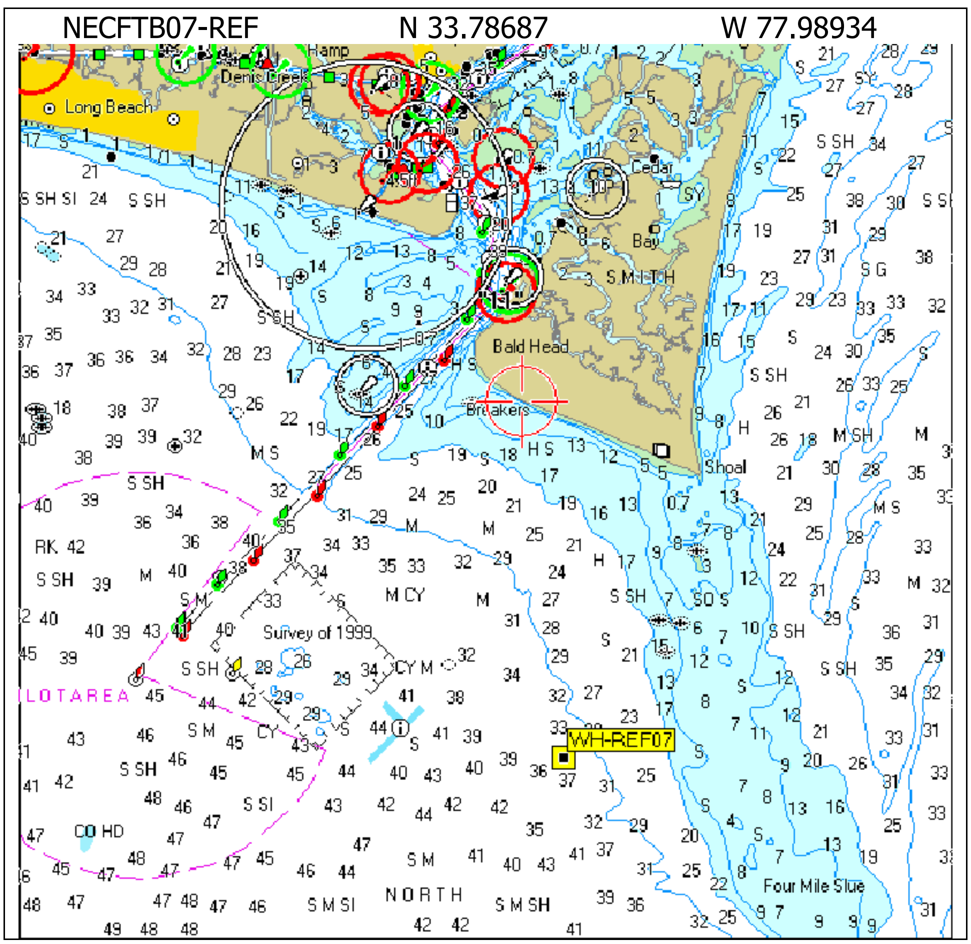
- Substantially free of contaminants;
- Serves as a point of comparison to identify potential effects of contaminants in the dredged material and to determine compliance with the limiting permissible concentration (LPC);
- Reflective, as possible, of hydrographic conditions characteristic of the disposal site; and

- As similar in grain-size distribution, organic content, and % moisture to the proposed dredged material as possible.

The following values are from core samples taken in 2004 approximately 0.6 miles upstream (NECFU04) and 1 mile downstream (NECFD04) of the TB. See Attachment 3 for core logs, maps and grain size data of the 2004 samples. The reference sample was collected in 2004 and again in 2007 (REF04 and REF07 respectively).

NECFU04: 23.4% fines, 76.6% sand, TOC = 1.67%
NECFD04: 10.0% fines, 87.7% sand, TOC = 0.62%
REF04: 18.9% fines, 81.1% sand ,TOC = 0.60%
REF07: 18.5% fines, 81.5% sand, TOC = 0.42%

The reference site is offshore of Cape Fear Inlet, in about 30-45 feet of water and will be a composite of a minimum of five grab samples; one set of coordinates is provided; as such, all subsamples will be collected from the immediate area.



## 10.5 Classification of Measurements as Critical or Noncritical

Horizontal and vertical accuracy of the sampling locations is critical in that they must be within the dredge prism. Toxicology results are key in determining the suitability of sediment to be disposed offshore and are critical as well.

## 10.6 Validation of Any Nonstandard Methods

No modifications to methods are expected in this project.

## 11.0 ELEMENT B2 – SAMPLING AND METHODS REQUIREMENTS

Element B2 encompasses the information indicated in Sections 11.1 through 11.4, below.

### 11.1 Describe the Sample Collection, Preparation, and Decontamination Procedures

**Field Sampling Schedule**
It is expected that sampling will be performed in a span of less than 1 week. This is dependent on several factors including but not limited to weather conditions, equipment, and accessibility. Redundant systems will be in place to limit down-time due to equipment failure (see Section 11.3, Corrective Action). Contact with facilities in the immediate area and local security forces (e.g., USGC) will be coordinated prior to mobilizing to the field. Contact information for all parties involved as well as local facilities and security forces will be distributed to all parties and will be on-hand in the field.

**Field and Sampling Procedures**
General field methodologies and procedures follow those outlined in the Green Book (USACE/EPA 1991) *and procedures documented in the Florida Department of Environmental Protection Standard Operating Procedures for Field Activities (DEP-SOP-001/01). Although the project will be performed in North Carolina, the Florida sample collection SOPs provide scientifically sound methods for equipment decontamination, instrument calibration, and sample handling. A copy of these publications will be on hand for reference during field activities.*

Prior to the sampling trip, the volume of sediment needed will be calculated; enough sample volume will be collected to ensure enough volume for all analyses and archiving. *It is estimated that 25 gallons of sediment per station will be collected in order to conduct all the physical, chemical, and toxicological analyses.*

**Sample Position Accuracy**
The coordinates will be entered into a *Trimble GeoXT* GPS receiver capable of sub-meter accuracy, as well as a back-up unit *(WAAS-enabled Garmin Map76)*. Sampling sites will be located onsite using the first unit, and will be confirmed with the second unit. The depth at all stations will be recorded. *For inshore sampling locations, depth will be recorded with a sounding chain at the sampling location. The depth at the offshore reference station will be recorded with the fathometer provided on the sampling vessel.*

At each site, water depth will be corrected to MLLW using a tide staff or the predicted tides from the National Oceanic and Atmospheric Administration (NOAA). The most recent bathymetric surveys will be provided by USACE-Wilmington prior to the sampling event and will be used as a reference in the field to confirm depths.

**Sampling**
Site conditions such as prevailing weather, wind direction, air temperature, and tidal cycle will be documented at each sampling site. *In situ* measurements, depth, date and time, coordinates, current conditions, sediment descriptions, number of containers, and team members will be recorded on project-specific field sheets. *An example Field Sheet is located at the end of this QAPP.*

**Water Grab Sampling:** Water samples will be collected consistent with recommendations in the SERIM*, at 1 meter above the bottom with either a non-contaminating pump (submersible pump designed for environmental water sampling or peristaltic pump) or with a Van Dorn type sampler. The preferred method will be to use a non-contaminating submersible pump, the other methods listed here are backup methods and will not likely be used.*

When sampling the inshore site water sample, *in situ* hydrographic measurements for water temperature, pH, water depth, dissolved oxygen, salinity, and conductivity will be collected at the surface of the water column *using either a YSI 650MDS or a Hydrolab Multi Probe Datasonde®. Turbidity will be measured using a Hach 2100P® Turbidimeter.* All instruments will be calibrated according to the manufacturers' specifications at the beginning and end of the sampling day.

**Sediment Core Sampling:** Core sampling will be performed by vibratory core. The ANAMAR Project Manager and a USACE-Wilmington representative will be onboard to direct the actual collection of the sediment. *ANAMAR will direct the crew of the coring/surveying vessel. Appropriate core liners will be used and all sampling activities will be done according to ANAMAR's protocols.* All equipment coming into contact with the samples will be of an approved material (e.g., Teflon®, stainless steel, polycarbonate [Lexan®]).

*The target penetration depth below the water surface will be calculated based on target core penetration, current water depth and current tide height. When sediment cores are collected using a vibracore, the retrieved sample is subject to material compaction. This means that a core with a penetration depth of 10 feet may result in a recovered core only 8-9 feet in length. Since the material is unlikely to compress uniformly along the length of the core, this will make the exact division line between the upper and lower sections difficult to determine. ANAMAR estimates that a difference of ±1 foot could be expected.*

*When the core is brought aboard the vessel, it will be placed horizontally on a clean surface. Using the actual penetration depth, and actual recovered core length, the division of the upper and lower samples (-28' MLLW) will be calculated. The lower portion of the core will be extruded into one decontaminated stainless steel bin, and the upper portion will be extruded into another. This will be repeated until the required volume of sediment has been collected. Both sections of the core will be photographed, and notes on the samples' appearance and characteristics will be recorded on sample specific field sheets. With the technicians using decontaminated stainless steel utensils and new disposable lab gloves, the samples will be transferred into pre-cleaned, pre-labeled 5-gallon Teflon® bags. All containers will be placed in coolers on ice immediately. Upon return to the boat dock, the samples will be transferred to and locked in a vehicle or a refrigerated trailer.*

**Sediment Grab Sampling:** Grab samples will be collected *with a stainless steel Van Veen, Ponar or similar type clamshell device and then emptied into a decontaminated stainless steel bin. When the required volume of sediment has been collected, a picture of the sample will be taken and notes on the sample's appearance and characteristics will be recorded on the field sheet. Using decontaminated stainless steel utensils and new disposable gloves, the technician will transfer the sample into pre-cleaned 5-gallon Teflon® bags. All containers will be properly labeled and placed in coolers on ice immediately. Upon return to the boat dock, the samples will be transferred to and locked in a vehicle or a refrigerated trailer.*

**Field Replicate:** One field replicate will be collected as described in the EPA document *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations* (EPA 1995). The field replicate will be analyzed for sediment chemistry, elutriate chemistry and physical parameters, but not for toxicological testing. It will be given a different sample ID so the laboratory will not be able to differentiate between it and its duplicate.

**Decontamination:** All equipment contacting sediment or water samples will be cleaned and decontaminated as described in *FDEP SOP, FC1131 (FDEP 2004). Below is a summarized list of procedures. Work surfaces on the sampling vessel will cleaned before the sampling day begins and before leaving each station. All equipment contacting sediment or water samples, gloves and any protective clothing will be changed and/or cleaned between sampling stations to prevent cross contamination.*

*Decontamination Procedures*

- *Wash and scrub to remove gross contamination*
- *Wash/scrub with Liquinox®*
- *Rinse with SITE WATER*
- *Rinse with DI WATER*
- *2X Rinse with ISOPROPANOL*
- *2X Rinse with HEXANE (added due to dioxin analysis, not in FDEP SOP FC1131)*
- *3X Rinse with DI WATER*
- *Air dry*
- *Store wrapped in new, clean aluminum foil*

*Any derived waste will be contained and disposed of in accordance with federal, state, and local laws.*

**Sample Storage and Transport:** *After collection, the samples will be immediately placed in pre-labeled containers, put in coolers, and packed with ice. Coolers will remain locked inside a field vehicle or in a refrigerated trailer. If the coolers will be in a vehicle, the ice will be checked and refreshed as needed, at a minimum of every morning and every evening until samples are shipped to the laboratory. The temperature inside the refrigerated trailer will be kept at <4°C and recorded twice daily, every morning and every evening. If the temperature in the trailer either remains slightly above 4°C (above ~ 5-6°C) for two consecutive readings, or if one reading is above ~8°C, the samples will be placed on wet ice.*

*Chain-of-custody forms will be filled out and will accompany samples at all times during transport from the field operations area to the laboratory. The forms will note the sample ID and date and time of collection). Each sample will be identified by a unique alphanumeric system. After samples are logged in at the laboratory and assigned a unique laboratory ID number, they will be stored, handled, processed, and analyzed as described in the Quality Assurance Manuals and/or Standard Operating Procedures (SOPs) of the testing laboratories.*

**Homogenization, Compositing, Elutriation:**
*Upon returning to the contractor's offices (or possibly on-site, depending on logistics and time available), the subsamples from each sample will be composited in a large decontaminated stainless steel bin and divided for physical, chemical, and toxicological analyses, and also for generation of elutriates. Elutriates will be generated using the methods described in the Inland Testing Manual (ITM) (USEPA/USACE 1998). The samples will be re-labeled and sent to the appropriate labs. Chain-of-custody forms from the field will have each subsample ID listed. When the samples are composited, the subsample IDs will no longer be appropriate and new chain-of-custody forms will be filled out and accompany the samples to the final destination. All samples will be kept at <4°C, either by being placed on wet ice or by being stored in a refrigerated trailer.*

## 11.2 Identify Support Facilities for Sampling Methods

| |
|---|
| This should include a brief description of the equipment and vessel (s) used in the sampling operation. |

All sampling will be done according to published procedures. Each sampling vessel will conform to USCG regulations, and all sampling activities will conform to the USACE Safety Manual (USACE 2003).

*Inshore vibracoring will be conducted from the USACE snag boat "Snell", and offshore sampling will be performed from a 24-foot or equivalent vessel equipped with a hoisting mechanism.*

### 11.3 Describe Sampling/Measurement System Failure Response and Corrective Action Process

**Corrective Action**

Any event that does not conform to the QAPP, SOPs, or SAP is considered a nonconformance event. These will be identified as quickly as possible and reported to the Project Manager (PM) as soon as practical. If the nonconformance event happens in the fieldwork portion of this project, it will be documented in the DQCR. The project director and/or project manager will confer with USACE-Wilmington and outline a procedure for accomplishing the task so the quality of the project is not compromised. Every effort will be taken to contact the USACE representative prior to any deviation from the above-mentioned procedures.

*Backups of field equipment and supplies will be on-hand in case of equipment failure or other factors that render the primary method unusable. Examples of what will be taken as backups include: Ponar sampler, Lexan® liners, sample containers, in situ multi-parameter meter, turbidimeter, peristaltic pump, etc.*

### 11.4 Describe Sampling Equipment, Sample Preservation, and Holding Times

All sampling techniques and equipment will be in accordance with *FDEP SOPs and/or USEPA published procedures (USEPA 1995).*

*Any sampling device or material coming into contact at any time with a sample will be decontaminated as described in Section 11.1 and made of an approved material (Teflon®, polycarbonate [Lexan®], or stainless steel). Cores will be taken in a polycarbonate liner with a stainless steel bit and core-catcher. Water will be collected with a non-contaminating pump. Grab samples will be taken with a Van Veen or Ponar type clamshell sampler. All samples will be placed in appropriate pre-cleaned containers and put in coolers on wet ice immediately after collection.*

*Other types of sampling equipment are described in section 11.1.*

*All holding times and preservation will conform to USEPA guidelines in QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations (USEPA 1995).*

## 12.0 ELEMENT B3 – SAMPLE HANDLING AND CUSTODY REQUIREMENTS

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.3. This section should include discussions of the following elements:

- Proposed sample preservation, transport and chain-of-custody procedures.
- Proposed sample storage and archiving procedures (e.g., temperatures and holding times, cross referencing is encouraged).

All sample handing will be done according to procedures and methods outlined in *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations* (USEPA 1995).

**Sample Handling**

All sediment and water containers will be labeled accurately and filled out entirely. The label information will be consistent with that provided on the chain-of-custody form. Sample labels will include the following information:

1. Project
2. Sample Identification number and station number
3. Matrix
4. Date and time of sample collection
5. Depth of sample
6. Name of collector
7. Sample preservation used, if required
8. Type of analysis
9. Lab number or name

*Samples will be composited and homogenized as described in Section 11.1. Section 11.1 also explains procedures pertaining to sample storage and transport.*

**Chain-of-Custody Requirements**

Chain-of-custody records from the field will have each subsample ID listed. When the samples are composited, the subsamples will no longer be appropriate and new chain-of-custody forms will be filled out and accompany the samples to the final destination. All samples will be kept at <4°C, either by being placed on wet ice or by being stored in a refrigerated trailer.

Upon receipt at the laboratories, the samples will be logged into the laboratory's LIMS and assigned a unique number for tracing through the analytical process in the lab. Any sample aliquot, tissue sample being transferred from the toxicology lab to the chemistry lab, or any other lab transfer of any sample (sediment, water, or tissue) will have complete chain-of-custody records. All chain-of-custody records will be included in the final report to USACE.

### Storage and Disposal of Samples

*The laboratories will retain all remaining unused sample volume under appropriate temperature and light conditions at least until the data generated from the samples goes through ANAMAR QA/QC and is approved as acceptable. Preferably, samples will be retained until the final report is submitted to the USACE. The storage/archive time will be dependant on space available at the laboratory.* Approval by the USACE Project Manager will be obtained prior to disposal of any sediment, water, or tissue sample if disposal is needed before the final report is submitted. Samples will be disposed of properly according to federal, state, and local laws.

*Additional information regarding sample storage is presented in Section 11.1 (Sample Storage and Transport).*

## 13.0 ELEMENT B4 – ANALYTICAL METHODS REQUIREMENTS

| See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.2. |
|---|

Element B4 encompasses the information indicated in Sections 13.1 through 13.3, below.

### 13.1 Subsampling

A minimum of five subsamples of each sample will be collected and composited for analysis.

### 13.2 Preparation of the Samples

| This information may be combined in a table with the requirement of 13.3, below. |
|---|

*The subsamples from each sample will be composited in a large, decontaminated stainless steel bin and divided for physical, chemical and toxicological analyses, and also for generation of elutriates. Elutriates will be generated using the methods described in the ITM (USEPA/USACE 1998). The samples will be re-labeled and sent to the appropriate labs. Chain-of-custody records from the field will have each subsample ID listed. When the samples are composited, the subsamples will no longer be appropriate and new chain-of-custody forms will be filled out and accompany the samples to the final destination. All samples will be kept at <4°C either by being placed on wet ice or by being stored in a refrigerated trailer.*

### 13.3 Analytical Methods

| This information may be combined in a table with the requirement of 13.2. Laboratories are allowed to use professional judgment in modifying and developing alternatives to approved test methods to take advantage of emerging technologies that reduce costs, overcome analytical difficulties, and enhance data quality. A necessary condition of method flexibility is the requirement that modified method produce results equivalent or superior to results produced by the approved reference method. The flexibility to select more appropriate methods provides an opportunity to use new technologies to overcome matrix interference problems, lower detection limits, improve laboratory productivity, or reduce the amount of hazardous wastes in the laboratory. |
|---|

### 13.3.1 Physical and Chemical Analysis

This section should present the following information in tabular format:

- Characteristics to be measured (e.g., conventional physical measurements, metals, PAHs, polychlorinated biphenyls, organotins, and pesticides),
- Proposed preparation/extraction and cleanup methods,
- Proposed analytical methods,
- Target Detection Limits (TDL) of elutriate, sediment (dry weight basis) and tissue (wet weight basis). TDLs should meet those specified in the SERIM Tables 5-3 to 5-7, 5-9 to 5-11, and 6-4 to 6-8.

Discussion of the proposed methods should be included to clarify any study-specific or lab-specific modifications or additions, or to justify substantive deviations from the methods in Tables 5-2 to 5-11 and 6-4 to 6-8 of the SERIM.

***Physical and Chemical Analysis of Sediment, Elutriates, and Tissues:*** *Physical and chemical analyses will be conducted on the same sediment used for the biological testing (i.e., all composited samples and reference sediments). Adequate sample will be collected to allow sufficient material to be analyzed to account for high water content in the sediment samples and dilution of samples when addressing detection limits and interferences. Sediment samples will be obtained from an estuarine environment. The contractor will utilize applicable measures to control salt interference. Composite samples from a particular location will be completely homogenized prior to obtaining splits for the required analyses. The concentration, reporting limit (RL), and method detection limit (MDL) will be reported on a dry weight basis.*

*If alternative methods or detection limits are used, approval from USEPA and USACE-Wilmington is required. For grain size distributions, in addition to reporting the percentages in each size class, a graph of the cumulative frequency percentages using U.S. Army Engineering (ENG) Form 2087 (Gradation Curves) or similar form will be used.*

*Sufficient sediment will be collected during field work to run all tests on all sediment samples (including duplicates), and to run re-tests of any of the samples if required. Analyses shall be performed in a timely fashion, allowing for retesting prior to expiration of holding times.*

*Elutriates will be generated using procedures described in the ITM (USEPA/USACE 1998).*

**Analytes, Methods, and Target Reporting Limits: Sediment Physical Analyses**

| Parameter | *Test Method* | Reporting Limit |
|---|---|---|
| Grain Size | *ASTM-D422* | 1.0 % |
| Total Solids/Water Content | *ASTM-D2216-80 Plumb 1998* | 1.0 % solids |
| Specific Gravity of soils | *ASTM D-854-00* | 0.01 mg/L |

**Analytes, Methods, and Target Reporting Limits: Sediment Chemistry**

| Test Parameters | *Test Method* | Reporting Limit (Dry Weights) |
|---|---|---|
| **METALS/OTHERS** | | |
| Antimony | *6010b/200.8* | 0.50 mg/kg |
| Arsenic | *6010b/200.8* | 0.10 mg/kg |
| Beryllium | *6010b/200.8* | 0.50 mg/kg |
| Cadmium | *6010b/200.8* | 0.10 mg/kg |
| Chromium | *6010b/200.8* | 0.10 mg/kg |
| Copper | *6010b/200.8* | 0.10 mg/kg |
| Lead | *6010b/200.8* | 0.10 mg/kg |
| Mercury | *7471A* | 0.05 mg/kg |
| Nickel | *6010b/200.8* | 0.10 mg/kg |
| Selenium | *6010b/200.8* | 0.20 mg/kg |
| Silver | *6010b/200.8* | 0.062 mg/kg |
| Thallium | *6010b/200.8* | 1.00 mg/kg |
| Zinc | *6010b/200.8* | 0.50 mg/kg |
| | | |
| Total Petroleum Hydrocarbons | *9071* | 0.25 mg/kg |
| Total Organic Carbon (TOC) | *9060(mod)* | 100 mg/kg |
| | | |
| **ORGANOTINS** | *Krone et al.* | |
| Monobutyltin | *Krone* | 1.0 μg/kg |
| Dibutyltin | *Krone* | 1.3 μg/kg |
| Tributyltin | *Krone* | 1.5 μg/kg |
| | | |
| **PESTICIDES** | | |
| Aldrin | *8081A* | 1.7 μg/kg |
| Chlordane & derivatives | | |
| Technical Chlordane | *8081A* | 1.7 μg/kg |
| $\alpha$ *(cis)*–Chlordane | *8081A* | 1.7 μg/kg |
| $\gamma$ *(trans)*–Chlordane | *8081A* | 1.7 μg/kg |
| Oxychlordane | *8081A* | 1.7 μg/kg |
| *Cis*-Nonachlor | *8081A* | 1.7 μg/kg |
| *Trans*-Nonachlor | *8081A* | 1.7 μg/kg |
| DDD & derivatives | | |
| o,p′ (2,4′)-DDD | *8081A* | 1.7 μg/kg |
| p,p′ (4,4′)-DDD | *8081A* | 1.7 μg/kg |
| o,p′ (2,4′)-DDE | *8081A* | 1.7 μg/kg |
| p,p′ (4,4′)-DDE | *8081A* | 1.7 μg/kg |
| o,p′ (2,4′)-DDT | *8081A* | 1.7 μg/kg |
| p,p′ (4,4′)-DDT | *8081A* | 1.7 μg/kg |
| Dieldrin | *8081A* | 1.7 μg/kg |
| Endosulfan & derivatives | | |
| Endosulfan I | *8081A* | 1.7μg/kg |
| Endosulfan II | *8081A* | 1.7μg/kg |
| Endrin & derivatives | | |

**Analytes, Methods, and Target Reporting Limits: Sediment Chemistry**

| Test Parameters | *Test Method* | Reporting Limit (Dry Weights) |
|---|---|---|
| Endrin | *8081A* | 1.7 µg/kg |
| Endrin aldehyde | *8081A* | 1.7 µg/kg |
| Endrin ketone | *8081A* | 1.7 µg/kg |
| Heptachlor and derivatives | | |
| Heptachlor | *8081A* | 1.7 µg/kg |
| Heptachlor epoxide | *8081A* | 1.7 µg/kg |
| Hexachlorocyclohexane (BHC) | | |
| α-BHC | *8081A* | 1.7µgµ/kg |
| β-BHC | *8081A* | 1.7 µg/kg |
| δ-BHC | *8081A* | 1.7 µg/kg |
| γ-BHC (Lindane) | *8081A* | 1.7 µg/kg |
| Methoxychlor | *8081A* | 1.7 µg/kg |
| Mirex© | *8081A* | 1.7 µg/kg |
| Toxaphene | *8081A* | 167 µg/kg |
| Total Chlorinated Pesticides | *8081A* | 10 µg/kg |
| | | |
| **PCB CONGENERS** | | |
| PCB-8 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-18 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-28 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-44 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-49 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-52 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-66 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-77 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-87 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-101 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-105 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-118 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-126 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-128 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-138 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-153 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-156 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-169 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-170 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-180 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-183 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-184 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-187 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-195 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-206 | *Mod 8082NOAA* | 1 µg/kg |
| PCB-209 | *Mod 8082NOAA* | 1 µg/kg |

**Analytes, Methods, and Target Reporting Limits:  Sediment Chemistry**

| Test Parameters | *Test Method* | Reporting Limit (Dry Weights) |
|---|---|---|
| **PCB AROCLORS** | | |
| PCB-1016 | *8082* | 33 µg/kg |
| PCB-1221 | *8082* | 33 µg/kg |
| PCB-1232 | *8082* | 33 µg/kg |
| PCB-1242 | *8082* | 33 µg/kg |
| PCB-1248 | *8082* | 33 µg/kg |
| PCB-1254 | *8082* | 33 µg/kg |
| PCB-1260 | *8082* | 33 µg/kg |
| | | |
| ***POLYNUCLEAR AROMATIC HYDROCARBONS*** | | |
| Acenaphthene | *8270SIM/8310* | 20 µg/kg |
| Acenaphthylene | *8270SIM/8310* | 20 µg/kg |
| Anthracene | *8270SIM/8310* | 20 µg/kg |
| Benzo(a)fluoranthene | *8270SIM/8310* | 20 µg/kg |
| Benzo(b)fluoranthene | *8270SIM/8310* | 20 µg/kg |
| Benzo(k)fluoranthene | *8270SIM/8310* | 20 µg/kg |
| Benzo(a)pyrene | *8270SIM/8310* | 20 µg/kg |
| Benzo(g,h,i)perylene | *8270SIM/8310* | 20 µg/kg |
| Chrysene | *8270SIM/8310* | 20 µg/kg |
| Dibenzo(a,h)anthracene | *8270SIM/8310* | 20 µg/kg |
| Fluorene | *8270SIM/8310* | 20 µg/kg |
| Fluoranthene | *8270SIM/8310* | 20 µg/kg |
| Indeno(1,2,3-cd)pyrene | *8270SIM/8310* | 20 µg/kg |
| 1-Methylnaphthalene | *8270SIM/8310* | 20 µg/kg |
| 2-Methylnaphthalene | *8270SIM/8310* | 20 µg/kg |
| Naphthalene | *8270SIM/8310* | 20 µg/kg |
| Phenanthrene | *8270SIM/8310* | 20 µg/kg |
| Pyrene | *8270SIM/8310* | 20 µg/kg |
| **DIOXINS** | | |
| All congeners | *8290* | 1.0 ppt (2378 TCDD) |

**Analytes, Methods, and Target Reporting Limits:  Elutriate Chemistry**

| Test Parameter | Test Method | Reporting Limit |
|---|---|---|
| **METALS/OTHERS** | | |
| Antimony | *6010b/200.8* | 1 µg/L |
| Arsenic | *6010b/200.8* | 1 µg/L |
| Beryllium | *6010b/200.8* | 1 µg/L |
| Cadmium | *6010b/200.8* | 1 µg/L |
| Chromium | *6010b/200.8* | 1 µg/L |
| Copper | *6010b/200.8* | 1 µg/L |
| Lead | *6010b/200.8* | 1 µg/L |
| Mercury | *7471A* | 0.2 µg/L |
| Nickel | *6010b/200.8* | 1 µg/L |
| Selenium | *6010b/200.8* | 2 µg/L |

