

Administrative Guidance – Management Framework for Disposal of Dredged/Excavated Sediment

(The requirements stipulated in WBTC No. 12/2000 “Fill Management” are relevant)

This Guidance is issued to provide information on the management framework for dredged/excavated sediment disposal under the Dumping at Sea Ordinance, Cap. 466 (DASO). It states the requirements for justifying the need for dredging and provides guidance for the authorized persons/ registered structural engineers/ registered geotechnical engineers (AP/ RSE/RGE) on how to obtain information on the sediment, which can then be used for supporting the permit application by the contractors and/or other parties responsible for the disposal. It also describes the classification of sediment into three categories based on their contaminant levels, outlines the procedures for assessing sediment quality and explains the marine disposal arrangements for the different sediment categories.

Effective Date

2. All private projects which involve the marine disposal of dredged/excavated sediment and the Sediment Sampling and Testing Plan (SSTP) has not been approved by the Director of Environmental Protection (DEP) shall follow this Guidance.

Rationale for Dredging

3. The allocation of sediment disposal space at sea will not be considered until the need for removal of the sediment has first been satisfactorily demonstrated. The rationale for sediment removal must therefore be provided to the Secretary of MFC for agreement, as early as possible, preferably at the Environmental Impact Assessment Stage, if one is conducted. Volumes of Category L sediment (see **Appendix A**) below 50,000 m³ are exempted from this requirement.

4. Dredging of sediment will be allowed without justification in the following cases:

- (a) emergency dredging for safety reasons or averting environmental hazards;
- (b) maintenance/deepening of the harbour fairways, berths, anchorages, navigation channels or approaches; and
- (c) maintenance (but not construction) of watercourses, rivers, stream courses, drainage channels or outfalls.

5. In all other cases, project proponents shall plan their projects on the assumption of keeping the mud in place. Time for consolidation of mud, with treatment if necessary, and consequential programme constraints shall be allowed for in programming. Additional time required for consolidation of mud left in place will not be accepted as justification for mud dredging. MFC will scrutinise applications for exemption taking into account factors including the practicality of performance specifications, completeness of risk management strategies, and comprehensiveness of option assessments including consideration of new technology. Where cost is considered, the estimation must include a fair and complete estimate of all cost components, including the actual cost of mud disposal (obtainable from MFC Secretariat) and necessary dredging and transportation, disposal management, monitoring and other associated activities.

Classification of Sediment

6. DEP, as the Authority under the Dumping at Sea Ordinance Cap. 466 (DASO), will classify sediments based on their contaminant levels with reference to the Chemical Exceedance Levels (CEL) laid down in **Appendix A**.

Determination of Sediment Quality

7. Guidelines on the initial data assessment, the sampling and testing procedures, the biological test criteria, and the submission requirements are set out in **Appendix B**. DEP may waive the sediment sampling and testing requirements in cases of:

- (a) emergency dredging for reasons of safety or averting environmental hazards; and
- (b) for small scale dredging works of maintenance nature and involving dredging volumes of less than 5,000 m³ *in situ*.

Previously obtained data or known history of the sediment in the vicinity should be submitted to DEP for consideration of the most appropriate arrangements for handling these materials.

8. Upon agreement of the rationale for sediment removal by the Secretary of MFC, the project proponent (government department or office) or its consultant shall, in consultation with DEP, assess whether the existing data can conclusively demonstrate that the sediment¹ is suitable for open sea disposal. If no such conclusion can be drawn, the project proponent must submit proposals for Sediment Sampling and Testing Plan to DEP for approval. The proposals shall be copied to the Secretary of MFC, together with details of the anticipated disposal requirements.

9. Upon completion of the sampling and chemical testing, the project proponent shall submit a Preliminary Sediment Quality Report (PSQR) to DEP with a copy to the Secretary of MFC. This report shall include the sampling details, the chemical testing results, quality control records, proposed classification and delineation of sediment according to **Appendix A**, and the information and/or records as specified by DEP in his approval of Sediment Sampling and Testing Plan.

