

II. SEDIMENT QUALITY PARAMETERS AND SAMPLING REQUIREMENTS

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Each dredging site and management area may have unique physical and chemical characteristics which will influence both the number of samples required to obtain a representative characterization of the sediment and the chemical analytes targeted in testing. Sediment testing is the most critical step in any dredging operation as proper or improper sediment characterization can have long lasting impacts on both the dredged area and the management site. Along with the physical, chemical and biological descriptions required in Chapter I, Section D.2., core sample collection and analysis will lead the applicant to more informed dredged material management decisions. The Divisions have selected a number of chemical analytes that may be tested for and these are identified in section A of this chapter. Section B describes the sampling and analysis requirements for sediment classification. If upland management of dredged material is a possible option, contact the Division of Solid and Hazardous Materials for additional testing requirements.

The TOGS relies on whole sediment chemistry analysis for determining the level of contamination and best management practices for the excavated dredged material. There are several reasons for relying on whole sediment chemistry analysis. Whole sediment chemistry is used in other Department guidance documents that predominantly rely on the Equilibrium Partitioning methodology. One such document is the Division of Fish, Wildlife, and Marine Resources, 1999, "Technical Guidance for Screening Contaminated Sediments". The whole sediment chemistry testing method is consistent with baseline values already measured in the Division of Water's sediment assessment and monitoring program and is used in scientific geochemical literature for soils and sediments.

The use of whole sediment chemistry in this TOGS is a consistent choice for sediment testing, and it has the added benefit of being simpler and less expensive than the extract concentrations used in the Toxicity Characteristic Leaching Procedure (TCLP) or the biotoxicity/bioaccumulation testing protocols.

The sampling required by the Divisions to determine whether to grant a dredge permit is not the same testing required by the USACE. It is acknowledged that for some dredging projects, or for in-water placement of dredged material at an EPA-designated site, the USACE may require applicants to conduct a suite of biological tests to support their permit application. If such test results are available, and considered sufficient to characterize the material to be dredged, and especially if open water placement is planned, the Divisions may elect to use this information (see Chapter III, Section B. 4) to make permit decisions in lieu of or in addition to whole sediment chemistry test results . When sediment contamination (Class B or C) is expected at the dredge site, the Divisions may still require whole sediment chemistry analysis in order to determine the appropriate best management practices to be implemented during the dredging or placement operations. Under USACE requirements, sampling would be required for open water placement according to the most recent version of "Evaluation of Dredged Material Proposed for Ocean Disposal Testing Manual" (USACE, Green Book) or "Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual Inland Testing Manual" (USACE Gold Book). The Divisions may also require mixing zone analyses (see Chapter V, Section C) based on the biological test results.

A. Chemical Selection

A key element to this TOGS is the selection of chemicals for analysis and the evaluation of dredging and management options. The Divisions, therefore, focused on chemicals known to be both toxic and persistent in the environment for the in-water/riparian protocol. The Divisions selected these chemicals as important to sediment evaluation. The list includes all chemicals for which there are fish flesh consumption advisories in New York State:

PCB
chlordan
DDT and its metabolites
mercury
dioxin
cadmium
mirex

Table 1 contains the suggested analytical methods for detection of selected chemicals and references the detection limits of those analytical methods.

In the aquatic environment, these chemicals can bioaccumulate to elevated levels. Fish consumption is the primary exposure path for humans and wildlife. Sediment quality threshold values (discussed in Chapter III and listed in Table 2) for all of the above, except DDT, are based on toxicity to aquatic benthic life. The DDT threshold value is based on the protection of wildlife. The threshold values are all lower than those that would be derived to assure that fish tissues do not exceed human health advisories. Table 1 contains the threshold values below which the sediment is considered to exhibit no appreciable contamination. Table 2.1 in Chapter III provides more details on the derivation of the threshold values. The substantial, dual threat from these chemicals to both human and aquatic life warrants their selection as sediment quality parameters.

Other substances selected for testing include:

BTEX, the sum of benzene, toluene and xylene concentrations, was selected as a general indicator of petroleum contamination (i.e., gasoline). BTEX can be a problem for aquatic life in areas associated with land-based petroleum or petroleum-use facilities, marinas, and/or spills.

Benzene is a known human carcinogen and deserves separate analysis from BTEX. Human exposure to benzene can occur from drinking contaminated surface or groundwater. However, the Screening Value for Benzene in Table 2 is derived for protection of benthic life.

Arsenic is widely distributed in the environment and forms a variety of organic and inorganic compounds, some of which are very toxic to aquatic organisms. Some arsenic compounds are readily absorbed by intestinal tract and muscle tissue.

Lead is a persistent bioaccumulative chemical of growing concern to public health managers. Evidence of bioaccumulation in aquatic life to levels of concern for human health is currently

sparse. The paths of lead to human exposure include contaminated soils and drinking water. Lead is also toxic to benthic life.

Copper is toxic to aquatic life, but is not known to be the source of widespread or severe damage to aquatic life in New York State waters. When copper contamination and adverse effects are known or suspected, the metal should be required for sample analysis.

Dieldrin was selected as a common indicator of pesticide use. It is bioaccumulative and the primary path of exposure to humans and wildlife is through the consumption of contaminated fish. Dieldrin is also toxic to benthic life, which is the basis for the Screening Value in Table 2.

Total Polycyclic Aromatic Hydrocarbons (PAH) generally show little tendency to biomagnify in food chains, although in some cases of high contamination, elevated PAH body burdens in fish and bivalves have occurred. Sediment concentrations of Total PAHs in sediments from as low as 4 ppm and certainly higher than 35 ppm are toxic to benthic life. Several compounds of the PAH family are known human carcinogens. PAH's are found in soils, air, surface waters and plant and animal tissues as a result of natural processes such as forest fires, microbial synthesis and volcanic activities. Anthropogenic sources of PAH's cause higher concentrations along transportation corridors, industrial sites and in urban soils resulting from the long term use of fossil fuels (i.e., coal and petroleum) and petroleum-derived products (i.e., asphalt pavement). Total PAH is an indicator of possible impact from the spectrum of PAH compounds.

NOTE: Copper, dioxin, chlordane, BTEX and mirex are case specific analytes. The analysis and evaluation of these case specific analytes is recommended for those waters known or suspected to have sediment contamination caused by those chemicals. In the case where known discharges or spills of other potentially harmful chemicals have occurred, in or near a dredge site, or in the case of potential water quality limiting substances (see appendix A) these other analytes should be included along with those listed in Tables 1 and 2. In the case where a marina is to be dredged, BTEX may be a parameter of concern due to past gasoline spillage into the water and possible accumulation into the sediments. These determinations are made at the discretion of Division staff.