**Analytes, Methods, and Target Reporting Limits: Elutriate Chemistry**

| Test Parameter | Test Method | Reporting Limit |
|---|---|---|
| Silver | *6010b/200.8* | 1 μg/L |
| Thallium | *6010b/200.8* | 1 μg/L |
| Zinc | *6010b/200.8* | 1 μg/L |
| | | |
| **ORGANOTINS** | *Krone* | |
| Monobutyltin | *Krone* | 0.01μg/L |
| Dibutyltin | *Krone* | 0.01μg/L |
| Tributyltin | *Krone* | 0.01 μg/L |
| | | |
| Total Petroleum Hydrocarbons | *9071* | 0.50 mg/L |
| | | |
| **PESTICIDES** | | |
| Aldrin | *8081A* | 0.5 μg/L |
| Chlordane & derivatives | | |
| Technical Chlordane | *8081A* | 0.5 μg/L |
| α *(cis)*–Chlordane | *8081A* | 0.5 μg/L |
| γ *(trans)*–Chlordane | *8081A* | 0.5 μg/L |
| Oxychlordane | *8081A* | 0.5 μg/L |
| *Cis*-Nonachlor | *8081A* | 0.5 μg/L |
| *Trans*-Nonachlor | *8081A* | 0.5 μg/L |
| DDD & derivatives | | |
| o,p′ (2,4′)-DDD | *8081A* | 0.05 μg/L |
| p,p′ (4,4′)-DDD | *8081A* | 0.05 μg/L |
| o,p′ (2,4′)-DDE | *8081A* | 0.05 μg/L |
| p,p′ (4,4′)-DDE | *8081A* | 0.05 μg/L |
| o,p′ (2,4′)-DDT | *8081A* | 0.05 μg/L |
| p,p′ (4,4′)-DDT | *8081A* | 0.05 μg/L |
| Dieldrin | *8081A* | 0.01 μg/L |
| Endosulfan & derivatives | | |
| Endosulfan I | *8081A* | 0.01 μg/L |
| Endosulfan II | *8081A* | 0.01μg/L |
| Endrin & derivatives | | |
| Endrin | *8081A* | 0.01μg/L |
| Endrin aldehyde | *8081A* | 0.01μg/L |
| Endrin ketone | *8081A* | 0.01μg/L |
| Heptachlor and derivatives | | |
| Heptachlor | *8081A* | 0.01μg/L |
| Heptachlor epoxide | *8081A* | 0.01μg/L |
| Hexachlorocyclohexane (BHC) | | |
| α-BHC | *8081A* | 0.01μg/L |
| β-BHC | *8081A* | 0.01μg/L |
| δ-BHC | *8081A* | 0.01μg/L |
| γ-BHC (Lindane) | *8081A* | 0.01μg/L |
| Methoxychlor | *8081A* | 0.01μg/L |
| Mirex© | *8081A* | 0.01μg/L |
| Toxaphene | *8081A* | 0.2 μg/L |

**Analytes, Methods, and Target Reporting Limits: Elutriate Chemistry**

| Test Parameter | Test Method | Reporting Limit |
|---|---|---|
| **PCB CONGENERS** | | |
| PCB-8 | *Mod 8082NOAA* | 2 ng/L |
| PCB-18 | *Mod 8082NOAA* | 2 ng/L |
| PCB-28 | *Mod 8082NOAA* | 2 ng/L |
| PCB-44 | *Mod 8082NOAA* | 2 ng/L |
| PCB-49 | *Mod 8082NOAA* | 2 ng/L |
| PCB-52 | *Mod 8082NOAA* | 2 ng/L |
| PCB-66 | *Mod 8082NOAA* | 2 ng/L |
| PCB-77 | *Mod 8082NOAA* | 2 ng/L |
| PCB-87 | *Mod 8082NOAA* | 2 ng/L |
| PCB-101 | *Mod 8082NOAA* | 2 ng/L |
| PCB-105 | *Mod 8082NOAA* | 2 ng/L |
| PCB-118 | *Mod 8082NOAA* | 2 ng/L |
| PCB-126 | *Mod 8082NOAA* | 2 ng/L |
| PCB-128 | *Mod 8082NOAA* | 2 ng/L |
| PCB-138 | *Mod 8082NOAA* | 2 ng/L |
| PCB-153 | *Mod 8082NOAA* | 2 ng/L |
| PCB-156 | *Mod 8082NOAA* | 2 ng/L |
| PCB-169 | *Mod 8082NOAA* | 2 ng/L |
| PCB-170 | *Mod 8082NOAA* | 2 ng/L |
| PCB-180 | *Mod 8082NOAA* | 2 ng/L |
| PCB-183 | *Mod 8082NOAA* | 2 ng/L |
| PCB-184 | *Mod 8082NOAA* | 2 ng/L |
| PCB-187 | *Mod 8082NOAA* | 2 ng/L |
| PCB-195 | *Mod 8082NOAA* | 2 ng/L |
| PCB-206 | *Mod 8082NOAA* | 2 ng/L |
| PCB-209 | *Mod 8082NOAA* | 2 ng/L |
| | | |
| **PCB AROCLORS** | | |
| PCB-1016 | *8082* | 0.05 μg/L |
| PCB-1221 | *8082* | 0.05 μg/L |
| PCB-1232 | *8082* | 0.05 μg/L |
| PCB-1242 | *8082* | 0.05 μg/L |
| PCB-1248 | *8082* | 0.05 μg/L |
| PCB-1254 | *8082* | 0.05 μg/L |
| PCB-1260 | *8082* | 0.05 μg/L |

| Test Parameter | Test Method | Reporting Limit |
|---|---|---|
| **POLYNUCLEAR AROMATIC HYDROCARBONS** | | |
| Acenaphthene | *8270SIM/8310* | 0.005 µg/L |
| Acenaphthylene | *8270SIM/8310* | 0.005 µg/L |
| Anthracene | *8270SIM/8310* | 0.005 µg/L |
| Benzo(a)fluoranthene | *8270SIM/8310* | 0.005 µg/L |
| Benzo(b)fluoranthene | *8270SIM/8310* | 0.005 µg/L |
| Benzo(k)fluoranthene | *8270SIM/8310* | 0.005 µg/L |
| Benzo(a)pyrene | *8270SIM/8310* | 0.005 µg/L |
| Benzo(g,h,i)perylene | *8270SIM/8310* | 0.005 µg/L |
| Chrysene | *8270SIM/8310* | 0.005 µg/L |
| Dibenzo(a,h)anthracene | *8270SIM/8310* | 0.005 µg/L |
| Fluorene | *8270SIM/8310* | 0.005 µg/L |
| Fluoranthene | *8270SIM/8310* | 0.005 µg/L |
| Indeno(1,2,3-cd)pyrene | *8270SIM/8310* | 0.005 µg/L |
| 1-Methylnaphthalene | *8270SIM/8310* | 0.005 µg/L |
| 2-Methylnaphthalene | *8270SIM/8310* | 0.005 µg/L |
| Naphthalene | *8270SIM/8310* | 0.005 µg/L |
| Phenanthrene | *8270SIM/8310* | 0.005 µg/L |
| Pyrene | *8270SIM/8310* | 0.005 µg/L |

**Chemical Analyses of Tissues.** Tissues from the 28-day bioaccumulation test organisms will be analyzed for the COCs listed below*:

**Analytes, Methods, and Target Reporting Limits: Tissue Chemistry***

| Test Parameter | Test Method | Reporting Limit (Wet Weights) |
|---|---|---|
| **METALS/OTHERS** | | |
| Antimony | *6010b/200.8* | 0.5 mg/kg |
| Arsenic | *6010b/200.8* | 0.2 mg/kg |
| Beryllium | *6010b/200.8* | 0.5 mg/kg |
| Cadmium | *6010b/200.8* | 0.1 mg/kg |
| Chromium | *6010b/200.8* | 0.5 mg/kg |
| Copper | *6010b/200.8* | 1 mg/kg |
| Lead | *6010b/200.8* | 0.2 mg/kg |
| Mercury | *7471A* | 0.02 mg/kg |
| Nickel | *6010b/200.8* | 1 mg/kg |
| Selenium | *6010b/200.8* | 0.20 mg/kg |
| Silver | *6010b/200.8* | 0.062 mg/kg |
| Thallium | *6010b/200.8* | 0.01 mg/kg |
| Zinc | *6010b/200.8* | 1 mg/kg |
| | | |
| % Moisture | *EPA 1986, 1987* | 0.1% |
| Lipids | *Lee et al., 1989* | 0.1% |
| | | |

**Analytes, Methods, and Target Reporting Limits: Tissue Chemistry***

| Test Parameter | Test Method | Reporting Limit (Wet Weights) |
|---|---|---|
| **ORGANOTINS** | *Krone et al.* | |
| Monobutyltin | *Krone* | 1.0 μg/kg |
| Dibutyltin | *Krone* | 1.3 μg/kg |
| Tributyltin | *Krone* | 1.5 μg/kg |
| | | |
| **PESTICIDES** | | |
| Aldrin | *8081A* | 1.7 μg/kg |
| Chlordane & derivatives | | |
| Technical Chlordane | *8081A* | 1.7 μg/kg |
| $\alpha$ *(cis)*–Chlordane | *8081A* | 1.7 μg/kg |
| $\gamma$ *(trans)*–Chlordane | *8081A* | 1.7 μg/kg |
| Oxychlordane | *8081A* | 1.7 μg/kg |
| *Cis*-Nonachlor | *8081A* | 1.7 μg/kg |
| *Trans*-Nonachlor | *8081A* | 1.7 μg/kg |
| DDD & derivatives | | |
| o,p′ (2,4′)-DDD | *8081A* | 1.7 μg/kg |
| p,p′ (4,4′)-DDD | *8081A* | 1.7 μg/kg |
| o,p′ (2,4′)-DDE | *8081A* | 1.7 μg/kg |
| p,p′ (4,4′)-DDE | *8081A* | 1.7 μg/kg |
| o,p′ (2,4′)-DDT | *8081A* | 1.7 μg/kg |
| p,p′ (4,4′)-DDT | *8081A* | 1.7 μg/kg |
| Dieldrin | *8081A* | 1.7 μg/kg |
| Endosulfan & derivatives | | |
| Endosulfan I | *8081A* | 1.7μg/kg |
| Endosulfan II | *8081A* | 1.7μg/kg |
| Endrin & derivatives | | |
| Endrin | *8081A* | 1.7 μg/kg |
| Endrin aldehyde | *8081A* | 1.7 μg/kg |
| Endrin ketone | *8081A* | 1.7 μg/kg |
| Heptachlor and derivatives | | |
| Heptachlor | *8081A* | 1.7 μg/kg |
| Heptachlor epoxide | *8081A* | 1.7 μg/kg |
| Hexachlorocyclohexane (BHC) | | |
| α-BHC | *8081A* | 1.7μgμ/kg |
| β-BHC | *8081A* | 1.7 μg/kg |
| δ-BHC | *8081A* | 1.7 μg/kg |
| γ-BHC (Lindane) | *8081A* | 1.7 μg/kg |
| Methoxychlor | *8081A* | 1.7 μg/kg |
| Mirex© | *8081A* | 1.7 μg/kg |
| Toxaphene | *8081A* | 167 μg/kg |
| Total Chlorinated Pesticides | *8081A* | 10 μg/kg |
| | | |

**Analytes, Methods, and Target Reporting Limits: Tissue Chemistry***

| Test Parameter | Test Method | Reporting Limit (Wet Weights) |
|---|---|---|
| **POLYNUCLEAR AROMATIC HYDROCARBONS** | | |
| Acenaphthene | *8310/8270 SIM* | 20 µg/kg |
| Acenaphthylene | *8310/8270 SIM* | 20 µg/kg |
| Anthracene | *8310/8270 SIM* | 20 µg/kg |
| Benzo(a)fluoranthene | *8310/8270 SIM* | 20 µg/kg |
| Benzo(b)fluoranthene | *8310/8270 SIM* | 20 µg/kg |
| Benzo(k)fluoranthene | *8310/8270 SIM* | 20 µg/kg |
| Benzo(a)pyrene | *8310/8270 SIM* | 20 µg/kg |
| Benzo(g,h,i)perylene | *8310/8270 SIM* | 20 µg/kg |
| Chrysene | *8310/8270 SIM* | 20 µg/kg |
| Dibenzo(a,h)anthracene | *8310/8270 SIM* | 20 µg/kg |
| Fluorene | *8310/8270 SIM* | 20 µg/kg |
| Fluoranthene | *8310/8270 SIM* | 20 µg/kg |
| Indeno(1,2,3-cd)pyrene | *8310/8270 SIM* | 20 µg/kg |
| 1-Methylnaphthalene | *8310/8270 SIM* | 20 µg/kg |
| 2-Methylnaphthalene | *8310/8270 SIM* | 20 µg/kg |
| Naphthalene | *8310/8270 SIM* | 20 µg/kg |
| Phenanthrene | *8310/8270 SIM* | 20 µg/kg |
| Pyrene | *8310/8270 SIM* | 20 µg/kg |
| | | |
| **DIOXINS** | | |
| All congeners | *8290* | 1.0 ppt (2378 TCDD-others slightly higher) |

* The list of analytes for tissues may be adjusted based on examination of sediment chemistry results.

### 13.3.2 Biological Analysis

| |
|---|
| This section should present an overview of the bioassay testing that is proposed. It should include a discussion of any project-specific parameters that have been prearranged that may influence future decision-making for this dredging project (i.e., additional bioaccumulation testing).[1] |

**Summary of Toxicity Test Species Requirements**

| |
|---|
| **SUSPENDED PARTICULATE PHASE TOXICITY**<br>Crustacean<br>Mysids, *Americamysis bahia* – 1-5 days old; age difference within batch to be 24 hours or less<br><br>Fish<br>Silverside, *Menidia menidia*, *M. beryllina*, or *M. peninsulae* -- 9-14 days old; age difference within batch to be 24 hours or less<br><br>Zooplankton<br>Bivalve larvae (oyster) (*Crassostrea virginica*) - Embryos within 4 hours of fertilization or<br>Sea urchin larvae (*Arbacia punctulata*) |
| **SOLID PHASE (WHOLE-SEDIMENT) TOXICITY**<br>Infaunal Amphipod<br>*Leptocheirus plumulosus*<br><br>Burrowing Polychaete<br>*Neries areceodentata* |
| **BIOACCUMULATION**<br>Burrowing Polychaete<br>Sand worm, *Nereis virens*<br><br>Bivalve<br>Bent-nose clam, *Macoma nasuta* relatively uniform in size |

[1] In some circumstances, EPA/USACE may agree to review draft data in order to expedite tiered testing (e.g., to decide on an appropriate compositing scheme, whether addition bioaccumulation testing is necessary, or a reduced list of analytes for bioaccumulation analysis). Any SAP proposing review of draft data should provide a full justification for the request being made.

**Bioassay Protocols**

Generally, the SAP should reference recommended protocols for conducting bioassays (e.g., ASTM or EPA standard methods). The following project-specific information should be included, as well as discussion of any proposed deviations from or clarifications of the recommended protocols:

- Species proposed for use and rationale for their selection (e.g., seasonal availability, substrate preference/tolerances), if necessary,
- Source of test organisms, and collection and handling procedure (including acclimation procedures),
- Control sediment source,
- Reference sediment source,
- Number of laboratory replicates proposed,
- Reference toxicant(s),
- Performance standards for control and reference samples,
- Performance standards for reference toxicant testing (e.g., laboratory mean and standard deviation on LC50/EC50 data for each species proposed for testing),
- Water quality parameters (e.g., salinity, temperature, pH, ammonia, and dissolved oxygen) to be measured in overlying water/elutriate, including measurement procedures and frequency,
- Proposed bioassay sediment interstitial water monitoring parameters (e.g., salinity, pH, ammonia, and sulfides), including measurement procedures and frequency. This should include any procedures for compensating for elevated interstitial concentrations.

Quality control procedures for toxicological analyses include the following:

**Water Bioassay Samples**

(See Green Book Section 11.1 -- Tier III: Water-Column Bioassays, for details.)

- Reference toxicant tests -- Geometric dilution series of five unreplicated concentrations, one of which must give >50% mortality and one of which must give <50% mortality; conducted once monthly per laboratory-cultured species and on each lot of purchased or field-collected organisms; 10 organisms per exposure chamber; 96-hour exposure (48-hour minimum for bivalve larvae); no sediment; use artificial seawater or clean natural seawater as the diluent, depending on which was employed in the bioassays.
- Control mortality ≤10% mean (≤30% abnormality for live oyster and sea urchin larvae)

**Sediment Bioassay Samples**

(See Green Book Section 11.2 -- Whole-Sediment Bioassays, for details.)

- Reference toxicant tests -- Geometric dilution series of five un-replicated concentrations, one of which must give >50% mortality and one of which must give <50% mortality; conducted once monthly per laboratory-cultured species and on each lot of purchased or field-collected organisms; 10 organisms per exposure chamber; 10-day exposure; use artificial seawater or clean natural seawater as the overlying water depending on which was employed in the bioassays.

- Ammonia in the overlying water and porewater will be monitored; appropriate action as described in the ITM (USEPA/USACE 1998) and/or the SERIM (USEPA/USACE 2008) will be taken for any ammonia results above limits recommended in the SERIM (<60 mg/l – see table 6-2 for *Leptocheirus plumulosus*).
- Control mortality ≤10% mean (amphipods control mortality ≤10% mean and no individual chamber ≥20% mortality)

**Sediment Bioaccumulation Samples**
(See Green Book Section 12.1 -- Tier III: Determination of Bioavailability, for details.)

- Reference toxicant tests -- Geometric dilution series of five un-replicated concentrations, one of which must give >50% mortality and one of which must give <50% mortality; conducted once monthly per laboratory-cultured species and on each lot of purchased or field-collected organisms; 20-25 organisms per exposure chamber; 28-day exposure; use artificial seawater or clean natural seawater as the diluent depending on which was employed in the bioaccumulation studies

Where control mortality is >10%, determine if the following conditions exist:

a. adequate replicates to obtain statistical power;
b. stressed organisms;
c. contaminated control sediment;
d. contamination of test system;
e. quality control problems; and
f. adequate tissue for chemical analyses.

Tissue samples from the 28-day bioaccumulation tests will be analyzed for the constituents listed in Section 13; the list of constituents may be adjusted based on examination of sediment chemistry results. Each series must include a minimum of five replicates of test sediment, five replicates of reference sediment, and three replicates of control sediment. An analysis will be made for each replicate. A minimum of 20 organisms per replicate is required for each test chamber, although more organisms may be required in order to conduct the specified tissue analyses at the end of the test exposure. All tissues will be depurated for 24 hours in clean sand prior to freezing.

## 14.0 ELEMENT B5 - QUALITY CONTROL REQUIREMENTS

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.5.

Field and laboratory QC procedures should follow recommended minimum laboratory QC outline in the SERIM, as well as standard industry practices for environmental samples. All QC in a cited method must be performed. This section should reference the guidance used or discuss the following QC components as they relate to the proposed sampling and analysis:

- Field cross-contamination and filter blanks
- Method blanks
- Duplicates (reported as relative standard deviation)
- Ongoing Precision and Recovery (OPR) [sometimes referred to as a laboratory control samples, quality control check sample, laboratory-fortified blank, or blank spike]
- Matrix spikes
- Spike duplicates
- Surrogate spikes
- QC batch size
- A detailed discussion should be included to clarify any study-specific or lab-specific modifications or to justify substantive deviations from recommended QC components.

*All chemical analyses will be performed by Columbia Analytical Services, Inc (CAS). CAS is a NELAC-certified laboratory; all analyses will be performed according to NELAC standards. The Quality Assurance Manual (QAM) and SOPs for CAS will clearly define quantitative and qualitative objectives for each analysis such as MDLs, precision, accuracy, completeness, representativeness, and comparability. The QAM and SOPs will be strictly adhered to for all analyses completed under the project. Appropriate standard quality-control checks such as sample splits and replicates, blanks, spiked blanks, matrix spikes and duplicates, surrogate and internal standards, and calibration standards will be incorporated into all laboratory activities and described in the laboratory's QAM and SOPs.*

*The QAM and SOPs will list the analytical equipment used for testing, along with relevant calibration and standard reference materials used, maintenance schedules, and recordkeeping methods. The accuracy and precision limits included in the QAM and SOPs of the analytical laboratory will meet the criteria established for this evaluation. The laboratory managers/directors listed in Section 2.0 will be responsible for assigning appropriately-trained analysts to perform the specific tests. As part of the NELAC certification, corrective procedures have been established if QA objectives are not met.*

### USACE-Specific Data Quality Objectives

Chemical data must conform to the data quality objectives listed below. Chemical data that fall outside of the acceptable limits will be re-tested at no additional cost to the government. All analytical anomalies will be described in detail in the final report.

## Data Quality Objectives for Chemical Analyses

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding times |
|---|---|---|---|---|
| PAHs and Pesticides | MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | 14 Days until extraction, 40 days thereafter |
| | MS/MSD | 1 set per 20 samples or 1 set per batch up to 20 samples | 70 - 130% for spike limits<br><br>30% RSD for precision | |
| | Duplicate | 1 per 20 samples or 1 per batch up to 20 samples | 30% RSD for precision (evaluated for analytes >3x RL) | |
| | SRM** | 1 per 20 samples or 1 per batch up to 20 samples | Within limits specified by provider (evaluated for analytes >3x RL) | |
| | ICV | Immediately following calibration curve | 80 - 120% Recovery | |
| | CCV | Minimum - one per 10 samples and at the end of each batch whenever batch is greater than 10 or for GC/MS at the beginning of every 12 hours | RRF or RF ≤25% for GC/MS methods and ≤15 for all other methods | |
| | Surrogates | Every sample | 30 - 150% Recovery | |
| | Internal Standard | Every sample | 50 - 200% Recovery | |
| | IC | Verify after each initial calibration | <20% RSD for each analyte or RF ≤30% for GC/MS | |
| | MDL | Verify MDL study once per year for each analyte of interest | Updated annually | |

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding times |
|---|---|---|---|---|
| Organotins | MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | 14 Days until extraction, 40 days thereafter |
| | MS/MSD | 1 set per 20 samples or 1 set per batch up to 20 samples | 70 - 130% for spike limits<br><br>40% RSD for precision | |
| | Duplicate | 1 per 20 samples or 1 per batch up to 20 samples | 40% RSD for precision (Evaluated for analytes >3x RL) | |
| | SRM** | 1 per 20 samples or 1 per batch up to 20 samples | Within limits specified by provider (Evaluated for analytes >3x RL) | |
| | ICV | Immediately following calibration curve | 75-125% Recovery | |
| | CCV | At the beginning of every 12 hours of analysis | 75-125% Recovery | |
| | Surrogates | Every sample | 20-150% Recovery | |
| | IC | Verify after each initial calibration | <20% RSD | |
| | MDL | Verify MDL study once per year for each analyte of interest | Updated annually | |

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding times |
|---|---|---|---|---|
| Dioxins | MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | 14 Days until extraction, 40 days thereafter |
| | LCS | 1 per 20 samples or 1 per batch up to 20 samples | 70-130% for spike limits | |

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding times |
|---|---|---|---|---|
| | MS/MSD or LCS/LCSD^ | 1 set per 20 samples or 1 set per batch up to 20 samples | 70-130% recovery for accuracy and ≤20 % difference for precision | |
| | ICV | Immediately following calibration curve | 50 - 150% recovery | |
| | CCV° | At the beginning of every 12 hours of analysis | 80 - 120% Native standards 65 - 135% Labeled standards | |
| | Initial Calibration Standards | Once per run | 80 - 120% Native standards 65 - 135% Labeled standards | |

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding times |
|---|---|---|---|---|
| Metals | MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | 180 Days |
| | MS/MSD | 1 set per 20 samples or 1 set per batch up to 20 samples | 70 - 130% for spike limits | |
| | Duplicate | 1 per 20 samples or 1 per batch up to 20 samples | 30% RSD (Evaluated for analytes >3x RL) | |
| | SRM | 1 per 20 samples or 1 per batch up to 20 samples | 70 - 130% Recovery (Evaluated for analytes >3x RL) | |
| | LCS/LFB | 1 per 20 samples or 1 per batch up to 20 samples | 70 - 130% Recovery | |
| | ICV | Immediately following calibration curve | 90 - 110% Recovery | |

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding times |
|---|---|---|---|---|
| | CCV | Minimum - one per 10 samples and at the end of each batch whenever batch is greater than 10 | 90 - 110% Recovery | |
| | LDR | Verify LDR once per quarter for ICP analysis and one time for mercury analysis | Refer to frequency | |
| | Initial Calibration for AA, Hg | Performed daily | Correlation coefficient ≥ 0.995 | |
| | MDL | Verify MDL study once per year for each analyte of interest | Updated annually | |
| | ICB | Immediately after initial calibration | No analyte should be detected > RL | |

| | | | | |
|---|---|---|---|---|
| TOC | MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | 28 Days |
| | MS/MSD | 1 set per 20 samples or 1 set per batch up to 20 samples | 75 - 125% for spike limits<br><br>20% RSD for precision (Evaluated for analytes >3x RL) | |
| | Triplicate | 1 per 20 samples or 1 per batch up to 20 samples | 20% RSD for precision (Evaluated for analytes >3x RL) | |
| | SRM** | 1 per 20 samples or 1 per batch up to 20 samples | Within limits specified by provider (Evaluated for analytes >3x RL) | |
| | ICV | Immediately following calibration curve | 80 - 120% Recovery | |

| Parameter | QC Measurement | Frequency | Acceptance Criteria | Storage/Holding times |
|---|---|---|---|---|
| | CCV | At the beginning of every 12 hours of analysis | 90 - 110% Recovery | |
| | IC | Verify after each initial calibration | cc > 0.9950 for all calibrations | |
| | MDL | Verify MDL study once per year for each analyte of interest | Updated annually | |
| Grain Size | Triplicate | 1 set per 20 samples or per batch | <20% RSD | Undetermined |
| % Solids and Specific Gravity | Duplicate | 1 set per 10 samples or per batch | Within 20% Relative % Difference | Undetermined |

** If SRMs are not available, use laboratory control samples

Achieving the desired reporting limits (RLs) and method detection limits (MDLs) is critical to providing a suitable evaluation of the COCs and the suitability of the sediments for ocean disposal. The laboratory must perform yearly MDL verification studies on the matrices tested under this project. The most recent MDL verification studies on sediment, water, and tissue matrices will be submitted with the final data report.

The final report will include detailed explanations when the actual reporting limits exceed those listed in this table and/or when an alternative test method is used. Any deviation from the proposed methods will receive prior approval from USACE-Wilmington.

## 15.0 ELEMENT B6 – INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.6.

**Field Instruments***: All field instruments will be maintained in accordance with manufacturers' recommendations and will comply with FDEP SOPs, including but not limited to cleaning, inspection, changing of batteries, DO membranes, etc. Maintenance records will be kept according to FDEP SOP FT1000 (FDEP 2004).*

*Each instrument will also be inspected, tested, and calibrated prior to mobilizing to the field to ensure they are in good working order.*

**Laboratory Instruments:** The QAM and/or SOPs for each laboratory listed in Section 4.3 list the analytical equipment used for testing, along with relevant calibration and standard reference materials used, maintenance schedules, and recordkeeping methods. The accuracy and precision limits included in the QAM and SOPs of the analytical laboratory meet the criteria established for this evaluation. The laboratory managers/directors listed in Section 4.3 will be responsible for assigning appropriately-trained analysts to perform the specific tests. As part of the NELAC certification, corrective procedures have also been established if QA objectives are not met.

## 16.0 ELEMENT B7 – INSTRUMENT CALIBRATION AND FREQUENCY

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.7.

All laboratory instruments used in the analysis of sediment, elutriate, tissue, and toxicological analyses will be calibrated according to the method, laboratory Quality Assurance Manual, SOPs, or any other NELAC-approved method. All records of calibration will also be documented and provided in the laboratory reports according to the above procedures.

*All instruments used to take readings in the field will be calibrated according to the manufacturers' recommended procedures at the beginning of each sampling day. An end-of-day reading will be taken to document that the instrument remained calibrated throughout the sampling day. This calibration will be recorded and documented on a calibration log and supplied to USACE with copies of all field paperwork. Acceptance limits for in situ measurements are below:*

- *pH: ±0.2 SU*
- *Conductivity: ±5%*
- *Dissolved Oxygen: ±5%*
- *Turbidity: 0.1-10 NTU ±10%; 11-40 NTU ±8%; 41-100 NTU ±6.5%; >100 NTU ±5%*

## 17.0 ELEMENT B8 – INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

| |
|---|
| See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.8. |

All sample containers will be certified pre-cleaned and will have a Certificate of Analysis showing the containers were free of COCs. *These Certificates of Analysis will be kept and retained with the project files by ANAMAR. For containers provided by the laboratory(s), Certificates of Analysis will be kept by the laboratory according to their QAM and/or SOPs.*

*All calibration standards used for field instruments will be in-date. Lot numbers and expiration dates of each standard used will be recorded on the calibration sheets. Standards will also be appropriate for the results measured in the field (i.e., if marine water is being measured, conductivity standards will be of the appropriate concentration to accurately represent marine water as opposed to fresh water).*

*All laboratory consumables will be inspected, handled, stored, documented, and used according to NELAC requirements and in accordance with each laboratory's QAM and/or SOPs.*

## 18.0 ELEMENT B9 – DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.9.

Various forms of data will be generated while implementing this project: photographs, maps, GIS data, research-derived data, etc. All data generated during this project will be retained by the contractor. Any data not required to be submitted as described in Section 6 will be supplied to USACE and/or US EPA upon request.