10. If certain Category H sediment are found in the sediment, the project proponent will be required to carry out a biological screening² in accordance with Section 3 of **Appendix B**, and submit a formal Sediment Quality Report (SQR) to DEP for approval. This must be done at least 3 months prior to the dredging contract being tendered or at least 2 months prior to the works order for maintenance dredging being issued. In cases where biological screening is not required, subject to the approval of DEP, the PSQR will be deemed to be the formal SQR.

11. At the time of approval of the SQR, DEP will specify the period beyond which the reliability of the SQR data must be reviewed. This period starts on the actual date of commencement of sampling and will be not less than three years. The project proponent shall obtain DEP's prior agreement to the review methodology and sampling locations. Depending on the review finding, further sampling and testing to update the data of the SQR may be required.

¹"The sediment" in paragraph 8 and subsequent paragraphs refers to the dredged/excavated sediment for disposal under a project/contract as proposed by the project proponent.

² For Category M sediment which requires cross-boundary disposal, the project proponent should refer to the requirements set out in DEVB memo ref. DEVB(W) 515/83/04 dated 6 October 2010

12. The project proponent must schedule the preparation of the SQR or its subsequent review in such a way that the SQR will still be reliable for a reasonable period of time after the award of the contract, to allow the contractor to apply for a dumping permit. The project proponent should also include a particular specification clause in the contract to draw the contractor's attention to the requirement that the SQR must still be reliable at the time of applying for a dumping permit under the DASO. The clause should also state the expiry date of the reliability period of the current SQR and that it is the contractor's responsibility to carry out, at his own expense, any work required to extend the reliability period of the SQR should he fail to apply for a dumping permit before the expiry date.

Allocation of Sediment Disposal Site

13. MFC will determine the most appropriate open sea or confined marine disposal site on the basis of the chemical and biological test results and formally allocate disposal space in accordance with the flow chart in **Appendix C**. For projects with disposal requirements of less than 50,000 m³ Category L sediment, the allocation of disposal space has been delegated to DEP. The project proponent may request the Secretariat of MFC to provisionally indicate an appropriate marine disposal site or sites after the rationale for sediment removal has been agreed. An estimate of the volume and quality of sediment to be dredged, supported by available ground investigation and testing data, should be provided to the Secretary of MFC at the time of submission of the request. The contract document should include the disposal requirements from MFC & DEP, and relevant guidelines given under Notes (1) to (5) in **Appendix C**.

14. For private projects allocated with marine disposal space, there will be a charge per cubic metre as measured *in situ* at the dredging site and as certified by the AP/RSE/RGE.

15. The MFC Secretariat maintains a database on fill requirements and surplus materials of civil engineering projects in Hong Kong to facilitate the planning and management of fill and disposal resources. The AP/RSE/RGE of private developments shall ensure that details of any fill requirements or disposal requirements, and the subsequent updates, are sent to the MFC Secretariat using the form downloaded from <https://www.cedd.gov.hk/eng/public-services-forms/fill-management/marine/database/index.html> preferably via electronic transfer, copied to Buildings Department.

Application for Marine Dumping Permit

16. DEP controls dumping at sea by means of DASO permits which are issued to contractors or other parties responsible for the disposal of dredged/excavated sediment. The contractor who will be undertaking the works must make a formal application to DEP for a dumping permit, and if the permit is granted, it will be the contractor's responsibility to ensure that the permit conditions are met to DEP's satisfaction.

APPENDIX A Sediment Quality Criteria for the Classification of Sediment

Contaminants	Lower Chemical Exceedance Level (LCEL)	Upper Chemical Exceedance Level (UCEL)
Metals (<i>mg/kg dry wt.</i>)		
Cadmium (Cd)	0.8	4
Chromium (Cr)	80	160
Copper (Cu)	65	110
Mercury (Hg)	0.3	1
Nickel (Ni)*	40	40
Lead (Pb)	75	110
Silver (Ag)	1	2
Zinc (Zn)	200	270
Metalloid (<i>mg/kg dry wt.</i>)		
Arsenic (As)	20	42
Organic-PAHs (<i>µg/kg dry wt.</i>)		
Low Molecular Weight PAHs	550	3160
High Molecular Weight PAHs	1700	9600
Organic-non-PAHs (<i>µg/kg dry wt.</i>)		
Total PCBs	23	180
Organometallics (<i>µg TBT/L in Interstitial water</i>)		
Tributyltin*	0.15	0.15

