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&
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Agenda item 4

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CONSIDERATION OF THE REPORT OF THE SCIENTIFIC GROUPS

Development of further guidance on disposal site selection

Note by the Secretariat

SUMMARY

Executive summary:	This document provides, at annex, the final draft of the guidance on disposal site selection, for approval by the governing bodies
Action to be taken:	Paragraph 4
Related documents:	LC/SG 44/2, LC/SG 43/16, LC/SG 42/2/2, LC/SG 42/16; LC/SG 43/2/1, LC/SG 40/16 and LC 42/17

Introduction

1 In 2017, the Scientific Groups established a Correspondence Group on the development of further guidance on disposal site selection under the co-lead of Canada and the United Kingdom (LC/SG 40/16, paragraphs 2.11 to 2.20 and annex 3).

2 At the joint session in 2021, the Scientific Groups reviewed the near final version of the draft guidance, as prepared by the Correspondence Group. Following discussion, the Groups approved the guidance (LC/SG 44/2, annex) and instructed the Secretariat to:

.1 finalize the guidance entitled "Guidelines for selecting sites for sea disposal and for developing site management and monitoring plans", taking into account document LC/SG 44/2, information from the informal group established during the joint session, and any comments made in plenary; and

.2 forward the guidance to the next session of governing bodies in 2021 for their approval.

3 The Scientific Groups also gratefully accepted the kind offer by Mexico to review the organization of the document to ensure that the document fulfilled the needs of a potential end user.

Action requested of the governing bodies

4 The governing bodies are invited to note the information provided, including the actions and recommendations by the Scientific Groups, and approve the guidance for disposal site selection, at annex.

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Guidelines for Selecting Sites for the Dumping of Wastes and Other Matter at Sea and for Developing Site Management and Monitoring Plans

Draft

London Convention & Protocol
International Maritime Organization

April 2021

Front Cover Photos:

Image on the left:
Taken by Pilbara Ports Authority
(formerly Port Hedland Port Authority)
Date: June 2012
Vessel: Trailing Suction Hopper
Dredger – Sebastiano Caboto
Dredge Operator: Jan De Nul
Group
Project: 2012 Port Hedland Maintenance Dredging Project – maintaining existing access channel, inner harbour turning basins and berth pockets
Dump-site: Disposal Site India at Port Hedland, Western Australia

Image on the right:
The dumping of the FV Westward in New England waters off the Northeast USA in Atlantic Ocean. Source: USEPA https://www.epa.gov/ocean-dumping/disposal-vessels-sea.

I ACKNOWLEDGEMENTS:

A Correspondence Group consisting of members of the London Convention and Protocol and official observer organizations developed these guidelines.

Suzanne Agius (Canada) and Jemma Lonsdale (United Kingdom) co-chaired the correspondence group.

London Protocol & Convention Site Selection Correspondence Group	
Co-Chairs: Canada and United Kingdom	
Correspondence Group Members	
Canada	*USA*
United Kingdom	*Italy*
South Africa	*China*
Japan	*Nigeria*
Greenpeace	*Singapore*
Netherlands	*ACOPS*
Ireland	*Greenpeace International*
Republic of Korea	*ISA*
Australia	*IMarEST*
Mexico	*WODA*

Environment and Climate Change Canada is recognized in particular for providing funding support for consultant Craig Vogt Inc. in drafting these guidelines.

Thanks also to the Office of the London Convention and Protocol, in the International Maritime Organization.

II PREFACE

This document provides detailed step-by-step guidelines on selection of dump-sites for the dumping of wastes and other matter at sea and on development of site management and monitoring plans to help manage dump-sites during and after use. These guidelines specifically address the wastes and other matter that may be considered for dumping at sea, listed in Annex 1 of the London Protocol.[1] These include:[2]

1. dredged material
2. sewage sludge
3. fish waste, or material resulting from industrial fish processing operations
4. vessels and platforms or other man-made structures at sea[3]
5. inert, inorganic geological material
6. organic material of natural origin
7. bulky items primarily comprising iron, steel, concrete and similarly unharmful materials for which the concern is physical impact

Generic and specific guidelines for the assessment of the above wastes and other matter that may be considered for dumping have been developed by the member countries of the London Protocol and London Convention to assist in implementation at the national level (London Protocol and Convention website). Those guidelines describe procedures to evaluate wastes and other matter being considered for dumping at sea, including assessment of alternatives to dumping, waste prevention audits, waste

Important Note to Readers

This document provides general information about disposal site selection. Annex B presents information regarding dump-site selection for each of the London Protocol categories of waste or other matter identified above and describes how, if at all, dump site selection and site management and monitoring differ from the main body of this guidance.

1 The step-by-step procedures in this guidance document are also applicable to dumping at sea of wastes and other matter considered under the requirements of the London Convention.

2 Annex 1 to the London Protocol also includes carbon dioxide streams from carbon dioxide capture processes for sequestration in sub- seabed geological formations. This waste stream is not included in these guidelines, given its unique characteristics.

3 This guidance does not address site selection for the creation of artificial reefs, which is covered in the London Convention and Protocol/UNEP Guidelines for the Placement of Artificial Reefs.

characterization, dump-site selection, assessment of potential adverse environmental effects of dumping, permitting procedures and monitoring. This document, *Guidelines for Selecting Sites for the Dumping of Wastes and Other Matter at Sea and for Developing Site Management and Monitoring Plans,* expands upon what is included in the generic and specific guidelines regarding site selection and site management and monitoring.

Alterations to the physical environment, risks to human health, risks to ecological and marine resources, and interference with other legitimate uses of the sea are primary concerns that will need to be addressed when selecting a new dump-site. After confirmation that there is a need for ocean dumping, the wastes and their constituents proposed for dumping at sea need to be characterized to establish whether the waste is appropriate and acceptable for dumping at the selected site.

This guidance document presents a six-step iterative process for the selection of dump-sites and the development of site management and monitoring plans. These steps are:

1. preliminary considerations
2. identification of candidate sites
3. physical, chemical, and biological characterization of potential dump-sites
4. evaluation of potential impacts at candidate sites based on characteristics of material expected to be dumped at sea
5. comparison of potential impacts among alternative candidate sites, followed by final dump-site selection
6. preparation of a site management and monitoring plan to guide how the site will be utilized and managed over some period of time (e.g. five years), after which the plan can be re-evaluated

These guidelines identify the information and data that are important for evaluating whether or not dumping activities at a newly proposed site might cause unacceptable impacts to the marine environment, human health, or other uses of the sea. Comprehensive information is generally needed on physical, chemical, and biological characteristics of the sea floor and the water column at the dump-site and the surrounding area.[4]

[4] From Paragraph 11 in Annex 2 of the Protocol, information required to select a dump-site shall include:
.1 physical, chemical and biological characteristics of the water column and the seabed;
.2 location of amenities, values and other uses of the sea in the area under consideration;
.3 assessment of the constituent fluxes associated with dumping in relation to existing fluxes of substances in the marine environment; and
.4 economic and operational feasibility.

This guidance document should be followed as closely as possible within a Contracting Party's scientific, technical and economic capabilities (Protocol Objectives (article 2)); however, specific considerations may need to be altered in some cases depending on the waste to be dumped, the degree of risk involved, and the size and complexity of the project.[5]

[5] From Paragraph 8 in Annex 2 of the Protocol, characterization of the wastes and their constituents shall take into account:

.1 origin, total amount, form and average composition;
.2 properties: physical, chemical, biochemical and biological;
.3 toxicity;
.4 persistence: physical, chemical and biological; and
.5 accumulation and biotransformation in biological materials or sediments.

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III INTRODUCTION

The objective of this document is to provide guidelines for both the selection of sites for the dumping of wastes and other matter at sea and the preparation of site management and monitoring plans for those dump-sites.

This document is based on the waste assessment and dumping requirements of the London Protocol and has been developed by parties to the London Protocol and the London Convention, the two primary international treaties protecting the world's ocean from pollution from dumping. These treaties are managed under the International Maritime Organization, a specialized agency of the United Nations.

Generic and specific guidelines for the assessment of wastes and other matter (sometimes referred to collectively as Waste Assessment Guidelines or WAGs) are available from the London Protocol and London Convention. These guidelines provide robust procedures for assessment and management of wastes proposed to be dumped at sea (see Box 1) and on the selection of dump-sites. This document expands upon the guidance in the generic and specific assessment guidelines for the selection and management of dump-sites.

Box 1: Key elements of the London Protocol and Convention generic and specific waste assessment guidelines

- *General – Is there a way that dumping of wastes or other matter at sea can be reduced or eliminated?*
- *Waste rrevention audit – What could be done to reduce or prevent generation of the waste?*
- *Consideration of waste management options - What are the alternatives to dumping at sea?*
- *Chemical, physical and biological properties - What are the characteristics of the waste?*
- *Action list - Will the waste cause unacceptable adverse impacts at the dump-site?*
- *Dump-site selection – Where in the sea is an acceptable dump-site? Are operational or management measures needed to alleviate the adverse impacts at the dump-site?*
- *Assessment of potential impacts (impact hypotheses) - What are the potential impacts at the dump-site?*
- *Permits and permit conditions - What conditions should be included in the permit?*
- *Monitoring - What compliance monitoring and field monitoring activities are needed?*

The generic and specific assessment guidelines embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Protocol and, when applicable, the London Convention. They are intended to assist individuals or bodies, including regulators, port authorities and other interested entities, by providing the tools to incrementally build an assessment, management and permitting system for waste or other matter to be considered for dumping at sea. The use of either generic or specific assessment guidelines by national authorities complements but does not replace the requirements described in Annex 2 of the London Protocol and, when applicable, the London Convention.

The London Protocol follows an approach under which dumping of wastes or other matter is prohibited except for those materials specifically enumerated in Annex 1, and in the context of that Protocol, this document would apply to the materials listed in that annex. The London Convention prohibits the dumping of certain wastes or other matter specified therein, and, in the context of that Convention, these guidelines would apply to wastes not prohibited for dumping at sea listed in the annexes to the Convention. When applying these guidelines under the London Convention, they should not be viewed as a tool for the reconsideration of dumping of wastes or other matter in contravention of Annex I to the London Convention.

This guidance document applies to dump-site selection for seven of the eight waste categories listed in London Protocol Annex 1. The eighth category of wastes, carbon dioxide streams from carbon dioxide capture processes for sequestration in sub-seabed geological formations, is not included in these guidelines, given its unique characteristics. The seven categories of waste that are included here are:

1. dredged material
2. sewage sludge
3. fish waste, or material resulting from industrial fish processing operations
4. vessels and platforms or other man-made structures at sea
5. inert, inorganic geological material
6. organic material of natural origin
7. bulky items primarily comprising iron, steel, concrete and similarly unharmful materials for which the concern is physical impact

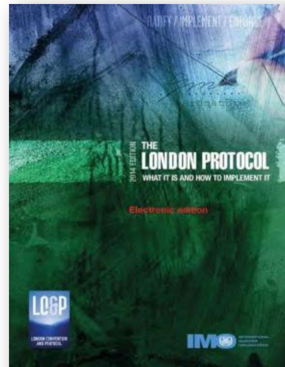
This guidance document presents a six-step iterative process for the selection of dump-sites and the development of site management and monitoring plans, including considerations within each step for collection of information needed to complete that step of the procedures. It is important to note that this guidance, while intended to be as generic as possible, is largely based upon experience with dredged material disposal (see Box 2). For context, Annex B1 provides information about dredged material and a link to the specific guidelines developed for assessment of dredged material for disposal at sea.

Box 2: Important note

The body of this document provides generic site selection, management and monitoring guidance for seven of the eight wastes and other matter listed in Annex 1 of the London Protocol that may be considered for dumping at sea. This guidance does not provide site selection guidance for the sub-seabed sequestration of carbon dioxide streams in sub-seabed geological formations.

The vast majority of matter dumped at sea by volume is dredged material, as reported by Contracting Parties to the LP and LC. As such, existing information on site selection is largely associated with dumping at sea of dredged material. The selection of dredged material dump-sites involves a comprehensive assessment of potential impacts to the marine environment and human health. The dumping of dredged material at sea has the potential to impact human health, marine ecosystem structure and dynamics including the sensitivity of species, populations, communities, habitats and processes, amenities and other legitimate uses of the sea. The body of this guidance document, while intended to be as generic as possible, is often based on the comprehensive assessment processes that have been developed for dredged material dump-site selection and for the development of site management and monitoring plans for dredged material.

Guidance about the ways in which dump-site selection for all seven London Protocol categories of waste or other matter considered in this guidance differs from the generic site-selection guidance provided in this document is provided in Annex B. Similarly, Annex B explains how the generic guidance on the development of site management and monitoring plans for dump-sites differs at dump-sites for each of the categories of waste or other matter.



This guidance document also contains a reference guide based on dredged material dump-site selection with checklists and tools to assist with dump-site selection (Annex A) and the development of site management and monitoring plans (Section IV, Step 6). In addition, this document includes case studies on the selection of dump-sites for dredged material (Annex D).

The reader is referred to the London Protocol and London Convention website for additional information on the provisions of the treaties and the available guidance materials:
http://www.imo.org/ourwork/environment/lclp/pages/default.aspx.

IV SELECTION OF DUMP-SITES—THE SIX STEPS

The London Protocol and Convention strive to prevent marine pollution and protect the marine environment by controlling the dumping of wastes and other matter at sea through the application of the generic and specific waste assessment guidelines, one element of which is selection of an appropriate dump-site. As described in Section III, this document provides general guidance that is primarily based on information about site selection for the disposal of dredged material at sea, but specific information about selecting sites and developing site management and monitoring plans for seven London Protocol waste categories is provided in Annex 1.

Where use of an existing dump-site is not feasible (e.g. if none exist, if existing sites are not suitable for the waste proposed to be dumped at sea, or if other site-specific issues preclude selection of existing sites), new candidate sites should be identified and characterized. Dump-sites should be selected to minimize the impact on the marine environment, including interference with other uses of the sea. The six primary steps for dump-site selection and preparation of a site management and monitoring plan are shown in Box 3.