Table 1 Method Detection Limits and Suggested Analytical Methods

Parameter Sediment/Soil	EPA Method CLP/RCRA	Required Method Detection Limits (mg/kg, ppm)	No Appreciable Contamination (Threshold Values (mg/kg, ppm))
Metals			
Arsenic	Metals - EPA 6010B	1.0	<14
Cadmium	Metals - EPA 6010B	0.5	< 1.2
Copper ⁺	Metals - EPA 6010B	2.5	< 33
Lead	Metals - EPA 6010B	5.0	< 33
Mercury *	Metals - EPA 6010B	0.2	< 0.17
PAH's and Petroleum-Related Compounds			
Benzene	EPA 8020, 8021, 8260	0.002	< 0.59
Total BTX ⁺	EPA 8020, 8021, 8260	0.002	< 0.96
Total PAH	EPA 8270	0.33	< 4
Pesticides			
Sum of DDT+DDE+DDD *	EPA 8081	0.029	< 0.003
Mirex **	EPA 8081	0.189	< 0.0014
Chlordane **	EPA 8081	0.031	< 0.003
Dieldrin	EPA 8081	0.019	< 0.11
Chlorinated Hydrocarbons			
PCBs (sum of aroclors)	EPA 8082	0.025	< 0.1
Dioxin (Toxic Equivalency Total) ⁺	EPA 1613B	0.000002	< 0.0000045

* Note: Threshold values lower than the Method Detection Limits are superseded by the Method Detection Limit.

+ Indicates case specific analytes.

B. Sampling and Analysis Requirements

Core samples should be collected and analyzed, at a laboratory certified by the New York State Department of Health (ELAP), to characterize the physical and chemical properties of the sediment in situ, prior to a dredging operation. Physical analysis should include grain size and TOC determinations. Chemical analysis should include appropriate chemical analytes and method detection limits from Table 1 with additional case-specific analytes as necessary. Evaluation of the analytical results of these samples will help determine the management and/or reuse options that can be considered, the types of dredging equipment that might be employed, and the environmental controls that may be necessary to reduce the potential impacts to fish and wildlife during dredging operations.

1. Sampling Exemptions

There are instances where sediment testing is not necessary and these exclusions are detailed below. If there are no recent spill incidents (within the past ten years) and there are no known present or historical contamination problems associated with the site or its environs, sampling and analysis of sediments for proposed dredging projects will generally not be required under the following circumstances:

- a. The material to be dredged is at least 90% sand and gravel.

or

- b. The entire project involves less than 1,500 cubic yards of dredged material.

or

- c. The Divisions determine that the site has been appropriately sampled and analyzed within the last five years and that data reveals sediments with no appreciable contamination. The Division of Water's Sediment Assessment and Management Section maintains an extensive database of results of chemical analyses of sediment from locations throughout the state. Information from the database can be provided to applicants upon request.

Note: Sampling exemptions are not generally available for projects involving open water placement. Additional sampling waivers may be applicable on a case by case basis.

2. Collection of Samples to Characterize Sediment

A sampling plan should be submitted to the Divisions prior to sampling, indicating the type, number and location of samples to ensure proper characterization of the proposed dredged material.

- a. Type of Sample. Sediment core samples should represent the complete depth of the material to be dredged, plus an additional one foot of material that will represent the new sediment surface. Sampling procedures are described in Appendix C. Methods of underwater investigation using free-fall gravity corers, or other equipment, and of logging cores and mapping sediments are given in Hunt (1984), ASTM (1993) and similar publications.

Each core should be broken into two segments:

! A segment homogenized over the complete dredging depth should be analyzed to determine the physical and chemical properties of the sediment to be dredged. Do not homogenize the core if the grain size, TOC or likelihood of contamination based on core lithology or known contamination history indicates that individual horizons within the core may be significantly different in sediment quality. Instead, sample and analyze the horizons separately or contact the Divisions for guidance.

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! A segment representing the top six inches of the sediment to be exposed after dredging should be archived for possible future analysis (see Table C-3 in Appendix C for holding times and storage requirements). If chemical analysis of the dredging depth segment reveals Class B or C (Table 2) sediments, then some or all of these substrate segments may need to be analyzed to determine the risk of increased contamination exposure after dredging.

- b. Number and Location of Samples. The applicant should propose how many samples will be collected, explain how this number was derived and why it is adequate to characterize the dredged material, including the detection of potential "hot spots" of highly contaminated sediments. The plan should also detail the locations of the sampling sites and state how they afford spatial representativeness while also providing coverage for areas likely to have been affected by specific contamination (i.e., a sampling bias should exist toward areas known to be affected by outfalls, tributaries, other industrial sources, historical spill areas, etc.). The number of samples should take into account project area, depth of dredging, potential heterogeneity of the sediments both horizontally and vertically and contaminant source locations. Projects that require dredging of relatively homogenous sediments will require fewer samples than those that require dredging of heterogeneous sediments. Sampling should preferably include no less than three sample locations for any given project. Examples of various methods for calculating how many samples would provide spatial representativeness in order to characterize a dredge site are presented in Appendix B.

- c. Cost Reduction Strategies. In the case of small projects, small marina operations, etc., strategies are available to manage the cost of the analyses. These strategies should yield a reasonably accurate representation of the spatial and vertical stratigraphy and contaminant distribution in the area to be dredged and take into account historical and current pollutant inputs. Divisions approval should be obtained before any of the sample size reduction strategies are used. Unless otherwise exempt from the sampling requirements, a minimum of three sediment samples should be analyzed to characterize any proposed dredging project.

Cost reduction strategies may include:

- i. Collect the required number of cores, then select those with the highest organic carbon levels and closest to known/potential contaminant sources for analysis. If the results of the initial analysis are valid, representative and indicate clean material, the other cores could be assumed likewise. More specifically, if the sediment with the highest silt and clay fraction reveals no appreciable contamination, then it is likely that relatively coarser textured samples would reveal similar or less contaminated results. If the results indicate contamination, however, then the other cores could be assumed similarly contaminated or they could be analyzed by the applicant.
 - ii. Collect the required number of cores and composite those with similar characteristics (e.g., grain size, TOC, color, etc.) for analysis. If this is done, a record of the cores that were composited, including their percentages of total organic carbon and USCS descriptions, as well as the post-compositing analytical results, should be submitted to the Divisions. Do not composite the cores if the grain size, TOC or likelihood of contamination based on core lithology or known contamination history indicates that individual horizons between the cores are appreciably different in sediment quality. Instead, sample and analyze the horizons separately or contact the Divisions for guidance.
 - iii. These strategies may also be used to reduce the number of substrate samples that need to be analyzed to characterize the sediment to be exposed as a result of the dredging operation. Analysis cost may also be reduced, for these samples, by limiting the analytical parameters to those found to be at Class B or C concentrations in the dredging depth segments.
- d. Quality Assurance and Quality Control The goal of the sampling strategies presented in this TOGS is to provide sediment data which are accurate, representative and legally defensible. Therefore, the importance of Quality Assurance/Quality Control (QA/QC) measures in sampling sediments cannot be overlooked. Failure to use proper containers and appropriate methods of sample

collection and preservation, collect an adequate number and type of QC samples, provide strict sample identification and chain-of-custody documentation and employ correct laboratory procedures can limit data usability, or render sample results invalid.