* *The contaminant level is considered to have exceeded the UCEL if it is greater than the value shown.*

The sediment is classified into 3 categories based on its contaminant levels:

- Category L: Sediment with all contaminant levels not exceeding the Lower Chemical Exceedance Level (LCEL). The material must be dredged, transported and disposed of in a manner which minimizes the loss of contaminants either into solution or by resuspension.
- Category M: Sediment with any one or more contaminant levels exceeding the Lower Chemical Exceedance Level (LCEL) and none exceeding the Upper Chemical Exceedance Level (UCEL). The material must be dredged and transported with care, and must be effectively isolated from the environment upon final disposal unless appropriate biological tests demonstrate that the material will not adversely affect the marine environment.
- Category H: Sediment with any one or more contaminant levels exceeding the Upper Chemical Exceedance Level (UCEL). The material must be dredged and transported with great care, and must be effectively isolated from the environment upon final disposal.
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Appendix B Guidelines for Sediment Assessment

The purpose of these guidelines is to set out the requirements for assessing, sampling, testing and categorising the sediment. The sampling and testing procedures are critical to the accurate evaluation of the sediment contamination, and close supervision by the project proponent is therefore necessary. All project departments/offices, consultants, developers or contractors (hereinafter called the "project proponent") must comply with these requirements when notifying Director of Environmental Protection (DEP) and Marine Fill Committee (MFC) of an intention to dredge/excavate and dispose of the sediment.

The sampling and testing procedures and the subsequent submission of a Sediment Quality Report normally require 8 months to complete.

A list of accredited laboratories capable of carrying out biological testing stipulated under these guidelines is kept and updated by DEP.

1. TIER 1 - Review of Existing Information for Site Contamination Assessment

The purpose of Tier I screening is to review available information to determine whether the sediment belongs to Category L material suitable for open sea disposal. If the project proponent considers that there is insufficient information to arrive at such a conclusion, the project proponent may proceed directly to Tier II screening.

(a) Submission requirements

The project proponent shall submit a formal proposal to DEP and copy to the Secretary of MFC in the Civil Engineering Department. The proposal should contain the following information:

- (i) project name;
- (ii) plan showing detailed location and boundary of the dredging/excavation site;
- (iii) estimated volume of dredged/excavated sediment requiring disposal;
- (iv) timetable for dredging/excavation operation and the corresponding disposal space required;
- (v) previous dredging/excavation history of the site;
- (vi) previous use of the site; and
- (vii) other available site specific information (e.g. sediment grain size, total organic carbon (TOC), geotechnical data and previous testing results).

(b) Necessity to proceed to Tier II - chemical screening

DEP will examine the submission and advise whether:

- (i) the information is sufficient to conclude that the sediment is suitable for open sea disposal and the submission can be accepted as a formal Sediment Quality Report; or
- (ii) Tier II - chemical screening is required.

2. TIER II - Chemical Screening

Tier II screening is designed to categorise the sediment based on its chemical contaminant levels, and to determine whether the sediment is suitable for open sea disposal without further testing.

(a) Submission requirements

The project proponent shall submit for approval a test proposal to DEP and copy to the Secretary of MFC. The proposal should contain the following information:

- (i) project name;
- (ii) plan showing detailed location and boundary of the dredging/excavation site;
- (iii) estimated volume of dredged/excavated sediment requiring disposal;
- (iv) the anticipated timetable for taking the sample, carrying out the tests, and producing the Sediment Quality Report for chemical & biological screening;
- (v) a plan showing the area to be dredged, the locations to be sampled and their Hong Kong metric grid coordinates;

In general, the following sampling arrangement should be adopted:

Sampling Arrangement

The purpose of the sampling arrangement is to collect representative samples for characterisation of the sediments of the dredging site. The sampling locations should be representative and reflecting the actual situation of the dredged materials as accurately as possible.