## 19.0 ELEMENT B10 – DATA MANAGEMENT, INTERPRETATION, AND REDUCTION

| See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.2.10. |
|---|

Element B10 encompasses the information indicated in Sections 19.1 19.2, below.

### 19.1 Data Management

*Each laboratory has established, NELAC-approved procedures for data management, collection, validation, reduction, and reporting. As such, the analytical results will be extensively reviewed in-house by the laboratories submitting the data.*

*Each laboratory will submit an Electronic Data Deliverable (EDD) and a hard copy data packet to ANAMAR. All data tables will be generated from the EDD and will be cross-checked against the hard copy data packet. When a data packet is received by ANAMAR, it will be reviewed by ANAMAR's QA/QC Officer, with emphasis on NELAC standards. All laboratory reports received will include laboratory QC data generated in the analysis of the project samples including results of all method blanks, lab duplicates/triplicates, matrix spikes, spike duplicates/triplicates, reference material, surrogate spikes, standards, check standards, and calibration verifications. The analytical results for of these QC samples will be reviewed and documented in a CQAR for each analytical data packet received. This report will be incorporated into the final data report. The CQAR consists of a checklist and a case narrative of the analytical runs. Any nonconformance, QC deficiency, or other problems that would impact data quality will be addressed in the CQAR. In particular, ANAMAR will compare data to the data quality objectives listed in Section 7, as well as confirm that target detection limits listed in Section 13.3.1 were reached. If any data quality objective is not reached, the laboratory will re-analyze the sample(s) and/or provide documentation for the failed criteria. The CQAR will contain a written record of the validity of each data package and its subsequent use in the report.*

*Field parameters, sample descriptions, site conditions, core logs, and additional information pertaining to the sample and sampling process will be recorded on sample-site-specific field sheets. Calibration data for field instruments will be recorded on calibration sheets. A DQCR will be filled out for each day of sampling and sample processing. Each of these records is integral to the successful completion of this project. As such, they will be reviewed, reported, and retained as described elsewhere in this document.*

*ANAMAR will use the password-protected Client Login section on the company's website (www.anamarinc.com) to upload documents for client access and to keep USACE-Wilmington up to date with all documents and data related to this project. This provides access to current documents and allows USACE-Wilmington to perform an in-progress data review data.*

### 19.2 Data Interpretation and Reduction

Data reduction in the final report will be done as discussed in the Green Book and the SERIM. This contract included the STFATE model. *Numerical models are components of the Tier III* *water column evaluations. The STFATE model will be used and run only for the COC that requires the greatest dilution for which an $LC_{50}$ can be determined. Numerical input parameters to be used for the STFATE will be coordinated with EPA Region 4 and USACE.*

*The results of the water column toxicity tests are used to calculate an $LC_{50}$ and/or an $EC_{50}$. The water column LPC for the dredged material is 1% of the $LC_{50}$. If the numerical mixing model predicts that the concentration of dredged material in the water column will not exceed 1% of the $LC_{50}$ concentration either outside the disposal site or within the disposal site 4 hours after the discharge of dredged material, the proposed discharge of dredged material meets the water column LPC. If either criterion is not met, the dredged material does not meet the water column LPC.*

*Toxicity and bioaccumulation data will undergo statistical analysis in accordance with the Green Book. The goal is to determine whether the mean effect of exposure to dredged sediment is significantly greater than the mean exposure to the reference sediment.*

*All reports will undergo extensive internal review and will be submitted to USACE-Wilmington. Accompanying the final report will be a CD containing all of the project files including electronic versions of all data reports, maps, figures, tables, text, photos, and any other electronic files used to generate the report.*

# GROUP C. ASSESSMENT AND OVERSIGHT

## 20.0 ELEMENT C1 – ASSESSMENTS AND RESPONSE ACTIONS

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.3.1.

Assessments and response actions throughout the life of this project are the responsibility of the QA/QC Officer and are performed in-part through the review and audit process.

Performance and systems audits are performed to evaluate the capability and performance of a measurement system. Audits are utilized to ensure that field and laboratory activities will provide data reflective of site conditions and within project QA/QC requirements. A performance audit is used to evaluate the accuracy of a measurement method or component of the method. A systems audit focuses on evaluating the principal components of a sample collection or data collection method to determine proper selection and use of that method.

*ANAMAR field sampling teams will be overseen and directed at all times by the Project Manager. Field teams are audited periodically, usually annually, by the ANAMAR Project Director, company President, or QA/QC Officer. These audits entail an observation and critique of sampling methods, collection, preservation, labeling, handling of sediment and/or water samples to ensure SOPs are being followed, that all equipment is calibrated and used properly, the Health and Safety Plan is being followed, and all aspects of the project are on schedule. Documentation of these audits is retained by ANAMAR.*

*Each laboratory used in this project regularly undergoes audits in accordance with their NELAC certifications. Although no project-specific laboratory audits are scheduled for this project, any deficiencies identified in a recent audit that may adversely affect the data quality for this project will be brought to the attention of the ANAMAR Project Manager.*

Any event that does not conform to the SAP/QAP, SOPs, or QAMS is considered a nonconformance event. These will be identified as quickly as possible and reported to the Project Manager as soon as practical. If the nonconformance event happens in the fieldwork portion of this project, it will be documented in the Daily Quality Control Report (DQCR). The project manager will confer with the USACE-Wilmington and outline a procedure for accomplishing the task so the quality of the project is not compromised. Every effort will be taken to contact the USACE and/or USEPA representative prior to any deviation from the procedures documented in this SAP/QAPP.

## 21.0 ELEMENT C2 – REPORTS TO MANAGEMENT

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.3.2.

The following reports must be submitted:

1. Sampling and Analysis /draft Quality Assurance Project Plan (SAP/QAPP), submitted to USEPA for review and comment;
2. Final Quality Assurance Project Plan (SAP/QAPP), submitted to USEPA following update from comments for final approval prior to sampling;
3. Site Specific Safety and Health Plan – Accident Prevention Plan;
4. Preliminary Sediment Chemistry Data Report;
5. MPRSA Section 103 Sediment Evaluation Testing Report.
6. Chemical Quality Assurance Report. The CQAR evaluates all of the representative data from the project field sampling and laboratory analyses. For each group of data, a data review checklist is completed that assesses daily field QC reports and specific QC chemical data quality indicators, and enables the reviewer to identify potential data problem areas that may require additional data validation. The CQAR identifies non-conformances, QC deficiencies, or other problems that would impact the data quality objectives as specified in the work plan and the QAPP. The CQAR summarizes the overall usability of the data for the intended purposes. This report will be an appendix to the Final Sediment Testing Report (see Section 5).
7. Daily Quality Control Reports (DQCR). A DQCR will be prepared by the Field Team Leader or Project Manager for each day sampling is conducted. This report will contain a description of the work performed, samples collected, general conditions, corrective actions taken, departures from the sampling plans, and any other notes or comments needed that will document the day's activities. This report will be an appendix to the Final Sediment Testing Report (see Section 5).

# GROUP D. DATA VALIDATION AND USABILITY

## 22.0 ELEMENT D1 – DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

| |
|---|
| See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.4.1. |

### Data Validation

Data validation is a process used to accept or reject data and determine if the data are traceable, defensible, and can be used for a particular project. Each laboratory will have established, state-approved procedures for data collection, validation, reduction, and reporting. As such, the analytical results will be extensively reviewed in-house by the laboratories submitting the data.

## 23.0 ELEMENT D2 – VALIDATION AND VERIFICATIONS METHODS

See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.4.2.

When a data packet is received by the contractor, it will be reviewed by the QA/QC Officer, with emphasis on NELAC standards. *All laboratory reports received will include laboratory QC data generated during analysis of the project samples including results of all method blanks, lab duplicates/triplicates, matrix spikes, spike duplicates/triplicates, reference material, surrogate spikes, standards, check standards, and calibration verifications. The analytical results for these QC samples will be reviewed and documented in a CQAR for each analytical data packet received. This report will be incorporated into the final data report. The CQAR consists of a checklist and a case narrative of the analytical runs. Any nonconformance, QC deficiency, or other problem that would impact data quality will be addressed in the CQAR. The contractor will compare data to the data quality objectives listed in Section 7.0, as well as confirm that target detection limits listed in Section 13.3 were reached. If any data quality objective is not reached, the laboratory will re-analyze the sample(s) and/or provide documentation for the failed criteria. The CQAR will provide a written record of the validity of each data package and its subsequent use in the report.*

*In situ readings and calibration of field equipment used to take the readings will be validated by the contractor's QA/QC Officer using the following criteria (meter reading compared to calibration standard):*

- *pH: ±0.2 SU*
- *Conductivity: ±5%*
- *Dissolved Oxygen: ±5%*
- *Turbidity: 0.1-10 NTU ±10%; 11-40 NTU ±8%; 41-100 NTU ±6.5%; >100 NTU ±5%*

*The instruments will be calibrated prior to each sampling day. An end-of-day reading will be taken at the completion of sampling each day. Any reading outside the above criteria will be flagged appropriately. Calibration sheets will document the pre-calibration, post-calibration, and end-of-day readings.*

*One blind duplicate QC sample will be collected in the field. This sample will be given a different name so the laboratory will not be able to differentiate between it and its duplicate.*

## 24.0 ELEMENT D3 – RECONCILIATION WITH DATA QUALITY OBJECTIVES

| |
|---|
| See *Guidance for Quality Assurance Project Plans* (G-5) Section 2.4.3. |

Data will be reconciled with the data quality objectives listed in Section 14 and with the target detection limits listed in Section 13.3 by comparison with the laboratory results. Chemical data that fall outside of the acceptable limits and not validated BY A QA/QC Officer will be re-tested at no additional cost to the government. All analytical anomalies will be described in detail in the final report. In the case of reruns, the initial and rerun result will be presented in the final report.

Many analytical methods describe procedures for analytical anomalies that occur during analysis. These method-specific procedures must be followed.

Tissue chemistry following the bioaccumulation potential tests will be run on each of the five replicates of each sample and species. The five individual results will be averaged and will be compared to the average of the reference sample for each analyte. Results greater than 100% of the reference sample will undergo statistical analysis according to procedures described in the Green Book and/or the SERIM.

## 25.0 REFERENCES

List the references you used to compile your QAPP.

USEPA and USACE. 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal-Testing Manual* (**Green Book**). EPA-503/8-91-001. February 1991. http://www.epa.gov/owow/oceans/gbook/gbook.pdf

USEPA and USACE. 2008. *Regional Implementation Manual - Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coast Waters* (**SERIM**). U.S. Environmental Protection Agency Region 4 and U.S. Army Corps of Engineers, South Atlantic Division, Atlanta, GA. http://www.epa.gov/region4/water/oceans/documents/Regional_Implementation_Manual.pdf

USEPA. 2001. *Requirements for Quality Assurance Project Plans* (QA/R-5) (PDF 120KB) - March 2001, EPA/240/B-01/003. These specifications are equivalent to Chapter 5 of EPA Manual 5360. http://www.epa.gov/quality/qs-docs/r5-final.pdf

USEPA. 2002. *Guidance for Quality Assurance Project Plans* (G-5) [G-5 publication] (PDF 401KB) - December 2002, EPA/240/R-02/009. (Note: This document replaces EPA/600/R-98/018 issued in February 1998.) http://www.epa.gov/quality/qs-docs/g5-final.pdf

USEPA. 2001. *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual.* EPA 823-B-01-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC. http://www.epa.gov/waterscience/cs/collectionmanual.pdf

USEPA. 1995. *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations – Chemical Evaluations*. EPA-823-B-95-001. http://www.epa.gov/waterscience/library/sediment/evaluationguide.pdf

# Appendix J

# SAMPLING AND ANALYSIS PLAN
# AND
# SEDIMENT TESTING REPORT
# REVIEWER'S CHECKLISTS

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# EPA Region 4 / USACE SAD
# Sampling and Analysis Plan (SAP)
# Reviewer's Checklist

| Project: | | | |
|---|---|---|---|
| Permit/File No: | | | |
| Review Item | Yes (x) | No (x) | NA (x) |
| **Project Description** | | | |
| 1. Is the type of dredging project described (Maintenance/New Work)? | | | |
| 2. Is permit status information given? | | | |
| 3. Is dredging history of the site provided? | | | |
| 4. Is dredging depth given? | | | |
| 5. Is dredging overdepth given? | | | |
| 6. Is dredging volume given? | | | |
| 7. Is the site description adequate (e.g. include discussion of land and water-based activities influencing sediment quality)? | | | |
| **Sampling** | | | |
| 1. Is bathymetry (hydrographic survey) provided? | | | |
| 2. Is hydrographic survey completed within 90 days? | | | |
| 3. Is area to be dredged clearly delineated on the survey? | | | |
| 4. Are dredging units defined? | | | |
| 5. Are sampling locations indicated on site bathymetric survey? | | | |
| 6. Are sampling locations representative of shoaling and expected contamination sources? | | | |
| 7. Are number of composites adequate given site history? | | | |
| 8. Are number of composites adequate given total volume to be dredged? | | | |
| 9. Is dredged material volume represented by each composite given? | | | |
| 10. Are proposed sample depths to permitted depth plus overdredge depth? | | | |
| 11. Is the compositing rationale fully described? | | | |
| 12. Is the sampling device described? | | | |
| 13. Reference stations | | | |
| a. Reference sediment site | | | |
| b. Elutriate preparation water | | | |
| c. Reference/dilution water for LPC determination | | | |
| **Testing, Biological and Chemical** | | | |
| 1. Are the following analyses included? | | | |
| a. Grain size | | | |
| b. Total organic carbon (TOC) | | | |
| c. Total solids | | | |
| d. Metals | | | |
| e. Phthalate esters | | | |
| f. Polycyclic aromatic hydrocarbons (PAHs) | | | |
| g. Polychlorinated biphenyls (PCBs) | | | |
| h. Pesticides | | | |
| i. Butlytins | | | |

| Project: | | | |
|---|---|---|---|
| 2. Is the proposed level of testing adequate given history of site and proposed disposal location? | | | |
| 3. Are names and contacts for all toxicity labs given? | | | |
| 4. Are names and contacts for all chemistry labs given? | | | |
| 5. Are proposed test species for water column toxicity testing appropriate? | | | |
| 6. Are proposed test species for benthic toxicity testing appropriate given the site's sediment conditions (e.g., expected grain size and salinity, results of earlier testing, test species availability)? | | | |
| 7. Are provisions made for pre-test measurements of interstitial water chemistry parameters (e.g., ammonia, sulfides, pH, and salinity)? | | | |
| 8 Are appropriate procedures described for adjusting interstitial water concentrations of these parameters if pre-test concentrations exceed the tolerance limits of the test organisms? | | | |
| 9. Should there be analyses for any special or nonstandard contaminants of concern? | | | |
| 10. Are the detection limits expressed in dry weight for sediments? | | | |
| 11. Are the detection limits expressed in wet weight for tissues? | | | |
| 12. Are the detection limits appropriate for chemical and physical analysis? | | | |
| NOTES: | | | |

Reviewer: ______________________________Date:______________

This checklist is not to be used as a guide to SAP development. It is used as a checklist for the reviewer to assure that key technical information is included in the SAP.

# EPA Region 4 / USACE SAD
# Sediment Testing Reports
# Reviewer's Checklist

| Project: | | | |
|---|---|---|---|
| Permit/File No: | | | |
| Review Item | Yes (x) | No (x) | NA (x) |
| Project Description | | | |
| 1. Location (map) of dredging project and disposal site | | | |
| 2. Project map (plan drawing, dredging unit boundaries, design depth, quantities) | | | |
| 3. Project volumes | | | |
| 4. General material description (new work/maintenance; sand/silt/clay) | | | |
| Sampling Information | | | |
| 1. Sample locations table (coordinates, depth) and map | | | |
| 2. Sampling device described | | | |
| 3. Discussion of rationale for sample location and compositing scheme | | | |
| 4. Sample depth described relative to project depth (below water/sediment interface) | | | |
| 5. Reference locations | | | |
| a. Reference sediment site location | | | |
| b. Elutriate Preparation Water Sample Location | | | |
| c. Elutriate Dilution Water Sample Location or Source of Dilution Water | | | |
| 6. Discussion of any problems encountered during sampling | | | |
| Materials and Methods | | | |
| 1. Description of field sampling and handling procedures | | | |
| 2. References for laboratory protocols | | | |
| a. EPA method number | | | |
| b. Detection limits | | | |
| c. Test species used in each test including supplier or collection site | | | |
| d. Source of seawater used in all tests | | | |
| e. Bioassay test procedures and QA/QC information | | | |
| f. Statistical analyses procedures | | | |
| Final Results | | | |
| 1. Summary Tables of Results | | | |
| a. Physical properties | | | |
| b. Sediment chemistry | | | |
| c. Elutriate chemistry (estimated from sediment chemistry or actual) | | | |
| d. Elutriate bioassays including statistical comparisons and LC50 calc | | | |
| e. Sediment toxicity including statistical comparison | | | |
| f. Tissue chemistry | | | |
| 2. Raw Data Sheets | | | |
| a. Physical properties | | | |
| b. Sediment chemistry | | | |
| c. Elutriate chemistry | | | |
| d. Tissue chemistry | | | |
| References | | | |

| Project: | | | |
|---|---|---|---|
| Discussion and Analysis | | | |
| 1. General discussion of results in comparison to historic results in area | | | |
| 2. Comparison of elutriate chemistry to WQC/WQS | | | |
| 3. Mixing model results (elutriate chemistry and bioassays) | | | |
| 4. Whole sediment toxicity test (comparison of dredged sediments to reference) | | | |
| 5. Statistical comparison of tissue concentrations (comparison of dredged sediments to reference) | | | |
| **QA/QC** | | | |
| 1. Appendices with sample collection, handling, and tracking? | | | |
| 2. Water quality monitoring results for elutriate bioassays? | | | |
| 3. Elutriate reference toxicant raw data? | | | |
| 4. Water quality monitoring results for sediment bioassays? | | | |
| 5. Sediment reference toxicant raw data? | | | |
| 6. Survivorship and water quality monitoring results for sediment bioaccumulation studies? | | | |
| 7. MDL studies and internal QC checks | | | |
| 8. Standard operating procedures | | | |
| 9. Quality Assurance Plan | | | |
| 10. References | | | |

Reviewer: ____________________ Date: __________

This checklist is not to be used as a guide to testing report content and format. It is used as a checklist for the reviewer to assure that key information is included in the testing report.

# Appendix K

# RECOMMENDED REFERENCE SITES FOR REGION 4 ODMDSs

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## Appendix K

## RECOMMENDED REFERENCE SITES FOR REGION 4 ODMDSs

The 1991 Green Book (EPA and USACE, 1991, Section 3.1.2) defines a reference sediment as, "*A sediment, substantially free of contaminants, that is as similar to the grain size of the dredged material and the sediment at the disposal site as practical, and reflects conditions that would exist in the vicinity of the disposal site had no dredged-material disposal ever occurred, but had all other influences on sediment condition taken place.*" (EPA and USACE, 1991, Section 3.1.2). Reference sediment sampling stations are selected to simulate conditions at the proposed disposal site in the absence of past dredged material disposal. Reference sediments must be collected for each evaluation. Results from previous evaluations are not acceptable.

In 2002 and 2006, EPA Region 4 undertook studies of potential areas to be used as a source of reference sediments for each ODMDS managed by EPA Region 4. The goal of the studies was to locate for each ODMDS reliable sources of reference sediments with a range of grain sizes. A reference site exhibiting the physical grain size characteristics (percent fines) most similar to the proposed dredged material could then be chosen.

One criterion for selecting a reference site was the consistency with which samples of similar grain size could be obtained. Sites exhibiting high variability between grabs were eliminated. All coordinates are based upon the North American Datum of 1983. Sediments for the reference sites also underwent chemical analysis to document that they are substantially free of contaminants. The 2002 and 2006 studies did not survey all of the Region 4 ODMDSs. In some cases, historically used reference sites that demonstrated consistent results were selected or status and trend monitoring stations for which grain size and chemical monitoring data are available were selected. Reference sites exhibiting the physical grain size characteristics (percent fines) most similar to the proposed dredged material should be selected for obtaining reference sediments.

# CONTENTS

# Wilmington District

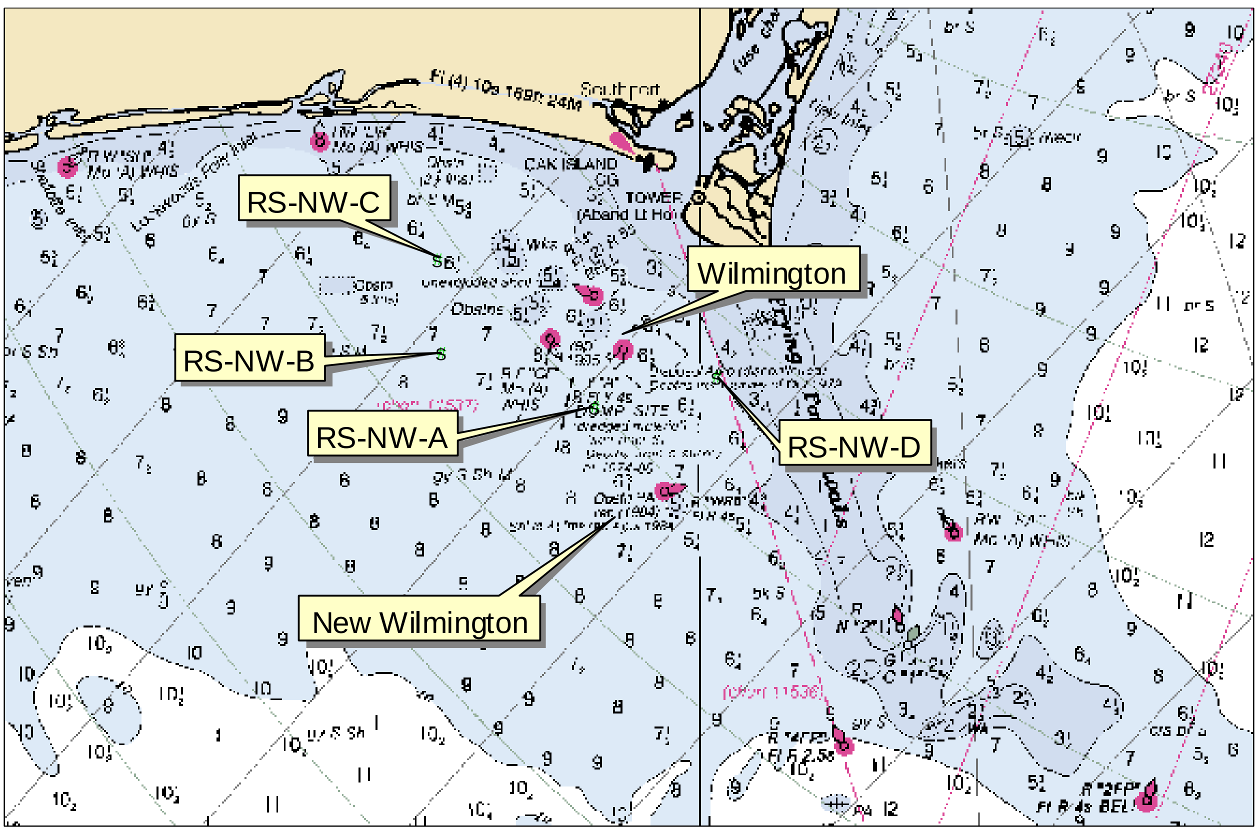
### Morehead ODMDS

None currently recommended

### New Wilmington ODMDS

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-NW-A | Sand* | 2.00 | n/a | 33 46.302 | 78 3.612 |
| RS-NW-B | Sand | 12.87 | 11.8 – 14.3 | 33 47.838 | 78 8.940 |
| RS-NW-C | Silty sand | 27.11 | 25.3 – 33.5 | 33 50.574 | 78 9.066 |
| RS-NW-D | Sandy silt | 63.81 | 53 – 66 | 33 47.136 | 77 59.370 |

* historically used

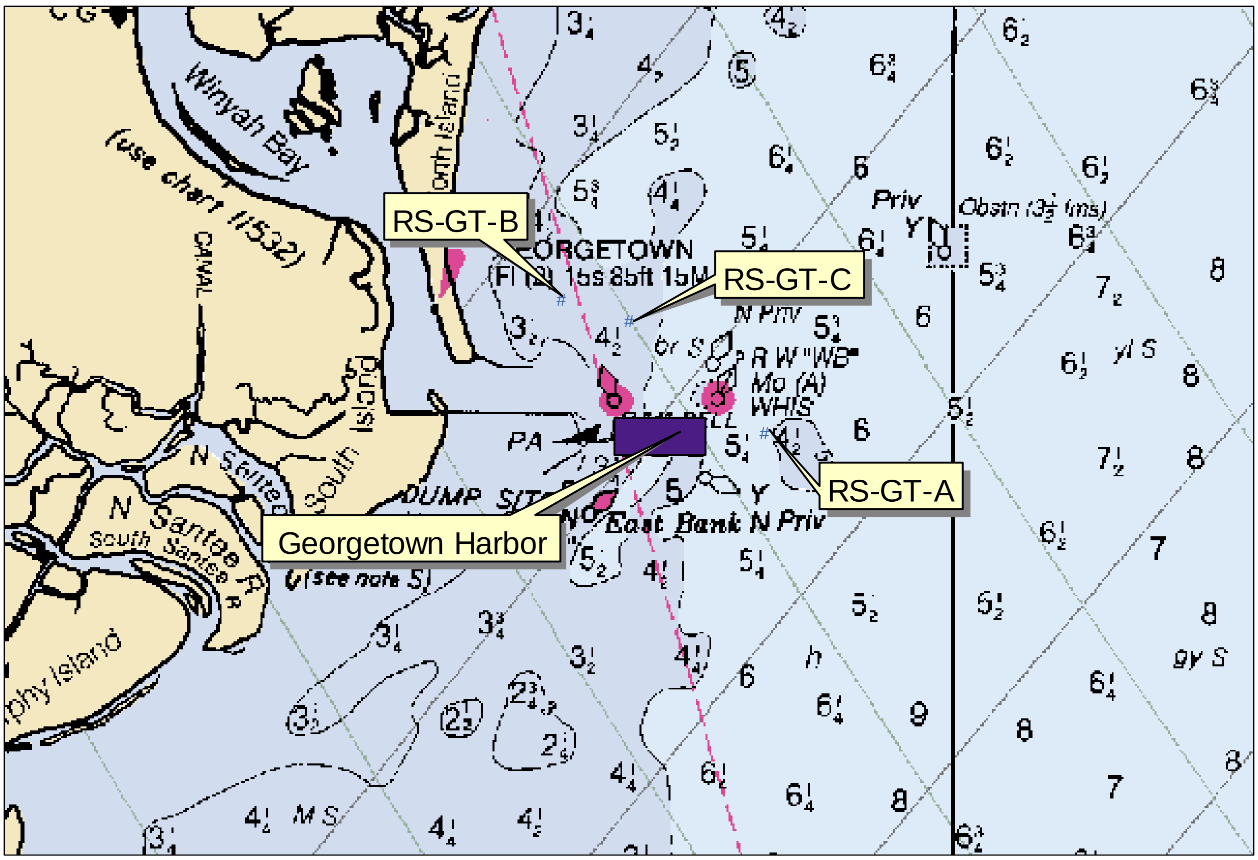


# Charleston District

**Georgetown ODMDS**

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm’ | Longitude dd° mm.mm’ |
|---|---|---|---|---|---|
| RS-GT-A | Sand* | 0.35 | 0.33 – 0.38 | 33 11.028 | 79 4.080 |
| RS-GT-B | Silty sand | 27.73 | 23.9 – 32.8 | 33 13.410 | 79 8.472 |
| RS-GT-C | Sand | 1.52 | 1.44 – 1.70 | 33 13.020 | 79 7.020 |