Box 3: Dump-site selection process

STEP 1: Preliminary considerations

STEP 2: Identification of candidate sites

STEP 3: Characterization of candidate sites

STEP 4: Assessment of potential impacts at candidate sites

STEP 5: Comparison of candidate sites and site selection

STEP 6: Preparation of the site management and monitoring plan

Annex B presents information about site selection for the dumping of wastes and other matter listed the London Protocol Annex 1. It is intended to describe how, if at all, site selection and the development of site management and monitoring plans for each London Protocol Annex 1 waste are different from that in the six steps for generic site selection in the main body of this report.

STEP 1: PRELIMINARY CONSIDERATIONS

Step 1: Preliminary considerations prior to dump-site selection

A. *Are there alternatives to dumping at sea?*

- *Through a waste prevention audit, are there opportunities for waste prevention at the source?*
- *Are there beneficial use opportunities available, given the characteristics of the wastes, that are practicable and economically feasible?*

B. *What are the characteristics of the waste or other matter? **

- *Size, quantities or volume of waste material*
- *Physical parameters (e.g. buoyancy, grain size)*
- *Chemical characteristics (type of waste and the composition and levels of contaminants)*
- *If needed, toxicity of the waste and potential for persistence or bioaccumulation*

*In certain cases, national authorities may choose to select a site before specific wastes have been proposed to be dumped. In these cases, the characteristics of a representative type of waste are needed.

ALTERNATIVES TO DUMPING AT SEA

Some waste or other matter can be valuable resources; opportunities should be explored for alternative use before the decision is made to dump the waste or other matter at sea. For example, alternative uses of dredged material include retaining clean sediment within natural sediment processes and cycles that support aquatic, estuarine and marine systems; habitat restoration and development; beach nourishment; shoreline stabilization and protection; capping of historical contaminated sediments; construction fill; and engineered caps on landfills.

As shown in the Step 1 box above, prior to selecting a site for a particular proposed dumping activity, alternatives to dumping at sea should include appropriate consideration of waste management options. Applicants for a permit, or in some cases the national authority, are responsible for assessing whether there are opportunities for waste prevention and reduction (See LP Annex 2 Waste Prevention Audit), and considering the hierarchy of waste management options that prioritizes alternatives to dumping at sea (e.g. reuse, recycling, treatment of the waste) (See LP Annex 2 Consideration of Waste Management Options).

In cases where the applicant will conduct the assessment of waste management options that considers the waste management hierarchy and prioritizes alternatives to ocean dumping, the applicant should submit the assessment to the national authority for review. If dumping at sea is found to be the appropriate management option, one or more potential (candidate) dump-sites should be identified and characterized to assist in selecting the best dump-site (see Step 2). Alterations to the physical environment, risks to fisheries and human health, devaluation of marine resources, and interference with other legitimate uses of the sea are viewed as primary concerns (among others). In order to limit potential impacts of dumping, existing dump-sites that have been selected for the specific waste may be considered to help ensure that any impacts of dumping are spatially limited.

CHARACTERISTICS OF THE WASTE OR OTHER MATTER TO BE DUMPED

In addition, prior to dump-site selection, the characteristics of the waste or other matter should be determined through appropriate physical, chemical and/or biological (acute and chronic toxicity) testing (see Step 1 box). Some national authorities, however, select sites using assumptions about proposed projects and the characteristics of the wastes instead of using specific project data or specific information about the wastes proposed for dumping. In these cases, detailed characteristics of the representative type or types of waste to be dumped are needed to enable the consideration of alternatives to disposal and an assessment of potential impacts on the environment and human health.

Once waste or other matter characteristics are known, the application of certain management measures (e.g. applying a buffer zone around the dump-sites) may be needed to reduce possible impacts to nearby sensitive areas. In addition, managing the exposures and adverse risks associated with dumping can also be addressed with operational and engineering controls. Operational controls to manage potential impacts could include:

- time, release rate and location of dumping
- quantity of materials dumped and frequency of dumping
- depth of release
- release under tow to increase mixing
- thin layer dumping of a material (e.g. dredged material)

Engineering controls can be used to manage potential impacts for dumping wastes of other material. For dredged material, such controls could include:

- submerged diffuser
- tremie tube
- lateral confinement
- confined dumping with capping[6]

[6] Containment on the seabed as a management measure is possible through use of confined aquatic cells (i.e. placement in natural-bottom depressions, historic borrow sites, constructed subaqueous pits, or behind subaqueous berms on the seafloor to receive wastes with engineered caps to confine the wastes). Confined dumping, however, can be costly and requires engineering expertise, and can present significant environmental risks; therefore, investigation of the site, the cap, and the contaminated materials to be capped would need to be done to a high level of certainty to ensure the long-term stability of the material dumped. See *Guidance for Subaqueous Dredged Material Capping* by Michael R. Palermo, James E. Clausner, Marian P. Rollings, Gregory L. Williams, Tommy E. Myers, Thomas J. Fredette and Robert E. Randall; U.S. Army Corps of Engineers. Technical Report DOER-1. June 1998.

STEP 2: IDENTIFICATION OF CANDIDATE SITES

STEP 2: Identification of candidate sites

Determine zone of siting feasibility

Use constraint mapping to identify candidate locations:

Where are environmentally sensitive areas?
Where are areas of incompatible uses?
Are there areas that may be suitable for dumping that can be identified as candidate dump-sites?

ZONE OF SITING FEASIBILITY

Dump-sites should be located in areas where dumping of wastes and other matter at sea will not cause unacceptable impacts to the environment or to other uses of the sea. In order to locate sites within potentially acceptable areas effectively, the initial consideration should be of factors affecting the operational feasibility of using a site.

The *zone of siting feasibility* is the area within a feasible radius from the source of the waste, the point of its generation, and/or the location where the waste would be loaded on a vessel, aircraft, or other structure at sea, and is determined by consideration of such factors as:

- seasonal weather restrictions and the transportation and dumping method, or equipment that will be utilized
- navigation restrictions
- operational and transport costs to the site
- political boundaries
- feasibility of surveillance and monitoring

If all candidate sites within the zone of siting feasibility would result in unacceptable impacts, alternate candidate sites should be considered. For example, candidate sites at greater distances should be considered when nearshore sites are unacceptable (would result in unacceptable impacts) or if other candidate sites offer environmental benefits or less environmental impact at reasonable increases in costs.

When seasonal conditions (e.g. weather, sea state, environmental windows) limit the schedule for when the dumping activity may take place, practical (operational) considerations may affect (e.g. reduce) distances considered between the waste loading site and the candidate dump-site. Some seagoing barges and hopper dredges, for example, have a limited range of operation for transporting dredged material, due to safety and other factors.

CONSTRAINT MAPPING: WHERE ARE ENVIRONMENTALLY SENSITIVE AREAS WITHIN THE ZONE OF SITING FEASIBILITY?

Constraint mapping involves identifying environmentally sensitive areas and potentially incompatible uses within the zone of siting feasibility. In some cases, the national authority will determine the zone of siting feasibility and conduct the constraint mapping. In other cases, once the zone of siting feasibility is established, constraint mapping can be undertaken by permit applicants in consultation with the national authority, other national or local government agencies, any indigenous peoples, and other stakeholders, as appropriate. Figures 2 and 3 provide examples of constraint mapping in the location of candidate dump-sites.

For examples of constraint mapping, the reader is referred to reports prepared by the United Kingdom for two dump-sites: Plymouth Dredged Material Dump-site and South-West Dredged Material Dump-site (UK 2016 and UK 2017); and by the United States on three dump-sites offshore of Oregon: Yaquina North Ocean Dump-site, Yaquina South Ocean Dump-site, and Rogue River Ocean Dredged Material Dump-site (USEPA 2012 and USEPA 2008).

Environmentally sensitive areas are those areas where natural resources may be adversely affected by dumping at sea, including, but not limited to:

- commercial, recreational, or subsistence fish or shellfish habitats
- breeding, spawning, nursery, refuge habitats, and feeding areas of at-risk, threatened or endangered species, species of ecological, commercial or recreational interest, and their food prey
- migration routes of finfish, whales, and other marine mammals
- areas supporting nesting marine-associated avifauna, including seabird colonies
- areas supporting moulting, over-wintering, and staging of marine-associated avifauna
- areas in proximity to areas of special scientific or biological importance, such as marine sanctuaries or marine reserves

Concerns about the location of a dump-site will likely focus upon the species of local significance and unique habitats or environmental features that ensure their continued viability. Sensitive habitats near the candidate sites should be identified, such as areas with abundant submerged aquatic vegetation or rocky outcrops. In addition, nearshore habitats should be identified including coastal marshes, wetlands, kelp beds and habitats that provide important habitat for juvenile and adult phases of sensitive species. These features should be identified and overlain on a map within the zone of siting feasibility, which should also show the transit route(s) to the candidate dump-sites.

CONSTRAINT MAPPING: WHERE ARE AREAS OF POTENTIALLY INCOMPATIBLE USES WITHIN THE ZONE OF SITING FEASIBILITY?

Potentially incompatible uses should also be identified and overlain on the constraint map within the zone of siting feasibility. Consultation with relevant national authorities, other sub-national and local agencies, indigenous peoples, and stakeholders, as appropriate, should be conducted to determine the significance and potential implications of ”other uses” if a dump-site were situated within the same area. Potentially incompatible uses and areas include, but are not limited to:

- indigenous peoples’ cultural and subsistence uses in the vicinity of the candidate dump-sites;
- natural or other features of historical or cultural importance (e.g. shipwrecks), archaeological remains, and areas of high aesthetic or environmental value (e.g. coral reefs);
- areas with hazardous features such as dump-sites for munitions and/or chemical warfare agents;
- hazardous shipwrecks;
- beaches, water sports, and other recreational activities;
- prospective mining, oil and gas exploration and development;
- sites that are or that could potentially be used for sea-based energy production (e.g. wave, tide, and wind farms);
- engineering uses of the sea floor, including mining, pipelines, water intake/discharge structures, cooling and desalination structures, deep ocean heat exchange, and undersea cables;
- navigation and shipping lanes;
- military training and exclusion zones (e.g. possible presence of unexploded ordinances);
- mineral extraction;
- aquaculture sites;
- public use of the shoreline;
- commercial, recreational and indigenous fisheries;
- areas of special scientific importance; and
- locations important for tourism or local economy, such as recreational diving sites or “view sheds.”

Consideration should be given as to whether potentially incompatible uses at candidate sites could be mitigated by management measures. The presence of historically or culturally important features (e.g. shipwrecks, archaeological sites) in surrounding areas that could be affected by dumping at a particular site should also be considered. In addition, an assessment of the need for further consultations with government agencies, indigenous peoples, and stakeholders should be made once the initial physical, chemical and biological data are available.

CONSTRAINT MAPPING: ARE THERE AREAS THAT MAY BE SUITABLE FOR DUMPING THAT CAN BE IDENTIFIED AS CANDIDATE DUMP-SITES?

Once the constraint mapping is completed and sensitive areas and areas of incompatible uses are shown on a map of the zone of siting feasibility, the available areas for candidate dump-sites should become more apparent (See Figures 2 and 3).

An initial consideration may be whether the candidate sites are non-dispersive or dispersive. Non-dispersive sites are generally associated with non-significant transport of materials from the site following disposal; that is, dumped wastes are expected to stay largely within a pre-determined dump-site footprint. Non-dispersive sites typically have low current speeds and are situated in areas where sediments tend to accumulate naturally, except for certain wastes such as glacial clay that is so fine that it is likely to disperse even at what is defined below as a non-dispersive site. In contrast, dispersive sites are associated with the transport of materials from the site, and some or all of the dumped material is expected to travel outside the dump-site footprint. Depending on the category of waste, dispersive sites may be selected to avoid impacts that might result if the material were to stay in one place (e.g. the creation of navigation hazards) or to take advantage of natural processes (e.g. natural movement of sediments from a dump-site to a sediment-starved area, or biological consumption of waste). When a site is selected to disperse material, the following should be considered:

- The site should be in areas with strong currents (e.g. average current speed > 25 cm/sec) that tend to maximize dispersion).
- The site should be a distance from shorelines and human use areas as measured from the edge of the dumping zone (e.g. one nautical mile).
- The site should be located so that the ultimate fate of dispersed material will not have a significant adverse impact on natural resources or sensitive areas.

Additional information may be needed to determine whether the candidate sites are:

- large enough (i.e. sufficient capacity) that the bulk of the material dumped at the site would be anticipated to remain either within the site limits or within a predicted area of impact to ensure that the area impacted by dumping is minimized (Note: this would not apply for dump-sites that are selected for dispersive characteristics);
- deep enough such that mounding or height of the waste or other matter at the site does not cause navigational risks to ships;
- large enough in relation to anticipated dumping volumes so that the site would be available for use for many years; and
- small enough to ensure that environmental impacts can be predicted and contained, and that monitoring can be conducted in the future.

When selecting the location of dump-sites, the possibility of taking advantage of natural sediment transport processes at dispersive sites should be considered, due to the potential benefits associated with dispersive sites that enable transport of sediments into sediment-starved areas.

When selecting sites at great depths, the potential increase in the cost and logistical complexity of monitoring should be considered and anticipated in advance.

During the selection of candidate sites, consultation should be occurring with the relevant national, sub-national, and local government departments; indigenous peoples; and stakeholders, as appropriate and necessary to confirm that use of a candidate site(s) is feasible prior to further study or data collection.

If a suitable candidate dump-site cannot be identified within the initial zone of siting feasibility, the geographic region under consideration can be enlarged or other non-ocean waste management options can be developed.

Figure 2: Identification of the zone of siting feasibility and constraints to location of a dredged material dump-site in Guam (Weston 2009).