The project-specific sampling and analysis plan for each dredging application should include a description of the project QA/QC program. The NYSDEC Analytical Services Protocol (ASP), dated June 2000, provides the in-laboratory QA/QC requirements and should be referenced and adhered to in the project QA/QC program. All data that might be subject to challenge, should be reported via ASP Category B deliverables. Otherwise, at least twenty-five percent of samples should be reported as ASP Category B deliverables. In-field QA/QC requirements should be specified in the project sampling and analysis plan. These requirements should include, but not necessarily be limited to: sample collection methods; decontamination of sampling equipment; sample container selection; sample preservation methods; number and type of QC samples (i.e. Matrix Spike/Matrix Spike Duplicate [MS/MSD], duplicates, etc.) to be collected; sample identification; and chain-of-custody procedures.

The Divisions' general guidelines for the number and type of QC samples to be collected is presented in Appendix C of this TOGS. These guidelines may be modified on a project-specific basis at the discretion of the Divisions. Also presented in Appendix C, are guidelines for the selection of sample containers and preservation methods, a sample chain-of-custody form, sampling procedures, and a glossary of selected QA/QC terminology and qualifiers.

III. EVALUATION OF RESULTS

After sediment sampling and analysis is complete, the proposed dredged material may be classified according to sediment type to allow the selection of an appropriate management option. This chapter provides the threshold values for in-water/riparian placement, in-water/riparian management options, and the methods employed for applying sampling results to the classification scheme. Chapters IV and V describe how sediment classification impacts dredging and in-water and riparian management of dredged material.

A. Sediment Quality Thresholds For In-water/Riparian Placement

The Divisions have carefully considered how sediment data should be structured and analyzed. This consideration has resulted in a classification system where sediment is placed in classes dependent upon its chemistry. The derivation of the sediment quality guidelines used in the classification system is consistent with the methodologies described in the Technical Guidance for Screening Contaminated Sediments (NYSDEC-DFWMMR 1999). The Divisions have established three classes of sediment quality thresholds for dredged material proposed for in-water/riparian placement. Based on the concentration of contaminants identified during the chemical analyses, sediment to be dredged is classified as Class A, B or C (Table 2). Management options are identified in Table 3 for each class. This system differs from EPA's categorical system for in-water placement that is based on bioaccumulation and biotoxicity.

1. Class A - No Appreciable Contamination (No Toxicity to aquatic life).

If sediment chemistry is found to be at or below the chemical concentrations which define this class, dredging and in-water or riparian placement, at approved locations, can generally proceed.

2. Class B - Moderate Contamination (Chronic Toxicity to aquatic life).

Dredging and riparian placement may be conducted with several restrictions. These restrictions may be applied based upon site-specific concerns and knowledge coupled with sediment evaluation.

3. Class C - High Contamination (Acute Toxicity to aquatic life).

As defined in Table 2, Class C dredged material is expected to be acutely toxic to aquatic biota and therefore, dredging and disposal requirements may be stringent. When the contaminant levels exceed Class C, it is the responsibility of the applicant to ensure that the dredged material is not a regulated hazardous material as defined in 6NYCRR Part 371. This TOGS does not apply to dredged materials determined to be hazardous. Questions regarding hazardous waste, should be referred to the Department's Division of Environmental Remediation.

Table 2 Sediment Quality Threshold Values for Dredging, Riparian or In-water Placement

Threshold values are based on known and presumed impacts on aquatic organisms/ecosystem. Where fresh water and marine threshold values differs sufficiently, the marine value is presented in parentheses. All concentrations are in mg/kg dry weight.

Compound	Class A	Class B	Class C	Derivation Code
Metals (mg/kg)				
Arsenic	< 14 (8.2)	(8.2) 14 - 53	> 53	1
Cadmium	< 1.2	1.2 - 9.5	> 9.5	1
Copper*	< 33	33 - 207 (270)	> 207 (270)	1
Lead	< 33 (47) 33	(47) - 166 (218)	> 166 (218)	1
Mercury ⁺	< 0.17	0.17 - 1.6 (1.0)	> 1.6 (1.0)	1
PAHs and Petroleum-Related Compounds (mg/kg)				
Benzene	< 0.59	0.59 - 2.16	> 2.16	2
Total BTEX*	< 0.96	0.96 - 5.9	> 5.9	2
Total PAH ¹	< 4	4 - 35 (45)	> 35 (45)	1
Pesticides (mg/kg)				
Sum of DDT+DDD+DDE ⁺	< 0.003	0.003 - 0.03	> 0.03	2
Mirex**	< 0.0014	0.0014 - 0.014	> 0.014	2
Chlordane**	< 0.003	0.003 - 0.036	> 0.036	1
Dieldrin	< 0.11	0.11 - 0.48	> 0.48	2
Chlorinated Hydrocarbons (mg/kg)				
PCBs (sum of aroclors) ²	< 0.1	0.1 - 1	> 1	3
2,3,7,8-TCDD* ³ (sum of toxic equivalency)	< 0.0000045	0.0000045 - 0.00005	> 0.00005	4

⁺ Threshold values lower than the Method Detection Limit are superseded by the Method Detection Limit. (See Table 1)

* Indicates case-specific parameter (see Chapter II, Section A) .

¹For Sum of PAH, see Appendix E

²For the sum of the 22 PCB congeners required by the USACE NYD or EPA Region 2, the sum must be multiplied by two to determine the total PCB concentration.

³TEQ calculation as per the NATO - 1988 method (see Appendix D)

Note: The proposed list of analytes can be augmented with additional site specific parameters of concern. Any additional analytes suggested will require Division approved sediment quality threshold values for the A, B and C classifications.