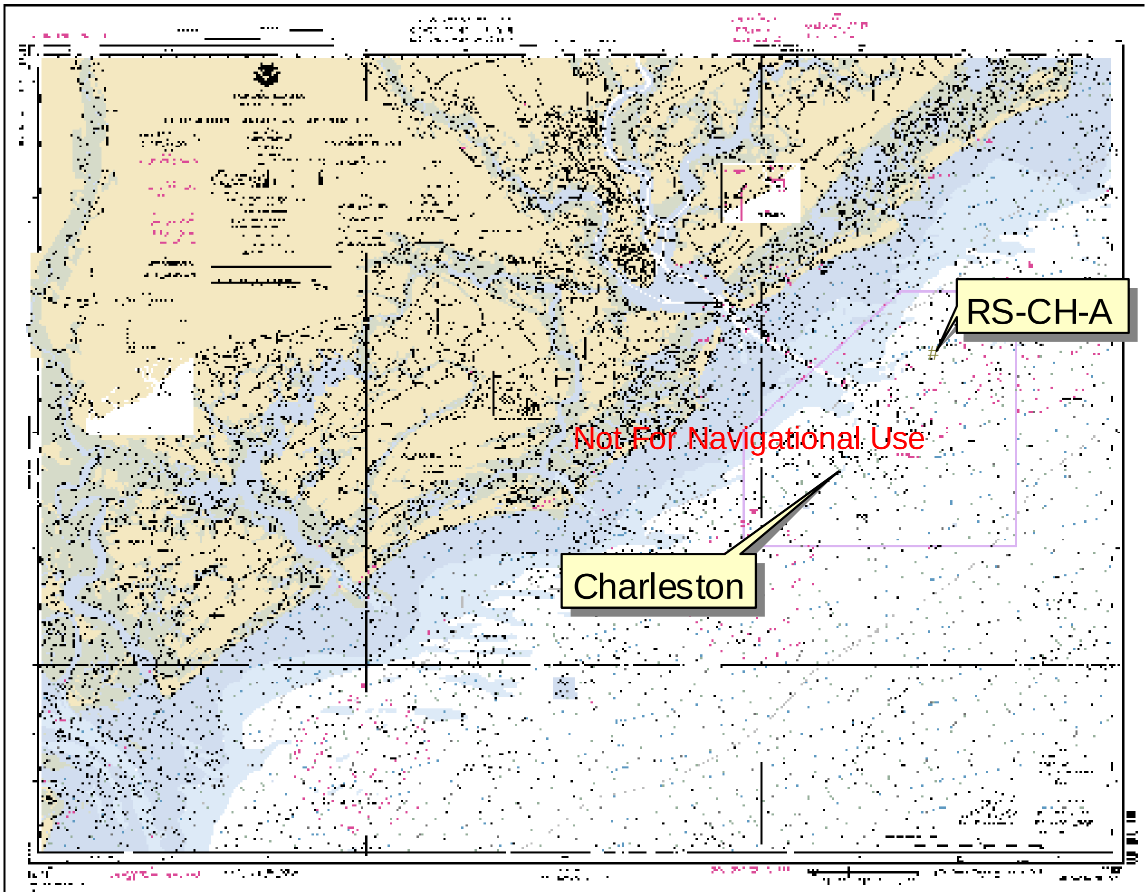
* historically used



**Charleston ODMDS**

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-CH-A | Sand* | 3.00 | n/a | 32 43.308 | 79 41.178 |

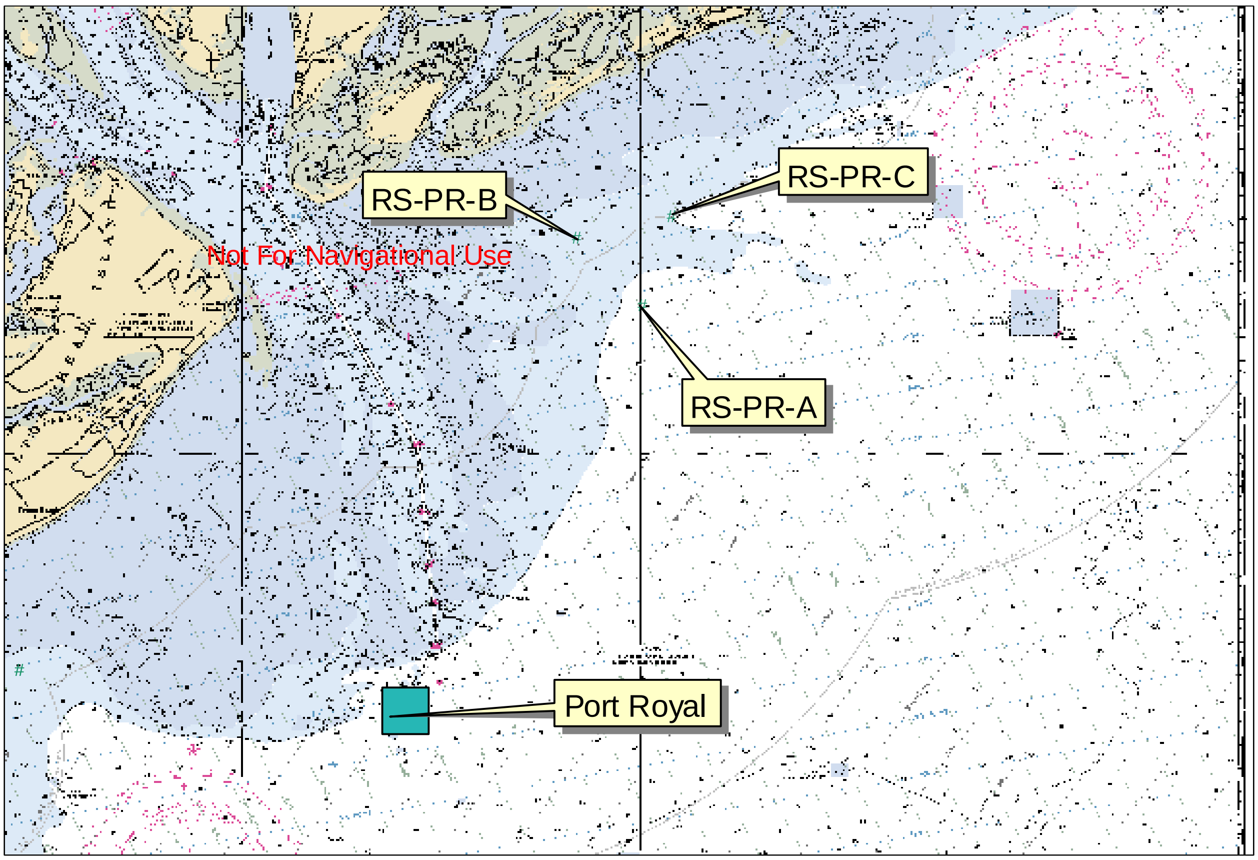
* historically used



## Port Royal ODMDS

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-PR-A | Sand | 7.46 | 5.56 – 9.16 | 32 13.128 | 80 29.898 |
| RS-PR-B | Sand | 9.19 | 6.43 – 12.60 | 32 14.592 | 80 31.542 |
| RS-PR-C | Sand | 9.36 | 6.61 – 11.10 | 32 15.036 | 80 29.190 |
| RS-PS-A | Sand* | 3.92 | 3.43 – 4.97 | 32 0.468 | 80 45.330 |
| RS-PS-B | Sand* | 3.02 | 2.33 – 3.33 | 32 0.258 | 80 45.504 |
| RS-PS-C | Sand* | 2.35 | 2.12 – 2.66 | 32 0.054 | 80 45.684 |
| RS-PS-D | Silty sand | 20.95 | 20.3 – 22.10 | 32 5.358 | 80 45.552 |

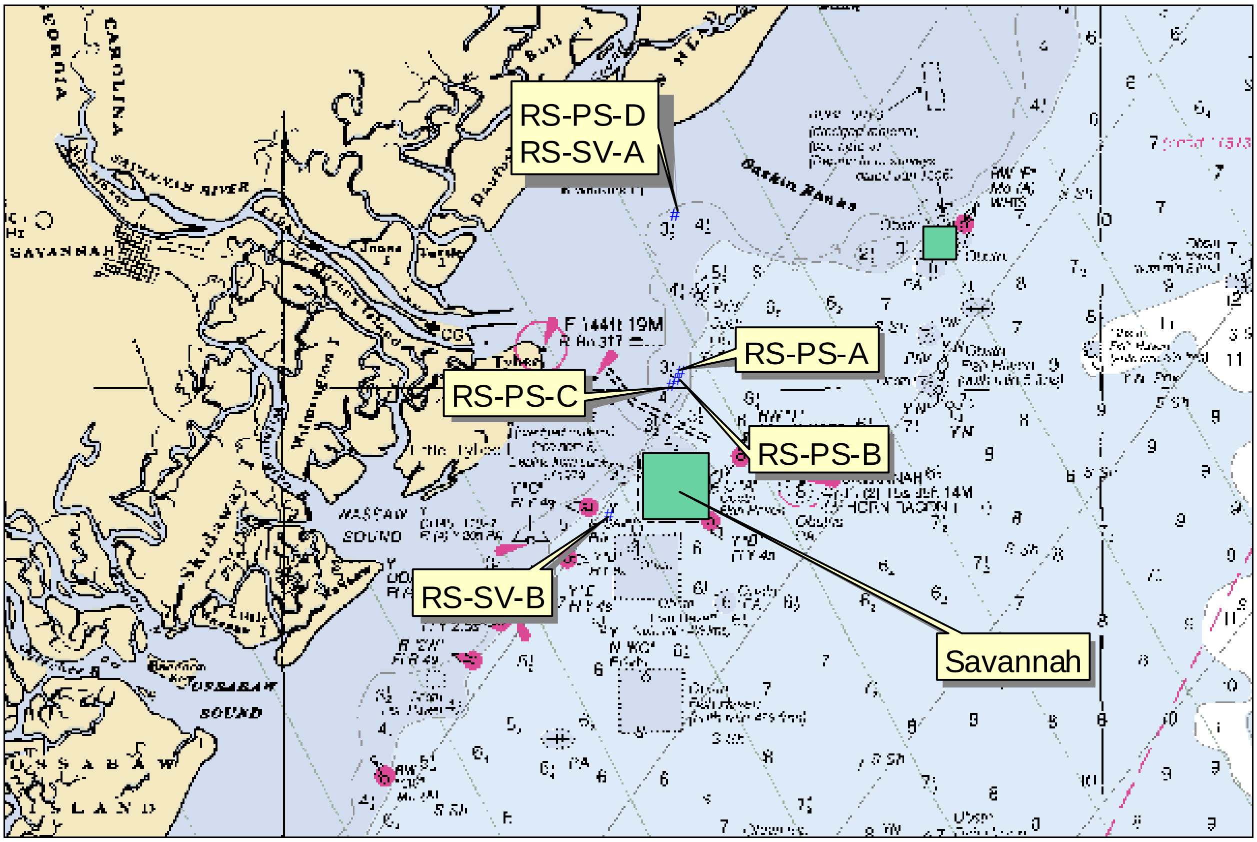
* used on one previous occasion



# Savannah District

## Savannah ODMDS

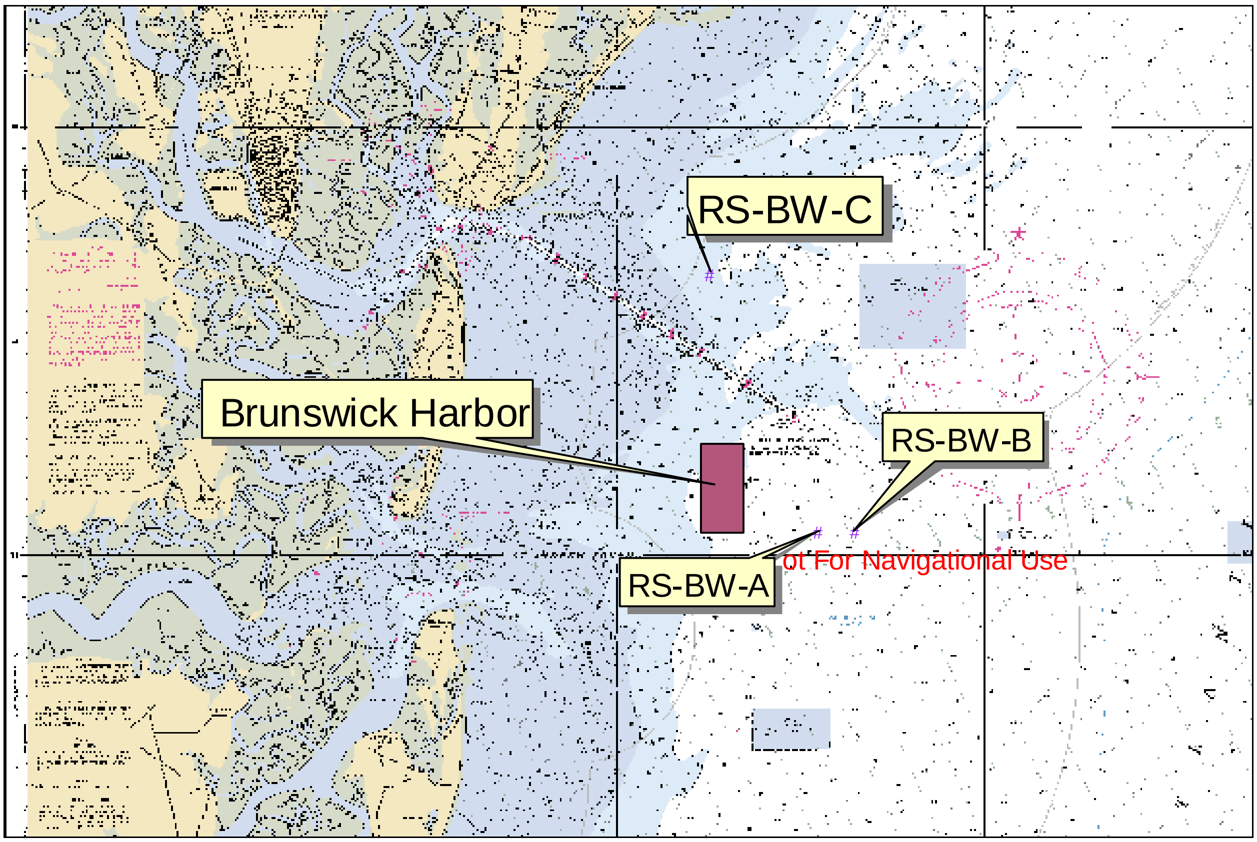
| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-PS-A | Sand, used once | 3.92 | 3.43 – 4.97 | 32 0.468 | 80 45.330 |
| RS-PS-B | Sand, used once | 3.02 | 2.33 – 3.33 | 32 0.258 | 80 45.504 |
| RS-PS-C | Sand, used once | 2.35 | 2.12 – 2.66 | 32 0.054 | 80 45.684 |
| RS-PS-D | Silty sand | 20.95 | 20.3 – 22.10 | 32 5.358 | 80 45.552 |
| RS-SV-A | Silty sand | 20.95 | 20.3 – 22.10 | 32 5.358 | 80 45.552 |
| RS-SV-B | Sand w/ some silt | 10.67 | 9.85 – 12.20 | 32 -4.020 | 80 48.000 |



## Brunswick ODMDS

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-BW-A | Sand* | 7.10 | 6.72 – 7.83 | 31 0.498 | 81 14.472 |
| RS-BW-B | Sand* | 2.15 | 1.85 – 2.67 | 31 0.498 | 81 13.458 |
| RS-BW-C | Sand w/ some silt | 23.90 | 25.2 – 27.6 | 31 6.528 | 81 17.406 |

* historically used

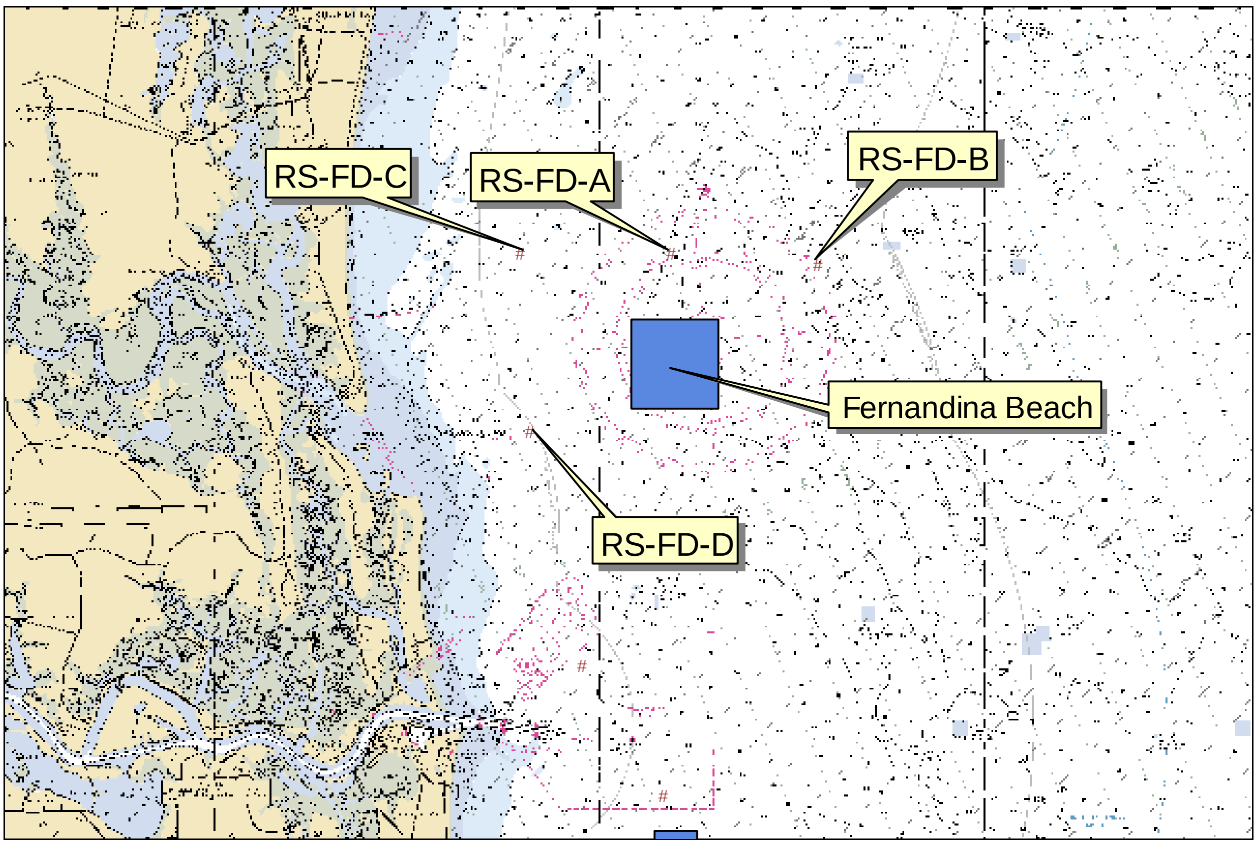


# Jacksonville District

**Fernandina ODMDS**

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-FD-A | Silty sand* | 14.51 | 12.1 – 18.2 | 30 34.500 | 81 18.084 |
| RS-FD-B | Sand | 4.89 | 4.63 – 5.51 | 30 34.236 | 81 14.286 |
| RS-FD-C | Silt/sand | 46.34 | 44.1 – 51.8 | 30 34.500 | 81 22.020 |
| RS-FD-D | Silty sand | 26.38 | 26.3 – 30.3 | 30 30.480 | 81 21.780 |

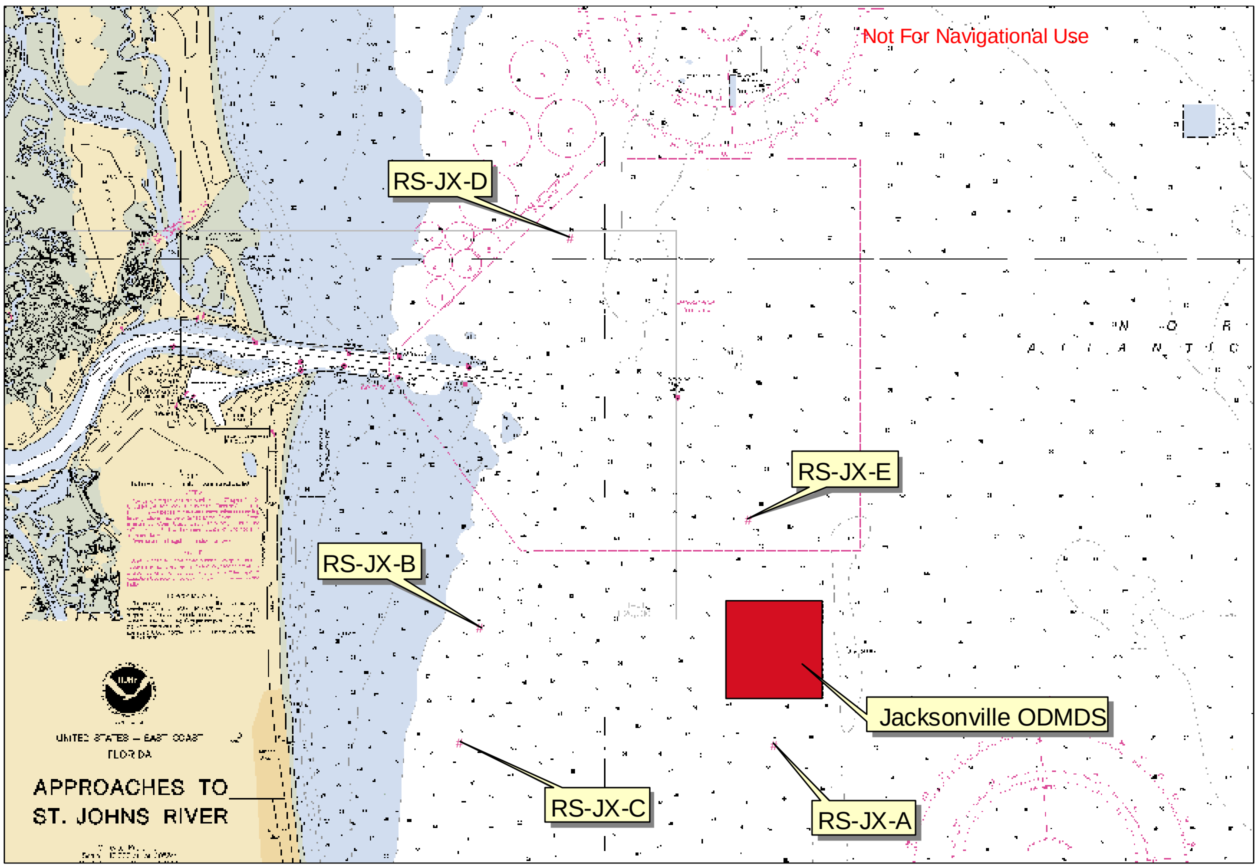
* historically used



## Jacksonville ODMDS

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-JX-A | Sand* | 5.30 | 4.76 – 5.61 | 30 20.016 | 81 17.982 |
| RS-JX-B | Sandy silt | 64.88 | 56.2 – 78.1 | 30 21.222 | 81 21.462 |
| RS-JX-C | Silty sand | 41.08 | 37.8 – 47.4 | 30 20.046 | 81 21.708 |
| RS-JX-D | Silt/sand | 49.53 | 43.7 – 58.1 | 30 25.200 | 81 20.400 |
| RS-JX-E | Sand w/ some silt | 15.00 | 15.5 – 17.1 | 30 22.320 | 81 18.300 |

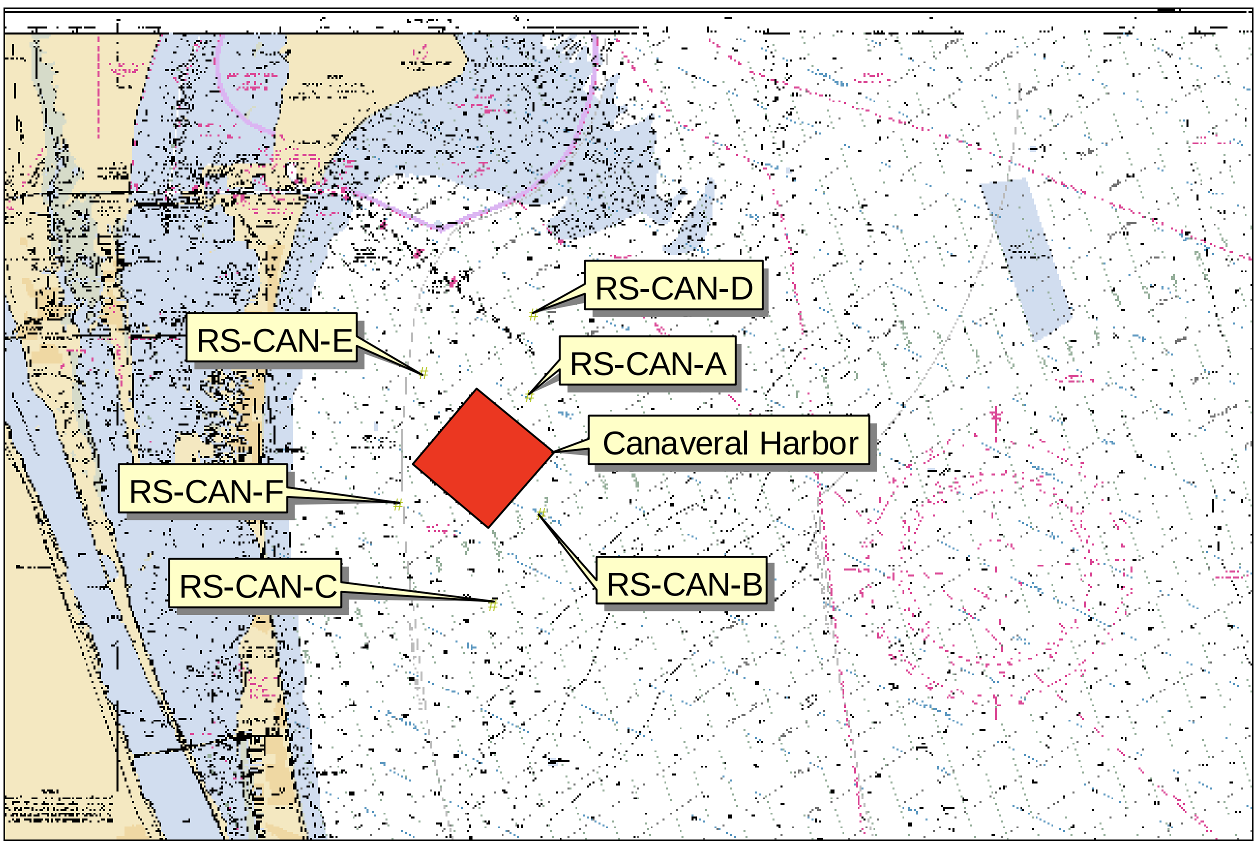
* historically used



## Canaveral ODMDS

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-CAN-A | Silty fine sand w/ some shell* | n/a | 40-43 | 28 20.100 | 80 29.832 |
| RS-CAN-B | Silty fine sand w/ some shell* | n/a | 40-43 | 28 17.502 | 80 29.562 |
| RS-CAN-C | Silt/clay* | n/a | 60-70 | 28 15.540 | 80 30.744 |
| RS-CAN-D | Silt/clay* | n/a | 60-70 | 28 21.852 | 80 29.736 |
| RS-CAN-E | Silt/clay | n/a | 10-20 | 28 20.574 | 80 32.436 |
| RS-CAN-F | Silt/clay | n/a | 10-20 | 28 17.742 | 80 33.078 |