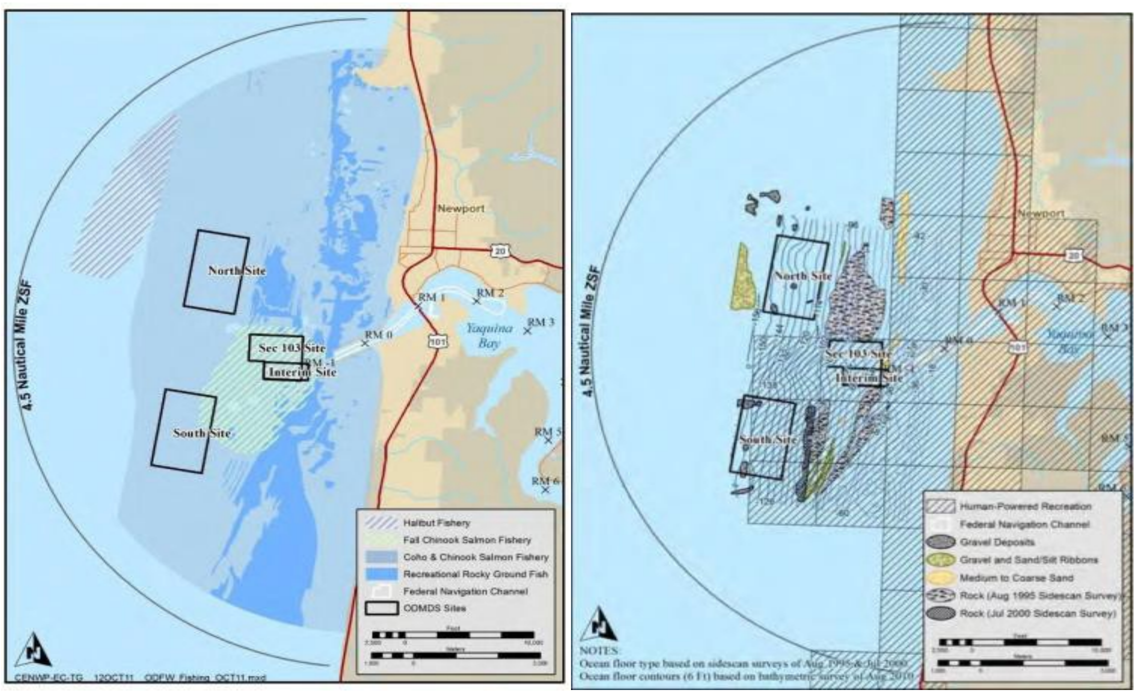


Figure 3. Example of constraint mapping within zone of siting feasibility to identify candidate dump-sites for dredged material. The map on left shows candidate sites (North and South) and recreational fishing areas and the map on the right identifies areas used for non-motorized recreation activities (e.g. kayaking, surfing, swimming, snorkelling and SCUBA diving) in addition to sediment type (U.S. EPA 2012).

STEP 3 CHARACTERIZATION OF CANDIDATE SITES

STEP 3
Characterization of candidate sites

What are the general characteristics of each candidate site?

What are the physical, chemical and biological characteristics of each site?

What are the other uses of the sites and nearby areas?

Is the information about each candidate site adequate to characterize it?

Once constraint mapping is complete and candidate sites are identified in consultation with national, sub-national, and local government departments, indigenous peoples, and stakeholders, a detailed description of the physical, chemical and biological characteristics of each site is needed. Information on historical uses of the site and the surrounding area should be collected as part of this effort.

Baseline studies of the physical, chemical and biological characteristics of the candidate sites are highly recommended. These studies not only provide a basis for selection of a site but also serve as a point of comparison for the results of any post-dumping studies in order to assess whether the effects of dumping were as predicted; indeed, it can be very challenging to interpret the results of post-disposal studies without baseline conditions to evaluate them against. In cases where the applicant will conduct the baseline studies, the applicant may submit sampling and analysis plans using appropriate techniques to the national authority for review prior to conducting the baseline studies (see Step 5).

WHAT ARE THE GENERAL CHARACTERISTICS OF EACH CANDIDATE SITE?

General information to be considered about each candidate site includes:

- historical dumping activities at or near the site;
- present and historical uses of, or events at or near, the site that could impact sediment quality (including any recent or historical spill events);
- site characteristics or activities that could affect movement of sediments;
- bathymetry;
- natural sedimentation rate (or erosion rate);
- archaeological remains/resources; and
- reasons for monitoring (driven by impact hypotheses and the need to validate permit assumptions) and the feasibility of monitoring.

In addition, it may be useful to name each candidate site, and consider the latitude and longitude of the centre point of circular candidate sites (with the radius) or corners of rectangular or irregular boundary sites in decimal degrees to six decimal places. Even for dispersive sites, disposal zone boundaries should be established as areas within which waste or other matter can be released, and expected dispersal areas should also be identified. This will ensure that waste or other matter is released from a location that will allow it to disperse as intended.

WHAT ARE THE PHYSICAL, CHEMICAL AND BIOLOGICAL CHARACTERISTICS AT EACH SITE?

The physical, chemical, and biological characteristics of the water column and the seabed should be assessed for candidate sites using the information described below. It is important that the national authority is consulted during the planning of any field studies of the candidate site(s), as the information needed to characterize each site will vary, and the national authority may be aware of existing data and information that may be pertinent. In some cases, the national authority will assess the candidate site(s). If the assessment of the possible uses of the candidate site or the physical, chemical and biological characteristics of the candidate site reveals that adequate information is not available, additional site-specific fieldwork may be required to address the gaps.

PHYSICAL CHARACTERISTICS OF THE WATER COLUMN

The following characteristics of the water column should be considered for candidate dump-sites:

- Detailed bathymetry of the candidate sites and surrounding areas.
- Expected water temperature and salinity (including thermoclines and haloclines) at the time of dumping and any relevant temporal/seasonal fluctuations.
- Expected background turbidity and natural fluctuations at the time of dumping and any relevant temporal/seasonal fluctuations.
- Identification of the dispersive nature of the candidate site, including assessment of the seasonal current flow, tidal cycles, wave climate, and up-welling at the candidate dump-sites (IMCO 1982).
- Currents at several locations in the water column: within one metre of the bottom, mid-depth, and within one metre of the surface. In open ocean areas, one lunar cycle might be adequate to determine tidal constituents for modelling. However, in nearshore areas with complex topographic inputs or areas affected by seasonal conditions, such as storm surges or peak river discharges, measurements should be taken for the months likely to have highest bottom currents. With regard to candidate sites for dredged material, measurements should also be taken in months likely to have the lowest bottom currents, because this is when mounding may occur as well as in months in which dumping will take place.
- Mean direction and velocity of the surface and bottom drifts.
- Suspended sediment / particulate concentration measurements within one metre of the bottom should be taken where currents are strong enough to cause re-suspension.
- Other current and wave information may be required including:
  - tidal period and orientation of the tidal ellipse
  - average number of storm days per year
  - velocities of storm-wave-induced bottom currents
  - general wind characteristics

CHEMICAL CHARACTERISTICS OF THE WATER COLUMN

Sampling and analysis of chemicals of concern that might be elevated in the water column at the dump-site may need to be conducted for comparison to local water quality criteria or standards where there is a risk that contaminants of concern may be transported from the source of the waste or other matter to the selected dump-site, or to quantify baseline conditions. Contaminants of concern should be identified by considering local conditions and may include heavy metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs).

PHYSICAL CHARACTERISTICS OF SEABED SEDIMENTS

- Particle size and total organic carbon (TOC))
- Per cent moisture or total solids
- Topography (e.g. flat, hilly, rock piles)
- Unique features (e.g. hydrothermal vents, seeps)
- Variability
- Other parameters may be required based on site-specific characteristics

CHEMICAL CHARACTERISTICS OF SEABED SEDIMENTS

- Arsenic, mercury, cadmium, lead, copper, other heavy metals
- High molecular weight hydrocarbons (including oil and grease)
- PCBs and PAHs
- Other contaminants of concern may need to be characterized based on site history (e.g. polybrominated diphenyl ethers (PBDEs), dioxins and furans, tributyltin (TBT), chlorinated pesticides, and nutrients)

BIOLOGICAL CHARACTERISTICS[7] OF THE WATER COLUMN AND BENTHOS IN AND AROUND DUMP-SITES

When considering biological characteristics, it is helpful to understand that the potential for substances to have adverse effects on living organisms cannot be predicted by knowing only that a substance is present. Instead, the potential for effects and toxicity on organisms depends on the organisms being sensitive to a particular substance and the nature of the exposure to that substance in the environment.

Important steps to take when examining biological characteristics of the water column and benthos include:

- determining the proximity to spawning, feeding, nursery, recruitment, migration, and other important habitats (IMCO 1982);
- describing marine resources including the presence of known sensitive species, pelagic and benthic species, endangered or at-risk species, as well as communities and migratory species in the vicinity of the dump-site;

[7] Consultation with the government agency/agencies responsible for the assessment of fisheries and other potential constraints on dumping is strongly recommended.

- enumerating and characterizing marine habitats and the benthic community;
- for benthic infauna analyses:
  - enumerating abundances and densities of organisms belonging to each species;
  - calculating community indices (species richness, diversity, evenness, dissimilarity); and
  - determining the body burden of contaminants of concern for selected benthic infauna;
- considering temporal/seasonal and spatial characteristics to identify potentially critical times or circumstances when dumping should not take place including:
  - periods of migration from one part of an ecosystem to another; and
  - growing, feeding, resting, and breeding periods of sensitive or threatened species;[8]
- considering potential effects from a contaminant or a mixture of contaminants present in any waste or other matter; and
- considering potential effects from exposure to non-contaminant stressors, such as low oxygen, salinity, ocean acidification, trawling, underwater noise, and the additive or synergistic effects of these stressors combined with potential contaminant-related effects.

Quality control

Sampling and analytical plans for characterization of candidate sites should be submitted to the national authority for review. All analytical data collected from environmental baseline studies and sampling activities should be quality-assured to auditable standards.

Quality assurance and quality control (QA/QC) should be followed throughout the site selection process and in the implementation of the site management and monitoring plan. QA/QC integrates management and technical practices into a single system to provide environmental data that are sufficient, appropriate and of known and documented quality. Quality assurance includes outlining specific standard operating procedures and guidelines prior to implementation. Quality control includes documentation that all of the procedures and guidelines outlined in the plan were followed by the reporting laboratory. Good QA/QC will reduce sampling error (by using unbiased methods to choose sampling sites) and measurement error (by standardization of methods and procedures) (U.S. EPA 2001). See also Annex 8 in IMO 2017.

Consideration of other uses of the candidate site or surrounding areas

Consideration should be given as to whether potentially incompatible uses at candidate sites could be mitigated by management measures. The presence of historically or culturally important features (e.g. shipwrecks, archaeological sites) in surrounding areas that could be affected by dumping at a particular site should also be

8 A review of applicable regulations on endangered species or species at risk should be undertaken as it applies to the candidate sites, including identification of a list of species at risk in the areas, potential impacts of the dumping of material at the proposed sites on any endangered species or species at risk in the areas, and proximity of the sites to sensitive areas or critical habitats of endangered species or species at risk.

considered. In addition, an assessment of the need for further consultations with government agencies, indigenous peoples, and stakeholders should be made once the initial physical, chemical and biological data are available.

STEP 4: ASSESSMENT OF POTENTIAL IMPACTS AT CANDIDATE SITES

STEP 4

Assessment of potential impacts at candidate sites

What are the quality, quantity and physical effects of waste or other matter?

Will chemical contamination at the site result in biological effects?

What impact hypotheses result from integrating information about potential effects?

What null hypotheses can be established?

Will dumping at a site result in cumulative effects?

Is the information about each candidate site adequate to determine possible effects of dumping at the site?

The evaluation of the potential effects of dumping of the waste material and its constituents should consider the near- and far-field (spatial) effects and also the short- and long- term (temporal) effects on marine resources and the environment. Particular attention should be paid to down-current water column impacts and the degree to which deposition and subsequent transport of material outside the dump-site may result in physical or toxicological effects on marine benthos (e.g. smothering, changes in benthos diversity, habitat modification). In addition, any future predicted uses of a candidate dump-site and its vicinity should be considered.

As noted in Step 3, baseline surveys of the candidate dump-site(s) provide a basis for initial assessments of the viability of the candidate site(s) and inform a subsequent assessment of potential impacts (see the reference guide in Annex A).

WHAT ARE THE QUALITY, QUANTITY AND PHYSICAL EFFECTS OF WASTE OR OTHER MATTER?

Two key steps should be taken before assessment of potential impacts at a candidate site(s) can be carried out:

1. Comprehensive testing of the waste material should ideally be conducted prior to evaluation of candidate dump-sites, providing details on its characteristics including the presence and mobility of contaminants.[9] This information can be used in plume modelling and establishing the size and capacity of the site as well as substrate compatibility. In cases where sites are designated well before projects are proposed or waste

9 Because the method of loading and dumping of wastes (e.g. for dredged material, loading could be done with either a hydraulic or mechanical dredge, and for dumping it could be done with a hopper-type discharge or pipeline-discharge) can alter the characteristics of the material, it is important to determine the physical, chemical and biological characteristics of the material as it is released from the vessel, in addition to the in situ characteristics. With regard to dredged materials, the most important physical characteristics are grain size distribution and the cohesiveness/degree of consolidation.

material has been characterized, data from the analysis of representative materials should be evaluated and site-specific limits of acceptability agreed upon for all material to be dumped at the site (i.e. biological testing with comparison to a reference, or relevant action levels set to avoid unacceptable effects). Setting site-specific limits that will not be exceeded, such as stating that water depth will not be allowed to become less than XXX meters deep, or that no material with concentrations of chemical YYY above ZZZ ppm will be dumped at the site, will help explain how impacts will be restricted and will help compare the suitability of different candidate sites.