Minimum Sampling Station Requirement

A volume-based approach is recommended for determining the minimum sampling station as illustrated in the Table below:

Estimated Total Volume of Dredged Materials (10,000 m ³)	Number of Sampling Station
<2.5	3
2.5 to <10	8
10 to <50	12
50 to <200	20
100k to <100k +100	(16+4k)
k is an integer which is larger than or equal to 2	

Sampling Design

Appropriate sampling design should be proposed by the project proponent, taking into consideration the sampling programme and site-specific conditions.

If the dredged materials are homogenous in nature and there is no identifiable source of anthropogenic contamination, the sampling stations should be evenly distributed across the entire dredging area using a grid pattern.

If the source of contamination is identified or the contamination gradient is known (e.g. near outfalls, or nullahs), the sampling stations should be placed from dense to sparse along the gradient from highly contaminated to less or unlikely contaminated. Vertical samples should be taken to identify the contamination extent when contaminated sediments are identified.

Sample of Reference Sediment

When biological screening is anticipated, samples of reference sediment should also be taken. Reference sediment required for the test may be collected from reference sites in Hong Kong waters designated by DEP from time to time. Alternative reference sites may be used. However, these alternative sites should be outside the influence of previous disposal operations but close enough to reflect similar natural environmental characteristics (e.g. grain size and TOC) of potential disposal sites. The project proponent should furnish information on these alternative sites to show that their sediments are clean and are of similar natural characteristics to that of the disposal sites.

- (vi) a schedule of the types of samples to be taken (e.g. grab samples, gravity coring, piston samples, vibrocores, etc.) with their locations and depths;

Where vertical profiles of samples are to be taken, samples should be continuous, and the top level of the sub-samples should be the seabed, 0.9m down, 1.9m down, 2.9m down, and then every 3m to the bottom of the dredged layers.

The size of samples collected should be adequate for this tier of chemical testing as well as the next tier of biological testing described in subsequent sections.

Parameters to be tested	Sample size*
Metals and metalloid	0.5 litre
Organic	0.5 litre
Biological response	6 litres

* Quantity to be confirmed by testing laboratory. The quantity of reference sediment to be collected needs to be separately worked out for each case, especially if biological dilution tests are anticipated.

- (vii) a schedule of tests to be carried out on the samples.

Unless otherwise specified, all samples shall be tested for all the contaminants (except Tributyltin (TBT)) stated in Table 1 - Analytical Methodology at the end of this Appendix. Analysis for other contaminants, such as TBT, Dichloro-diphenyl-trichloroethane (DDT), other organo-chlorine compounds, and other hazardous chemicals which arise from specific industrial discharge or spillage, may also be required by DEP in areas where contamination by such compounds is suspected. The composite samples for biological testing should also be tested for moisture content, grain size (% <63µm), TOC and ammonia (as mgN/L) and salinity in porewater.

(b) Sampling and testing requirements

- (i) Sampling practice and sample storage

All sampling bottles should be labelled with the station number, sample length, diameter and depth, sampling date and time, together with a full description of the sample.

The recommended types of sampling bottle and pretreatment methods are:

Parameters to be tested	Sampling bottle	Pretreatment Procedure [#]
Metals and metalloid	High density polyethylene bottles*	USEPA SW-846 ⁺ Chapter 3
Organic	Wide mouth Borosilicate glass bottles with Teflon lined lid	USEPA SW-846 Chapter 4
Biological response	Wide mouth Borosilicate glass bottles with Teflon lined lid or high density polyethylene bottles *	USEPA SW-846 Chapter 3 or Chapter 4 as appropriate.

* Heavy duty plastic bags may be used for the storage of sediment sample for testing metals, metalloid and biological response.

Other equivalent methods such as “The specification for marine monitoring – Part 3: Sample collection, storage and transportation” (GB17378.3-2007) may be used subject to the approval of DEP.

- + Test methods for evaluating solid waste: physical/chemical methods, SW-846, 3rd edition, United States Environmental Protection Agency.