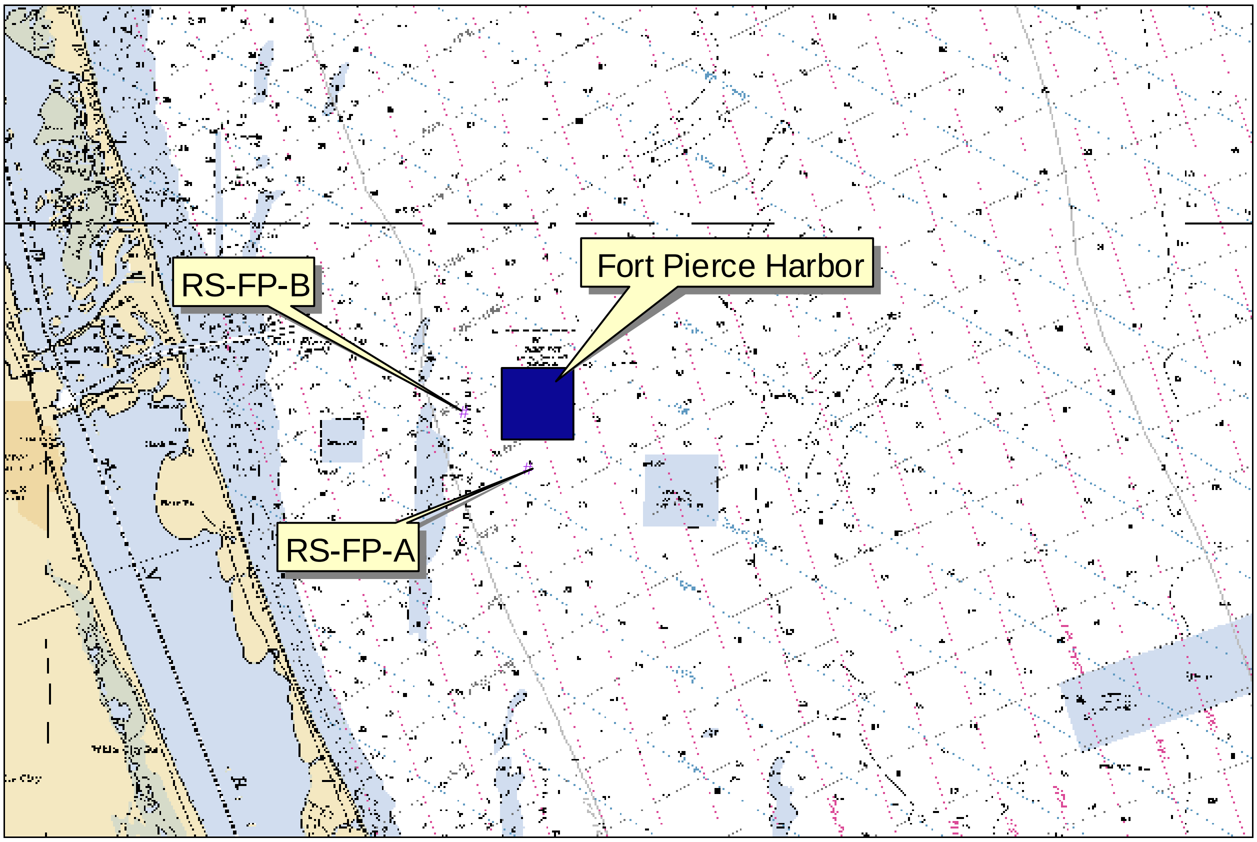
* historically used



### Fort Pierce ODMDS

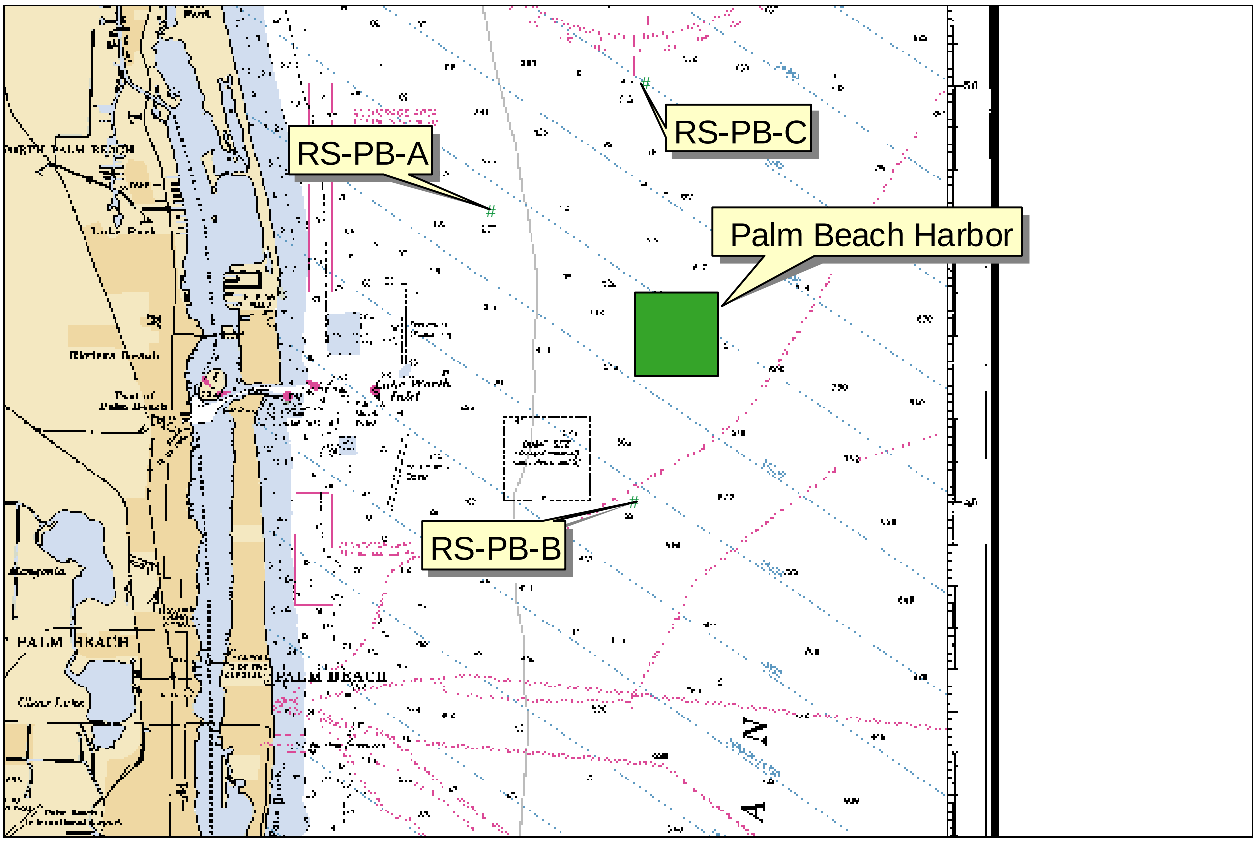
| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-FP-A | Fine sand w/ shell* | 1.40 | n/a | 27 26.616 | 80 12.138 |
| RS-FP-B | Fine sand w/ shell* | 7.00 | n/a | 27 27.378 | 80 13.098 |

* historically used



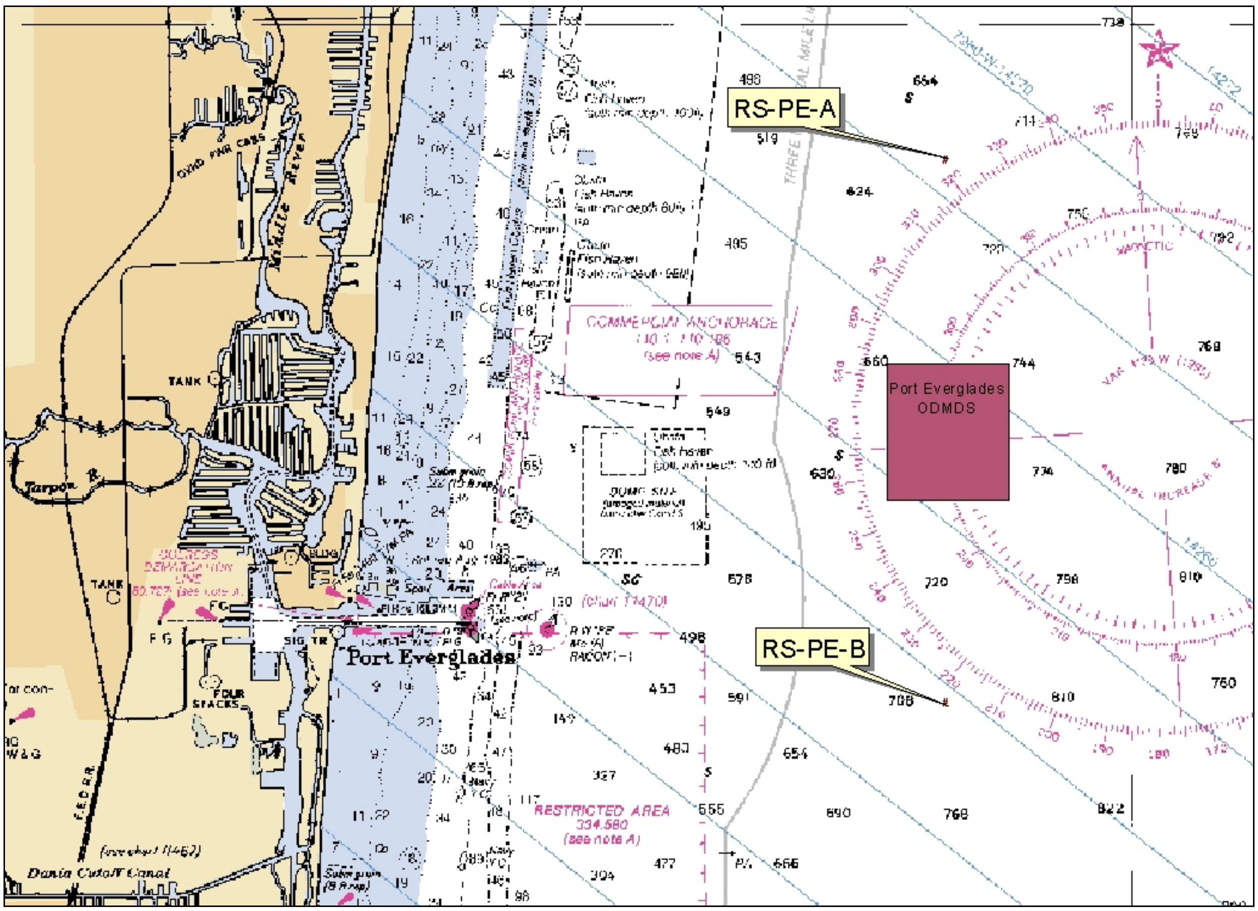
**Palm Beach ODMDS**

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-PB-A | Fine sand w/ shell | 1.00 | n/a | 26 48.486 | 79 59.052 |
| RS-PB-B | Silt/clay | n/a | 15-17 | 26 45.000 | 79 57.138 |
| RS-PB-C | Silt/clay | 25.00 | n/a | 26 49.998 | 79 57.000 |



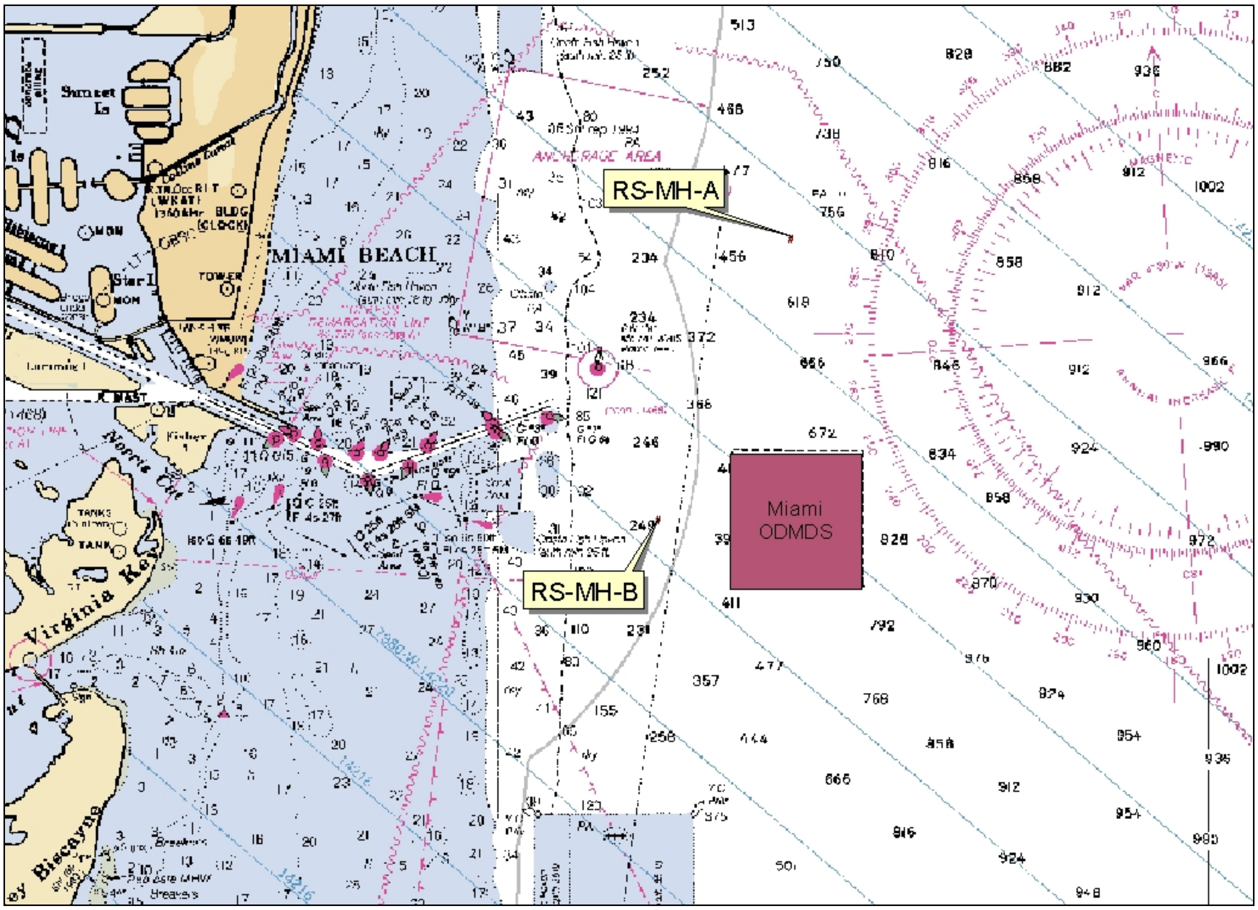
## Port Everglades ODMDS

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-PE-A | Silty fine sand | 15.00 | n/a | 26 9.000 | 80 1.500 |
| RS-PE-B | Silty fine sand | 15.00 | n/a | 26 4.998 | 80 1.500 |



## Miami ODMDS

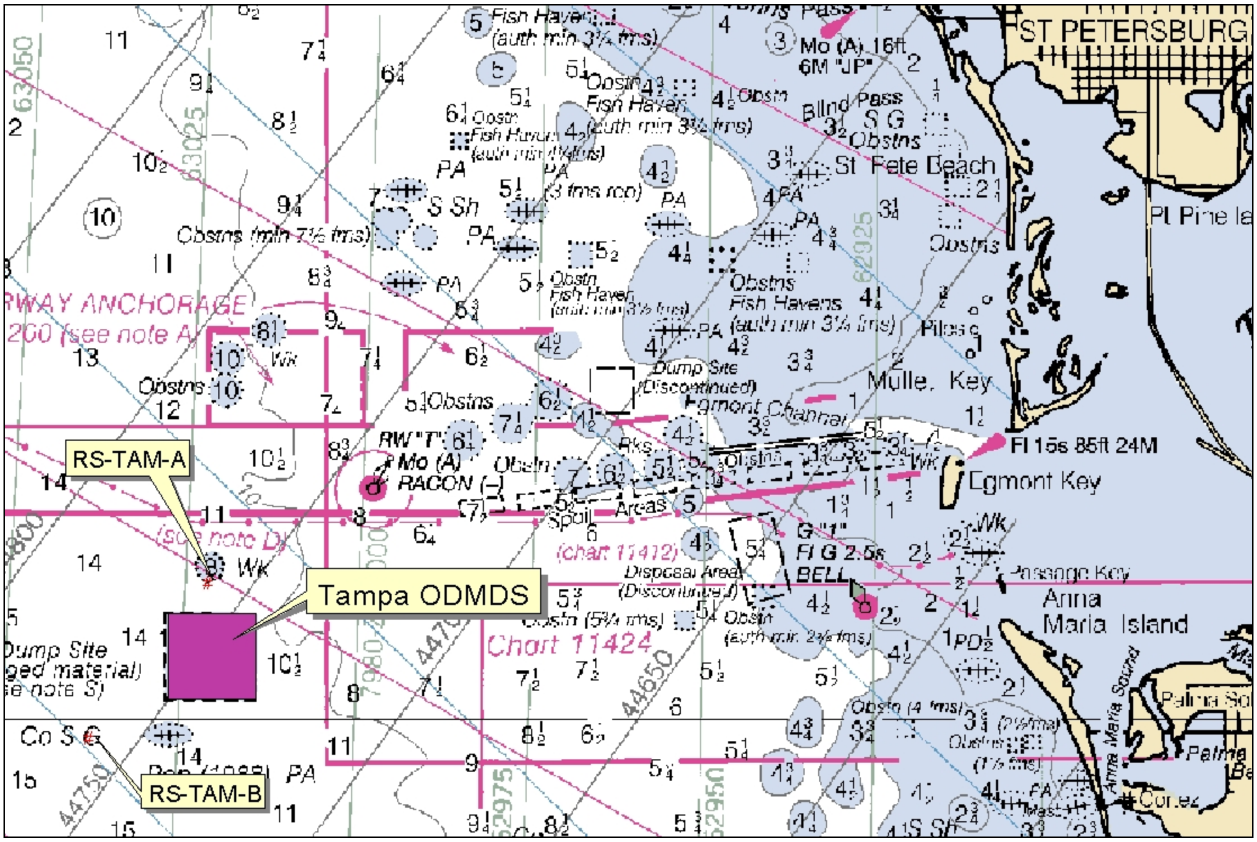
| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm’ | Longitude dd° mm.mm’ |
|---|---|---|---|---|---|
| RS-MH-A | Fine sandy clay | n/a | 30-50 | 25 47.079 | 80 3.383 |
| RS-MH-B | Fine sand | n/a | 15-20 | 25 44.999 | 80 4.461 |



**Tampa ODMDS**

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-TAM-A* | Sand | n/a | 2.7-6.7 | 27 33.16 | 83 4.9 |
| RS-TAM-B* | Sand | n/a | 2.7-6.7 | 27 29.57 | 83 4.88 |

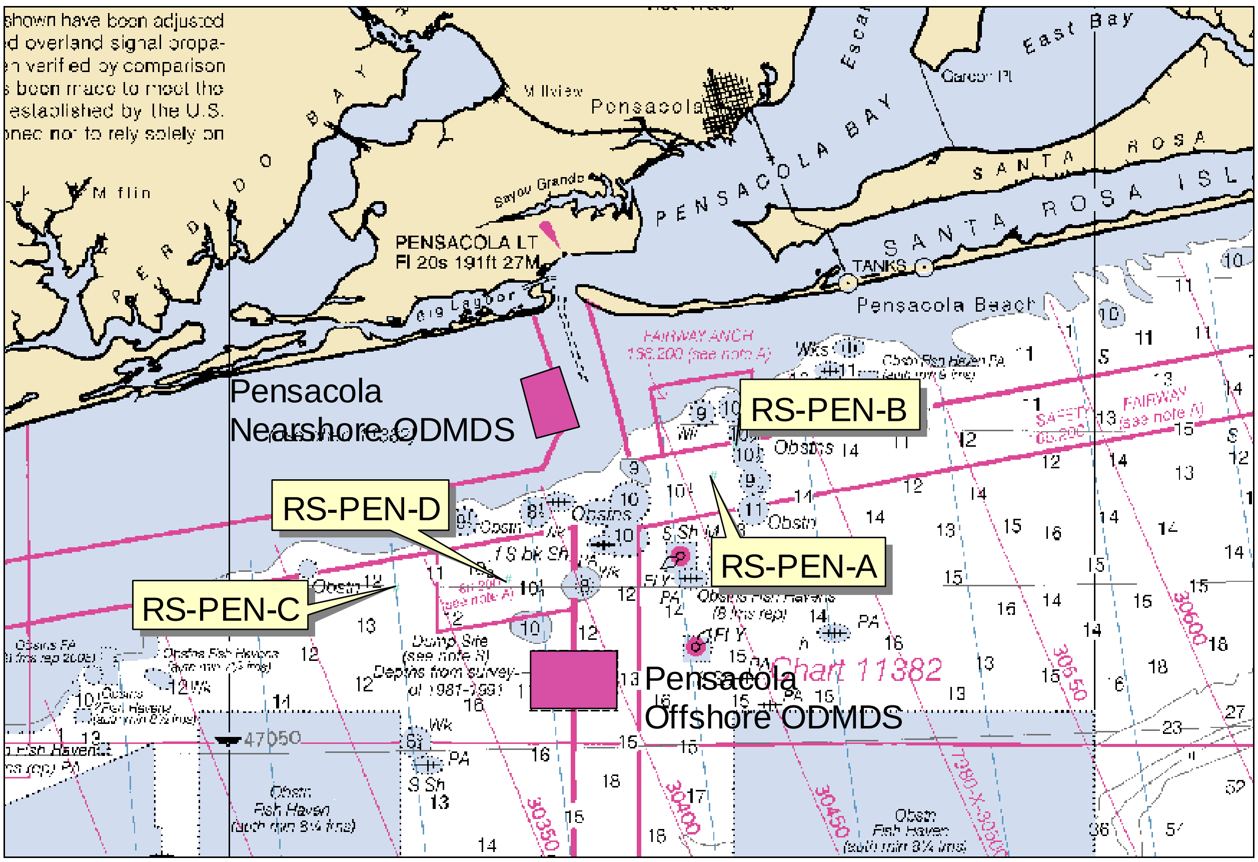
* Two to three grabs are taken at each location and the sediments are composited to create the reference sediment.



# Mobile District

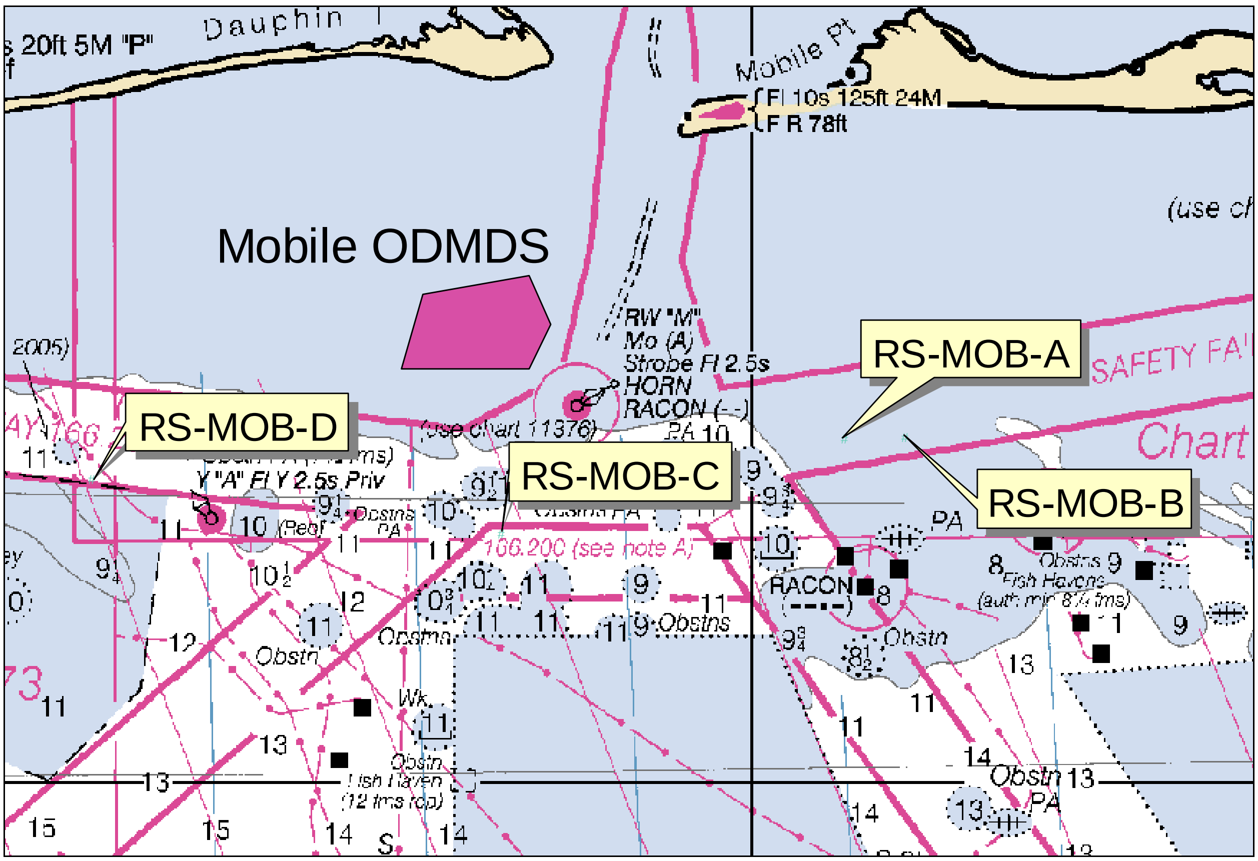
**Pensacola Offshore ODMDS**

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-PEN-A | Sand | 0.68 | 0.62 - 0.76 | 30 14.0982 | 87 13.1088 |
| RS-PEN-B | Sand | 2.3 | 1.90 - 2.86 | 30 15.0198 | 87 12.3492 |
| RS-PEN-C | Sand | 1.05 | 0.85 - 1.15 | 30 10.758 | 87 24.093 |
| RS-PEN-D | Sand | 1.06 | 0.68 - 1.35 | 30 10.9992 | 87 20.2458 |



## Mobile ODMDS

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm’ | Longitude dd° mm.mm’ |
|---|---|---|---|---|---|
| RS-MOB-A | sand | 0.55 | 0.00 - 0.86 | 30 7.0578 | 87 57.774 |
| RS-MOB-B | sand | 1.24 | 0.94 - 2.02 | 30 7.0692 | 87 56.3472 |
| RS-MOB-C | silty sand | 31.93 | 20.00 - 42.10 | 30 5.124 | 87 5.8278 |
| RS-MOB-D | silty sand | 40.73 | 33.50 - 52.10 | 30 6.225 | 87 15.4452 |

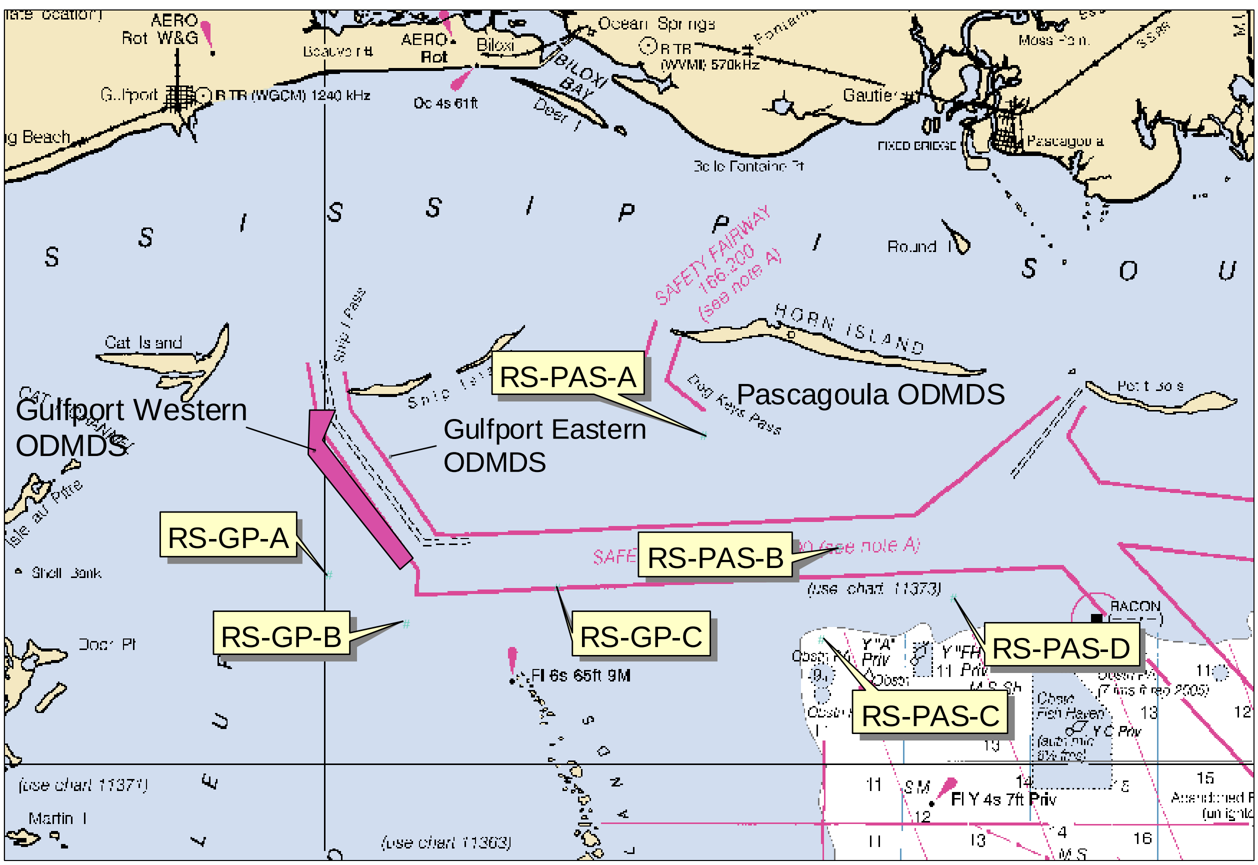


**Pascagoula ODMDS**

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-PAS-A | sandy silt | 74.23 | 72.70 - 76.60 | 30 11.1378 | 88 105.1032 |
| RS-PAS-B | silt | 89.73 | 87.60 - 92.40 | 30 7.3512 | 88 99.8772 |
| RS-PAS-C | sandy silt | 70.55 | 50.80 - 77.90 | 30 4.2402 | 88 100.512 |
| RS-PAS-D | silty sand | 22.83 | 11.20 - 34.40 | 30 5.634 | 88 95.367 |

**Gulfport Eastern & Gulfport Western ODMDSs**

| Station I.D. | Description | Avg. % Fines | Range of % Fines | Latitude dd° mm.mm' | Longitude dd° mm.mm' |
|---|---|---|---|---|---|
| RS-GP-A | sandy silt | 74.93 | 64.50 - 91.50 | 30 6.411 | 88 119.7252 |
| RS-GP-B | sandy silt | 76.4 | 72.40 - 81.60 | 30 4.7898 | 88 116.7192 |
| RS-GP-C | silt | 93.57 | 92.10 - 96.10 | 30 6.003 | 88 110.8122 |
| RS-GP-A | sandy silt | 74.93 | 64.50 - 91.50 | 30 6.411 | 88 119.7252 |



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# Appendix L

# TEST CONDITIONS

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# Appendix L
# TEST CONDITIONS

NOTE: Adjustments to references were made to provide updates and consistency throughout the test acceptance criteria presented in this appendix. If discrepancies in units, ranges, etc., are noticed between the materials presented here and the publication references, please use the information in these Appendix L tables as your test condition guidelines.