2. Specification of the quantities of material to be dumped and frequency of dumping, along with information on dumping management options (including realistic dumping scenarios). Information that should be considered includes:

   - dumping method;
   - maximum quantity per load to be dumped (e.g. in cubic metres or metric tonnes);
   - dumping rate (e.g. cubic metres or metric tonnes per hour or per day);
   - frequency of dumping events per day, week, or month;
   - speed of a vessel or aircraft during dumping (e.g. in knots or kilometres per hour);
   - time required for the dumping event;
   - track following a specific route or path during the dumping event;
   - time required to complete all dumping activity for the project; and
   - site-specific limits of acceptability, if applicable, considering potential impacts.

Physical Impacts. Predicting the behaviour of material during and after dumping is critical to identifying potential physical impacts, including burial or smothering or impacts of suspended solids in sensitive environments (see Box 4). For example, for dredged material, full grain size data are used to model turbidity plume characteristics during and after dumping. Several plume-tracking models are available for predicting the fate and transport of dredged material into the sea. Grain size data are also used to assess whether the material proposed for dumping is physically different from the substrate at and around the dump-site. When the material being dumped at sea is dredged, it may be advantageous to seek compatibility among the physical characteristics of the sediment at the dredging site (i.e. the dredged material), the sediment type at the candidate dump-site, and, depending upon local currents, sediment found in areas adjacent to, or near to, the candidate dump-site. This may reduce the creation of areas with very different physical characteristics and help ensure that the disposal site can be recolonized by local species once disposal is finished.

Box 4 Potential physical impacts

- Burial and smothering of benthos in the dump-site (temporary or permanent). Within the footprint of the dump-site, some impact (periodic burial of the infaunal community) is to be expected and deemed acceptable
- Habitat destruction or alteration due to changes in bottom topography and/or the dumping of sediment (e.g. if the material being dumped is dredged material) that is different from sediments at the dump-site
- Transportation of plumes of suspended solids (or suspended sediments, if the material being dumped is dredged material) from the dump-sites to sensitive areas, such as seagrass beds, algal beds or coral reefs
- Reduced light penetration, leading to sub-lethal effects or death of light-sensitive organisms and habitats
- Changes in seabed composition, leading to sub-lethal effects
- Changes in benthic community structures
- Reduced function, growth, or survivorship of sessile benthic fauna through clogging of feeding mechanisms or smothering (especially filter-feeding organisms in sensitive habitats)
- Alteration of current velocities and wave conditions affecting sediment regimes and leading to erosion of areas (such as seagrass beds) or accumulation of sediment

Important considerations related to physical effects include:

- Direction of the dispersion footprint and distance travelled by associated plumes. With regard to dredged material, fine fractions may remain in suspension in the water column and be transported to sensitive areas or interfere with other uses of the sea.

- Erodability – with regard to certain wastes or other matter, such as dredged material, once it reaches the sea floor, it may remain there or be eroded and moved by currents and affect sensitive areas.

- Shoaling – some material may not move from where it is deposited and shoaling may occur; therefore, it needs to be determined whether the candidate site can accommodate this and future material without any unacceptable adverse effects.

WILL CHEMICAL CONTAMINATION CAUSE BIOLOGICAL EFFECTS AT THE CANDIDATE SITE?

The expected consequences of dumping should be described in terms of the habitats, processes, species, communities and uses that may be affected. Box 5 lists a number of possible biological impacts from dumping wastes or other matter at a site. The precise nature of the predicted effect (e.g. change, response or interference) should be described. Action levels established to avoid biological effects may be used to predict whether waste or other matter will cause biological effects at a disposal site. These action levels can also be used to predict the expected consequences of disposal at a candidate site (e.g. waste or other matter with chemical concentrations below action levels are not anticipated to cause adverse biological effects at the candidate site).

Box 5: Potential biological impacts: Acute and chronic toxicity

- Direct toxicity to benthos
- Disruption of the life cycle (breeding, feeding, migration, resting) of a species
- Spatial distribution of a species
- Fragmentation of an important population
- Bioaccumulation of contaminants up the food chain, potentially resulting in risks for marine mammals and/or human health
- Interference with the recovery of a species

WHAT IMPACT HYPOTHESES RESULT FROM INTEGRATING INFORMATION ABOUT POTENTIAL IMPACTS?

Assessment of the potential effects should lead to a concise statement of the expected consequences of the dumping activity, i.e. the “impact hypothesis.” This provides a basis for deciding whether to approve or reject the candidate dump-site for a waste or other material (e.g. dredged material) and what monitoring should be required.

The impact hypotheses should integrate information on the type and characteristics of the material to be dumped, the candidate dump-site conditions, and pathways of concern including:

- Changes to the nature of the seabed: its topography, geochemical and geological characteristics, benthic communities (including fisheries resources), and prior dumping activities in the area.
- Changes to the physical nature of the water column: including depth, temperature, the possible existence of a pycnocline/thermocline, currents (tidal, wave-induced, residual), and suspended matter where these characteristics may affect the transport of wastes or other matter (e.g. dredged material) dumped at the site.
- Changes to the chemical and biological nature of the water column: including pH, salinity, dissolved oxygen, nutrients, primary productivity, and contaminant concentrations, e.g. trace metals.
- Biological and ecological effects of dumping wastes or other material (e.g. dredged materials) including individual toxicological and bioaccumulation effects, changes in community structure, disruption of ecological processes, degradation of water and sediment quality, and alteration of sediment characteristics. These possible effects should be considered both within the dump-site and within nearby areas that could be influenced by the dumped material. The assessment should recognize that there may be some pre-existing background contaminant exposure of organisms resident at the dump-site, and thus, there would exist a potential concern for added incremental contaminant exposure arising from the dumping of wastes or other materials (e.g. dredged material).
- Impacts to indigenous peoples’ interests.
- Impacts to historical sites (e.g. shipwrecks).
- Impacts to other uses of the sea.

The impact hypotheses form the basis for defining field monitoring. For example impact hypotheses and potential monitoring programmes to address them, see Box 6. A measurement programme should be designed to ascertain that changes in the receiving environment are consistent with predictions. The following questions should be answered:

- What testable hypotheses can be derived from the impact hypothesis?
- What measurements (e.g. type, location, frequency, performance requirements) are required to test these hypotheses?

Two examples of impact assessment for dredged material candidate sites follow:

Box 6 Example impact hypotheses and monitoring for dredged material

Impact hypothesis*	Monitoring programme
Dumping dredged material will result in transport of dredged material to off-site habitats.	Sample to assess turbidity plumes during dumping operations and evaluation of sediment samples from off-site areas
Dumping dredged material will result in mounding and/or interfere with shipping/boating.	Conduct bathymetric surveys during and after dumping actions.

Impact hypotheses represent what is thought will happen, whereas the null hypotheses in the Annexes are statements that monitoring programmes are meant to disprove.

At a non-dispersive dredged material candidate site, an impact assessment will delineate the area that will be altered by the dumped dredged material and identify effects to the area. In most cases, the primary impact zone will be entirely smothered if sediment is dumped. The assessment should project the likely timescale of recovery or recolonization after dumping, as well as the nature of recolonization (i.e. whether the benthic community structure will be altered). The assessment should also specify the likelihood, scale and severity of residual impacts outside this primary dumping zone for dredged material.

At a dispersive dredged material candidate site, an impact assessment will define the area likely to be altered in the short and long term and the severity of any changes. The likely extent of long-term transport of dredged material from the dump-site should be specified, and this flux should be compared with existing transport fluxes in the area and assess the likely scale and severity of effects in the long term. In some cases, the dumping of fine-grained material at dispersive sites within, and close to, estuaries or in the littoral zone along the coastline can have beneficial effects for habitats and species by maintaining or enhancing sediment budgets. In these cases, dredged material dump-sites that take advantage of natural sediment transport processes should be considered to enable transport of sediments into sediment-starved areas (e.g. marsh and wetland habitats, beach nourishment).

WHAT NULL HYPOTHESES CAN BE ESTABLISHED?

Impact hypotheses represent what is thought will happen, whereas null hypotheses are statements which monitoring programmes are meant to disprove. Basing monitoring programmes on null hypotheses is a prospective (and not retrospective) approach, in that acceptable and unacceptable adverse impacts are clearly defined before sampling begins, predicting what environmental resources are at risk and the magnitude and extent of that risk from dumping of material at the site.

Annex B includes examples of null hypotheses for eight categories of waste or other matter. Annex A includes general null hypotheses that may be useful in establishing null hypotheses for any waste category being considered.

WILL DUMPING AT A SITE RESULT IN CUMULATIVE EFFECTS?

A cumulative effects assessment should be conducted when repeated or multiple dumping operations occur. It is also important to consider possible interactions with other activities in the area, including historical, current and planned dumping activities. In some cases, dumping at sea may cause different effects than other activities that occur in the same area (e.g. land run-off and wastewater discharges, deposits from the atmosphere, resource extraction, and other sources such as maritime transport). The effects from dumping can make effects from other activities worse (e.g. dumping could cause additive or multiplicative effects), and so existing stresses on biological communities and risks to human health should be considered as part of the assessment of potential impacts caused by dumping at sea activities.

Any future predicted uses of a candidate dump-site beyond the immediate project should be identified, as this will help inform the site selection review process and cumulative effects assessment. If it is anticipated that a future project may use the candidate dump-site, the following questions would assist framing issues and appropriate next steps:

1. Is the capacity of the site adequate to accommodate future uses?
2. Will the new project affect other nearby uses?
3. Are the physical, chemical and biological characteristics of the material to be dumped at the site appropriate to site conditions?
4. What are the potential impacts upon the site and surrounding areas, including impacts upon benthic organisms, the fish and shellfish, sensitive species, and important habitats associated with dumping?
5. What management measures are needed to mitigate potential impacts?
6. What additional information may be required to verify predictions in the analyses leading up to permit issuance?

Features of cumulative effects frameworks include:

- using an ecosystem-based approach and incorporating ecosystem components at different organizational levels and evaluating impacts on the overall ecosystem;
- applying a risk assessment and management framework;
- obtaining reference conditions to allow comparisons against the state of the ecosystem if there was no effect from the proposed pressure(s);
- incorporating environmental, social and economic parameters and considering the effectiveness of existing management measures;
- using the best available scientific and engineering evidence; and
- using a flexible and repeatable framework, thereby allowing the assessment to be adapted and improved in light of future information.

The reader is referred to Annex C for case studies about assessing cumulative effects.

ADEQUACY OF INFORMATION

If the assessment of possible impacts at a candidate site or sites reveals that adequate information is not available to determine the possible effects of the proposed dumping of waste of other matter (e.g. dredged material) at the site or sites, including potential long-term harmful consequences, additional site-specific modelling or fieldwork may be required to address the gaps. For example, computer modelling may be needed to predict water and waste material movements,[10] or more samples may need to be collected to perform additional testing. Refer to Section IV, Step 3 for more detail.

[10] A model used by the US EPA and the US Army Corps of Engineers, the Automated Dredging and Disposal Alternatives Management System (ADDAMS), can be used to evaluate initial mixing of dredged material. The model provides an interactive computer-based design system that can be run on a personal computer. Guidance is provided in appendix B of EPA 503/8-91/001 the *Evaluation.*

STEP 5: COMPARISON OF CANDIDATE SITES & SITE SELECTION

STEP 5

Comparison of Candidate Sites & Site Selection

Compare potential residual adverse effects at each candidate site

Evaluate compatibility with other uses

Assess acceptability of potential adverse impacts at the sites

Identify applicable management and monitoring techniques

Select the dump-site

The fifth step of the site selection process involves a comparison of the potential adverse effects and overall acceptability of each candidate site. An analysis of each candidate site should be considered in light of a comparative assessment of human health risks, environmental impacts, hazards (including accidents), economics, and exclusion of future uses. If this assessment reveals that adequate information is not available to confidently determine the possible effects of the proposed dumping at the candidate sites, including potential long-term harmful consequences, then these candidate sites should not be considered until sufficient information is available. In some cases, additional baseline data collection, or possibly a pilot study, could be conducted to gather information.

If two or more candidate sites have been identified as acceptable, the relative impacts of dumping activities at each site should be compared. This comparison should include quantitative and qualitative evaluations of the perceived risks. See the reference guide in Annex A for examples of questions to consider when determining potential impacts on the other uses of the site and surrounding areas.

The likelihood and consequences of potential impacts of dumping should be predicted based upon any management measures expected to be used at the site to control or mitigate impacts. Management provisions should account for candidate dump-sites where impacts to marine life are considered unacceptable during certain times of the day or year. Biological considerations related to the timing of dumping operations include:

- daily feeding and foraging times of sensitive species;
- periods when marine organisms are migrating from one part of the ecosystem to another (e.g. from an estuary to open sea or vice versa) and growing, breeding, and spawning periods;
- periods when marine organisms are hibernating on or are buried in the sediments; and
- periods when particularly sensitive and at-risk species are exposed.

In addition, the safety of the vessel and crew in all weather and ocean conditions should be taken into account when deciding the timing of dumping actions.

Candidate sites for which assessment has shown that dumping would result in unacceptable impacts, even with management measures applied, can be eliminated from consideration. If no sites are acceptable, then no site can be selected for dumping at sea in the zone of siting feasibility, and the zone of siting feasibility may be extended to other potential candidate sites, if possible.

The candidate site that is selected should be environmentally acceptable and have the least potential adverse environmental impact at acceptable economic costs. Because the trade-off between environmental and economic factors, as well as other concerns, is not an exact science, public participation in the decision is desirable. The final decision regarding the acceptability of a candidate dump-site is determined by the national authority.