Table 2.1 Derivation Codes for Chemical Threshold Values

Derivation Code	Explanation
1	<p>Values are the geometric mean (GM) between Long & Morgan (1990) and Persaud (1992). Class A values are the GM of ER-L¹ and Lowest Effect Level. Class C values are the GM of the ER-M¹ and Severe Effect Levels. The resulting GMs were compared to marine water ER-L and ER-M values published by Long & Morgan (1992). When compared, the lowest of the two corresponding values was selected. When there was a large difference between a freshwater (Long & Morgan (1990) or Persaud (1992) GM) and a saltwater (Long & Morgan 1992) value, the marine value was recorded in parentheses, and is applicable to marine water dredging and management only. For total PAHs, Persaud (1992) had no toxicity values so only those of Long and Morgan (1990) were used. This approach is consistent with that described in the Technical Guidance for Screening Contaminated Sediments Document (DFW/DMR 1999). The Chlordane values were developed by NYSDEC generally following the Long and Morgan method.</p>
2	<p>NYSDEC water quality standards were used in conjunction with the U.S. EPA equilibrium partitioning methodology (see DFW/DMR 1993, pages 5-11) to calculate sediment quality threshold values for organic compounds assuming 2% organic carbon and equating K_{ow} to K_{oc}, consistent with the reality of contaminant uptake in biological organisms (Kenaga and Goring, 1980). Class A value is for the protection of benthic life from chronic toxicity. The Class C value is for the protection of benthic life from acute toxicity. If aquatic life standards were not available from 6NYCRR Part 703.5 to generate the sediment screening criterion, a guidance value was derived in accordance with 6 NYCRR Part 706.1. For total BTEX, the A and C values are the geometric means of the A and C values for benzene, xylene, ethylbenzene, and toluene. For DDT (sum of DDT, DDD, & DDE), the A value was based upon the 6 NYCRR 703.5 standard for the protection of wildlife. Because this value (0.00022 mg/l) was below the limit of analytical detection, the analytical detection limit of 0.003 mg/l was selected as a default value. The C value was the level at which significant mortality to <i>daphnia magna</i> has been documented (Long & Morgan, 1990). This approach is consistent with that described in the Technical Guidance for Screening Contaminated Sediments Document (DFW/DMR 1999).</p>
3	<p>Synthesis of Consensus Based Sediment Quality Assessment Values (D.D. MacDonald, et al., Jan 2000), Marine and Estuarine Sediment Quality Values (E.R. Long, et al., Nov 1993), PCB soil cleanup levels in NYSDEC Division of Environmental Remediation TAGM HWR-92-4046 and of sediment quality values from NYSDEC Division of Fish, Wildlife and Marine Resources Technical Guidance for Screening Contaminated Sediments, 1998.</p>
4	<p>A mean of the NYSDEC Fish and Wildlife bioaccumulation number, of the USEPA's low risk to mammals, the disposal of paper sludge in pasture land and the bioaccumulation protection of fish values, was calculated and rounded down to the nearest 0.5 ppt. This value is 0.0000045 ppm or 4.5 ppt. Additionally, the soil/sediment action level for 2,3,7,8 TCDD in the RCRA hazardous waste program (TAGM DHSR 3028, 1992) is 4.5 ppt. The on-land application limit of 50 ppt is used as the contaminated level from the USEPA - Paper Industry Agreement from Environment Reporter, 29 April 1994, pages 2222-3.</p>

¹ **Error! Main Document Only.** The ER-L values are the concentrations equivalent to the lower 10 percentile of the screened available data and indicated the low end of the range of concentrations in which effects were observed or predicted (concentrations above which adverse effects may begin). The ER-M values were the concentrations equivalent to the 50 percentile point in the screened available data (concentrations above which effects were frequently observed or predicted).

Table 3 RIPARIAN/IN-WATER Management Options

Activity	Class A	Class B	Class C
Dredging	Any means meeting generally accepted and approved practices	Closed bucket suggested or any means meeting environmental objectives	Closed bucket or other method minimizing loss of resuspended sediment ordinarily required
Riparian Placement	Any means meeting generally accepted and approved practices	Placement at riparian sites already containing more contaminated material. New riparian sites should be covered with Class A sediments to insure isolation of the dredged material. The depth of the cap will be determined on a site specific basis.	Riparian sites should be lined and capped with clay or other impermeable material and covered with Class A sediments to ensure long-term isolation of the dredged material from the environment. The depth of the cover material will be determined on a site specific basis.
In-water Placement	Any means meeting generally accepted and approved practices	In water placement discouraged. When applicable, sites should be capped with Class A sediment to insure isolation of the dredged material	In-water disposal ordinarily precluded.
Barge Overflow	Barge overflow may be allowed (site specific)	Usually, no barge overflow. May be allowed on site specific basis	No barge overflow
Post dredging Monitoring	May be required	See Chapter V	See Chapter V

NOTES:

1. Environmental Objectives for Dredging, Chapter IV, Section A applies to all classes.
2. Environmental Objectives for Dredged Material Management Placement at Riparian and/or In-water Sites, Chapter IV, Section B applies to all classes.
3. Riparian sites are adjacent to or within the 100-year flood plain of the surface waters in which dredging is proposed. These sites are typically diked with controlled outlets for retention of sediment and are typically regulated under Section 401 of the CWA. They do not constitute "on-land" placement.
4. Due to site specific circumstances, an applicant has full responsibility to justify all operations, including both those described above and any other selected alternatives.
5. Depending on conditions, hydraulic dredging to a confined disposal facility or excavation in the dry is the recommended method for PCB concentrations of greater than 10 ppm. Dredged material should be disposed of directly at final disposal sites. An applicant may justify another method of dredging and disposing of this material, as long as no net dumping of contaminated dredged material is proposed. If concentrations approach 50 ppm, Division of Environmental Remediation should be consulted.

B. Application of Sampling Results

1. Because these dredge and placement or disposal levels are based upon a limited number of screening parameters, one or more exceedances of a threshold in any level may be considered presumptive evidence that dredged material management should meet the restrictions of the more stringent level. However, judgment should be applied in interpreting the results. For example, failure of only one sample may be an analytical or sampling anomaly. Failure of two or three samples within a reasonable range of statistical, analytical variability may also not warrant special treatment. Biological testing may be used as an additional tool to evaluate the level of classification of the dredged material (See Section B.4). Consult with Division of Water and the Division of Fish, Wildlife, and Marine Resources staff in these cases before classifying material.

2. If one or more samples exceed Class C (high contamination, acute toxicity) thresholds for sediment quality, in-water disposal will likely be precluded. For riparian placement, the Division of Solid & Hazardous Materials staff and if necessary the Division of Environmental Remediation staff should be consulted to determine further site characterization needs and to assess dredging and disposal requirements (i.e., Part 373 site or other facility).