## TABLE OF CONTENTS

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Crassostrea virginica* LARVAE, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 48 h, based on control development; not to exceed 54 h |
| 3. Temperature: | 25 ± 1°C |
| 4. Salinity: | Optimal 30 (range: 18-32) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to ASTM protocol |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 20-30 ml |
| 11. Test solution volume: | 10-30 ml |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | Larvae, less than 4 h after fertilization |
| 14. Concentration of organisms per test chamber: | 15-30/ml; do not exceed 30/ml |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5, plus 1 chamber for water quality monitoring |
| 16. Feeding requirements: | None |
| 17. Test solution aeration: | None |
| 18. Dilution water: | Optimal 30 (range: 18-32) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |
| 20. Dilution series: | 100%, 50%, 10%, 1% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |
| 21. Endpoint: | Survival, embryo shell development to hinged, D-shaped prodisoconch I larva |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Crassostrea virginica* LARVAE, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 22. Sample holding requirements:* | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Field sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥90% survival **AND** ≥70% shell development to hinged, D-shaped prodisoconch I larva in the control |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

ASTM. 2004. Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Four Species of Saltwater Bivalve Mollusks. Annual Book of ASTM Standards, Vol. 11.06. E724-98(2004). American Society for Testing and Materials, Philadelphia, PA.

USEPA. 1995. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms. First edition. EPA/600/R-95/136 West Coast Manual.

| SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Mytilus edulis* LARVAE, ACUTE TOXICITY WATER COLUMN TEST | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 48 h, based on control development; not to exceed 54 h |
| 3. Temperature: | 16 ± 1ºC |
| 4. Salinity: | Optimal 30 (range: 18-32) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to ASTM protocol |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 20-30 ml |
| 11. Test solution volume: | 10-30 ml |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | Larvae, less than 4 h after fertilization |
| 14. Concentration of organisms per test chamber: | 15-30/ml; do not exceed 30/ml |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5, plus 1 chamber for water quality monitoring |
| 16. Feeding requirements: | None |
| 17. Test solution aeration: | None |
| 18. Dilution water: | Optimal 30 (range: 18-32) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |
| 20. Dilution series: | 100%, 50%, 10%, 1% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |
| 21. Endpoint: | Survival, embryo shell development to hinged, D-shaped prodisoconch I larva |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Mytilus edulis* LARVAE, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 22. Sample holding requirements:* | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Field sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥90% survival **AND** ≥70% shell development to hinged, D-shaped prodisoconch I larva in the control |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

ASTM. 2004. Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Four Species of Saltwater Bivalve Mollusks. Annual Book of ASTM Standards, Vol. 11.06. E724-98(2004). American Society for Testing and Materials, Philadelphia, PA.

USEPA. 1995. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms. First edition. EPA/600/R-95/136. West Coast Manual.

| SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Mercenaria mercenaria* LARVAE, ACUTE TOXICITY WATER COLUMN TEST | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 48 h, based on control development; not to exceed 54 h |
| 3. Temperature: | 25 ± 1ºC |
| 4. Salinity: | Optimal 30 (range: 18-32) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to ASTM protocol |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 20-30 ml |
| 11. Test solution volume: | 10-30 ml |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | Larvae, less than 4 h after fertilization |
| 14. Concentration of organisms per test chamber: | 15-30/ml; do not exceed 30/ml |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5, plus 1 chamber for water quality monitoring |
| 16. Feeding requirements: | None |
| 17. Test solution aeration: | None |
| 18. Dilution water: | Optimal 30 (range: 18-32) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |
| 20. Dilution series: | 100%, 50%, 10%, 1% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |
| 21. Endpoint: | Survival, embryo shell development to hinged, D-shaped prodisoconch I larva |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Mercenaria mercenaria* LARVAE, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 22. Sample holding requirements:* | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Field sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥90% survival **AND** ≥60% shell development to hinged, D-shaped prodisoconch I larva in the control |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

ASTM. 2004. Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Four Species of Saltwater Bivalve Mollusks. Annual Book of ASTM Standards, Vol. 11.06. E724-98(2004). American Society for Testing and Materials, Philadelphia, PA.

USEPA. 1995. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms. First edition. EPA/600/R-95/136. West Coast Manual.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Arbacia punctulata* LARVAE, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 48-96 h; test duration is based on the time necessary for ≥70% of control embryos to develop to the pluteus stage. 72 ± 2 h (optimal) |
| 3. Temperature: | 20 ± 1ºC (general) |
| 4. Salinity: | Optimal 30 (range: 27-36) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to ASTM protocol |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 20-30 ml |
| 11. Test solution volume: | 10-30 ml |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | Larvae, less than 4 h after fertilization |
| 14. Concentration of organisms per test chamber: | 15-30/ml; do not exceed 50/ml |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5, plus 1 chamber for water quality monitoring |
| 16. Feeding requirements: | None |
| 17. Test solution aeration: | None; unless DO falls below 60% of saturation |
| 18. Dilution water: | Optimal 30 (range: 27-36) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |
| 20. Dilution series: | 100%, 50%, 10%, 1% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |
| 21. Endpoint: | Survival, embryo development |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Arbacia punctulata* LARVAE, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 22. Sample holding requirements:* | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Field sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥70% survival **AND** ≥70% normal embryo development in controls |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

ASTM. 2004. Standard Guide for Conducting Static Acute Toxicity Tests with Echinoid Embryos. Annual Book of ASTM Standards, Vol. 11.06. E1563-98(2004-e1). American Society for Testing and Materials, Philadelphia, PA.

USEPA. 1990. Conducting the Sea Urchin Larval Development Test. ERL-Narragansett Standard Operating Procedure 1.03.007.

USEPA. 1995. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms. First edition. EPA/600/R 95/136. West Coast Manual.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Strongylocentrotus purpuratus* LARVAE, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 48-96 h; test duration is based on the time necessary for ≥70% of control embryos to develop to the pluteus stage. 72 ± 2 h (optimal) |
| 3. Temperature: | 12 ± 1ºC (general)<br>*S. purpuratus* 12 ± 1ºC (WA, OR, AK)<br>*S. purpuratus* 14 ± 1ºC (CA) |
| 4. Salinity: | Optimal 30 (range: 27-36) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to ASTM protocol |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 20-30 ml |
| 11. Test solution volume: | 10-30 ml |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | Larvae, less than 4 h after fertilization |
| 14. Concentration of organisms per test chamber: | 15-30/ml; do not exceed 50/ml |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5, plus 1 chamber for water quality monitoring |
| 16. Feeding requirements: | None |
| 17. Test solution aeration: | None, unless DO falls below 60% of saturation |
| 18. Dilution water: | Optimal 30 (range: 27-36) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Strongylocentrotus purpuratus* LARVAE, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 20. Dilution series: | 100%, 50%, 10%, 1% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |
| 21. Endpoint: | Survival, embryo development |
| 22. Sample holding requirements:* | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Field sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥70% survival **AND** ≥70% normal embryo development in controls |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

ASTM. 2004. Standard Guide for Conducting Static Acute Toxicity Tests with Echinoid Embryos. Annual Book of ASTM Standards, Vol. 11.06. E1563-98(2004)e1. American Society for Testing and Materials, Philadelphia, PA.

USEPA. 1995. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms. First edition. EPA/600/R-95/136. West Coast Manual.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA** ***Lytechinus pictus* LARVAE, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 48-96 h: Test duration is based on the time necessary for ≥70% of control embryos to develop to the pluteus stage. 72 ± 2 h (optimal) |
| 3. Temperature: | 12 ± 1ºC (general) |
| 4. Salinity: | Optimal 30 (range: 27-36) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to ASTM protocol |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 20 - 30 ml |
| 11. Test solution volume: | 10 - 30 ml |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | Larvae, less than 4 h after fertilization |
| 14. Concentration of organisms per test chamber: | 15-30/ml; do not exceed 50/ml |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5, plus 1 chamber for water quality monitoring |
| 16. Feeding requirements: | None |
| 17. Test solution aeration: | None, unless DO falls below 60% of saturation |
| 18. Dilution water: | Optimal 30 (range: 27-36) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |
| 20. Dilution series: | 100%, 50%, 10%, 1% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA** ***Lytechinus pictus*** **LARVAE, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 21. Endpoint: | Survival, embryo development |
| 22. Sample holding requirements: * | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Field sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥70% survival **AND** ≥70% normal embryo development in controls |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

ASTM. 2004. Standard Guide for Conducting Static Acute Toxicity Tests with Echinoid Embryos. Annual Book of ASTM Standards, Vol. 11.06. E1563-98(2004)e1. American Society for Testing and Materials, Philadelphia, PA.

USEPA. 1995. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms. First edition. EPA/600/R-95/136. West Coast Manual.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Americamysis bahia*, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 1. Test type: | Static-renewal |
| 2. Test duration: | 96 h |
| 3. Temperature: | 20 ± 1°C; or 25 ± 1°C (recommended); test temperatures must not deviate (i.e., maximum minus minimum temperature) by more than 3°C during the test (required) |
| 4. Salinity: | Optimal 30 (range: 20-30) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to Section 10.2 of reference method (EPA, 2002) |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 250 ml |
| 11. Test solution volume: | 200 ml |
| 12. Renewal of test solutions: | After 48 h (required minimum) |
| 13. Age of test organisms: | 1-5 d; ≤24 h range in age (required) |
| 14. Number of organisms per test chamber: | Minimum of 10 |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5 |
| 16. Feeding requirements: | *Artemia* nauplii are made available while holding prior to test; feed 0.2 ml of concentrated suspension of *Artemia* nauplii ≤24 h old, daily (approximately 100 nauplii per mysid) |
| 17. Test solution aeration: | None unless DO concentrations fall below 60% of saturation. Rate should not exceed 100 bubbles/min. |
| 18. Dilution water: | Optimal 30 (range: 20-30) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR *Americamysis bahia*, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |
| 20. Dilution series: | 100%, 50%, 10% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |
| 21. Endpoint: | Survival |
| 22. Sample holding requirements:* | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Field sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥90% survival in control treatment |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**Reference:**

USEPA. 2002. Methods for Measuring Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. 5th edition. EPA-821-R-02-012. U.S. Environmental Protection Agency, Office of Water, Washington, DC 20460.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE ATLANTIC SILVERSIDE, *Menidia menidia*, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 96 h |
| 3. Temperature: | 20 ± 1°C; or 25 ± 1°C (recommended); test temperatures must not deviate (i.e., maximum minus minimum temperature) by more than 3°C during the test (required) |
| 4. Salinity: | Optimal 30 (range: 15-32) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to Section 10.2 of reference method (EPA, 2002) |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 250 ml (minimum); 1000 mL recommended |
| 11. Test solution volume: | 200 ml (minimum); 500 mL recommended |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | 9-14 d, ≤24 h range in age |
| 14. Number of organisms per test chamber: | Minimum of 10 |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5 |
| 16. Feeding requirements: | *Artemia* nauplii are made available while holding prior to test; add 0.2 ml *Artemia* nauplii concentrate (approximately 1000) at 48 h |
| 17. Test solution aeration: | None unless DO concentrations fall below 60% of saturation. Rate should not exceed 100 bubbles/min. |
| 18. Dilution water: | Optimal 30 (range: 15-32) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE ATLANTIC SILVERSIDE, *Menidia menidia*, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |
| 20. Dilution series: | 100%, 50%, 10% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |
| 21. Endpoint: | Survival |
| 22. Sample holding requirements:* | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Field sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥90% survival in controls |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**Reference:**

USEPA. 2002. Methods for Measuring Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. 5th edition. EPA-821-R-02-012. U.S. Environmental Protection Agency, Office of Water, Washington, DC 20460.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE INLAND SILVERSIDE, *Menidia beryllina*, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 96 h |
| 3. Temperature: | 20 ± 1°C; or 25 ± 1°C (recommended); test temperatures must not deviate (i.e., maximum minus minimum temperature) by more than 3°C during the test (required) |
| 4. Salinity: | Optimal 30 (range: 1-32) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to Section 10.2 of reference method (EPA, 2002) |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size:* | 250 ml (minimum); 1000 mL recommended |
| 11. Test solution volume:* | 200 ml (minimum); 500 mL recommended |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | 9-14 d, ≤24 h range in age |
| 14. Number of organisms per test chamber: | Minimum of 10 |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5 |
| 16. Feeding requirements: | *Artemia* nauplii are made available while holding prior to test; add 0.2 ml *Artemia* nauplii concentrate (approximately 1000) at 48 h |
| 17. Test solution aeration: | None unless DO concentrations fall below 60% of saturation. Rate should not exceed 100 bubbles/min. |
| 18. Dilution water: | Optimal 30 (range: 1-32) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |

| SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE INLAND SILVERSIDE, *Menidia beryllina*, ACUTE TOXICITY WATER COLUMN TEST | |
|---|---|
| 20. Dilution series: | 100%, 50%, 10% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |
| 21. Endpoint: | Survival |
| 22. Sample holding requirements:* | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Field sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥90% survival in controls |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**Reference:**

USEPA. 2002. Methods for Measuring Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. 5th edition. EPA-821-R-02-012. U.S. Environmental Protection Agency, Office of Water, Washington, DC 20460.

| SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE TIDEWATER SILVERSIDE, *Menidia peninsulae*, ACUTE TOXICITY WATER COLUMN TEST | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 96 h |
| 3. Temperature: | 20 ± 1°C; or 25 ± 1°C (recommended); test temperatures must not deviate (i.e., maximum minus minimum temperature) by more than 3°C during the test (required) |
| 4. Salinity: | Optimal 30 (range: 15-32) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to Section 10.2 of reference method (EPA, 2002) |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size:* | 250 ml (minimum); 1000 mL recommended |
| 11. Test solution volume:* | 200 ml (minimum); 500 mL recommended |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | 9-14 d, ≤24 h range in age |
| 14. Number of organisms per test chamber: | Minimum of 10 |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5 |
| 16. Feeding requirements: | *Artemia* nauplii are made available while holding prior to test; add 0.2 ml *Artemia* nauplii concentrate (approximately 1000) at 48 h |
| 17. Test solution aeration: | None unless DO concentrations fall below 60% of saturation. Rate should not exceed 100 bubbles/min. |
| 18. Dilution water: | Optimal 30 (range: 15-32) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE TIDEWATER SILVERSIDE, *Menidia peninsulae*, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 20. Dilution series: | 100%, 50%, 10% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |
| 21. Endpoint: | Survival |
| 22. Sample holding requirements:* | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Field sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥90% or greater survival in controls |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**Reference:**

USEPA. 2002. Methods for Measuring Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. 5th edition. EPA-821-R-02-012. U.S. Environmental Protection Agency, Office of Water, Washington, DC 20460.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE SHEEPSHEAD MINNOW, *Cyprinodon variegatus*, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 96 h |
| 3. Temperature: | 20 ± 1°C; or 25 ± 1°C (recommended); test temperatures must not deviate (i.e., maximum minus minimum temperature) by more than 3°C during the test (required) |
| 4. Salinity: | Optimal 30 (range: 5-32) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to Section 10.2 of reference method (EPA, 2002) |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 250 ml (minimum); 1000 mL recommended |
| 11. Test solution volume: | 200 ml (minimum); 500 mL recommended |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | 1-14 d, ≤24 h range in age |
| 14. Number of organisms per test chamber: | Minimum of 10 |
| 15. Number of replicate chambers per elutriate concentration: | Minimum of 5 |
| 16. Feeding requirements: | *Artemia* nauplii are made available while holding prior to test; add 0.2 ml *Artemia* nauplii concentrate (approximately 1000) at 48 h |
| 17. Test solution aeration: | None unless DO concentrations fall below 60% of saturation. Rate should not exceed 100 bubbles/min. |
| 18. Dilution water: | Optimal 30 (range: 5-32) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | 100% elutriate, 100% control water, 100% dilution water (if different from control) |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE SHEEPSHEAD MINNOW, *Cyprinodon variegatus*, ACUTE TOXICITY WATER COLUMN TEST** | |
|---|---|
| 20. Dilution series: | 100%, 50%, 10% of the dredged material elutriate (Note: lower concentrations may be necessary if test elutriate is toxic or contains very fine non-settleable solids) |
| 21. Endpoint: | Survival |
| 22. Sample holding requirements:* | <2 wk for sediments. Toxicity tests prepared from sediments should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for site, dilution, and control waters; elutriates are to be used within 24 h of preparation |
| 23. Sample volume required:^ | 1 L sediment per sample station/4 L site water for creation of 100% elutriate |
| 24. Test acceptability: | ≥90% survival in controls |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**Reference:**

USEPA. 2002. Methods for Measuring Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. 5th edition. EPA-821-R-02-012. U.S. Environmental Protection Agency, Office of Water, Washington, DC 20460.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE AMPHIPOD, *Ampelisca abdita*, 10-DAY ACUTE TOXICITY SEDIMENT TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 10 d |
| 3. Temperature: | 20 ± 1ºC |
| 4. Salinity: | Optimal 28 (range: 20-32) ± 2‰ |
| 5. DO concentration: | Not less than 60% saturation |
| 6. pH: | Optimal 7.8 ± 0.5; measure according to ASTM protocol |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | Continuous light |
| 10. Test chamber size: | 1-L glass beaker or jar with 10-cm inner diameter |
| 11. Test solution volume: | 200 ml (about 2-cm depth minimum)<br>700 ml overlying water |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | 3 to 5 mm, no mature males or females |
| 14. Number of organisms per test chamber: | 20 |
| 15. Number of replicate chambers per treatment: | 5 |
| 16. Feeding requirements: | none |
| 17. Test solution aeration: | Water in each test chamber should be aerated overnight before start of test, and throughout the test; aeration at rate that maintains >90% saturation of DO concentration without disturbing the sediment surface. |
| 18. Overlying water: | Optimal 28 (range: 20-32) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | Site sediment, a reference sediment, and a control sediment |
| 20. Endpoint: | Survival |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE AMPHIPOD, *Ampelisca abdita*, 10-DAY ACUTE TOXICITY SEDIMENT TEST** | |
|---|---|
| 21. Sample holding requirements:* | <2 wk for sediments. Sediment toxicity tests should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for overlying water |
| 22. Field sample volume required:^ | 4 L of site, reference site, and control sediment, depending on chamber size |
| 23. Test acceptability: | ≥90% survival in controls **AND** meet requirements of Table A1.3 in ASTM 2004 and Table 11.3 in USEPA 1994 |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**Note:** It is recommended that *Ampelisca abdita* **NOT** be used for tests with sediments having <10% silt/clay content. Pore-water/overlying water ammonia concentrations greater than 30 mg/l total (or 0.4 mg/l unionized) ammonia at pH 7.7 will result in mortality. Follow recommended procedures in Appendix N to reduce ammonia levels before beginning tests.

**References:**

ASTM. 2004. Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Invertebrates. Annual Book of ASTM Standards, Vol. 11.06. E1367-03e1. American Society for Testing and Materials, Philadelphia, PA.

USEPA. June 1994. Methods for Assessing the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods. EPA/600/R-94/025.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE AMPHIPOD, *Leptocheirus plumulosus*, 10-DAY ACUTE TOXICITY SEDIMENT TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 10 d |
| 3. Temperature: | 25 ± 1ºC |
| 4. Salinity | Optimal 20 (range: 1-32) ± 2‰ |
| 5. DO concentration | Not less than 60% saturation |
| 6. pH | Optimal 7.8 ± 0.5; measure according to ASTM protocol |
| 7. Light quality | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | Continuous light |
| 10. Test chamber size: | 1-L glass beaker or jar with 10-cm inner diameter |
| 11. Test solution volume: | 200 ml (about 2 cm depth minimum)<br>700 ml overlying water |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | 2 to 4 mm, no mature males or females |
| 14. Number of organisms per test chamber: | 20 |
| 15. Number of replicate chambers per treatment: | 5 |
| 16. Feeding requirement: | none |
| 17. Test solution aeration: | Water in each test chamber should be aerated overnight before start of test, and throughout the test; aeration at rate that maintains >90% saturation of DO concentration without disturbing the sediment surface |
| 18. Overlying water: | Optimal 20 (range: 1-32) ± 2‰, natural seawater or artificial seawater prepared with Milli-Q® or equivilant deionized water |
| 19. Test treatments: | Site sediment, a reference sediment, and a control sediment |
| 20. Endpoint: | Survival |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE AMPHIPOD, *Leptocheirus plumulosus*, 10-DAY ACUTE TOXICITY SEDIMENT TEST** | |
|---|---|
| 21. Sample holding requirements:* | <2 wk for sediments. Sediment toxicity tests should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for overlying water |
| 22. Field sample volume required:^ | 4 L of site, reference site, and control sediment, depending on chamber size |
| 26. Test acceptability: | ≥90% survival in controls **AND** meet requirements of Table A1.3 in ASTM 2004 and Table 11.3 in USEPA 1994 |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

NOTE: Pore-water/overlying water ammonia concentrations greater than 60 mg/l total (or 0.8 mg/l unionized) ammonia at pH 7.7 will result in mortality. Follow recommended procedures in Appendix N to reduce ammonia levels before beginning tests.

**References:**

ASTM. 2004. Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Invertebrates. Annual Book of ASTM Standards, Vol. 11.06. E1367-03e1. American Society for Testing and Materials, Philadelphia, PA.

Schlekat, C.E., B.E. McGee and E. Reinharz. 1992. Testing Sediment Toxicity in Chesapeake Bay Using the Amphipod *Leptocheirus plumulosus*: An Evaluation. Environ. Toxicol. Chem. 11:225-236.

USEPA. June 1994. Methods for Assessing the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods. EPA/600/R-94/025.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE MYSID SHRIMP, *Americamysis bahia*, 10-DAY ACUTE TOXICITY SEDIMENT TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 10 d |
| 3. Temperature: | 20 ± 1°C; or 25 ± 1°C (recommended); test temperatures must not deviate (i.e., maximum minus minimum temperature) by more than 3°C during the test (required) |
| 4. Salinity | Optimal 30 (range: 20-30) ± 2‰ |
| 5. DO concentration | 60-100% of saturation |
| 6. pH | Optimal 7.8 ± 0.5; measure according to Section 10.2 of reference method (EPA, 2002) |
| 7. Light quality | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 1 L (minimum) |
| 11. Test solution volume: | 200 ml (about 2 cm depth minimum)<br>700 ml overlying water |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | 1-5 d; 24 h range in age |
| 14. Number of organisms per test chamber: | Minimum of 10 |
| 15. Number of replicate chambers per treatment: | Minimum of 5 |
| 16. Feeding requirement: | *Artemia* nauplii are made available while holding prior to test; feed 0.2 ml of concentrated suspension of *Artemia* nauplii ≤24 h old, daily (approximately 100 nauplii per mysid) |
| 17. Test solution aeration: | None unless DO concentrations fall below 60% of saturation; rate should not exceed 100 bubbles/min. |
| 18. Overlying water: | Optimal 30 (range: 20-30) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE MYSID SHRIMP, *Americamysis bahia*, 10-DAY ACUTE TOXICITY SEDIMENT TEST** | |
|---|---|
| 19. Test treatments: | Site sediment, a reference sediment, and a control sediment |
| 20. Endpoint: | Survival |
| 21. Sample holding requirements:* | <2 wk for sediments. Sediment toxicity tests should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for overlying water |
| 22. Field sample volume required:^ | 4 L of site, reference site, and control sediment, depending on chamber size |
| 23. Test acceptability: | ≥90% survival in controls |

***** Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

ASTM. 2004. Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Invertebrates. Annual Book of ASTM Standards, Vol. 11.06. E1367-03e1. American Society for Testing and Materials, Philadelphia, PA.

USEPA. June 1994. Methods for Assessing the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods. EPA/600/R-94/025.

USEPA. October 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, 5$^{th}$ Ed. EPA-821-R-02-012.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE POLYCHAETE, *Neanthes arenaceodentata*, 10-DAY ACUTE TOXICITY SEDIMENT TEST** | |
|---|---|
| 1. Test type: | Static non-renewal |
| 2. Test duration: | 10 d |
| 3. Temperature: | $20 \pm 1^{o}C$ |
| 4. Salinity: | Optimal 30 (range: 28-36) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5 |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D |
| 10. Test chamber size: | 1 L minimum |
| 11. Test solution volume: | 200 ml (about 2 cm depth minimum)<br>700 ml of overlying water |
| 12. Renewal of test solutions: | None |
| 13. Age of test organisms: | 2-3 wk post emergence |
| 14. Number of organisms per test chamber: | 5-10 |
| 15. Number of replicate chambers per treatment: | 5 |
| 16. Feeding requirement: | None |
| 17. Test solution aeration: | Trickle flow (<100 bubble/min) |
| 18. Overlying water: | Optimal 30 (range: 28-36) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 19. Test treatments: | Site sediment; reference sediment; and control sediment |
| 20. Endpoint: | Survival |
| 21. Sample holding requirements:* | <2 wk for sediments; sediment toxicity tests should be started within 2 wk of sampling, but not later than 8 wk after sampling; <14 d for overlying water |
| 22. Field sample volume required:^ | 4 L of site, reference site, and control sediment, depending on chamber size |

| SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE POLYCHAETE, *Neanthes arenaceodentata*, 10-DAY ACUTE TOXICITY SEDIMENT TEST | |
|---|---|
| 23. Test acceptability: | ≥90% survival overall in controls, with >80% survival in individual replicates |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**Reference:**

ASTM. 2007. Standard Guide for Conducting Sediment Toxicity Tests with Polychaetous Annelids. Annual Book of ASTM Standards, Vol. 11.06. E1611-00(2007). American Society for Testing and Materials, Philadelphia, PA.

| SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE BIVALVE, *Macoma nasuta*, 28-DAY SEDIMENT BIOACCUMULATION TEST | |
|---|---|
| 1. Test type: | Flow-through or static renewal |
| 2. Test duration: | 28 d |
| 3. Temperature: | 12-16 ± 1°C |
| 4. Salinity: | Optimal 30 (range: 25-35) ± 2‰ |
| 5. DO concentration: | 60-100% saturation |
| 6. pH: | Optimal 7.8 ± 0.5 |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 12L/12D, 16L/8D, 10L/14D |
| 10. Test chamber size: | Large chamber (20-30 L volume) |
| 11. Test solution volume: | At least 200 g wet wt sediment per g wet flesh (without shell) |
| 12. Sediment depth: | At least 5 cm of sediment depth in large chamber |
| 13. Renewal of test solutions: | Flow-through = 5-10 vol/d;<br>Static Renewal = 3x/wk |
| 14. Age of test organisms: | Adults of same year class, 2-4 yr, 28-45 mm shell length |
| 15. Number of organisms per test chamber: | Depends on chamber size and need for subsequent analysis |
| 16. Number of replicate chambers per treatment: | Minimum of 5 (5-8 recommended) |
| 17. Feeding requirements: | None |
| 18. Test solution aeration: | Moderate, as needed to maintain DO >60% saturation |
| 19. Overlying water: | Optimal 30 (range: 25-35) ± 2‰; natural or artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 20. Test treatments: | Site sediment; reference sediment; and control sediment |
| 21. Endpoint: | Survival, tissue residue |

| SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE BIVALVE, *Macoma nasuta*, 28-DAY SEDIMENT BIOACCUMULATION TEST | |
|---|---|
| 22. Sample holding requirements:* | <2 wk for sediments. Sediment toxicity tests should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for overlying water |
| 23. Field sample volume required:^ | 10 L of site, reference site, and control sediment, depending on chamber size |
| 24. Test acceptability: | ≥90% survival in control and reference treatments; ≥75% survival in test treatments - notify local EPA & USACE district office immediately if criteria are not met |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

ASTM. 2007. Standard Guide for Conducting Determination of the Bioaccumulation of Sediment Associated Contaminants by Benthic Invertebrates. Annual Book of ASTM Standards, Vol. 11.06. E1688-00a(2007). American Society for Testing and Materials, Philadelphia, PA.