<u>Annex D contains two case studies that provide examples of the site selection process.</u>

STEP 6: PREPARATION OF SITE MANAGEMENT AND MONITORING PLAN

STEP 6
Preparation of the site management and monitoring plan

Identify management measures to manage potential impacts

Identify compliance monitoring and field monitoring requirements

Site management and monitoring are integral parts of managing the at-sea dumping of materials in the marine environment to ensure dumping is in accordance with permit conditions and predicted impacts to the marine environment. Site management and monitoring plans can be a valuable tool for managing dump-sites during and after dumping; such plans provide a framework for management, mitigation, and monitoring of the site to avoid or minimize potential impacts of dumping at the selected dump-site or detect impacts that might be occurring. Typically, such a plan includes the control strategies for the project, environmental objectives, auditable performance criteria, and mitigating corrective actions.

Site management and monitoring plans should include:

- management objectives related to potential adverse effects at the dump-site;
- consideration of the times, rates, quantities, types of material dumped, and dumping method;
- null hypotheses and a tiered approach for monitoring dumping operations;
- consideration of the various methodologies to monitor the quantities, distribution, movement and characteristics of the waste or other material dumped (e.g. dredged material) during project activities; and
- associated response measures if monitoring indicates an exceedance of thresholds or outcomes significantly different than predicted.

See Box 7 for a summary outline of a site management and monitoring plan based on components and measures for a dredged material dump-site, including main headings. Additional and more detailed information about monitoring plans can be found in guidance document titled Low cost, low technology field monitoring: assessment of the effects of disposal in marine waters of dredged material or inert, inorganic, geological material (2016 Edition) (imo.org), and Low cost, low technology compliance monitoring (2017 Edition) (imo.org).

Box 7: General outline of a site management and monitoring plan[1]

- **Description of the project**
  a. Description of the project providing context for need of the site
- **Description and anticipated use of the dump-site**
  a. History of waste material dumped at the site**.** Activities at the site should be documented. For example:
     i. Known historical uses of dump-site
     ii. Transportation and dumping methods used
  b. Anticipated use of the site
     i. Site capacity
     ii. Suitable materials to be dumped at the site
  c. Summation of information utilized in determining the overall size of the site and its life span
  d. Consideration of anticipated closure date for site, if applicable
  e. Consideration of future uses of the site
- **Regulatory regime.** Identify the statutory and regulatory authorities: international, national, sub-national, and local.
- **Roles and responsibilities.** Identify the roles and responsibilities of site management and monitoring actions. Identify responsible parties for conduct of the project implementation monitoring and any required management measures. Identify government agencies with approval authority.
- **Description of the existing environment.**
  a. Summarize the characteristics of the loading and dump-sites and adjacent areas, including the water column, sediments, biota, resources and other uses (existing and potential) of the area.
  b. Description and location of site (map and location coordinates, boundary of dump-site, boundary of release zone, and bathymetry)
- **Description of the material to be dumped**. Provide a summary of waste types, and their status relevant to these guidelines.
- **Description of potential impacts**. Summarize both the potential short-term and long-term impacts and any uncertainties regarding the predicted impacts.
- **Goals and objectives of the Management and Monitoring Plan.** Where applicable, specific management activities designed to address concerns identified during the site selection process should be clearly stated.
  a. Goals: e.g. Ensure sensitive resources are not affected; ensure waste material remains within the site boundaries.
  b. Objectives: e.g. Define site boundaries recognizing potentially dynamic nature of waste transport regime at a given site; define the capacity of the site recognizing waste transport regime dynamics; provide economically/technically feasible site; use conditions necessary for protection of marine environment; establish monitoring objectives; establish schedule for review/revision of the plan.

Box 7: General outline of a site management and monitoring plan (continued)

- **Management measures/conditions or practices**
    a. Identification of dumping controls, conditions or requirements
    b. Identification of critical amenities and site conditions warranting further consideration or continuing evaluation (e.g. unusual currents that could affect dispersal)
    c. Management measures may include:
        i. Dumping methods
        ii. Quantity restrictions
        iii. Weather restrictions
        iv. Waste grain size restrictions
        v. Seasonal restrictions
        vi. Equipment restrictions
        vii. Discharge point and allowable tolerances in position
        viii. Provisions to address spillage and leakage of waste material
- **Dump-site compliance and field monitoring**
    a. Monitoring requirements should be designed to provide the following:
        i. Information documenting that dumping activities are occurring in compliance with permit/site restrictions
        ii. Information indicating the short-term fate of materials dumped of at the dump-site are consistent with predictions
    b. Should identify a tiered approach which links specific measured effects with predetermined management actions
    c. Should be based upon development of realistic questions (null hypotheses) regarding potential impacts at the site.
- **Target thresholds/triggers and associated response measures**
- **Consultation and engagement**
    a. Record of consultation/engagement activities
- **Review and revision of the site management and monitoring plan**
    a. Frequency of review/revision of plan
- **References**

In general, the applicant proposes a site management and monitoring plan for the selected dump-site, to be approved by the national authority. In some cases, the national authority may prepare the site management and monitoring plan as part of the site selection process.

Monitoring should be in the form of "Compliance Monitoring" and "Field Monitoring";[11]

- Compliance monitoring establishes whether dumping operations conform with permit conditions.
- Field monitoring for trend or impact assessment provides information on the fate and effects of the dumped materials and is undertaken to verify that the predictions made during the site selection process were correct and sufficient to protect the marine environment and human health.

Monitoring programmes should be multi-tiered with several different levels of complexity. Each level should be designed based upon null hypotheses (e.g. Step 3 in Annex A. For wastes other than dredged material, see the sample null hypotheses for each waste category in Annex B). Results of monitoring that indicate the failure to reject the null hypothesis at any tier could prevent further, often costlier, monitoring at the next more complex level (IMO 2017).

The site management and monitoring plan should address the timing, rate and locations of dumping if possible. These elements can then inform permit conditions and the compliance monitoring that will be conducted to verify that permit conditions were respected. The site management and monitoring plan should explain how field and compliance monitoring studies will be tiered, and what management actions will be associated with each tier (i.e. what further monitoring or other actions will be taken if initial monitoring results suggest that impact hypotheses did not accurately predict effects observed at the site). Management actions could include modifying the time, rate, and location when/where dumping is allowed, or the cessation of use of the site for dumping. The plan should also explain how permits will be modified to reflect management actions triggered through compliance or field monitoring.

11 [Placeholder for reference to IMO publications: Low cost, low tech field monitoring guidance, and Low cost, low tech compliance monitoring guidance.]

ANNEXES

ANNEX A: QUICK REFERENCE GUIDE BASED ON DREDGED MATERIAL DUMP-SITE SELECTION

This "Quick Reference Guide" is intended for assistance in selection of dump-sites for dredged material. It is not meant to be an exhaustive list; it includes examples of information used in site selection, to show the breadth of information that might be needed. For wastes other than dredged material, the considerations may or may not be relevant (e.g. the considerations are far too detailed for a single vessel disposal).

STEP 1. Preliminary considerations

Considerations for waste prevention and for identifying alternatives to dumping at sea?

- Can the creation of the waste be avoided or can the quantity be reduced through waste prevention?
- What alternatives to dumping can be considered? (e.g. reuse, recycling)
- Feasibility of transporting material from load site to alternative use site
- Characteristics of material needed or suitable for potential alternatives
- Means of offsetting transport/engineering costs if they are greater than disposal costs

What are the characteristics of the waste or other matter? *

- Size, quantities, or volume of waste material
- Physical parameters (e.g. buoyancy, grain size)
- Chemical characteristics (e.g. type of waste and the composition and levels of contaminants, extent of contaminant residues remaining on vessels, platforms, other man-made structures, or bulky items after clean-up)
- If needed, toxicity of the waste and potential for persistence or bioaccumulation

*In certain cases, national authorities may choose to select a site before specific wastes have been proposed to be dumped. In these cases, the characteristics of a representative type of waste are needed.

STEP 2. Identification of candidate sites

Zone of siting feasibility - Sample considerations

- Seasonal weather restrictions and type of disposal vessel
- Navigation restrictions
- Operational and transport costs to the site
- Political boundaries
- Feasibility of surveillance and monitoring
- Characterization of the material to be dumped and methods of disposal

Examples of environmentally sensitive areas

- Commercial and recreational fishing and shellfishing grounds
- Habitats of importance for refuge, breeding, spawning, foraging, nursery grounds of important species and their food organisms (including both marine flora and fauna and marine-associated fauna (e.g. seabirds))
- Migration routes of finfish or whales and other marine mammals
- Habitats of at risk, threatened or endangered species
- Aquaculture sites
- Coral reefs
- Seagrass beds

Examples of uses that are potentially incompatible with dump-site selection in the vicinity

- Indigenous/Traditional uses in the vicinity of the candidate disposal sites
- Archaeological features, such as close proximity to natural or features of historical or cultural importance
- Beaches and water sports
- Engineering uses of the sea floor, including mining, pipelines or undersea cables
- Navigation and shipping lanes
- Military training and exclusion zones
- Mineral extraction
- Areas of special scientific or biological importance, such as marine sanctuaries or marine reserves
- Public use of the shoreline
- Prospective oil and gas exploration and development
- Commercial and recreational fishing
- Areas of high aesthetic value or of significant cultural or historical importance

STEP 3. Characterization of candidate dump-sites*

Examples of physical dump-site characteristics to consider

Temperature/salinity/pH
Depth
Dissolved oxygen
Turbidity
Currents and upwelling
Waves
Bathymetry
Wind

Examples of seafloor characteristics to consider

Bathymetry
Areas of natural sediment accumulation or dispersion
Grain size
Total organic carbon
Contaminants

- baseline concentrations of regulated contaminants or site-specific contaminants of concern e.g. PBDEs, dioxins, furans, pesticides, nutrients)**

Examples of biota characteristics to consider
Requirements will vary according to site and may include:

- macroinfauna—identification of species, abundance, and life-stages present
- meiofauna – identification of species and abundance
- macroepifauna – identification of species and abundance
- Bioaccumulation in macroepifauna tissues (e.g. of Hg, Cd, Pb, Cu, other heavy metals, PCBs, petroleum hydrocarbons, pesticides)

* In general, the names of all contractors and laboratories performing collection and testing prior to commencement of sediment sampling should be provided to the national authority**.** Sampling plans are to be submitted to the national authority for review. Quality assurance and control procedures should be clearly provided along with the results of sampling from accredited laboratories. Data should not be accepted unless it is accompanied by its quality assurance procedures.

** Contaminants of concern should be identified from testing of the material proposed to be disposed and historical information regarding spills and other uses potentially impacting the waste or other matter and candidate disposal sites.

STEP 4. Assessment of potential impacts at candidate sites

Examples of direct physical impacts from dumping activity

- Reduction of light penetration, which may lead to sub-lethal effects or death of light sensitive organisms and habitats
- Changes to or smothering of benthic community structures and habitats
- Reduced function, growth, or survivorship of sessile benthic fauna through clogging of feeding mechanisms or smothering (especially filter-feeding organisms and sensitive species)
- Alteration of current velocities and wave conditions affecting sediment regimes and leading to erosion of areas (such as seagrass beds)
- Reduction in dissolved oxygen levels due to an increase in nutrient concentrations potentially resulting in anoxia/hypoxia

Examples of potential biological impacts from dumping activity

- Disruption of the life cycle (breeding, spawning, feeding, migration, resting) of a species
- Adverse effects on the spatial distribution of a species
- Fragmentation of an important population
- Introduction of invasive species or disease that may impact the population
- Practices that interfere with the recovery of a species.
- Toxicity
- Bioaccumulation (e.g. effects on human health or on marine mammals)

Examples of null hypotheses

- Null hypothesis 1: During initial deposition, the material will be carried through the water column to sensitive areas in amounts that would be harmful to the value or amenity of such areas.
- Null hypothesis 2: The dumped material will subsequently reach sensitive areas (through re-suspension and sediment transport) in amounts that would be harmful to the value or amenity of such areas.
- Null hypothesis 3: The dumped waste material will cause unacceptable biological and ecological effects such as toxicological and bioaccumulation effects, changes in community structure, and disruption of ecological processes.
- Null hypothesis 4: The dumped material will subsequently reach sensitive areas (through erosion, re-suspension and sediment transport) in amounts that would cause unacceptable shoaling in shipping lanes or affect other uses of the sea or sensitive areas.

STEP 5: Comparison of candidate sites and selection of dump-site for dredged material

Samples considerations and questions to consider include, but are not limited to:

1. *Regulatory concerns:* Do other government departments/agencies have concerns or regulatory requirements pertaining to selection of this particular site?
2. *Unusual topography/Unique bottom features:* Would disposal of material in this candidate site affect physical bottom feature that is unique within the local or regional area?
3. *Physical sediment compatibility:* Does the candidate site have similar sediment characteristics to anticipated material to be dumped?
4. *Chemical sediment compatibility:* Does the candidate site have similar chemical characteristics to anticipated material to be dumped?
5. *Influence of past disposal:* Would disposal of material in this candidate site be affected by previous disposal of waste or other matter?
6. *Living resources of limited distribution:* Would disposal of material in this candidate site affect any living resources that do not have a coast-wide distribution?
7. *Commercial fisheries:* Would disposal of material in this candidate site affect any commercial fishing activity?
8. *Recreational fisheries:* Would disposal of material in this candidate site affect any recreational fishing activity?
9. *Breeding/Spawning areas:* Would disposal of material in this candidate site affect breeding and spawning areas of any species?
10. *Nursery areas:* Would disposal of material in this candidate site affect nursery areas of any species?
11. *Feeding areas:* Would disposal of material in this candidate site affect feeding areas of any species?
12. *Migration routes:* Would disposal of material in this candidate site affect migration routes of species?
13. *Critical habitat of threatened or endangered species:* Would disposal of material in this candidate site affect critical habitat of threatened or endangered species?
14. *Spatial distribution of benthos:* Would disposal of material in this candidate site change the benthic invertebrate community structure (e.g. fine-grain species to coarse-grain species)?
15. *Marine mammals:* Would disposal of material in this candidate site affect marine mammals or their habitat (e.g. underwater noise, bioaccumulation, effects on marine mammal prey)?
16. *Human health:* Would disposal of material in this candidate site pose unacceptable risks to human health?
17. *Mineral deposits:* Would any known mineral deposits be affected by the disposal of material?
18. *Navigation hazard:* Would the disposal of material create a navigation hazard (e.g. creation of shoals, reduced navigational depth)?
19. *Other uses of sea:* Would disposal of material impact other uses of the sea not addressed elsewhere, such as cables, pipelines, towboat lanes, and pilot transfer points?