The samples should be kept at 4°C in the dark and should not be frozen. All samples should be promptly analysed. If this is impractical, the recommended maximum holding time is:

Sample type	Maximum holding time
Chemical test	2 weeks
Biological test	8 weeks

(ii) Analytical methodologies for chemical screening

The analytical method used for detecting each contaminant should be in accordance with the methodology described in Table 1 - Analytical Methodology at the end of this Appendix.

(c) Quality assurance/quality control (QA/QC) requirements

All tests must be conducted by laboratories accredited by Hong Kong Laboratory Accreditation Scheme (HOKLAS) or, in case of overseas laboratories, by equivalent national accreditation for these tests.

(d) Necessity to proceed to Tier III - biological screening

There is no need to proceed to Tier III for Category L and M sediments. However, the project proponent must proceed to Tier III for further analysis of certain Category H sediment. Tier III screening is only required if one or more contaminant levels exceed 10 times the Lower Chemical Exceedance Level (LCEL).

3. TIER III - Biological Screening

The purpose of Tier III screening is to identify the most appropriate disposal option for certain Category H sediments.

(a) Submission requirements

The project proponent shall submit for approval a test proposal to DEP and copy to the Secretary of MFC. The proposal should contain the following information:

- (i) the number of biological tests;
- (ii) the arrangement for preparing the composite samples; and
- (iii) the test species and test conditions.

In general, all biological tests should be conducted on composite samples. Composite sample is prepared by mixing up to 5 samples of the same category which are continuous in vertical or horizontal profile.

Sediment classified as Category H and with one or more contaminant levels exceeding 10 times LCEL shall be subjected to the following two toxicity tests in

a diluted manner (dilution test).:

a 10-day amphipod toxicity test; or

a 20-day polychaete toxicity test.

and

a 48-96 hour larvae (bivalve or echinoderm) toxicity test.

The samples shall be prepared prior to toxicity testing as follows:

Sediment characteristics	Preparation method
Category H sediment (> 10 x LCEL)	Sample to be mixed with 9 portions of reference sediment
Category H sediment (> 10 x LCEL) suspected of ammonia contamination	Additional set of sample (after dilution for Cat. H sediment) to be purged [#] for ammonia removal (for amphipod test only).

If the ammonia concentration in the overlying water of the test system is ≥ 20 mg/L, purging of sediment is required. This is performed by replacing the overlying water at a rate of 6 volume replacements/24 h for 24 hours, and repeated once only if the ammonia level still exceeds 20 mg/L.

(b) Testing requirements

The test endpoints and decision criteria are summarized in Table 2 at the end of this Appendix. The sediment is deemed to have failed the biological test if it fails in any one of the two selected toxicity tests.

Only ecologically relevant species should be used for carrying out the biological screening tests. The species to be used for each type of test are as following:

Test Types	Species	Reference Test Conditions*
10-day amphipod toxicity test	<i>Ampelisca abdita</i>	U.S.EPA(1994)/PSEP(1995)
	<i>Leptocheirus plumulosus</i>	U.S.EPA(1994)
	<i>Eohaustorius estuarius</i>	U.S.EPA(1994)/PSEP(1995)
	<i>Grandidierella japonica</i>	GB 30980-2014
	<i>Ampelisca bocki</i>	GB 30980-2014
	<i>Ampelisca brevicornis</i>	GB 30980-2014
20-day polychaete toxicity test	<i>Neanthes arenaceodentata</i>	PSEP(1995)
	<i>Neanthes japonica</i>	GB 30980-2014
	<i>Glycera chirori</i>	GB 30980-2014
	<i>Neohlys californiensis</i>	GB 30980-2014
48-96 hour larvae (bivalve or echinoderm) toxicity test	Bivalve: <i>Mytilus</i> spp.	PSEP(1995)
	<i>Crassostrea gigas</i>	PSEP(1995)
	<i>Acrassostrea rivularis</i>	GB 30980-2014
	Echinoderm : <i>Dendraster excentricus</i>	PSEP(1995)
	<i>Strongylocentrotus</i> spp.	PSEP(1995)
	<i>Anthocardaris crassipina</i>	GB 30980-2014

*U.S.EPA (U.S. Environmental Protection Agency) 1994. Methods for assessing the toxicity of sediment-associated contaminants with estuarine and marine amphipods. Office of Research and Development. U.S. Environmental Protection Agency, Cincinnati, OH. EPA/600/R94/025.