Ferraro, S., H. Lee II, R. Ozretich, and D. Specht. 1990. Predicting Bioaccumulation Potential: A Test of a Fugacity-Based Model. Arch. Environ. Contamin. Toxicol. 19:386-394.

Lee, H., II, B. Boese, J. Pelletier, M. Winsor, D. Specht, and R. Randall. 1993. Guidance Manual: Bedded Sediment Bioaccumulation Tests. EPA/600/R-93/183. 232 pp.

| SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE BIVALVE, *Yoldia limatula,* 28-DAY SEDIMENT BIOACCUMULATION TEST | |
|---|---|
| 1. Test type: | Flow-through or static renewal |
| 2. Test duration: | 28 d |
| 3. Temperature: | 5-20ºC (activity minimal at lowest temperature) |
| 4. Salinity: | Optimal 30 (range: 27-35) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5 |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 16L/8D, 14L/10D, 12L/12D |
| 10. Test chamber size: | Large chamber (20-30 L volume) |
| 11. Test solution volume: | At least 200 g wet wt sediment per g wet flesh (without shell) |
| 12. Sediment depth | 5 cm of sediment depth in large chamber; *Yoldia* actively resuspends sediments into water column, additional sediment may need to be added during test to maintain minimal sediment depth |
| 13. Renewal of test solutions: | Flow-through = 5-10 vol/d;<br>Static renewal = 3x/wk |
| 14. Age of test organisms: | Adults of same year class, 2-4 yr, 28-45 mm shell length |
| 15. Number of organisms per test chamber: | Depends on chamber size and need for subsequent analysis |
| 16. Number of replicate chambers per treatment: | Minimum of 5 (5-8 recommended) |
| 17. Feeding requirements: | None |
| 18. Test solution aeration: | Moderate, as needed to maintain DO >60% of saturation |
| 19. Overlying water: | Optimal 30 (range: 27-35) ± 2‰, natural or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE BIVALVE, *Yoldia limatula*, 28-DAY SEDIMENT BIOACCUMULATION TEST** | |
|---|---|
| 20. Test treatments: | Site sediment, a reference sediment, and a control sediment |
| 21. Endpoint: | Survival, tissue residue |
| 22. Sample holding requirements:* | <2 wk for sediments. Sediment toxicity tests should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for overlying water |
| 23. Field sample volume required:^ | 10 L of site, reference site, and control sediment, depending on chamber size |
| 24. Test acceptability: | ≥90% survival in control and reference treatments; ≥75% survival in test treatments - notify local EPA & USACE district office immediately if criteria are not met |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

ASTM. 2007. Standard Guide for Determination of the Bioaccumulation of Sediment Associated Contaminants by Benthic Invertebrates. Annual Book of ASTM Standards, Vol. 11.06. E1688-00a(2007). American Society for Testing and Materials, Philadelphia, PA.

Bender, K. and W.R. Davis. 1984. Effects of Feeding on *Yoldia limatula* on Bioturbation. Ophelia. 23: 91-100.

Lee, H., II, B. Boese, J. Pelletier, M. Winsor, D. Specht, and R. Randall. 1993. Guidance Manual: Bedded Sediment Bioaccumulation Tests. EPA/600/R-93/183. 232 pp.

| SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE SAND WORM, *Nereis virens*, 28-DAY SEDIMENT BIOACCUMULATION TEST | |
|---|---|
| 1. Test type: | Flow-through or static renewal |
| 2. Test duration: | 28 d |
| 3. Temperature: | 10 ± 5°C |
| 4. Salinity: | Optimal 30 (range: 25-35) ± 2‰ |
| 5. DO concentration: | 60-100% of saturation |
| 6. pH: | Optimal 7.8 ± 0.5 |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 12L/12D |
| 10. Test chamber size: | Large chamber (20-30 L volume) |
| 11. Test solution volume: | At least 200 g wet wt sediment per g wet flesh |
| 12. Sediment depth: | 5-10 cm depth in large chamber |
| 13. Renewal of test solutions: | Flow-through = 5-10 vol/d;<br>Static renewal = 3x/wk |
| 14. Age of test organisms: | Adult (3-15 g) |
| 15. Number of organisms per test chamber: | Depends on chamber size and need for subsequent analysis |
| 16. Number of replicate chambers per treatment: | Minimum of 5 (5-8 recommended) |
| 17. Feeding requirements: | None |
| 18. Test solution aeration: | Trickle flow (<100 bubbles/min);<br>Moderate, as needed to maintain DO >60% saturation |
| 19. Overlying water: | Optimal 30 (range: 25-35) ± 2%; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 20. Test treatments: | Site sediment, a reference sediment, and a control sediment |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE SAND WORM, *Nereis virens*, 28-DAY SEDIMENT BIOACCUMULATION TEST** | |
|---|---|
| 21. Endpoint: | Survival, tissue residue |
| 22. Sample holding requirements:* | <2 wk for sediments. Sediment toxicity tests should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for overlying water |
| 23. Field sample volume required:^ | 10 L of site, reference site, and control sediment, depending on chamber size |
| 24. Test acceptability: | ≥90% survival in control and reference treatments; ≥75% survival in test treatments - notify local EPA & USACE district office immediately if criteria are not met |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

ASTM. 2007. Standard Guide for Conducting Sediment Toxicity Tests with Polychaetous Annelids. Annual Book of ASTM Standards, Vol. 11.06. E1611-00(2007). American Society for Testing and Materials, Philadelphia, PA.

ASTM. 2007. Standard Guide for Conducting Determination of the Bioaccumulation of Sediment Associated Contaminants by Benthic Invertebrates. Annual Book of ASTM Standards, Vol. 11.06. E1688-00a(2007). American Society for Testing and Materials, Philadelphia, PA.

Lee, H., II, B. Boese, J. Pelletier, M. Winsor, D. Specht, and R. Randall. 1993. Guidance Manual: Bedded Sediment Bioaccumulation Tests. EPA/600/R-93/183. 232 pp.

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE POLYCHAETE, *Arenicola marina*, 28-DAY SEDIMENT BIOACCUMULATION TEST** | |
|---|---|
| 1. Test type: | Flow-through or static renewal |
| 2. Test duration: | 28 d |
| 3. Temperature: | 20 ± 1ºC |
| 4. Salinity: | Optimal 30 (range: 27-35) ± 2‰ |
| 5. DO concentration: | 60-100% saturation |
| 6. pH: | Optimal 7.8 ± 0.5 |
| 7. Light quality: | Ambient laboratory illumination |
| 8. Light intensity: | 500-1000 lux |
| 9. Photoperiod: | 12L/12D |
| 10. Test chamber size: | Large chamber (20-30 L volume) |
| 11. Test solution volume: | Minimum 400 g wet wt sediment per g wet flesh |
| 12. Sediment dept | ≥15 cm |
| 13. Renewal of test solutions: | Flow-through = 5-10 vol/d;<br>Static renewal = 3x/wk |
| 14. Age of test organisms: | <1 yr (3-6 g wet wt, 5-10 cm length) |
| 15. Number of organisms per test chamber: | Depends on chamber size and need for subsequent analysis |
| 16. Number of replicate chambers per treatment: | Minimum of 5 (5-8 recommended) |
| 17. Feeding requirements: | None |
| 18. Test solution aeration: | Trickle-flow (<100 bubbles/min); moderate, as needed to maintain DO >60% saturation |
| 19. Overlying water: | Optimal 30 (range 27-35) ± 2‰; natural seawater or suitable artificial seawater prepared with Milli-Q® or equivalent deionized water |
| 20. Test treatments: | Site sediment, a reference sediment, and a control sediment |
| 21. Endpoint: | Survival, tissue residue |

| **SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE POLYCHAETE, *Arenicola marina*, 28-DAY SEDIMENT BIOACCUMULATION TEST** | |
|---|---|
| 22. Sample holding requirements:* | <2 wk for sediments. Sediment toxicity tests should be started within 2 wk of sampling, but not later than 8 wk after sampling.<br><14 d for overlying water |
| 23. Field sample volume required:^ | 10 L of site, reference site, and control sediment, depending on chamber size |
| 24. Test acceptability: | ≥90% survival in control and reference treatments; ≥75% survival in test treatments - notify local EPA & USACE district office immediately if criteria are not met |

* Obtain prior approval from your local EPA and USACE district offices if sediment samples will be held longer than the specified sample holding requirements. Prior approval could be obtained during the review and approval of the Sampling and Analysis Plan.

^ This is the minimum volume required to run the test one time. If you need to repeat the test or archive the sample, you should collect additional equivalent volumes.

**References:**

Gordon, D.C., J. Dale and P.D. Keiger. 1978. Importance of Sediment-Working by the Deposit-Feeding Polychaete *Arenicola marina* on the Weathering Rate of Sediment-Bound Oil. J. Fish Res. Bd. Canada. 35:591-603.

Huttel, M. 1990. Influence of the Lugworm *Arenicola marina* on Porewater Nutrient Profiles of Sand Flat Sediments. Mar. Biol. Prog. Ser. 62:241-248.

Lee, H., II, B. Boese, J. Pelletier, M. Winsor, D. Specht, and R. Randall. 1993. Guidance Manual: Bedded Sediment Bioaccumulation Tests. EPA/600/R-93/183. 232 pp.

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# Appendix M

# TESTING GUIDANCE FOR DIOXIN AND OTHER SUPPLEMENTAL CONTAMINANTS

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# Appendix M

## TESTING GUIDANCE FOR DIOXIN AND OTHER SUPPLEMENTAL CONTAMINANTS

Table M-1: Dioxin and Dioxin-Like Compounds

| Congener | Analytical Method | Sediment Target Detection Limit | Tissue Target Detection Limit | Humans/ Mammals TEF[2] | Fish TEF[2] |
|---|---|---|---|---|---|
| Chlorinated dibenzo-p-dioxins (CDD) | | | | | |
| 2,3,7,8-TCDD | 8290, 1613 | 1 ppt | 0.5 ppt | 1 | 1 |
| 1,2,3,7,8-PentaCDD | 8290, 1613 | 5 ppt | 0.5 ppt | 1 | 1 |
| 1,2,3,4,7,8-HexaCDD | 8290, 1613 | 5 ppt | 5 ppt | 0.1 | 0.5 |
| 1,2,3,6,7,8-HexaCDD | 8290, 1613 | 5 ppt | 5 ppt | 0.1 | 0.01 |
| 1,2,3,7,8,9-HexaCDD | 8290, 1613 | 5 ppt | 5 ppt | 0.1 | 0.01 |
| 1,2,3,4,6,7,8-HeptaCDD | 8290, 1613 | 5 ppt | 5 ppt | 0.01 | 0.001 |
| Chlorinated dibenzofurans (CDFs) | | | | | |
| 2,3,7,8-TetraCDF | 8290, 1613 | 1 ppt | 0.5 ppt | 0.1 | 0.05 |
| 1,2,3,7,8-PentaCDF | 8290, 1613 | 5 ppt | 0.5 ppt | 0.05 | 0.05 |
| 2,3,4,7,8-PentaCDF | 8290, 1613 | 5 ppt | 5 ppt | 0.5 | 0.5 |
| 1,2,3,4,7,8-HexaCDF | 8290, 1613 | 5 ppt | 5 ppt | 0.1 | 0.1 |
| 1,2,3,6,7,8-HexaCDF | 8290, 1613 | 5 ppt | 5 ppt | 0.1 | 0.1 |
| 1,2,3, 7,8,9-HexaCDF | 8290, 1613 | 5 ppt | 5 ppt | 0.1 | 0.1 |
| 2,3,4,6,7,8-HexaCDF | 8290, 1613 | 5 ppt | 5 ppt | 0.1 | 0.1 |
| 1,2,3,4,6,7,8-HeptaCDF | 8290, 1613 | 5 ppt | 5 ppt | 0.01 | 0.01 |
| 1,2,3,4,7,8,9-HeptaCDF | 8290, 1613 | 5 ppt | 5 ppt | 0.01 | 0.01 |
| Polychlorinated biphenyls[1] | | | | | |
| 3,3',4,4' tetraCB (77) | 1668 | 1 ppb | 1 ppb | 0.0001 | 0.001 |
| 3,3',4,4',5 pentaCB (126) | 1668 | 1 ppb | 1 ppb | 0.1 | 0.005 |
| 3,3',4,4',5,5' hexaCB (169) | 1668 | 1 ppb | 1 ppb | 0.01 | 0.00005 |

1 NOTE: These PCB congeners are already required per Sections 5.2 and 7.3 of the RIM

2 World Health Organization toxic equivalency factors (TEF): PCDDs, PCDFs and PCBs constitute a group of persistent environmental chemicals. Due to their hydrophobic nature and resistance towards metabolism, these chemicals have been found in fatty tissues of animals and humans. Several PCDDs, PCDFs, and PCBs have been shown to cause toxic responses similar to those caused by 2,3,7,8-TCDD, the most potent congener within these groups of compounds. These toxic responses include dermal toxicity, immunotoxicity, carcinogenicity, and adverse effects on reproduction, development, and endocrine functions. The complex nature of PCDD, PCDF, and PCB mixtures complicates the risk evaluation for humans, fish. and wildlife. Therefore, the concept of TEFs has been developed. The TEF indicates an order of magnitude estimate of the toxicity of a compound relative to TCDD. TEF values, in combination with chemical residual data (sediments, tissues, water) can be used to calculate toxic equivalent (TEQ) concentrations. TEQ concentrations are calculated using the following equation:

$$TEQ = \sum_{n1}[PCDD_i \times TEF_i] + \sum_{n2}[PCDF_i \times TEF_i] + \sum_{n3}[PCB_i \times TEF_i]$$

TEQs can then be used for risk characterization and management purposes. (Van den Berg et al., 1998)

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# Appendix N

# METHODS TO REDUCE AMMONIA FOR WHOLE SEDIMENT TOXICITY TESTS

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEC 21 1993

OFFICE OF
WATER

**MEMORANDUM**

**SUBJECT:** Technical Panel Recommendations Concerning Use of Acute Amphipod Tests in Evaluation of Dredged Material

**FROM:** Tudor T. Davies, Director
Office of Science and Technology
U.S. Environmental Protection Agency

David G. Davis, Deputy Director
Office of Wetlands, Oceans and Watersheds
U.S. Environmental Protection Agency

John P. Elmore, Chief
Operations, Construction and Readiness Division
Directorate of Civil Works
U.S. Army Corps of Engineers

**TO:** EPA Regional Ocean Dumping Coordinators

EPA Regional Wetlands Coordinators

Corps of Engineers Regulatory and Civil Works Elements

Over the past two years, the U.S. Army Corps of Engineers (Corps) and the Environmental Protection Agency (EPA) have been working jointly toward development and implementation of two testing manuals for evaluating dredged material proposed for disposal in aquatic environments. These documents are titled, "Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual" and "Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters - Inland Testing Manual". The Ocean Disposal Manual was published in 1991, and the draft Inland Testing Manual was recently distributed for Corps and EPA review. Following publication of the Ocean Disposal Manual, as the Corps and EPA began to implement this revised ocean testing protocol, some laboratories experienced problems conducting amphipod bioassays and replicating laboratory test results. Some of the laboratories conducting the tests attributed these problems to ammonia and hydrogen sulfide toxicity, as well as amphipod sensitivity to grain size. In order to evaluate the use of amphipod bioassays in the dredged material regulatory programs, EPA and the Corps convened a meeting of Experts on June 18, 1993. This memorandum transmits the findings of that meeting and subsequent discussions.

The meeting participants supported the continued use of amphipod bioassays in the dredged material regulatory programs, and recommended application of the guidance provided in this memo until EPA publishes standard sediment toxicity test protocols in 1994.

The meeting participants reviewed the results of EPA research on test protocol development, and the influences of grain size, ammonia, and hydrogen sulfide toxicity. Standard acute amphipod toxicity test method protocols to be completed by EPA this year (for five species) will include this information. Tables 1 and 2, attached to this memorandum, contain test condition acceptability ranges - based on the "best professional judgement" of the EPA researchers developing the standard protocols - for the following test organisms used to evaluate dredged material: marine and estuarine amphipods (Rhepoxynius, Ampelisca, Eohaustorius, Leptocheirus), a freshwater amphipod (Hyalella), a freshwater midge (Chironomus), and a freshwater oligochaete used in bioaccumulation tests (Lumbriculus). Test condition acceptability ranges are given for temperature, salinity, grain size, and ammonia. Hydrogen sulfide toxicity is not believed to be a problem if dissolved oxygen levels are maintained in the overlying water. At certain open-water dredged material disposal sites (e.g., dispersive situations and situations with well-oxygenated overlying water), ammonia and hydrogen sulfide may not be contaminants of concern. Whenever chemical evidence of ammonia is present at toxicologically important levels, and ammonia is not a contaminant of concern, the laboratory analyst should reduce ammonia in the sediment's interstitial water to below 20 mg/l before adding the benthic test organism. Ammonia levels in the interstitial water can be reduced by sufficiently aerating the sample at saturation and replacing two volumes of water per day. The analyst should measure interstitial ammonia each day until it reaches 20 mg/l. After placing the test organism in the sediment, the analyst should ensure that ammonia concentrations remain within an acceptable range (see Tables 1 and 2) by conducting the toxicity test with continuous flow or volume replacement not to exceed two volumes per day. Table 3 lists several peer-reviewed papers that deal with the information discussed above. A comparison of life cycle/ecological characteristics for the marine and estuarine amphipod species mentioned above is presented in Table 4.

The EPA researchers developing the standard protocols recommended that laboratories running the amphipod toxicity tests take the following steps to reduce the likelihood of obtaining invalid test results.

1) Minimize handling stress of the organisms.

2) Ship the test animals to laboratories quickly at appropriate temperatures.

3) Make certain that proper temperature and other water quality characteristics are always maintained for the test animals.

4) For marine tests, run tests within ten days of receiving test animals in the laboratory. (Tests with some species may need to be run sooner.)

5) Conduct concurrent reference toxicity tests at the start of a sediment test.

6) Feed the test animals if necessary before use.

7) Use the proper life stage of animal for the test.

8) Always run necessary controls for the tests.

9) Remember that all amphipod test species are not the same, and be aware of species specific differences in test acceptability conditions.

10) Culture Hyalella azteca at the testing laboratory.

It is recommended that test acceptability conditions (including interstitial water ammonia) be measured before initiating a test. If any test conditions lie outside of acceptability ranges, alternative test species may be chosen for use whose test acceptability conditions match the dredged material. (But for ammonia, follow the guidance in paragraph 3 of this memo.)

The panel discussed performance requirements for selecting a contractor. It was recommended that as part of the "request-for-proposal" process, contractors should be required to submit three sets of control data to show that they can successfully run the particular test. More detailed guidance is available in the draft document "QA/QC Guidance for Laboratory Dredged Material Bioassays" USACE, Waterways Experiment Station [D. Moore, T. Dillon, J. Word, J. Ward, MP XX-93 (draft may be obtained from senior author)]. EPA and the Corps will work on additional detailed guidance for QA/QC of biological tests in 1994.

EPA and the Corps recognize the need for the development of standard amphipod test protocols, and for continued training on amphipod toxicity test methods. EPA will publish and distribute standard acute toxicity test method protocols for all species listed in the attached tables in FY 94. The Corps and EPA will continue to hold training workshops on the test methods, and to develop training tools such as videos describing test method protocols. EPA and the Corps will also initiate discussions on the feasibility of developing a laboratory certification or accreditation program to support dredged material regulatory activities.

If you have additional questions concerning the amphipod bioassays described in this memo please contact the following persons. For questions concerning the freshwater test contact Dr. Gary Ankley at EPA's environmental research laboratory in Duluth, Minnesota 218-720-5603; for questions concerning the marine and estuarine amphipod tests contact Dr. Norm Rubinstein at EPA's environmental research laboratory in Narragansett, Rhode Island 401-782-3002, Dr. Rick Swartz at EPA's environmental research laboratory in Newport, Oregon 503-867-4031, or Dr. Tom Dillon at the U.S. Army Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi 601-634-3922.

Attachments

Table 1

**FRESHWATER SEDIMENT TOXICITY AND BIOACCUMULATION TEST APPLICATION CONDITIONS**

| PARAMETER | Hyalella | Chironomus | Lumbriculus |
|---|---|---|---|
| Temperature ($^{o}$C) | 23 | 23 | 23 |
| Overlying Salinity (ppt) | <15 | <1 | <1 |
| Grain Size (% silt/clay) | full range | pending | full range |
| Total Ammonia (mg/L $NH_3$+$NH_4$) | * | * | * |
| Sulfides | ** | ** | ** |

*The toxicity of total ammonia to Hyalella azteca is a function of both water hardness and pH. For Lumbriculus variegatus and Chironomus tentans total ammonia toxicity increases as pH increases, with little apparent effect due to hardness. For a frame of reference, the 10-d LC50 for total ammonia in Lake Superior water (40-42 mg/L hardness) is 17.5 (14.8-20.7) mg/L at pH 7.5 for Hyalella azteca, 21.4 (19.2-23.9) mg/L at pH 7.8 for Lumbriculus variegatus, and 186 (156-222) mg/L at pH 7.7 for Chironomus tentans. A framework for deciding whether observed sediment (or elutriate) toxicity may be due to ammonia is presented in EPA/USACE (1993; Appendix F).

**Hydrogen Sulfide is not likely to be a problem in these tests if adequate dissolved oxygen levels are maintained in the overlying water.

EPA/USACE. 1993. Evaluation of dredged material proposed for discharge in inland and near coastal waters - testing manual (Inland Testing Manual). Draft Report. U.S. Environmental Protection Agency, and U.S. Army Corps of Engineers, Washington, DC.

## Table 2

**MARINE AND ESTUARINE AMPHIPOD TOXICITY TEST APPLICATION CONDITIONS**

| PARAMETER | Rhepoxynius | Ampelisca | Eohaustorius | Leptocheirus |
|---|---|---|---|---|
| Temperature ($^{o}C$) | 15 | 20 | 15 | 25 |
| Overlying Salinity (ppt) | >25 | >20 | 2-34 | 2-32 |
| Grain Size (% silt/clay) | <90 | >10 | full range | full range |
| Ammonia (total mg/L, pH 7.7)* | <30 | <30 | <60 | <60 |
| Ammonia (UI[1] mg/L, pH 7.7)* | <0.4 | <0.4 | <0.8 | <0.8 |
| Sulfides | ** | ** | ** | ** |

*A framework for deciding whether observed sediment (or elutriate) toxicity may be due to ammonia is presented in EPA/USACE (1993; Appendix F). This document should be consulted if ammonia is suspected to be a contaminant of concern.

**Hydrogen Sulfide is not likely to be a problem in these tests if adequate oxygen levels are maintained in the overlying water.

[1]Unionized

EPA/USACE. 1993. Evaluation of dredged material proposed for discharge in inland and near coastal waters - testing manual (Inland Testing Manual). Draft Report. U.S. Environmental Protection Agency, and U.S. Army Corps of Engineers, Washington, DC.

**Table 3**

American Society for Testing and Materials. E1367-92. Guide for conducting 10-day static sediment toxicity tests with marine and estuarine amphipods. In: Annual Book of ASTM Standards, Water and Environmental Technology, Vol. 13.04, Philadelphia, PA, 1992.

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Ankley, G.T., Benoit, D.A., Balough, J.C., Reynoldson, T.B., Day, K.E., and Hoke, R.A. Evaluation of potential confounding factors in sediment toxicity tests with three freshwater benthic invertebrates. Environ. Toxicol. Chem.; In press, 1994.

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**Table 3**, Continued

Call, D.J., Brooke, L.T., Ankley, G.T., Benoit, D.A., Phipps, G.L., West, C.W., and Hoke, R.A. A method for determining bioaccumulation of sediment-associated contaminants using the oligochaete, Lumbriculus variegatus. EPA Region 5, Chicago, IL, 1993.

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DeWitt, T.H., Swartz, R.C., and Lamberson, J.O. Measuring the acute toxicity of estuarine sediments. Environ. Toxicol. Chem. 8:1035-1048, 1989.

Ingersoll, C.G. and Nelson, M.K. Testing sediment toxicity with Hyalella azteca (Amphipoda) and Chironomus riparius (Diptera). In: Aquatic Toxicology and Risk Assessment, 13th volume, ASTM STP 1096, W.G. Landis and W.H. van der Schalie, Eds. Philadelphia, PA, pp. 93-109, 1990.

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Scott, K.J. and Redmond, M.S. The effects of a contaminated dredged material on laboratory populations of the tubicolous amphipod, Ampelisca abdita. In: Aquatic Toxicology and Hazard Assessment: 12th Volume, ASTM STP 1027, U.M. Cowgill and L.R. Williams, Eds. Philadelphia, PA, American Society for Testing and Materials, pp. 289-303, 1989.

Swartz, R.C. Marine sediment toxicity tests. In: Contaminated Marine Sediments - Assessment and Remediation, Washington, D.C., National Academy Press, pp. 115-129, 1989.

## Table 4

### COMPARISON OF FOUR MARINE AND ESTUARINE AMPHIPOD SPECIES FOR ACUTE TESTS

| Characteristic | Rhepoxynius | Ampelisca | Eohaustorius | Leptocheirus |
|---|---|---|---|---|
| Substrate Relation | Free burrowing | Tube dwelling, closed | Free burrowing | Tube dwelling, open |
| Zoogeography | Pacific | Atlantic-Gulf San Francisco Bay | Pacific | Atlantic |
| Habitat | Polyhaline | Poly-upper mesohaline | Oligo-mesohaline | Oligo-meshohaline |
| Life Cycle | Annual | 30-40 days | Annual | 30-40 days |
| Availability | Field | Field-culture | Field | Field-Culture |
| Response Data Base | Extensive | Extensive | Low to moderate | Low to moderate |
| Ecological Importance | High | High | High | High |

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

JUN 14 1994

MEMORANDUM

OFFICE OF WATER

SUBJECT: Recommendations for Conducting Sediment Toxicity Test with *Mysidopsis bahia* when Ammonia may be Present at Toxic Levels

FROM: for Elizabeth Southerland, Acting Director
Standards and Applied Science Division (4305)
Office of Science and Technology

TO: Mario P. Del Vicario, Chief
Marine and Wetlands Protection Branch
U.S. EPA Region 2

The purpose of this memorandum is to provide guidance to U.S. EPA Region 2 on conducting the mysid ten-day solid phase sediment toxicity test to evaluate dredged material for open water disposal. This guidance is provided in response to a letter mailed to Region 2 on April 22, 1994 from Monte Greges, U.S. Army Corps of Engineers, New York District, requesting guidance on running the mysid test when ammonia is present at potentially toxic concentrations.

The Office of Science and Technology held a conference call on May 16, 1994 with EPA and U.S. Army Corps of Engineers scientists and our consultants to develop an acceptable protocol for running the mysid test when ammonia may be present at toxic levels. The following protocol was recommended by conference call participants who are identified below as recipients of this memorandum.

1. The Corps of Engineers and EPA issued joint guidance on December 21, 1993 offering recommendations, based on the best available information, for reducing ammonia levels in test systems used for acute amphipod sediment bioassays. When running mysid tests, it is recommended that the procedure described in the December 21 memorandum be used with modifications pertaining specifically to *Mysidopsis bahia*.

2. The Corps of Engineers/EPA December 21 guidance memorandum states that at certain open-water dredged material disposal sites (e.g. dispersive situations and situations with well-oxygenated overlying water), ammonia and hydrogen sulfide

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may not be contaminants of concern. If chemical evidence of ammonia is present at toxicologically important levels (i.e. ammonia concentrations exceeding the species-specific acceptability ranges), and ammonia is not a contaminant of concern, the laboratory analyst running the mysid ten-day sediment toxicity test should reduce ammonia in the in the test system overlying water to the appropriate acceptable level before adding the test organism.

3. For *Mysidopsis bahia*, the species-specific acceptable level for unionized ammonia concentration in the test system overlying water (i.e sublethal water column concentration for a ten-day sediment test) is 0.6 mg/L in tests run at 26±1°C, 31± g/Kg salinity, and pH of 7.9-8.0 using one day old organisms . At a test pH of 7.5, the acceptable concentration of unionized ammonia is 0.3 mg/L. These acceptability levels were derived on the basis of acute toxicity tests conducted with ammonia by D.C. Miller, S. Poucher, J.A. Cardin, and D. Hansen at EPA's Environmental Research Laboratory, Narragansett, Rhode Island.