20. *Degraded areas:* Would disposal in this candidate site continue to affect or improve any degraded area?
21. *Recreational uses: Would disposal of material affect recreational uses (e.g. aesthetics, beach erosion or beach nourishment)?*
22. *Cultural/Historic sites:* Would disposal of material in this candidate site affect or protect a cultural/historic site (e.g. smother and archaeological site)?
23. *Physical oceanography, waves/circulation:* Would disposal of material affect wave/circulation patterns?
24. *Direction of transport/Potential for settlement:* Would disposal of material affect direction of waste transport and/or potential for settlement?
25. *Monitoring:* Would use of this candidate site affect either ongoing field monitoring or the ability to monitor using conventional methods? (Field monitoring typically would include periodic hydrographic surveys and could include sediment sampling or biological data collection).
26. *Shape/Size of candidate site:* Is the candidate site suitable for the operation and manoeuverability of a disposal vessel? Is the candidate site oriented so the disposal vessel can place material while heading into the waves? Is the depth of water sufficient to open the hopper doors/dump scow? Can the disposal vessel operate safely? Is the size of the candidate site large enough for long-term use?
27. *Size of buffer zone:* Is the candidate site a sufficient distance from important resources or features to protect them from any effect of disposal?
28. *Potential for cumulative effects:* Would disposal of material contribute to cumulative effects from other activities?

<u>STEP 6. Preparation of site management and monitoring plan</u>

<u>Site management and monitoring plans should include:</u>

- Consideration of any management objectives relating to possible adverse effects that could develop at the dump-site
- Consideration of the times, rates, quantities and types of material disposed
- Consideration of the various methodologies for monitoring the movement and characteristics of disposed material (e.g. what is feasible given the location and depth of the dump-site and the null hypothesis that need to be tested?)
- A tiered approach for monitoring disposal operations
- Null hypotheses that provide the basis for an effective field monitoring programme for the material disposed of
- Target thresholds and associated response measures that may be applied should the project implementation monitoring indicate outcomes significantly different than expected.

Examples of management measures that can be used to manage potential impacts

- Management plans can list any conditions that are needed to reduce or mitigate expected effects at the dump-site. These conditions should then be reflected in any permits that are issued granting permission to use the dump-site. At a dump-site in shallow water where a minimum navigational clearance needs to be maintained, the management plan could include conditions for using the site (e.g. disposal must not cause mounding that reduces water depth to less than X metres, or, disposal must be done while steaming within the dump-site coordinates).
- At a dump-site in the vicinity of a sensitive habitat (e.g. a coral reef), the management plan could include a condition requiring visual monitoring of disposal plumes and the cessation of dumping if plumes extend in the direction of the sensitive habitat.

Examples of compliance and field monitoring requirements based on impact hypotheses

- Consider a site where there is concern about effects on a nearby coral reef that is close to shore.
- The management plan can identify the need to conduct compliance monitoring (e.g. observation from shore, real-time reporting requirements, vessel tracking) to made sure vessels carrying out dumping reach the disposal site before releasing any waste or other matter, instead of dumping material closer to shore and closer to the sensitive reef.
- The management plan can also specify the need for field monitoring around the perimeter of the disposal site to try to reject the hypothesis that dumped material will be transported outside site boundaries and smother the reef. First, field monitoring to verify whether and to what extent material is being transported outside the disposal site can be conducted (e.g. bathymetric surveys, sediment traps). The management plan can indicated that if there is any indication of off-site transport, field monitoring efforts will be escalated to assess whether smothering is being observed at the coral reef, and whether this smothering is causing adverse effects.
- Lastly, the plan can indicate what measures should be taken if monitoring confirms the null hypotheses (e.g. site closure, changes to conditions of site use, identification of an alternative site).

ANNEX B: DUMP-SITE SELECTION FOR WASTES AND OTHER MATTER LISTED IN LP ANNEX I, OTHER THAN DREDGED MATERIAL

This Annex presents information about site selection for the dumping of wastes and other matter listed in the London Protocol Annex 1, other than carbon dioxide streams for sub-seabed sequestration. It addresses vessels separately from platforms and other man-made structures at sea, even though these are listed as a single category in Annex 1 of the London Protocol. It is generally intended to describe how, if at all, site selection and the development of site management and monitoring plans for each London Protocol Annex 1 waste may be different from that in the six steps for site selection in the main body of this report.[12]

For each of the waste categories in this Annex, prior to site selection and use of the site, an assessment should be conducted to determine whether there are alternatives to dumping at sea, and the characteristics of the waste need to be determined. This is similar to site selection for dredged material. Considerations for assessing alternatives to disposal are shown in Section IV, Step 1.

[12] For site selection for carbon dioxide streams from carbon dioxide capture processes for sequestration, readers are referred to Carbon Dioxide Streams Assessment Guidelines found at http://www.imo.org/en/OurWork/Environment/LCLP/Publications/wag/Pages/default.aspx.

ANNEX B-1 DREDGED MATERIAL

The specific guidelines for assessment of dredged material are found at:
https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/2014%20WAGs%20English.zip

What is Dredged Material?

Dredged material is sediments (and other accompanying material) which have been removed from the bottom of a waterbody for various reasons, including:

- To support the development and maintenance of water-based infrastructure (e.g. navigation systems, flood mitigation, and water supply systems);
- As part of remediation measures for areas of contaminated sediment; and/or
- To restore structure and function to aquatic ecosystems (e.g. habitat restoration/creation). Dredged material predominantly consists of sedimentary deposits of natural materials (e.g. rock, sand, silt, clay, and natural organic matter).

[Placeholder for dredged material photo and caption]

SELECTION AND MANAGEMENT OF SITES FOR THE DUMPING OF DREDGED MATERIAL AT SEA

Step 1: Preliminary considerations

Follow all guidelines in Section IV, Step 1.

Step 2: Identification of candidate sites

Follow all guidelines in Section IV, Step 2.

Step 3: Characterization of candidate sites

Follow all guidelines in Section IV, Step 3.

Step 4: Assessment of potential impacts at candidate sites

Follow all guidelines in Section IV, Step 4.

Step 5: Comparison of candidate sites and site selection

Follow all guidelines in Section IV, Step 5.

Step 6: Preparation of the site management and monitoring plan

Follow all guidelines in Section IV, Step 6. Monitoring should be conducted to assess whether the dumped dredged material releases chemical contaminants to the marine environment to a significant degree and to determine whether there are significant changes to the marine environment at the dump-site.

Examples of null hypotheses for dumping of dredged materials are shown in the text box. These hypotheses may be used to develop field monitoring programmes.

Example null hypotheses and needed monitoring for dredged material	
Null hypothesis	Monitoring programme
(For a non-dispersive site) Dredged material has moved outside of the established dump-site boundaries.	Sediment sampling and sediment images taken at several stations within and surrounding the dump-site to determine the extent and location of disposed dredged material.
Mounding of disposed dredged material is high enough to create a navigation hazard for vessels in the area.	Bathymetry of the site should be collected before and after each disposal activity to ensure that dumped dredged material does not exceed the site's capacity or form a navigational hazard.

ANNEX B-2 FISH WASTE, OR MATERIAL RESULTING FROM INDUSTRIAL FISH PROCESSING OPERATIONS

The specific guidelines for assessment of fish waste, or material resulting from industrial fish processing operations are found at:

https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/2014%20WAGs%20English.zip

<u>What is Fish Waste?</u>

Fish waste may include, but is not limited to, particles of flesh, skin, bones, entrails, shells, or liquid stick water, and includes wastes from industrial fish processing operations or aquaculture. Fish wastes degrade rapidly in warm temperatures. If not appropriately stored or managed, fish wastes create aesthetic problems and strong odours as a result of bacterial decomposition. The organic components of the waste have a high biological oxygen demand and, if not managed properly, high oxygen demand poses environmental and health problems. Some fish wastes are transported for disposal at sea. Environmental concerns associated with dumping fish wastes at sea include:

- reduced oxygen levels in the ocean waters at the ocean bottom;
- burial or smothering of living organisms; and
- introduction of disease or non-native invasive species to the ecosystem of the ocean floor.

Fish wastes. Photos credit: Left: Bluepeacemaldives.org/blog. Right: U.S. EPA

Shells to be dumped at Blanc-Sablon dumping at sea site (June 2013)
Location: Blanc-Sablon, Lower North Shore, Quebec Region, Canada
Credit: Louis Blais, Former Environmental Officer, Environment and Climate Change Canada

Crab shells to be dumped at Bonne-Esperance Bay dumping at sea site (June 2013)
Location: Bonne-Esperance Bay, Lower North Shore, Quebec Region, Canada
Credit: Louis Blais, Former Environmental Officer, Environment and Climate Change Canada

SELECTION AND MANAGEMENT OF SITES FOR DUMPING FISH WASTES AT SEA

Step 1: Preliminary considerations

Follow all guidelines in Section IV, Step 1, including assessment of alternatives to disposal, waste prevention audit, and waste characterization.

Step 2: Identification of candidate sites

Follow the guidelines in Section IV, Step 2. The potential for oxygen depletion and excess bacterial growth is a key consideration when fish wastes are dumped at sea. It is likely, given the nature of fish wastes, that the most important dump-site selection criterion is the promotion of biological consumption (i.e. consumption of the wastes by marine organisms).

To promote biological consumption, care should be taken to find dispersive sites that make the waste more available to consuming organisms. Dispersive dump-sites will also minimize impacts associated with mounding of wastes, subsequent increases in biological oxygen demand and contamination with bacteria associated with partly degraded organic waste.

Step 3: Characterization of candidate sites

Follow all guidelines in Section IV, Step 3. As noted in Step 2, emphasis upon the dispersive nature of the site is important to ensure that the fish wastes are available as a food source to marine organisms and that dissolved oxygen levels are not suppressed due to the increased biological oxygen demand (BOD) load from the fish wastes.

Step 4: Assessment of potential impacts at candidate sites

Follow all guidelines in Section IV, Step 4, except, for fish wastes, a detailed characterization of the constituents is not usually warranted, depending upon their nature and the circumstances leading to the fish waste. The characterization is often more of a physical description of the fish waste rather than the results of chemical and biological testing. The exception is the potential presence of chemicals used in aquaculture or in industrial fish processing. The presence of contaminants may also be of concern for any fish wastes subjected to chemical pre-treatment or particle flocculation. Chemical analysis and biological testing might be needed if chemicals are added to the fish waste or may be present.

To assess the extent of smothering impacts at the dump-site, estimates of size and quantities of fish waste to be dumped on a daily basis are needed, and an assessment is needed of the potential for introducing disease or invasive species into the local waters at the dump-site, including non-indigenous parasites to the wild stocks.

Where eutrophication is a concern, fish wastes will add nutrients to the water body, and these incremental amounts should be considered.

The nature of the fish wastes is a significant aspect of dump-site selection. Whole fish present different potential impacts compared to fish that have been ground (e.g. whole fish can float and present aesthetic effects).

Particular attention should be paid to the possible reduction in dissolved oxygen in the water column, especially near the sea floor, and changes in sediment oxidation-reduction conditions, considering the likely rate of waste consumption by marine organisms. Creation of a bacterial layer on the seabed should also be assessed.

Depending upon the water body, other inputs of nutrients, and water circulation, eutrophication may be an issue, and assessments of the potential to cause or add to the severity of eutrophication may be needed, including modelling.

These impacts should be considered in both the near and far-field, i.e. on-site and off-site.

<u>Step 5: Comparison of candidate sites and site selection</u>

Follow all guidelines in Section IV, Step 5, favouring sites that promote biological consumption.

<u>Step 6: Preparation of the site management and monitoring plan</u>

Follow all guidelines in Section IV, Step 6. Examples of null hypotheses for fish waste disposals are shown in the text box below, and can be used to develop field monitoring programmes.

Example null hypothesis and needed monitoring for fish wastes	
Null hypothesis	**Monitoring programme**
Fish wastes are accumulating at the dump-site and are causing unacceptable mounding, unacceptable benthic bacterial colonies or significant reductions in dissolved oxygen.	Bathymetric surveys to assess mounding and sampling programmes for benthic bacteria and dissolved oxygen in the water column.

ANNEX B-3 VESSELS

The *Revised specific guidelines for the assessment of vessels* (2016) are found at: https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/2016%20Rev%20Specific%20Guidelines%20for%20vessels.pdf

What are Vessels?
The London Protocol defines vessels as any waterborne craft of any type whatsoever. For purposes of these Guidelines, this includes submersibles, air-cushioned craft and floating craft, whether self-propelled or not.

The dumping of the FV Westward off on the north-east coast of the USA in the Atlantic Ocean. Credit: U.S. EPA and Chuck Fuller.

SELECTION AND MANAGEMENT OF SITES FOR THE DUMPING OF VESSELS AT SEA

Step 1: Preliminary considerations

Follow all guidelines in Section IV, Step 1, including assessment of alternatives to disposal, waste prevention audit, and waste characterization.

Step 2: Identification of candidate sites

Follow all guidelines in Section IV, Step 2. Caution should be taken when selecting dump-sites in areas with strong currents, as these can move any size of vessel away from the dump-site and potentially towards sensitive areas.

While already noted in Section IV, Step 2, it is emphasized that because of the possible large size of vessels, it should be ensured that candidate sites will not interfere with shipping and boating, or other uses of the area, such as fishing or future energy development (e.g. pipelines).