3. In the event that dredging may expose more highly contaminated sediments, as evidenced by the analysis of a sample segment representing the top six inches of the sediment to be exposed after dredging, prevent or limit exposure by one of the following options:

- dredge to a shallower depth than originally proposed;
- dredge to a greater depth until cleaner sediments are exposed; or
- dredge to a greater depth and then cap with available cleaner material.

4. Biological Testing of Dredged Material for Management Options.

Although the Divisions do not routinely require biological testing, the Army Corps of Engineers (USACE) may require applicants to conduct a suite of biological tests to support their federal dredging permit application. If such test results are available and considered sufficient to characterize the material to be dredged, and especially if open water placement is planned, the Divisions may elect to use this information in lieu of or in addition to whole sediment chemistry test results to make permit decisions for dredging and management of dredged material. When sediment contamination (Class B or C) is expected at the dredge site, the Divisions may still require whole sediment chemistry analysis in order to determine the appropriate best management practices to be implemented during dredging or placement operations.

Biological testing conducted to satisfy federal regulations and guidance usually consists of:

- ! 24-96 hour elutriate (suspended particulate and water) dilution series assays
- ! 10 day solid phase acute toxicity assays

! 28 day solid phase bioaccumulation assays.

If toxicity and bioaccumulation testing indicates a lower level of concern for acute and chronic effects than the corresponding sediment chemical results, then the Divisions, after evaluating project specifics (such as proximity of sensitive habitats and water use areas, the volume of material, the duration and seasonal window of the dredging, or the characteristics of the contaminant(s) of concern) would have the option of approving the management of the material at a lower classification level.

For more information on biological testing and the application of test results, see Appendix F.

IV. GENERAL GUIDELINES FOR DREDGING AND IN-WATER AND RIPARIAN MANAGEMENT OF DREDGED MATERIAL

This Chapter discusses management objectives for dredging and riparian and in-water placement of dredged material, design considerations for riparian placement facilities, and guidelines for monitoring activities during dredging and placement activities. These measures may help minimize any impacts incident to dredging and may ensure the long term protection of the dredged material placement area. The beneficial reuse of dredged material should be promoted when practical. It is important to keep the following objectives in mind so that aquatic habitats, wetland habitats, and riparian areas are protected.

A. General Dredging Guidelines

1. Environmental Objectives for Dredging

Dredging projects should comply with the specific provisions of all permits issued for the activity and should be planned, permitted and conducted toward achieving the following environmental objectives:

! Minimize the resuspension of silt, oil and grease and other fine particles or materials by careful equipment operation, floating booms, silt curtains or screens and other suitable means.

! Minimize the amount of material disturbed or returned to the water body. For mechanical dredging of sediments containing contaminant concentrations at levels of concern, the use of a closed, watertight bucket and the elimination of barge overflow may be required.

! Avoid damage to nearby wetlands and habitats from dredging activities.

! Avoid known historical or archaeological sites and minimize impacts if any previously unknown sites are discovered.

! Avoid dredging in particular water bodies during fish migration and spawning periods specified by the Division of Fish, Wildlife and Marine Resources for species of concern. Timing restrictions may be eased or lifted for small, closely monitored dredging projects, if the use of containment measures, such as silt curtains, adequately isolate the site during fish spawning and rearing periods.

! Avoid littoral zones and any adverse impacts to the littoral zone whenever possible.

! Avoid exposing benthic organisms to more highly contaminated underlying material.

2. Best Management Practices

Best Management Practices (BMP's) that meet the environmental objectives for dredging may include, but are not limited to, the following options. BMP's should be chosen with

consideration of site and project specific conditions and apply to all dredged material regardless of how it is to be managed.

Clamshell Dredge: When using a clamshell dredge, the amount of suspended solids dispersed during the dredging operation should be minimized by maximizing the size of the bucket used for dredging. This minimizes the number of “bites” needed to dredge a particular site. Bucket retrieval rates should be controlled to minimize turbidity. The spuds or anchors of the haul barge should be carefully placed outside the contaminated area to reduce resuspension of contaminated sediments. When off loading dredged material using a clamshell or backhoe, the bucket should not swing over open water.

Closed Clamshell: The closed clamshell bucket reduces the amount of suspended solids in the upper water column at the site of dredging. A closed clamshell bucket may be required when the sediments to be dredged contain contaminants at levels of concern as determined by the Divisions or if warranted by site specific conditions. Bucket retrieval rates should be controlled to minimize turbidity. The spuds or anchors of the haul barge should be carefully placed outside the contaminated area to reduce resuspension of contaminated sediments. When off loading dredged material using a clamshell or backhoe, the bucket should not swing over open water. The environmental bucket should have a sealing system to minimize the loss of material during transport through the water column. Excessive loss of water from the bucket should be investigated and repaired. An experienced bucket dredge operator with sufficient control over bucket depth, bucket closure and bucket hoist speed should be used.

Hydraulic Dredge: Hydraulic dredging, a vacuum-suction dredging process, is preferable when the placement site is within pumping distance of the dredge site. This type of dredge reduces the resuspension of suspended solids at the dredge site. However, large volumes of high percent water content material are created by this method and this water may require greater settling time and/or treatment prior to discharge.

Barge Overflow: No barge overflow should be allowed during transport of dredged material outside the dredged area. Barge overflow may be allowed during the dredging operation if the dredged material is determined to be Class A material. It should be avoided during the dredging operation if the dredged material is Class B or Class C (See Table 3) or if there are site specific reasons for not approving its use with Class A material.

Silt curtains: Silt curtains, can greatly reduce the long-term turbidity occurring during the dredging operation in water current flows of less than 1 foot per second (ft/sec). Silt curtains have been used to protect tidal creeks near the dredging area. Very poor silt curtain performance can be expected in flows of greater than 1 ft/sec. Controlling long term turbidity may also be accomplished using sheet pilings to cut off the disturbed area during work.

Shunting: Shunting, pumping via pipe of the free water in a barge to the bottom of the water column, may be permitted as an alternative to barge overflow as long as no disruption of in-place sediments occurs.

Tidal Periods: In certain semi-enclosed water bodies, dredging may only be allowed during the incoming tide. This practice may minimize the dispersal of contaminated sediments by allowing time for settling of suspended sediments.

Dredging Inspectors: In some cases, independent USACE certified dredging inspectors may be required to observe the dredging operation and report on compliance with permit requirements.

Coffer dam dewatering: Some dredging projects may include the construction of a coffer dam in the water column, with dewatering of the coffer dam prior to the dredging operation. Coffer dam dewatering should be conducted in a manner so as to preclude visible increases in turbidity or sheens in the waterbody. If the underlying sediments to be dredged are Class C, coffer dam dewatering effluent may need to be treated (settling, filtering, etc) prior to discharge back to the waterbody.