PSEP (Puget Sound Estuary Program) 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments.

GB 30980-2014. The assessment procedure for marine dumping of dredged material.

(c) Quality assurance/quality control (QA/QC) requirements

All biological tests must be conducted by laboratories with appropriate accreditation.

The biological test shall include appropriate quality assurance/quality control such as:

- (i) Negative Control

- (ii) Positive Control

4. Reporting Requirement after Completion of Chemical & Biological Screening

Submission requirements

Upon completion of each stage of screening (chemical and biological), the project proponent shall submit to DEP and copy to the Secretary of MFC a report on the results covering all tests conducted so far. The report should include the following information where appropriate:

- (i) plans showing the delineation of each of the 3 categories of dredged/excavated material and the corresponding types of disposal required based on the chemical and biological screening results, and
- (ii) the following information:
 - Name and location of the testing laboratory
 - Location of samples and source of reference sediments, method of collection, handling, preservation and storage, dates and times of sample collection and receipt at the testing laboratory

(For chemical screening)

- Dates of analysis
- Analytical methods and detection limits
- Tabulated sample results with units, including reporting basis (e.g., wet, dry, TOC normalized)
- QA/QC results
- Explanations for all departures from the standard protocols and discussion of possible effects on the data

(For biological screening)

- Test species information such as the source, size, history and age of test organisms
- Source of control seawater and control sediment used, including any pretreatment
- Preparation procedures for test sediment sample and test organisms
- Test conditions for each test including any deviation from standard procedures and discussion of possible effects on the data
- Water quality measurement during testing
- QA/QC results
- Effect measurements, end point results and their statistical significance

Table 1 - Analytical Methodology

Parameters	Preparation Method <i>US EPA Method</i>	Determination Method <i>US EPA Method</i>	Reporting Limit
Metals (mg/kg dry wt.)			
Cadmium (Cd)	3050B	6020A or 7000A or 7131A	0.2
Chromium (Cr)	3050B	6010C or 7000A or 7190	8
Copper (Cu)	3050B	6010C or 7000A or 7210	7
Mercury (Hg)	7471A	7471A	0.05
Nickel (Ni)	3050B	6010C or 7000A or 7520	4
Lead (Pb)	3050B	6010C or 7000A or 7420	8
Silver (Ag)	3050B	6020A or 7000A or 7761	0.1
Zinc (Zn)	3050B	6010C or 7000A or 7950	20
Metalloid (mg/kg dry wt.)			
Arsenic (As)	3050B	6020A or 7000A or 7061A	1
Organic-PAHs (µg/kg dry wt.)			
Low Molecular Weight PAHs+	3550B or 3540C and 3630C	8260B or 8270C	55
High Molecular Weight PAHs++	3550B or 3540C and 3630C	8260B or 8270C	170
Organic-non-PAHs (µg/kg dry wt.)			
Total PCBs+++	3550B or 3540C and 3665A	8082	3
Organometallics (µg TBT/L in interstitial water)			
Tributyltin	Krone et al. (1989)* - GC/MS UNEP/IOC/IAEA**	Krone et al. (1989)* - GC/MS UNEP/IOC/IAEA**	0.015