Step 3: Characterization of candidate sites

Follow all guidelines in Section IV, Step 3. For vessel disposal, the primary concerns relate to physical effects, and so the characterization of the candidate sites should focus primarily upon the physical attributes and oceanographic properties (i.e. the presence of currents that could move a vessel) of the candidate site and the potential for unacceptable physical impacts to the biological resources at the site and in the surrounding area.

Understanding the habitat alteration in terms of sea floor characteristics of the site is important, as vessels could create habitat and attract fish. In addition, consideration of the impacts of large vessels on local sediment transport (which might include contaminated sediments) in the littoral zone could be relevant in certain locations.

Step 4: Assessment of potential impacts at candidate sites

The physical, chemical or biological property characterization considerations for potential vessel dump-sites differ slightly than characterization considerations for other wastes, as noted below. Otherwise, all guidelines in Section IV, Step 4 should be followed.

It is generally assumed that the pollution prevention plan[13] and the best environmental practices as outlined in the appendix in the Specific Guidelines for Assessment of Vessels will be followed prior to vessel dumping at sea. However, it is important to recognize that site-specific evaluations of potential chemical, physical and biological impacts may be needed even when these guidelines are followed.

For example, there may be concern about the release of contaminants from a vessel dumped at sea, even after it is has been cleaned to the maximum extent feasible in accordance with the specific waste assessment guidance for vessels. This guidance contains a list of best environmental practices, which state that “qualified personnel should take appropriate measures to remove to the maximum extent practicable all materials that may degrade the marine environment.” The guidance also contains a Pollution Prevention Plan, which states that vessels are to be cleaned to the maximum extent feasible. Given the complexity of some vessels and that potentially polluting materials have been removed to a practical and feasible limit, there remains some concern for release of contaminants, such as residues from oil or possibly PCBs in older vessels. If a significant sheen on the surface is identified, there may be need to initiate more intense monitoring than originally anticipated, or mitigation may be necessary depending upon the severity of the leakage from the vessel that was dumped.

13 A **pollution prevention plan,** as described in the Revised Specific Guidelines for Assessment of Vessels (2016), should include specific actions to identify potential sources of pollution. The purpose of this plan is to assure that wastes (or other matter and materials capable of creating floating debris) potentially contributing to pollution of the marine environment have been removed to the maximum extent possible.

Lastly, vessel dumping may result in biological impacts if there are organisms left in the ballast or on the hull.

To determine the suitability for sea dumping of vessels at a specific dump-site, an analysis should be conducted to predict the extent to which there may be physical, chemical, or biological impacts on existing and adjacent habitats and marine communities (e.g. coral reefs and soft bottom communities).

Step 5: Comparison of candidate sites and site selection

Follow all guidelines in Section IV, Step 5. For vessels, the provisions in the pollution prevention plan and the best management practices should be followed; another point of emphasis in the selection of a dump-site for vessels is to ensure that navigation hazards are not created, nor hazards to commercial or recreational fishing.

Step 6: Preparation of the site management and monitoring plan

Follow all guidelines in Section IV, Step 6 to develop a site management and monitoring programme for a vessel dump-site. You should also consider the following factors when developing a plan:

The dumping of vessels at sea, where the “waste” is a solid, does not present the same types of potential environmental concerns as the dumping of other wastes, such as liquids or sediments, where the waste materials can be readily distributed into the environment. In addition, significant sources of potential contaminants should have been removed from the vessels prior to dumping at sea. Thus, dumping of vessels does not necessarily fit the standard paradigm of rigorous biological or chemical monitoring to assess impacts resulting from contaminants in the waste stream, so management and monitoring of vessel disposal sites need not include all of the elements described in Section IV, Step 6.

However, visual observations following dumping of vessels may identify oil-based sheens resulting from tankage or pipelines that had been cleaned but with residues remaining. Some minor losses would be expected and, depending upon the severity and length of time seepage is occurring, monitoring and management actions may be necessary, but not be as rigorous as in some of the other of the waste categories.

Examples of null hypotheses for vessel disposals are shown in the text box below, and can be used to develop field monitoring programmes.

Example null hypotheses and needed monitoring for vessels	
Null hypothesis	Monitoring programme
Vessels are dumped at sea such that they interfere with shipping or boating.	Bathymetric surveys to assess the location and depth of the final resting place.
Vessels were insufficiently clean and so their disposal will introduce chemical residues that cause unacceptable impacts to on-site or off-site marine resources.	Conduct visual observations looking for oil-based plumes and, if found, initiate sampling programme to assess chemical contamination and effects.

Vessels will not remain within the footprint of the dump-site.	Visual and/or bathymetric surveys to assess the location of the vessel on the sea floor over time.

ANNEX B-4 PLATFORMS OR OTHER MAN-MADE STRUCTURES AT SEA

The *Revised specific guidelines for assessment of platforms or other man-made structures at sea* were adopted in 2019 and can be found at:

https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/2019%20Revised%20guidance%20for%20platforms.pdf. The guidelines presented in this document do not apply to the conversion of properly decommissioned structures to an artificial reef. This is covered in the London Convention and Protocol/UNEP Guidelines for the Placement of Artificial Reefs.

<u>What are Platforms or Other Man-Made Structures at Sea?</u>

Platforms are defined as facilities designed and operated for the purpose of producing, processing, storing, or supporting the production of mineral resources. This includes the topside and associated foundation structure.

The category of "other man-made structures at sea" is not defined under the London Protocol nor under the London Convention, but could refer to other structures for which the Contracting Party requires a permitting procedure to abandon or dispose of, in accordance with domestic legislation or other relevant international obligations, and taking into account the objectives of LP article 2 and LC articles I and II, respectively.

Two methods for removing oil platforms.
Left: removal of platform modules to an onshore recycling yard using a crane vessel. Credit: AFGruppen, 2011. Right: removal of the Brent Bravo platform top side in a 'one-lift' operation by the Pioneering Spirit vessel. The topside was taken onshore for recycling. Credit: Allseas Associates, 2019.

Tipping of a steel jacket at an onshore recycling facility. This type of steel structure may also be dumped at sea at a suitable location, or toppled in place when removal is not feasible. Credit: AFGruppen, 2011.

SELECTION AND MANAGEMENT OF DUMP-SITES FOR PLATFORMS OR OTHER MAN-MADE STRUCTURES AT SEA

Step 1: Preliminary considerations

Follow all guidelines in Section IV, including assessment of alternatives to disposal, waste prevention audit, and waste characterization.

Step 2: Identification of candidate sites

Follow all guidelines in Section IV, Step 2, except for platforms and certain other man-made structures, which if toppled in place would result in the existing location becoming the dump-site. In these cases, the possible dump-site is already known based upon the assumption that it is infeasible to move the platform or other man-made structure to another site. Make sure that the existing location is acceptable as a candidate site. To do this, consider whether the candidate site would be acceptable based on the considerations outlined in this document and whether the impacts at the site are acceptable. In addition, consideration of whether the site is dispersive or non-dispersive is not a practical consideration.

While already noted in Section IV, Step 2, it is emphasized that, because of the possible large size of platforms and structures, it should be ensured that candidate sites will not interfere with shipping and boating, or other uses of the area, such as fishing or future energy development (e.g. pipelines).

Step 3: Characterization of candidate sites

Follow all guidelines in Section IV, Step 3. Because the primary concerns relate to physical effects, the characterization of the candidate sites should focus primarily upon the physical attributes of the potential site and the potential for unacceptable physical impacts to the biological resources at the site and in the surrounding area.

Understanding the habitat alteration in terms of the sea floor characteristics of the site is important, as platforms or other man-made structures could create habitat and attract fish. In many cases, platforms will be toppled on-site, but in cases where platforms or other man-made structures at sea are towed to a site and released, more information would be desirable about the site characteristics.

Step 4: Assessment of potential impacts at candidate sites

The physical, chemical or biological property characterization considerations for potential vessel dump-sites differ slightly than characterization considerations for other wastes, as noted below. Otherwise, all guidelines in Section IV, Step 3 should be followed.

It is assumed that the pollution prevention plan and the best environmental practices specified in Sections 4 and 5 of the Specific Guidelines for Assessment of Platforms or Other Man-Made Structures at Sea will be followed prior to the disposal of a platform or other man-made structure at sea. However, it is important to recognize that site-specific evaluations of potential chemical, physical and biological impacts may be needed even when these guidelines are followed.

For example, there may be concern about the release of contaminants from a platform or other man-made structure dumped at sea, even after it is has been cleaned to the maximum extent feasible in accordance with the Specific Guidelines for Platforms or Other Man-Made Structures at Sea. These guidelines state that the pollution prevention plan and best environmental practices should be followed within technical and economic feasibility. Given the complexity of platforms or other man-made structures at sea and that potentially polluting materials have been removed to a practical and feasible limit, there remains some concern for release of contaminants, such as residues from hydrocarbons and stocks of chemicals used in oil and gas production. If a significant sheen on the surface is identified, there may be need to initiate more intense monitoring than originally anticipated, or mitigation may be necessary depending upon the severity of the leakage from the toppled structure.

The dumping of platforms or other man-made structures at sea may also result in physical impacts depending on their size and shape, and where they are dumped in relation to sea floor features and currents. The presence of a platform or other man-made structure at a particular location on the sea floor could lead to changes in sediment accumulation or dispersion, which could alter or impact surrounding habitats.

To determine the suitability for sea dumping of a platform or other man-made structure at a specific dump-site, an analysis should be conducted to predict the extent to which there may be physical, chemical or biological impacts on existing and adjacent habitats and marine communities (e.g. coral reefs and soft bottom communities).

Step 5: Comparison of candidate sites and site selection

Follow all guidelines in Section IV, Step 5. The exposures and risks associated with dumping can generally be addressed using operational and engineering controls. For platforms or other man-made structures at sea, operational and engineering controls should be addressed in the pollution prevention plan and application of best management practices.

Step 6: Preparation of the site management and monitoring plan

Follow all guidelines in Section IV, Step 6 to develop a site management and monitoring programme for a platform or other man-made structure dump-site. You should also consider the following factors when developing a plan:

Significant sources of potential contaminants should be removed from the platforms or other man-made structures at sea prior to dumping, and when developing the site management and monitoring programme, these factors should be considered.

The dumping of platforms or other man-made structures at sea, where the “waste” is a solid, does not present the same types of potential environmental concerns as the dumping of other wastes and other matter, such as liquids or sediments, where the waste or other matter can be readily distributed into the environment. Thus, dumping of platforms or other man-made structures at sea does not necessarily fit the standard paradigm of rigorous biological or chemical monitoring to assess impacts resulting from contaminants in the waste stream.

However, visual observations following at-sea dumping of platforms or other man-made structures at sea may identify oil-based sheens resulting from tankage or pipelines that had been cleaned but with residues remaining. Some minor losses would be expected and, depending upon the severity and length of time seepage is occurring, monitoring and management actions may be necessary but need not necessarily be as rigorous as in some of the other waste categories.

Examples of null hypotheses for platforms and other man-made structure disposals are shown in the text box below, and can be used to develop field monitoring programmes.

Example null hypotheses and needed monitoring for platforms and man-made structures	
Null hypothesis	Monitoring programme
Platforms or other man-made structures at sea are dumped such that they interfere with shipping or boating.	Bathymetric surveys to assess the location and depth of the final resting place.
Platforms or other man-made structures at sea are not sufficiently clean and so their disposal will introduce contaminant residues and cause unacceptable impacts to on-site or off-site marine resources.	Conduct visual observations looking for oil-based plumes, and if found, initiate sampling programme to assess chemical contamination and effects.

ANNEX B-5 INERT, INORGANIC GEOLOGICAL MATERIALS

The specific guidelines for assessment of inert, inorganic geological materials are found at: https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/2014%20WAGs%20English.zip

What is Inert, Inorganic Geological Material?

- The material is inert, and the relative hazards are confined to physical impacts.
- The chemical nature of the material (including uptake of any elements or substances from the material by biota) is such that the only effects will be due to its physical properties.
- Inert materials will not interact with biological systems other than through physical processes.

Loading inert, inorganic geological material onto a barge for sea dumping in Papua New Guinea. Photo Credit: Newcrest Mining Limited

SELECTION AND MANAGEMENT OF SITES FOR THE DUMPING OF INERT, INORGANIC GEOLOGICAL MATERIAL AT SEA

Step 1: Preliminary considerations

Follow all guidelines in Section IV, Step 1 including assessment of alternatives to disposal, waste prevention audit, and waste characterization. It is particularly important to confirm that any material proposed for disposal in this category is geological, inert, and free from man-made contamination before it is considered for disposal, as per the LC/LP Eligibility Criteria for Inert, Geological Matter in LC 28/15 - ANNEX 8.

Step 2: Identification of candidate sites

Follow all guidelines in Section IV, Step 1.

Step 3: Characterization of candidate sites

The primary concerns stemming from the disposal of inert, inorganic geological materials relate to physical effects. The characterization of the candidate sites should focus primarily upon the potential for unacceptable physical impacts to the biological resources at the site and in the surrounding area.[14] Follow the guidelines related to physical and biological impacts in Section IV, Step 3.

Step 4: Assessment of potential impacts at candidate sites

Follow all guidelines in Section IV, Step 4. Inert, inorganic, geological materials will not interact with biological systems other than through physical processes. Potential impacts that should be assessed include the degree to which physical deposition of material may result in effects on marine benthos (e.g. smothering, changes in benthos diversity, habitat modification). Assessment of chemical impacts should also be considered to demonstrate the material is inert and that it poses no concern in relation to the release of trace metals.

Step 5: Comparison of candidate sites and site selection

Follow all guidelines in Section IV, Step 5 with consideration that comparison of candidate sites should focus upon concerns regarding physical impacts upon biota as well as sediment transport mechanisms.

Step 6: Preparation of the site management and monitoring plan

Follow all guidelines in Section IV, Step 6. Monitoring should be conducted to assess whether the dumped inert, inorganic, geological material releases chemicals to the marine environment to a significant degree.