4. If unionized ammonia levels in the test system overlying water exceed the acceptability level for *Mysidopsis bahia* (0.6 mg/L at pH 7.9-8.0 or 0.3 mg/L at pH 7.5) the system should be flushed at a rate of two volume replacements per day until it reaches a concentration of unionized ammonia at or below the acceptability level. Overlying water should be aerated during flushing, and the analyst should measure the overlying water ammonia concentration each day until the acceptable concentration is reached. Overlying water should be sampled approximately 1 cm above the sediment surface.

5. After adding the test organisms to the system, the analyst should ensure that ammonia concentrations remain within an acceptable range by conducting the toxicity test with continuous flow or volume replacement not to exceed two volumes per day. It is recommended that overlying water concentration of ammonia be measured again at the end of the test.

6. Accurate measurement of sample pH is crucial in the calculation of the unionized ammonia fraction. EPA's Narragansett laboratory recommends the use of specific equipment and procedures for determining pH of seawater (see Attachment 1)

We are sending this memorandum concurrently to EPA Region 2 and the conference call participants who recommended guidance. We ask that conference call participants provide any comments or modifications of the recommended procedure to Tom Armitage of my staff by June 24, 1994. We will notify Region 2 if any changes in the guidance are required.

Attachment

cc: Bob Engler (COE WES)
Tom Dillon (COE WES)
David Moore (COE WES)
Monte Greges (COE NY District)
Gary Ankley (EPA ORD)
Don Miller (EPA ORD)
Norm Rubenstein (EPA ORD)
Rick Swartz (EPA ORD
Tom Chase (EPA OWOW)
Alex Lechich (EPA Region 2)
Joel O'Conner (EPA Region 2)
Dave Tomey (EPA Region 1)
John Scott (SAIC)

Use of criteria for developing water quality-based permit limits and for designing waste treatment facilities requires the selection of an appropriate wasteload allocation model. Dynamic models are preferred for the application of these criteria (U.S. EPA 1985b). Limited data or other considerations might make their use impractical, in which case one should rely on a steady-state model (U.S. EPA 1986).

## IMPLEMENTATION

Water quality standards for ammonia developed from these criteria should specify use of environmental monitoring methods which are comparable to the analytical methods employed to generate the toxicity data base. Total ammonia may be measured using an automated idophenol blue method, such as described by Technicon Industrial Systems (1973) or U.S. EPA (1979) method 350.1. Un-ionized ammonia concentrations should be calculated using the dissociation model of Whitfield (1974) as programmed by Hampson (1977). This program was used to calculate most of the un-ionized values for saltwater organisms listed in Table 1 and 2 of this document. Accurate measurement of sample pH is crucial in the calculation of the un-ionized ammonia fraction. The following equipment and procedures were used by EPA in the ammonia toxicity studies to enhance the precision of pH measurements in salt water. The pH meter reported two decimal places. A Ross electrode with ceramic junction was used due to its rapid response time; an automatic temperature compensation probe provided temperature correction. Note that the responsiveness of a new electrode may be enhanced by holding it in sea water for several days prior to use. Two National Bureau of Standards buffer solutions for calibration preferred for their stability were (1) potassium

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# Appendix O

# QUALITY CONTROL (QC)
# SUMMARY TABLES

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# Appendix O

# QUALITY CONTROL (QC) SUMMARY TABLES

## PROJECT, SAMPLING, AND LABORATORY INFORMATION

PROJECT, SAMPLING, AND LABORATORY INFORMATION

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# EPA Region 4
## SERIM Data Review and Validation Requirements
## Dredged Material Disposal Evaluation

**Project:** ______________________________

Project Initiation Date: ______________________________

Project Sampling Dates:

Begin: ______________________________

End: ______________________________

Final Report Date: ______________________________

Final Review Date: ______________________________

*I certify the review in this document conforms to all applicable regulatory and project-specific requirements.*

______________________________
QA Officer

______________________________
(Director or President, Validation Company)

# Table of Contents

# Data Review Instructions

This document contains a review table listing specific data quality objectives.  The purpose of the review spreadsheet is to provide a template for validation of the project data quality objectives.  The tables are contained in an Excel spreadsheet and are designed to follow the project from initial setup to final review.  They may also be filled out manually, using the printed copies as templates.

The Table of Contents on page 2 lists the sections of this document that should be filled out for each project.

Prior to sampling, complete the section titled Project Review.  This provides information about the contract and the approval of the SAP/QAPP.

Also, prior to sampling, complete the section titled Laboratory Information.  This will verify that the laboratory is capable of meeting the DQOs as required.

After sampling, begin filling in the section titled Sample Custody.  This section verifies that the samples were properly collected and shipped to the analytical laboratory.  For this section, several questions require the laboratory report to be completed and submitted to the contractor before they can be answered.

Once the data report has been received by the contractor, begin filling in the section titled Analytical Review Summary.  This section shows information about the contractor review prior to submission of the report to the client by the contractor.

The remaining sections are organized according to analytical group and matrix and should be completed as each section is reviewed.  Each section has a field for entering the analytical method number used.  Unless otherwise specified, each analytical method should be completed on its own page.  Then complete the review of specific QC targets listed in the table.   Any QC value that does not meet the specified criteria should  be explained in the Review Comments box.  In addition, verify that the laboratory has submitted a case narrative for any QC failures along with corrective actions taken.  If this is not received, contact the laboratory to add this to the final report.

# Project Review

The following sections must be completed prior to field sampling or laboratory analysis:

The SAP/QAPP was prepared and submitted for approval by the Corps of Engineers District Office and EPA Region 4.

| |
|---|
| Submitted by: |
| Date submitted: |

The SAP/QAPP was approved by the Corps of Engineers District Office and EPA Region 4.

| |
|---|
| Approved by: |
| Date Approved: |

Any deviations from District-approved protocols for sampling or analysis were clearly stated to the District and approved by the District office and EPA Region 4.

# Laboratory Information

Use one sheet for each laboratory that will perform analytical work for this project.

Laboratory Name/Identification:________________________________________________________________

Is lab NELAC certified? Yes/No If Yes, please supply certification number__________________________

**Can lab meet the QC requirements below as specified in the SAP/QAPP?**

| Yes/No | |
|---|---|
| | Analytical requirement |
| | Instrumentation |
| | MDL's |
| | Precision and accuracy |
| | Required turnaround time |

Note below any requirements the laboratory is unable to meet.

# Sample Custody

Was all required information on the chain-of-custody form:

| (Yes/No) | |
|---|---|
| | Did chain of custody forms accompany samples to subcontract lab? |
| | Is the project identification on the chain of custody? |
| | Are the analyses requested printed on the sample containers? |
| | Were all samples correctly identified? |
| | Were the analyses correctly identified on the chain of custody or an attached document listed on the chain of custody? |
| | Were sample dates and times listed on the chain of custody? |
| | Were the chains of custody signed by both the relinquisher and receiver of the samples? |
| | Was the carrier identified on the chain of custody? |
| | If more than one chain of custody was needed for samples, are the chains of custody clearly numbered? |
| | Were samples packed on wet ice, with an expected receipt temperature of 4 ± 2°C? |
| | Were any sample conditions or irregularities (broken bottles, improper temperature) noted on the chain of custody or accompanying paperwork? |
| | Was the chain of custody submitted as part of the report to the primary contractor? |
| | Were all requested analyses performed? |
| | Was adequate sample volume provided to the contractor lab? |
| | If any anomalous behavior of the samples was found, was it noted in the lab case narrative? |

Additional sample custody issues or deficiencies:

# Analytical Review Summary

Were all raw data included in the final report?

(Yes/No)

| | |
|---|---|
| | Prep logs |
| | Analytical logs |
| | Data reduction logs |
| | Calculations |
| | Data report |
| | QC Package |

Verify that samples were prepared according to the method specified.

| | |
|---|---|
| | 10% check |
| | 100% check |

Verify that samples were analyzed according to the method specified.

| | |
|---|---|
| | 10% check |
| | 100% check |

Verify that data were properly transferred from run to data report.

| | |
|---|---|
| | 10% check |
| | 100% check |

Verify that QC was calculated and within limits and complete the QC forms provided in this package.

| | |
|---|---|
| | 10% check |
| | 100% check |

Additional data quality issues:

# List of Acronyms

| | |
|---|---|
| IC | Initial Calibration |
| MDL | Method Detection Limit |
| LCS | Laboratory Control Sample |
| CCV | Continuing Calibration Verification |
| MB | Method Blank |
| MS/MSD/MST | Matrix Spike/Matrix Spike Duplicate/Matrix Spike Triplicate |
| IS | Internal Standard |
| LFB | Laboratory Fortified Blank |
| RL | Reporting Limit |
| LDR | Linear Dynamic Range |
| SRM | Standard Reference Material |
| ICV | Initial Calibration Verification |
| SAP/QAPP | Sampling and Analysis Plan/Quality Assurance Project Plan |
| SERIM | EPA Region 4 - Southeast Regional Implementation Manual |

# CHEMISTRY REVIEW

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Project Identification:________________________________________

Reviewed by:________________________________________

Review Date:________________________________________

**Parameter: Metals** (e.g. Silver, Arsenic)

**List Metals Analyzed:**________________________________________

**Matrix:** ☐ Sediment ☐ Water/Elutriate ☐ Tissue

**Analytical Method Used:** ________________________________________

| QC Measurement | Frequency | Acceptance Criteria | Criteria Met (Y/N) | Review Comments |
|---|---|---|---|---|
| MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | | |
| MS/MSD/MST | 1 set per 20 samples or per batch | 70 - 130% for spike limits<br><br>30% RSD for precision | | |
| Duplicate | 1 per 20 samples or 1 per batch up to 20 samples | 30% RSD for precision | | |
| SRM | 1 per 20 samples or 1 per batch up to 20 samples | 70 - 130% Recovery | | |
| LCS/LFB | 1 per 20 samples or 1 per batch up to 20 samples | 70 - 130% Recovery | | |
| ICV | Immediately following calibration curve | 90 - 110% Recovery | | |

Project Identification:________________________________________

Reviewed by:_____________________________________________

Review Date:_____________________________________________

**Parameter: Metals** (e.g. Silver, Arsenic)

**List Metals Analyzed:**__________________________________________________

**Matrix:** ☐ Sediment ☐ Water/Elutriate ☐ Tissue

**Analytical Method Used:** ______________________________________________

| | | | | |
|---|---|---|---|---|
| CCV | Minimum - check calibration at middle and end of each batch or 1 per 10 analyses, whichever is greater | 90 - 110% Recovery | | |
| LDR | Verify LDR once per quarter for ICP analyses and one time for mercury analysis | | | |
| IC | Verify initial calibration for AA and mercury analysis performed daily | cc > 0.9950 for all calibrations | | |
| MDL | Verify MDL study once per year for each analyte of interest | Updated annually | | |
| ICB | Immediately after initial calibration | No analyte should be detected > RL | | |

Project Identification:______________________________________________

Reviewed by:______________________________________________

Review Date:______________________________________________

**Parameter: Metals** (e.g. Silver, Arsenic)

**List Metals Analyzed:**_______________________________________________

**Matrix:** ☐ Sediment ☐ Water/Elutriate ☐ Tissue

**Analytical Method Used:** _______________________________________________

| Additional Issues Related to Data Quality | *Use this space to enter any additional comments related to this section that were not addressed above.* |
|---|---|

Project Identification:______________________________________________

Reviewed by:______________________________________________

Review Date:______________________________________________

**Parameter:** ☐ PAHs ☐ Pesticides ☐ PCBs

**Matrix:** ☐ Sediment ☐ Water/Elutriate ☐ Tissue

**Analytical Method Used:**______________________________________________

| QC Measurement | Frequency | Acceptance Criteria | Criteria Met (Y/N) | Review Comments |
|---|---|---|---|---|
| MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | | |
| MS/MSD/MST | 1 set per 20 samples or per batch | 50 - 150% for spike limits<br><br>50% RSD for precision | | |
| Duplicate | 1 per 20 samples or 1 per batch up to 20 samples | 30% RSD for precision | | |
| SRM | 1 per 20 samples or 1 per batch up to 20 samples | Within limits specified by provider | | |
| ICV | Immediately following calibration curve | 80 - 120% Recovery | | |
| CCV | At the beginning of every 12 hours of analysis | <15% Difference | | |

Project Identification:______________________________________________
Reviewed by:_________________________________________________
Review Date:_________________________________________________

**Parameter:** ☐ PAHs ☐ Pesticides ☐ PCBs
**Matrix:** ☐ Sediment ☐ Water/Elutriate ☐ Tissue

**Analytical Method Used:**_______________________________________________

| | | | | |
|---|---|---|---|---|
| Surrogates | Every sample | 30 - 150% | | |
| Internal Standard | Every sample | 30 - 150% | | |
| IC | Verify after each initial calibration | <20% RSD for each analyte | | |
| MDL | Verify MDL study once per year for each analyte of interest | Updated annually | | |
| ICB | Immediately after initial calibration | No analyte should be detected > RL | | |

| | |
|---|---|
| Additional Issues Related to Data Quality | *Use this space to enter any additional comments related to this section that were not addressed above.* |

Project Identification:______________________________________________

Reviewed by:______________________________________________

Review Date:______________________________________________

**Parameter: Tributyltins**

**Matrix:** ☐ Sediment ☐ Water/Elutriate ☐ Tissue

**Analytical Method Used:**________________________________________________

| QC Measurement | Frequency | Acceptance Criteria | Criteria Met (Y/N) | Review Comments |
|---|---|---|---|---|
| MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | | |
| [illegible] | 1 set per 20 samples or per batch | 40% | | |
| Duplicate | 1 per 20 samples or 1 per batch up to 20 samples | 40% | | |
| SRM | 1 per 20 samples or 1 per batch up to 20 samples | Within limits specified by provider | | |
| ICV | Immediately following calibration curve | 75-125% | | |
| CCV | At the beginning of every 12 hours of analysis | 75-125% | | |
| Surrogates | Every sample | 20-150% | | |
| IC | Verify after each initial calibration | <20% RSD | | |

Project Identification:____________________________________________

Reviewed by:____________________________________________

Review Date:____________________________________________

**Parameter: Tributyltins**
**Matrix:** ☐ Sediment ☐ Water/Elutriate ☐ Tissue

**Analytical Method Used:**____________________________________________

| | | | | |
|---|---|---|---|---|
| MDL | Verify MDL study once per year for each analyte of interest | Updated annually | | |

| | |
|---|---|
| Additional Issues Related to Data Quality | *Use this space to enter any additional comments related to this section that were not addressed above.* |

Project Identification:_____________________________________________

Reviewed by:_____________________________________________

Review Date:_____________________________________________

**Parameter: Dioxins**

**Matrix:** ☐ Sediment ☐ Water/Elutriate ☐ Tissue

**Analytical Method Used:**_____________________________________________

| QC Measurement | Frequency | Acceptance Criteria | Criteria Met (Y/N) | Review Comments |
|---|---|---|---|---|
| MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | | |
| LCS | 1 per 20 samples or 1 per batch up to 20 samples | 70 - 130% for spike limits | | |
| MS/MSD or LCS/LCSD^ | 1 set per 20 samples or per | 70 - 130% recovery for | | |
| ICV | Immediately following calibration curve | 50 - 150% | | |
| CCV° | At the beginning of every 12 hours of analysis | 80 - 120% Native standards 65 - 135% Labeled standards | | |
| Initial Calibration Standards | Once per run | 80 - 120% Native standards 65 - 135% Labeled standards | | |

° For method 1613B, one CCV run at the beginning of the 12-hour clock is required. For Method 8290, two CCVs are required – one at the beginning and one at the ending of the 12-hour clock.

NOTE: MDL studies don't apply to dioxin/furan testing since the detection limits are calculated for each compound on each run depending on the signal/noise of the HRMS instrument.

Project Identification:____________________________________________
Reviewed by:________________________________________________
Review Date:________________________________________________

**Parameter: Dioxins**
**Matrix:** ☐ Sediment ☐ Water/Elutriate ☐ Tissue

**Analytical Method Used:**______________________________________________

| Additional Issues Related to Data Quality | *Use this space to enter any additional comments related to this section that were not addressed above.* |
|---|---|

Project Identification:______________________________________________

Reviewed by:__________________________________________________

Review Date:__________________________________________________

**Parameter: TOC**

**Matrix: Sediment**

**Analytical Method Used:**_______________________________________________

| QC Measurement | Frequency | Acceptance Criteria | Criteria Met (Y/N) | Review Comments |
|---|---|---|---|---|
| MB | 1 per 20 samples or 1 per batch up to 20 samples | No analyte should be detected > RL | | |
| MS/MSD/MST | 1 set per 20 samples or per batch | 75 - 125% for spike limits<br><br>20% RSD for precision | | |
| Triplicate | 1 per 20 samples or 1 per batch up to 20 samples | 20% RSD for precision | | |
| SRM | 1 per 20 samples or 1 per batch up to 20 samples | Within limits specified by provider | | |
| ICV | Immediately following calibration curve | 80 - 120% Recovery | | |
| CCV | At the beginning of every 12 hours of analysis | 90 - 110% | | |

Project Identification:_______________________________________________

Reviewed by:__________________________________________________

Review Date:__________________________________________________

**Parameter: TOC**

**Matrix: Sediment**

**Analytical Method Used:**_________________________________________

| | | | | |
|---|---|---|---|---|
| IC | Verify after each initial calibration | cc > 0.9950 for all calibrations | | |
| MDL | Verify MDL study once per year for each analyte of interest | Updated annually | | |

| | |
|---|---|
| Additional Issues Related to Data Quality | *Use this space to enter any additional comments related to this section that were not addressed above.* |

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# PHYSICAL REVIEW

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Project Identification:______________________________________________

Reviewed by:________________________________________________________

Review Date:________________________________________________________

**Physical Analysis: Grain Size, % Solids, Specific Gravity, Bulk Density, and Atterburg Limits**

☐ Grain Size ☐ Bulk Density ☐ Specific Gravity ☐ %Solids ☐ Atterburg Limits

**Analytical Method Used:**_______________________________________________

| QC Measurement | Frequency | Acceptance Criteria | Criteria Met (Y/N) | Review Comments |
|---|---|---|---|---|
| Triplicate | 1 set per 20 samples or per batch | <20% RSD | | |

**Physical Analysis: Bulk Density and Atterburg Limits**

☐ Bulk Density ☐ Atterburg Limits

**Analytical Method Used:**_______________________________________________

| QC Measurement | Frequency | Acceptance Criteria | Criteria Met (Y/N) | Review Comments |
|---|---|---|---|---|
| Duplicate | 1 set per 10 samples or per batch | Within 20% Relative % Difference | | |

Project Identification:________________________________________________
Reviewed by:______________________________________________________
Review Date:______________________________________________________

**Physical Analysis: Grain Size, % Solids, Specific Gravity, Bulk Density, and Atterburg Limits**

| | |
|---|---|
| Additional Issues Related to Data Quality | *Use this space to enter any additional comments related to this section that were not addressed above.* |

# TOXICOLOGY REVIEW

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Project Identification:______________________________________________

Reviewed by:______________________________________________

Review Date:______________________________________________

| **Part I** | **General Data Reporting Requirements** |
|---|---|
| **SUMMARY TABULAR DATA AND PROJECT NARRATIVE**<br>**Each of the following elements should be present as described.** | |
| | A summary table listing the percent survival in all control, reference, and test samples |
| | A summary table containing the $LC_{50}/EC_{50}$ values for the suspended particulate phase (SPP) tests and t-tests from the solid phase tests |
| | A narrative which summarizes all of the deviations from the Green Book and Regional Guidance Manual protocols. Deviations of sample handling, test conditions, ammonia purging procedures, control performance, reference toxicant test performance, organism handling/acclimation, and water quality parameters should be provided in this section. |
| | A summary table which documents collection dates and holding times for the test, control, and reference sediment samples. Holdin g times for site water, SPP, and lab saltwater for all tests should be included in this table. |
| | The data narrative should describe the major biological project activities and results. Computerized tables of results, water quality, and other pertinent information should be placed in this portion of the biological data package. |

| **RAW BIOLOGICAL AND WATER QUALITY DATA FROM TESTS** | |
|---|---|
| | Survival Data |
| | Water Quality Parameters |
| | Feeding Schedule and Amount (if applicable) |
| | Organism Observations |
| | Summary of Test Conditions |

| **TEST ORGANISM HOLDING, HANDLING AND ACCLIMATION** | |
|---|---|
| | Organism Shipping Data Sheet Provided by Supplier |
| | Copy of Overnight Shipping Airbill (if applicable) |
| | Internal Receiving and Distribution Data |
| | Holding/Acclimation Records (including water quality, renewals, and feeding) |
| | Mortality During Holding and Acclimation |
| | Taxonomic Identification for Each Species |

Project Identification:____________________________________________
Reviewed by:_________________________________________________
Review Date:_________________________________________________

| **REFERENCE TOXICANT DATA** | |
|---|---|
| | Raw Bench Sheets For Reference Toxicant Tests |
| | Reference Toxicant Stock & Test Solution Preparation Sheet |
| | LC50/EC50 Statistical Calculations |
| | Updated Reference Toxicant Control Charts with Acceptability Limits |

| **STATISTICAL DATA FROM DREDGE MATERIAL TESTS** | |
|---|---|
| | Provide all computer-generated $LC_{50}$, $EC_{50}$, and/or t-test Spreadsheets or graphical interpolations for the SPP and solid phase tests. |

| **INVALID TEST DATA** | |
|---|---|
| | If a test was prepeated for any reason, the data from the original test must be included in the final report. If a serious deviation occurs which has the potential to affect test acceptability, the USACE NY District and EPA Region 2 must be contacted immediately to determine if a retest is needed. |

Project Identification:______________________________________________

Reviewed by:_________________________________________________

Review Date:_________________________________________________

| Part II | Test-Specific Information (additional to items specified in Part I) |
|---|---|
| **AMPHIPOD SOLID PHASE TEST** | |
| | Pretest Overlying Water Renewal Log and Total Porewater Ammonia Data |
| | Total/Unionized Porewater Ammonia Measured in Dummy Jars During Testing |

| | |
|---|---|
| **MYSID SOLID PHASE TEST** | |
| | Pretest Overlying Water Renewal Log and Total Porewater Ammonia Data |
| | Total/Unionized Overlying Unionized Ammonia Measured During Testing |

| | |
|---|---|
| **SUSPENDED PARTICULATE PHASE TESTS (SPP)** | |
| | SPP Preparation Log (All volumes, Mixing Times, Centrifuge Information etc.) |
| | Raw Data for Bivalve Gamete Collection and Preparation |

| | |
|---|---|
| **BIOACCUMULATION TESTING** | |
| | Daily Flow Calibration Log – Initial and Final Adjusted Flows |
| | Pre- and Post-test Depuration Logs – Time Started/Ended and Flow Rates |
| | Receiving Logs for All Natural Saltwater (If Collected) |
| | Preparation Logs for All Artifiical Saltwater |
| | If Control Survival <90%, Provide Detailed Narrative for the 5 Factors |
| | Raw Statistical Data Comparing Test and Reference Tissue Chemistry |

| | |
|---|---|
| **SAMPLING / SAMPLE HANDLING** | |
| | Chain of Custody Forms for All Test, Control, and Reference Samples |
| | Field Data Sheets and/or Sampling Logs (Including Photos If Available) |
| | Log of Test Sediment Composite Preparation |
| | Sieving – Size of Mesh Used for Samples Used in Toxicity Tests/Bioaccumulation |
| | Holding Times for All Samples (Test, Reference, Control, Elutriate, Lab Saltwater) in Summary Chart Format |

Project Identification:__________________________________________________

Reviewed by:______________________________________________________

Review Date:______________________________________________________

| **Laboratory:** | **Solid Phase Test** | **Solid Phase Test** | **Suspended Particulate Tests** | | | **Bioaccumulation Tests** | |
|---|---|---|---|---|---|---|---|
| | **Amphipod** | **Mysid** | **Minnow** | **Mysid** | **Bivalve Larvae** | **Sand Worm** | **Clam** |
| **Test Species:** Identify each species used for toxicology in the cells to the right | | | | | | | |
| Correct species used as stated in the SAP/QAPP? (Y/N) | | | | | | | |
| Test Condition Within Acceptable Limits? (Y/N) | | | | | | | |
| Control Survival (Y/N) | | | | | | | |
| Reference Toxicant Response " 2sd (Y/N) | | | | | | | |
| Temperature (Y/N) | | | | | | | |
| Dissolved Oxygen (Y/N) | | | | | | | |
| pH (Y/N) | | | | | | | |
| Salinity (Y/N) | | | | | | | |
| Acclimation Procedures (Y/N) | | | | | | | |
| Sediment Holding Time <6 wks (Y/N) | | | | | | | |
| Statistical Analyses Appropriate (Y/N) | | | | | | | |
| Ammonia Management (Y/N) | | | | | | | |
| **Overall test data valid? (Y/N)** | | | | | | | |

# Appendix P

# TOXICITY TEST EXPERIMENTAL DESIGN AND WATER QUALITY FORM

# Appendix P

## TOXICITY TEST EXPERIMENTAL DESIGN AND WATER QUALITY FORM

| **Toxicity Test Experimental Design and Water Quality Measurements** | | |
|---|---|---|
| **Sample Identification** | | |
| Dates sampled | | |
| Date received at lab | | |
| Approximate volume received | | |
| Sample storage conditions | | |
| **Test Species** | | |
| Supplier | | |
| Date acquired | | |
| Acclimation/holding time | | |
| Age class | | |
| **Test Procedures** | | |
| Test location | | |
| Test type/duration | | |
| Test dates | | |
| Control water | | |
| Test temperature | Recommended: | Actual: |
| Test salinity | Recommended: | Actual: |
| Test dissolved oxygen | Recommended: | Actual: |
| Test pH | Recommended: | Actual: |
| Test total ammonia | Recommended: < NOEC* | Actual: |
| Test unionized ammonia | Recommended: < NOEC * | Actual: |
| Test photoperiod | | |
| Test chamber | | |
| Replicates/SPP concentration/treatment | | |
| SPP concentrations | | |
| Organisms/replicate | Recommended: | Zero-Time Range: |
| Exposure volume | | |
| Feeding | | |
| Water renewal | | |
| **Deviations from Test Protocol:** | | |

* NOEC (No-Observed-Effect Concentration): The highest concentration of an effluent or toxicant that causes no observable adverse effects on the test organisms (EPA 2000).

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# ACRONYMS

| | |
|---|---|
| 1991 Green Book | *Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual* (EPA and USACE, 1991) |
| APHA | American Public Health Association |
| ASTM | ASTM International (formerly American Society for Testing and Materials) |
| CCC | Criteria Continuous Concentration |
| CDD | Chlorinated dibenzo-p-dioxin(s) |
| CDF | Chlorinated dibenzofuran(s) |
| CFR | Code of Federal Regulations |
| CMC | Criterion Maximum Concentration |
| COC(s) | Contaminant(s) of Concern |
| CWA | Clean Water Act |
| DU | Dredging Unit |
| EPA (USEPA) | U.S. Environmental Protection Agency |
| FDA | Food and Drug Administration |
| GC/FPD | Gas Chromatograph/Flame Photometric Detection |
| HMWpah | High Molecular Weight PAHs |
| ITM | Inland Testing Manual (EPA, 1998) |
| LDC | London Dumping Convention |
| LMWpah | Low Molecular Weight PAHs |
| LPC | Limiting Permissible Concentration |
| LRL | Laboratory Reporting Limit |
| MPRSA | Marine Protection, Research, and Sanctuaries Act of 1972 |
| N/A | Not Applicable |
| NELAC | National Environmental Laboratory Association Conference |
| NEPA | National Environmental Policy Act |
| NOAA | National Oceanic and Atmospheric Administration |
| NPDES | National Pollutant Discharge Elimination System |
| O&M | Operation and Maintenance |
| ODMDS | Ocean Dredged Material Disposal Site |
| PAH | Polynuclear Aromatic Hydrocarbons |
| PCB | Polychlorinated Biphenyl |
| QA/QC | Quality Assurance/Quality Control |
| QAP | Quality Assurance Plan |
| QAPP | Quality Assurance Project Plan |
| RIM | Regional Implementation Manual |
| SAD | South Atlantic Division (USACE) |
| SAP | Sampling and Analysis Plan |
| SERIM | Southeast Regional Implementation Manual |
| SMMP | Site Management and Monitoring Plan |
| SOW | Scope of Work |
| TBD | To Be Determined |
| TBP | Theoretical Bioaccumulation Potential |
| TDL | Target Detection Limit |
| USACE | U.S. Army Corps of Engineers |
| USCS | Unified Soil Classification System |
| WQC | Federal Water Quality Criteria |
| WQS | State Water Quality Standards |