- Footnotes: (i) The reporting limits shown in this table are the most stringent limits which will be specified by DEP. Project proponents should consult DEP on the required limits in the preparation of proposals for sampling and chemical testing of the sediment.
- (ii) Other equivalent methods such as “The Specification for Marine Monitoring – Part 5: Sediment Analysis” (GB17378.5-2007) may be used subject to the approval of DEP.
- + Low molecular weight PAHs include acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene
- ++ High molecular weight PAHs include benzo[a]anthracene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, fluoranthene, pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, indeno[1,2,3-c,d]pyrene and benzo[g,h,i]perylene
- +++ The reporting limit is for individual PCB congeners. Total PCBs include 2,4' diCB, 2,2',5' triCB, 2,4,4' triCB, 2,2',3,5' tetraCB, 2,2',5,5' tetraCB, 2,3',4,4' tetraCB, 3,3',4,4' tetraCB, 2,2',4,5,5' pentaCB, 2,3,3',4,4' pentaCB, 2,3',4,4',5 pentaCB, 3,3',4,4',5 pentaCB, 2,2',3,3',4,4' hexaCB, 2,2',3,4,4',5' hexaCB, 2,2',4,4',5,5' hexaCB, 3,3',4,4',5,5' hexaCB, 2,2',3,3',4,4',5 heptaCB, 2,2',3,4,4',5,5' heptaCB, 2,2',3,4',5,5',6 heptaCB (ref: the "summation" column of Table 9.3 of *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual (The Inland Testing Manual)* published by USEPA).
- * Krone et al. (1989), A method for analysis of butyltin species and measurement of butyltins in sediment and English Sole livers from Puget Sound, *Marine Environmental Research* 27 (1989) 1-18. Interstitial water to be obtained by centrifuging the sediment and collecting the overlying water.
- ** UNEP/ICO/IAEA refers to IAEA's Marine Environment Laboratory reference methods. These methods are available free of charge from UNEP/Water or Marine Environmental Studies Laboratory at IAEA's Marine Environment Laboratory. Interstitial water to be obtained by centrifuging the sediment and collecting the overlying water.

Table 2 - Test Endpoints and Decision Criteria for Tier III Biological Screening

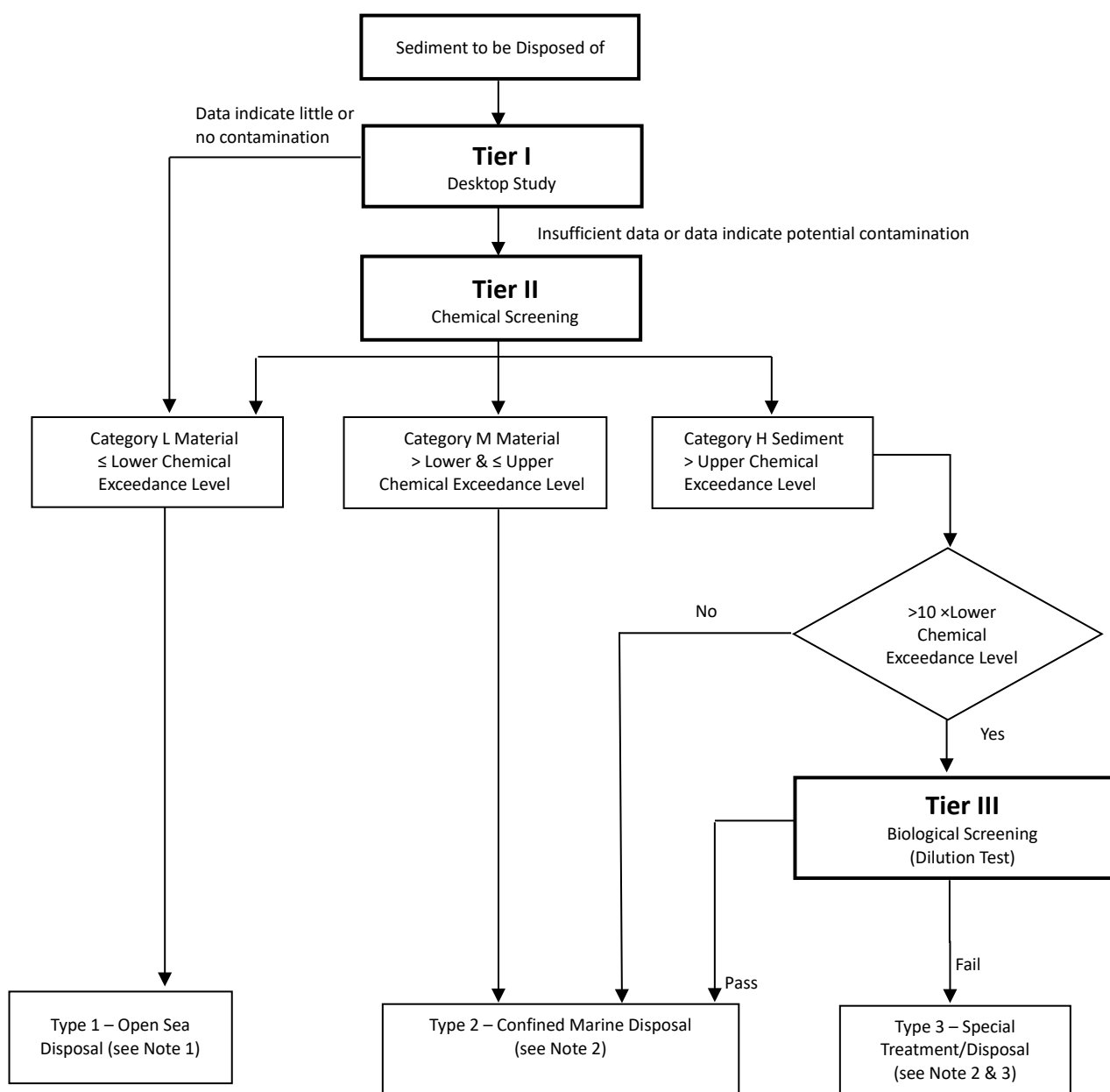
Toxicity test	Endpoints measured	Failure criteria
10-day amphipod	Survival	Mean survival in test sediment is significantly different ($p \leq 0.05$) ¹ from mean survival in reference sediment and mean survival in test sediment < 80% of mean survival in reference sediment.
20-day polychaete worm	Dry Weight ²	Mean dry weight in test sediment is significantly different ($p \leq 0.05$) ¹ from mean dry weight in reference sediment and mean dry weight in test sediment < 90% of mean dry weight in reference sediment.
48-96 hour larvae (bivalve or echinoderm)	Normality Survival ³	Mean normality survival in test sediment is significantly different ($p \leq 0.05$) ¹ from mean normality survival in reference sediment and mean normality survival in test sediment < 80% of mean normality survival in reference sediment.