Flocculent addition: The proposed addition of a flocculent, during sediment dewatering operations, requires the submission of the Water Treatment Chemical (WTC) Usage Notification Requirements for SPDES Permittees form if the dewatering effluent is to be discharged to waters of the State. The permittee must demonstrate that any flocculent remaining in the effluent will not be toxic to organisms in the receiving water.

B. General Guidelines for In-Water and Riparian Management of Dredged Material

1. Environmental Objectives for Dredged Material Management at Riparian and/or In-water Sites

a. Riparian sites.

! New placement sites should not be located in wetlands or other specially protected or regulated habitats or in identified significant habitats.

! Placement within the 100 year flood-plain may be limited if the fill would cause an increase in the backwater elevation of a given flood event.

! Contaminated material should be covered with Class A sediments to a depth that ensures the long-term isolation of dredged material from the surrounding environment.

! Sites planned for use during multiple dredging seasons should be covered, with an interim cover that is equivalent to the final cover, if the period between use exceeds three years for Class B material and one year for Class C sediments. The need for an interim cover can be determined on a case-by case basis, depending on the bioaccumulative nature of the contaminants of concern. Alternatively, a dredging project that involves sediments with different levels of contamination may be dredged so that the most contaminated sediments are placed at the disposal site first and are then subsequently covered with cleaner sediments.

! Use of and maintenance of existing sites should minimize impacts to nearby wetlands. Any material re-excavated from riparian placement areas for other use should meet the sediment quality requirements for the other use.

! Placement sites should be maintained and operated to prevent the uncontrolled release of sediments beyond the boundary of the site or into surface waters.

b. Non-capped, In-water sites.

! In-water placement should be limited to dredged material that is homogeneous, consists of generally coarse grained material and shows no evidence of appreciable contamination. In water placement should only be used when practicable on-land or riparian management alternatives are not available.

! In-water placement of contaminated dredged material in any "clean" area viewed as an economic or environmental resource of New York State should be discouraged. As an example, such areas might support sand mining, commercial or sport fishing and/or be near public bathing beaches.

! In-water placement of dredged materials at EPA-designated sites will continue to be a viable option, since these sites have undergone environmental review, are authorized for such placement, and have established sediment criteria.

! The placement area should not be located in specially protected or regulated habitats or identified significant habitats.

! In-water placement activities must be approved by the Divisions and must minimize intrusion into littoral areas.

! The resuspension of fine-grained materials should be minimized for in-water placement areas by use of silt curtains, floating booms, the proper selection and careful operation of equipment and other suitable means.

! Characteristics of the dredged material should be similar to existing characteristics at the placement area to ensure that aquatic communities will reestablish themselves.

c. In-water capped sites.

These sites should be limited to moderately contaminated sediments (Class B) when no upland or riparian management sites are available.

In addition to the considerations in item b above, the following apply.

! Site-specific biological surveys, toxicity and bioaccumulation testing may be required for approval and for post-placement monitoring. These studies should

support the contention that biota exposed to the site after placement will not contain appreciably more body burdens of contaminants and will not experience acute or chronic toxicity.

!Existing depressions and old excavations (e.g., borrow pits) should be considered before any new excavations are created. Capping with Class A sediments and leveling to surrounding bottom contours will likely be required.

!Cap material should be deposited in a thickness that will provide long-term isolation of the dredged material from the overlying water. Capping material should have the same characteristics as the surrounding bottom sediments to prevent differential scouring and encourage re-establishment of benthic communities.

!Placement area should not be proposed for future dredging or mining; it must be recorded on USGS, NOAA or other appropriate maps, using Universal Transverse Mercator (UTM) or New York Transverse Mercator (NYTM) coordinates.

2. Design Consideration for Riparian Confined Disposal Facilities

For the purpose of this TOGS, “riparian” is defined as the 100 year flood plain plus any adjacent wetland integral to the surface water. Riparian confined disposal facilities are by this definition any facility located within the 100 year flood plain or adjacent wetland. Other names for a confined disposal facility may be upland disposal site or containment site. These sites are typically diked with controlled outlets for retention of sediment and are typically regulated under Section 401 of the CWA. They do not constitute “on-land” placement.

1. Riparian disposal facilities should be located, where possible, on soils with low permeability (i.e., Soil Conservation Service soil groups C and D).
2. The disposal facility should retain dredge water for the time required to meet discharge conditions (see Chapter V, Section A). The volume needed to provide this retention period should be in addition to the volume needed for solids storage. Disposal facilities designed to receive solids from more than one dredging cycle should use any excess volume to increase the retention period to the maximum practicable extent.
3. Inlet and outlet openings should not be placed directly in-line with each other unless baffles are in place to provide adequate settling time.
4. A minimum water depth of three feet should be provided for retention, using a controlled-outlet weir, in a disposal facility served by a hydraulic dredge. The weir overflow rate should be controlled in order to achieve an acceptable effluent concentration for suspended solids.

5. The length-to-width ratio of the disposal facility should be greater than two to one where the length is the distance between the inlet and the outlet.
6. A baffle could be constructed as part of the outfall structure to prevent the release of floating debris and oils.
7. The outlet should convey the discharge in an erosion-free manner, preferably to an existing stable channel.

NOTE: The prime objective of these design considerations is to enable reasonable capture of fine grain sediments, which contain most of the contaminants. Any number of engineered methods can increase fine grain capture. Design of confined disposal facilities for Class C sediments are site-specific and should ensure optimal fines (see glossary) capture to retain pollutants.

**APPENDIX B VARIOUS METHODS FOR
CALCULATING HOW MANY SAMPLES SHOULD BE
COLLECTED TO CHARACTERIZE A DREDGE SITE**

Balduck's Method

The method of gridded sampling proposed by Balduck, 1992 (in Keillor 1993) may be used for dredge site characterization with certain modifications based on site size, dredge history, environmental flags (e.g., fish advisory), and the presence or absence of potential pollutants in the drainage basin or local environment. The Balduck equation considers the area (not volume) to be dredged and is used only to determine the number of sediment cores to be collected to provide spatially representative sampling of the dredge site. Core sample depth and segmentation guidelines are described in Chapter II, Section B.2.

Balduck's equation, modified for English units, is:

$$N=(Df)(30)((W)(L)(\frac{1}{1.2 \times 10^6}))^{0.33}$$

where

N = the total number of coring (sampling) stations;

$\frac{1}{1.2 \times 10^6}$ = factor to convert square yards into square kilometers;

W = the width (in yards) of a single dredge area or the widest dredge area where there are multiple areas to be dredged;

L = the length (in yards) of a single dredge area or the sum of the lengths of the parts of a combined dredge area;

Df = a dredge factor consisting of a multiplier (unitless) from 1 to 3 based on the site's dredging, environmental or pollutant history and other case-specific factors discussed below.

**Table B-1: Balduck Method for Selection of Sample Size
Number of Samples for Analysis per Area (sq. yds.) to be Dredged**

Dredging Area (sq. yds.)	Balduck Method		
	Number of Samples	Number of Samples	Number of Samples
	Df = 1	DF = 2	Df = 3
5,000 - 10,000	5 - 6	10 - 12	15 - 18
10,000 - 20,000	6 - 7	12 - 14	18 - 21
20,000 - 30,000	8 - 9	16 - 18	24 - 27
30,000 - 50,000	9 - 10	18 - 20	27 - 30
50,000 - 65,000	11	22	33
65,000 - 85,000	12	24	36
85,000 - 100,000	13	26	39
100,000 - 130,000	14	28	42
130,000 - 160,000	15	30	45
160,000 - 200,000	16	32	48
200,000 - 230,000	17	34	51
230,000 - 280,000	18	36	54
280,000 - 330,000	19	38	57
330,000 - 380,000	20	40	60
380,000 - 440,000	21	42	63
440,000 - 500,000	22	44	66
500,000 - 580,000	23	46	69
580,000 - 650,000	24	48	72
650,000 - 750,000	25	50	75
750,000 - 830,000	26	52	78
830,000 - 930,000	27	54	81
930,000 - 1,030,000	28	56	84

Df equals 1 for sites:

! with no previous sediment data; and

! no suspected likelihood of appreciable contamination.

Df equals 2 for sites:

! with no previous sediment data; but

! where there is a likelihood of contamination based on history of surrounding land uses (e.g., heavy industry), spills, observed environmental stresses; and dredging has occurred within the last five years; or

! near particularly sensitive features, e.g., water supply intakes, unique habitats.

Df equals 3 for sites:

! with documented contamination from past sediment data; or

! in areas of established fish advisories or spills or site-specific contamination of concern (e.g., copper, mirex, dioxin, PCB's) in the drainage basin; or

! where there is a likelihood of contamination and dredging has not occurred in the last five years.

NOTE:

Df of 0.5 where:

! previous data show no contamination.

! there is no likelihood of contamination.

SORENSEN

A Dutch formula for estimating sample density for conventional maintenance dredging was proposed by Sorensen (1984). The formula is as follows:

$$N = 3 + \left[\frac{(A^{0.5} * d^{0.33})}{50} \right]$$

where

N = number of cores

A = area (sq. Meters)

d = depth (meters)

ENVIRONMENT CANADA

An Environment Canada method for selecting the number of samples was presented by MacKnight (1991). These guidelines call for calculating the dimensions of a sampling block (grid rectangle), using 1000 cubic meters as a sampling block volume. For larger areas, this method calls for more samples than the other two methods. For small dredge areas, fewer samples would be suggested. The Canadian method calls for a sample in the center of each 1000 cubic meter block and is less random than the other two methods.

For more information on this method see: Mudrock A + S.D. MacKnight, 1991. Handbook of Techniques for Aquatic Sediments Sampling. pp.210. CRC Press, Boca Raton, FL.

APPENDIX C SEDIMENT SAMPLING

Table C-1 QC SAMPLES FOR SEDIMENTS			
Sample Type	Purpose	Collection	Documentation
Duplicate	Check laboratory and field procedures	1 sample per week or 10% of all field samples, whichever is greater	Assign two separate sample numbers, submit blind to the lab
Equipment (Rinseate) Blank	Check field decontamination procedures	Collect when sampling equipment is decontaminated and reused in the field.	Assign separate sample number
Matrix Spike and Matrix Spike Duplicate (MS/MSD)*	Required by laboratory protocols.	1 sample per twenty sediment samples	Assign both samples the same sample number. Indicate MS/MSD on chain-of-custody form.

*This is not necessary with PCB congener method or high resolution pesticide method or dioxin/furan analyses.

Table C-2 SAMPLE CONTAINERS AND VOLUMES FOR SEDIMENT SAMPLES		
Type of Analysis	Type and Size of Container	Number of Containers and Sample Volume (per sample)
Purgeable (Volatile) Organics	2-oz. glass jar with Teflon lined cap	Two; fill completely
Extractable Organics, Dioxin/Furan Pesticides/PCBs	8-oz. amber glass jar with Teflon-lined cap	One; fill completely
Metals	8-oz. glass jar with Teflon-lined cap	One; fill half full

Table C-3 SAMPLE PRESERVATION AND HOLDING TIMES FOR SEDIMENT SAMPLES		
Parameter	Preservative	Maximum Holding Time¹
Volatiles	Cool to 4°C	7 days
PCBs/Pesticides	Cool to 4°C	Extract within 5 days, analyze within 40 days
Extractable organics	Cool to 4°C	Extract within 5 days, analyze within 40 days
Metals	Cool to 4°C	6 months
Mercury	Cool to 4°C	26 days
Dioxin/Furan	Cool to 4°C	Extract within 30 days, analyze within 1 year

¹ Holding times are based on verified time of sample receipt (VTSR). Source NYSDEC Analytical Services Protocol.

Sampling Procedures

Core Samples

Sediment cores should be collected using a vibra-coring apparatus, or other appropriate coring device. Selected equipment is to be used in accordance with the manufacturer's instructions. Clean, decontaminated core tube liners must be used. The bottom of the coring tube liner should be immediately capped and taped upon removal of the coring apparatus from the water. The core tube liner should then be removed from the coring apparatus and its top immediately capped and taped.

The core tube liner and boat deck should then be rinsed with ambient water to reduce the risk of contaminated sediments becoming airborne as they dry.

A visual inspection of the sediment cores should then be performed. Individual horizons or strata within each core should be measured, along with the overall core length. These measurements and all significant features should be documented in a field notebook. The field notebook should also document the date, time, and location of each sample collected. Using a permanent marker, the date, time, and sample location should also be recorded on the sediment core tube liner. High resolution photographs of the cores may be taken.

The sediment core (or segment if appropriate) should be emptied into a clean tub and mixed with a clean spatula made of appropriate material. Generally sediment to be analyzed for trace metals should not come into contact with metals and sediment to be analyzed for organic compounds should not come into contact with plastics. When the sediment appears mixed to a uniform color and consistency, a clean scoop should be used to place the material into acid washed wide mouth glass jars with Teflon® lined screw lids. After a jar is capped and labeled, it should be immediately placed on ice in a cooler.