¹ Statistically significant difference should be determined using appropriate two-sample comparisons (e.g., *t-tests*) at a probability of $p \leq 0.05$.

² Dry weight means total dry weight after deducting dead and missing worms.

³ Normality survival integrates the normality and survival end points, and measures survival of only the normal larvae relative to the starting number.

APPENDIX C Management Framework for Dredged/Excavated Sediment



Notes

- (1) Most open sea disposal sites are multi-user facilities and as a consequence their management involves a flexibility to accommodate varying and unpredictable circumstances. Contract documents should include provisions to allow the same degree of flexibility should it be necessary to divert from one disposal site to another during the construction period of a contract.

- (2) For sediment requiring Type 2 or Type 3 disposal, contract documents should state the allocation conditions of MFC and DEP. At present, East Sha Chau mud pits are designated for confined marine disposal.
- (3) If any sediment suitable for Type 3 disposal (Category H sediment failing the biological dilution test) is identified, it is the responsibility of the project proponent, in consultation with DEP, to identify and agree with him/her, the most appropriate treatment and/or disposal arrangement. Such a proposal is likely to be very site and project specific and therefore cannot be prescribed. This will not preclude treatment of this sediment to render it suitable for confined marine disposal.
- (4) The allocation of disposal space may carry a requirement for the project proponent to arrange for chemical analysis of the sediment sampled from 5% of the vessels en-route to the disposal site. For certain Category H sediment, the chemical tests will be augmented by biological tests. Vessel sampling will normally entail mixing five samples to form a composite sample from the vessel and undertaking laboratory tests on this composite sample. All marine disposal sites will be monitored under the general direction of the Civil Engineering Department. However, exceptionally large allocations might require some additional disposal site monitoring. These will be stipulated at the time of allocation.
- (5) Trailer suction hopper dredgers disposing of sediment at East Sha Chau must use a down-a-pipe disposal method, the design of which must be approved in advance by DCE. The dredging contractor must provide equipment for such disposal.