All sample containers should be labeled using a permanent marker to indicate the date, time, and sampling location. This information should then be recorded in a field log book and on a chain of custody form which will follow the samples. Sediment material not placed in sample bottles should be returned to the location from which it was collected. All sample bottles should be placed in coolers with ice and delivered to the laboratory via overnight delivery service.

Sediment Data Qualifiers

Qualifiers for Organics Analyses

Value	If the result is a value greater than or equal to the quantification limit, report the value.
U	Indicates compound was analyzed for, but not detected.
J	Indicates an estimated value.
N	Indicates presumptive evidence of a compound.
P	This flag is used for a pesticide/Aroclor target analyte where there is greater than 25% difference for detected concentrations between the two GC columns (see Form X). The lower of the two values is reported on Form I and flagged with a "P".
C	This flag applies to pesticide results where the <u>identification</u> has been confirmed by GC/MS.
B	This flag is used when the analyte is found both in the associated blank and in the sample.
E	This flag identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.
D	This flag identifies all compounds identified in an analysis at a secondary dilution factor. If a sample or extract is re-analyzed at a higher dilution factor, as in the "E" flag above, the "DL" suffix is appended to the sample number on the Form I for the diluted sample, and all concentration values reported on that Form I are flagged with the "D" flag. This flag alerts data users that any discrepancies between the concentrations reported may be due to dilution of the sample or extract.

NOTE: These qualifiers do not apply to the PCB congener method 1668, but are applicable to the recommended PCB method 8082.

Qualifiers for Metals Analyses

B	The reported value is less than the Contract Required Detection Limit but greater than the Instrument Detection Limit.
U	The Analyte was analyzed for but not detected, i.e., less than the Instrument Detection Limit.
E	The reported value is estimated because of the presence of an interference.

Glossary of Selected QA/QC Terms
(source: NYSDEC ASP, 10/95)

Analytical Services Protocol (ASP) - the collection of analytical methods and corresponding reporting and quality control procedures that has been adopted by the Division of Water.

Contract Required Quantitation Limit (CRQL) - minimum level of quantitation acceptable under the ASP.

Equipment Rinseate - a sample of analyte-free media which has been used to rinse the sampling equipment. It is collected after completion of decontamination and prior to sampling. This blank is useful in documenting adequate decontamination of sampling equipment.

Field Blank - any sample submitted to the laboratory identified as a blank prepared in the field. The purpose of the field blank is to document whether or not there was contamination introduced in the collection of the sample.

Field Duplicates - an additional sample taken from the same homogenized sample and sent to the analytical laboratory for identical analysis.

Holding Time - the elapsed time, expressed in days, from the date of receipt of the sample by the laboratory until the date of its preparation (digestion, distillation or extraction) and/or analysis.

Matrix - the predominant material, component, or substrate (e.g., sediment) of which the sample to be analyzed is composed. Matrix is not synonymous with phase (liquid or solid).

Matrix Spike (MS) - aliquot of a sample fortified (spiked) with known quantities of specific compounds (target analytes) and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

Matrix Spike Duplicate (MSD) - a second aliquot of the same matrix as the MS that is spiked with identical concentrations of target analytes as the MS, in order to document the precision and bias of the method in a given sample matrix.

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

Minimum Quantitation Limit - the minimum level that an analyte can be quantitated within a specified precision.

Percent Moisture - an approximation of the amount of water in a sediment sample made by drying an aliquot of the sample at 105 °C. The percent moisture determined in this manner

also includes contributions from all compounds that may volatilize at or below 105 °C, including water. Percent moisture may be determined from decanted samples and from samples that are not decanted.

Practical Quantitation Limit (PQL) - is the lowest level that can be measured within specified limits of precision during routine laboratory operations on most effluent matrices.

Project - single or multiple data collection activities that are related through the same planning sequence.

Replicate - independent samples which are collected as close as possible to the sample point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently at the same laboratory. These replicates are used to characterize sediment heterogeneity.

Semivolatile Compounds - compounds amenable to analysis by extraction of the sample with an organic solvent. Used synonymously with Base/Neutral/Acid (BNA) compounds.

Tentatively Identified Compounds (TICs) - compounds detected in samples that are not target compounds, internal standards or surrogate standards. Up to 30 peaks (those greater than 10% of peak areas or heights of nearest internal standards) are subjected to mass spectral library searches for tentative identification.

Time - when required to record time on any deliverable item, time shall be expressed as Military Time, i.e., a 24-hour clock.

Trip Blank - a sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures.

Validated Time of Sample Receipt (VTSR) - the date on which a sample is received at the laboratory facility, as recorded on the shipper's delivery receipt and chain-of-custody.

Volatile Compounds - compounds amenable to analysis by the purge and trap technique. Used synonymously with purgeable compounds.

Wet Weight - the weight of a sample aliquot including moisture (undried).

APPENDIX D TEQ CALCULATION FOR DIOXIN/FURAN

The 2,3,7,8-TCDD equivalent for a congener is obtained by multiplying the concentration of that congener by its Toxicity Equivalency Factor (TEF) from the table below. The TEQ is the sum of the products.

<u>CONGENER</u>	<u>TEF</u>
2,3,7,8 -Tetrachlorodibenzo-p-dioxin	1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.5
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01
Octachlorodibenzo-p-dioxin	0.001
2,3,7,8-Tetrachlorodibenzofuran	0.1
1,2,3,7,8-Pentachlorodibenzofuran	0.05
2,3,4,7,8-Pentachlorodibenzofuran	0.5
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01
Octachlorodibenzofuran	0.001

TEQ calculation as per: NATO.1988. International Toxicity Equivalency Factors (I-TEF) Method of Risk Assessment for Complex Mixtures of Dioxins and Related Compounds. North Atlantic Treaty Organization. Report Number 176.

Known standards and guidelines are based on the method outlined above. In 1998 an expert meeting of the WHO was held to derive consensus TEF's for dioxins/furans and dioxin-like PCB's. A new list of TEF's was recommended which included values for humans, mammals, fish and birds. A copy of these numbers is available in:

Environmental Health Perspectives, December 1998. Toxic Equivalency Factors (TEFs) for PCB's, PCDD's, PCDF's for Humans and Wildlife. Volume 106, Number 12.

APPENDIX E SUM OF PAH'S

PAH's in sum of PAH's

Acenaphthene
Acenaphthylene
Anthracene
Benz(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzo(a)pyrene
2-Chloronaphthalene
Chrysene
Dibenz(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-c,d)-pyrene
2-Methylnaphthalene
Naphthalene
Phenanthrene
Pyrene

The sum of the concentrations of these eighteen PAH analytes are used to calculate the sum of PAH for Table 2. If one or more analytes are missing from the list, sum the remaining analytes for the calculation of sum of PAH.