Examples of null hypotheses for inert, inorganic material disposals are shown in the text box below, and can be used to develop field monitoring programmes.

[14] If categorized correctly and the London Protocol criteria for inert, inorganic geological material are met, only physical effects should be of concern.

Example null hypotheses and needed monitoring for inert, inorganic geological materials	
Null hypothesis	Monitoring programme
During initial deposition, the material will be carried through the water column to any sensitive area in amounts that would be harmful to the value or amenity of such areas.	Map initial area of deposition and determine if a sensitive area was reached by such deposition. If so, determine whether the scale of deposition is of concern in relation to physical impacts on valued components of the impacted area.
Inert materials will release chemicals to a significant degree, and will cause unacceptable impacts due to chemical toxicity at the dump-site.	Sample sediments at the dump-site to check chemicals concentrations compared with a reference site. If chemical concentrations are elevated, test dump-site sediments for toxicity, and compare results to a reference site.

ANNEX B-6 ORGANIC MATERIALS OF NATURAL ORIGIN[15]

The specific guidelines for assessment of organic materials of natural origin are found at: https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/2014%20WAGs%20English.zip

<u>What are Organic Materials of Natural Origin?</u>

Organic materials of natural origin are animal and vegetable matter predominantly of agricultural origin.

Muskox offal dumped on Arctic sea ice (offal will fall into the ocean when the ice melts).
Credit: Enforcement Officer from Environment and Climate Change Canada

SELECTION AND MANAGEMENT OF SITES FOR DUMPING OF ORGANIC MATERIALS OF NATURAL ORIGIN AT SEA

Step 1: Preliminary considerations

Follow all guidelines in Section IV, Step 1, including assessment of alternatives to disposal, waste prevention audit, and waste characterization.

Step 2: Identification of candidate sites

Follow the guidelines in Section IV, Step 2. The potential for oxygen depletion and excess bacterial growth is a key consideration when organic materials of natural origin are dumped at sea. It is likely, given the nature of these wastes, that the most important dump-site selection criterion is the promotion of biological consumption (i.e. consumption of the wastes by marine organisms).

15 Occasionally during a voyage, a cargo of natural origin (e.g. spoiled plant crops or animal carcass) may spoil and mariners are faced with the need to manage the problem. When the dumping at sea of a spoilt cargo needs to be considered, there is often a need to act quickly, and so applying a full site selection process would not be feasible or practical. Please see LC-LP.1/Circ.58 for specific guidance on the management of spoilt cargo developed by the London Protocol and Convention http://www.imo.org/en/OurWork/Environment/LCLP/Documents/58.pdf"

To promote biological consumption, care should be taken to find dispersive sites that make the waste more available to consuming organisms. Dispersive dump-sites will also minimize impacts associated with mounding of wastes, subsequent increases in biological oxygen demand and contamination with bacteria associated with partly degraded organic waste.

Step 3: Characterization of candidate sites

Follow all guidelines in Section IV, Step 3. As noted in Step 2, emphasis upon the dispersive nature of the site is important to ensure that the organic materials are available as a food source to marine organisms and that dissolved oxygen levels are not suppressed due to the increased biological oxygen demand (BOD) load from the organic materials.

Step 4: Assessment of potential impacts at candidate sites

Follow all guidelines in Section IV. Organic wastes are materials of natural origin, and a detailed characterization of the constituents of organic material is not usually warranted, depending upon its nature and the circumstances leading to its production. The characterization of the waste should include a description of its nature (including physical characteristics), and the circumstances leading to its production, rather than the result of detailed chemical and biological testing. Any organic material that has been exposed to contamination as the result of industrial processes or agricultural practices should not be considered for disposal at sea.

To assess the extent of smothering impacts at the dump-site, estimates of size and quantities of organic material of natural origin to be dumped on a daily basis are needed. Depending upon the water body, other inputs of nutrients, and water circulation, eutrophication may be an issue, and assessments of the potential to cause or add to the severity of eutrophication may be needed, including modelling. Where eutrophication is a concern, organic materials will add nutrients to the water body, and these incremental amounts should be considered.

The nature of the organic materials is a significant aspect of dump-site selection. Larger materials may present different potential impacts compared to materials that have been ground.

Particular attention should be paid to the possible reduction in dissolved oxygen in the water column, especially near the sea floor, and changes in sediment oxidation-reduction conditions, considering the likely rate of dispersion or consumption by marine organisms. The potential for creation of a bacterial layer on the seabed should also be assessed.

These impacts should be considered in both the near and far-field, i.e. on-site and off-site.

Step 5: Comparison of candidate sites and site selection

Follow all guidelines in Section IV, Step 5 favouring sites that promote biological consumption as explained in Step 2.

Step 6: Preparation of the site management and monitoring plan

Follow all guidelines in Section IV, Step 6 recognizing that monitoring may not be needed in certain locations given the high-energy marine environment where issues of depleted oxygen, eutrophication, or excess bacterial growth are not expected.

For use in developing field monitoring programmes, examples of null hypotheses for organic materials of natural origin are shown in the text box.

Example null hypotheses and needed monitoring for organic materials of natural origin	
Null hypothesis	Monitoring programme
Dumping of organic materials at the dump-site causes depressed dissolved oxygen levels.	Conduct sampling programme at the site and, if necessary, in the surrounding area, measuring dissolved oxygen.
The dump-site is non-dispersive and therefore organic materials are accumulating and mounding on the sea floor.	Conduct bathymetric or video surveys to assess whether the organic wastes are staying at the dump-site.

ANNEX B-7 BULKY ITEMS

What are Bulky Items?

Bulky items are primarily composed of iron, steel, concrete and similarly unharmful materials for which the concern is physical impact and limited to those circumstances where such wastes are generated at locations, such as small islands with isolated communities, having no practicable access to disposal options other than dumping.

SELECTION AND MANAGEMENT OF SITES FOR THE DUMPING OF BULKY ITEMS AT SEA

Step 1: Preliminary considerations

Follow all guidelines in Section IV, Step 1, including assessment of alternatives to disposal, waste prevention audit, and waste characterization. Significant sources of potential contaminants should be removed from bulky wastes prior to dumping.

Step 2: Identification of candidate sites

Follow all guidelines in Section IV, Step 2. While already noted in Section IV, it is emphasized that because of the possible large size of bulky items, it should be ensured that candidate sites will not interfere with shipping and boating, or other uses of the area, such as fishing or future energy development (e.g. pipelines).

Step 3: Characterization of candidate sites

Follow all guidelines in Section VI, Step 3. Because the primary concerns relate to physical effects, the characterization of the candidate sites should focus primarily upon the physical attributes of the potential site and the potential for unacceptable physical impacts to the biological resources at the site and in the surrounding area. Understanding the habitat alteration in terms of the sea floor characteristics of the dump-site is important, as these types of wastes could create habitat and attract fish. In addition, consideration of the impacts of large bulky items on local sediment transport (which might include contaminated sediments) in the littoral zone could be relevant in certain locations.

Step 4: Assessment of potential impacts at candidate sites

Because appropriately clean bulky items will not interact with biological systems other than through physical processes, assessment of potential impacts does not require detailed consideration, other than inspection of bulky items to ensure contaminants have been removed. In certain dump-sites, impacts should be assessed from burial or the addition of a new type of substrate to the sea floor that might attract new biota. Follow guidelines in Section IV, Step 4 addressing potential physical and biological impacts.

Step 5: Comparison of candidate sites and site selection

Follow all guidelines in Section VIII. Comparison of candidate sites should focus upon concerns regarding physical impacts upon biota as well as sediment transport mechanisms.

Step 6: Preparation of the site management and monitoring plan

Follow all guidelines in Section IV, Step 6 to develop a site management and monitoring programme for bulky wastes. Significant sources of potential contaminants should be removed from bulky wastes prior to dumping, and when developing the site management and monitoring programme, these factors should be considered.

The dumping of bulky items at sea, where the “waste” is a solid, does not present the same types of potential environmental concerns as the dumping of other wastes and other matter, such as liquids or sediments, where the waste or other matter can be readily distributed into the environment. Thus, dumping of bulky items at sea does not necessarily fit the standard paradigm of rigorous biological or chemical monitoring to assess impacts resulting from contaminants in the waste stream.

However, monitoring to address chemical impacts may be needed when there is reason to believe that contaminant residues may remain on or in bulky items at the time of their disposal. For example, visual observations following at-sea dumping of platforms or other man-made structures at sea may identify oily residues. In these cases, some minor losses would be expected and, depending upon the severity and length of time seepage is occurring, monitoring and management actions may be necessary but need not necessarily be as rigorous as in some of the other of the waste categories.

Examples of null hypotheses for bulky item disposals are shown in the text box below, and can be used to develop field monitoring programmes.

Example null hypotheses and needed monitoring for bulky items	
Null hypothesis	Monitoring programme
The dumping of bulky items impacts sensitive habitats outside of the dump-site.	Conduct bathymetry to determine whether the bulky items remain in the dump-site.
The bulky items are not cleaned adequately, so visible sheens from oil-based contamination appear when the dumping operation concludes.	Visual surveys of the surface water should be conducted, and if an oil sheen is observed, initiate sampling programme to assess chemical contamination.

ANNEX B-8 SEWAGE SLUDGE

The specific guidelines for assessment of sewage sludge are available at: https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/2014%20WAGs%20English.zip

What is Sewage Sludge?

Sewage sludge is the residue remaining from the treatment of municipal sewage. It is an organic-rich waste produced primarily by physical processes but also by chemical and biological treatment processes.

- Sewage contains aqueous domestic waste as well as surface drainage and, in many cases, a component of treated and untreated industrial effluent. Sewage sludge tends to concentrate a wide range of substances including plastics.
- It has a high BOD and may be contaminated with pathogens and parasites. Untreated sewage effluents discharged to rivers, estuaries and coastal waters can pose a high risk to environmental resources, amenities and human health. It may, therefore, create environmental, aesthetic, and health problems if not managed properly.

NOTE: For the past several years, very few countries have reported the disposal of sewage sludge at sea.

SELECTION AND MANAGEMENT OF SITES FOR DUMPING OF SEWAGE SLUDGE AT SEA

Step 1: Preliminary considerations

Follow all guidelines in Section IV, Step 1, including assessment of alternatives to disposal, waste prevention audit, and waste characterization.

Step 2: Identification of candidate sites

Follow all guidelines in Section IV, Step 2. With sewage sludge, it is important to consider the proximity of the site to recreational and shellfish areas, with special consideration being given to human exposures to pathogens.

Step 3: Characterization of candidate sites

Follow all guidelines in Section IV, Step 3. Comprehensive characterization of the site and down-current areas is needed following the guidelines in Section IV. It is particularly important to assess the transport and fate of the sludges, the potential for reduction in dissolved oxygen in the water column, and changes in sediment oxidation-reduction (REDOX) conditions.

In addition, consideration should be given to the organic matter flux and associated changes in oxygen demand. Particular consideration should be given to nutrient fluxes and potential eutrophication.

The potential for the waste to release floating plastics to the marine environment should also be considered.

Step 4: Assessment of potential impacts at candidate sites

Follow all guidelines in Section IV, Step 4. It is important to consider the potential exposure and impacts of sewage sludge dumping on recreational and shellfish areas with special consideration given to human exposures to pathogens.

Particular attention should be paid to the possible reduction in dissolved oxygen in the water column, taking into account the likely rate of waste consumption by marine organisms.

Depending upon the water body, other inputs of nutrients, and water circulation, eutrophication may be an issue. Assessments, including modelling, of the potential of sewage sludge to cause eutrophication may be needed. Impacts from sewage sludge dumping may occur far away from the dump-site where particles settle to the sea floor.

Step 5: Comparison of candidate sites and site selection

Follow all guidelines in Section IV, Step 5.

Step 6: Preparation of the site management and monitoring plan

Follow all guidelines in Section IV, Step 6. The site management and monitoring plan should specifically address whether dumping of sewage sludge is resulting in unacceptable impacts due to chemical constituents, pathogens or other constituents of sewage sludge.

Examples of null hypotheses for sewage sludge disposal are shown in the text box below, and can be used to develop field monitoring programmes.

Example null yypotheses and needed monitoring for sewage sludge	
Null hypothesis	Monitoring programme
Sewage sludge is resulting in unacceptably depressed oxygen levels at the dump-site and in surrounding areas.	Sampling programme of dissolved oxygen levels at various depths, both within the dump-site and in surrounding areas.
Chemical constituents in sewage sludge are causing unacceptably elevated levels of chemicals in off-site sediments.	Sampling programmes of off-site sediments, analysis of chemical constituents, and comparison to the permitted sediment levels. Chemical analyses should focus on pharmaceuticals, personal care products, and other constituents that are known to concentrate in sewage sludge.
Plastic debris will be released to the marine environment as a result of dumping.	Sampling programme to identify macro-plastic materials in the sewage sludge before it is released to the marine environment.
Beaches near the dump-site will be polluted with pathogens or plastics as a result of dumping.	Visually inspect beaches for plastic debris coming from the sewage sludge and conduct a sampling programme of beaches for pathogens, both efforts using reference beaches.

ANNEX C: CASE STUDIES ILLUSTRATING CONSIDERATION OF CUMULATIVE EFFECTS IN THE SELECTION AND MANAGEMENT OF DUMP-SITES AT SEA

Name of Disposal Site: HU022 Hedon Haven

This dump-site in the Humber Estuary (on the east coast of the UK) was designated for the dumping of material from Hedon Haven for clearing of drainage dykes. The works had been carried out historically but had not previously required a marine licence in the UK due to changes in legislation so was considered a capital dredge (material that has not been disturbed for at least 10 years). The dredging project was for the removal of 17,000 cubic metres (17,221 tonnes) of silt material. The dredge was to be carried out by a cutter suction dredger and the material pumped through the vessel and dumped behind the vessel, into the estuary, via a pipeline. In this instance, a full characterization study, including cumulative effects, was not deemed necessary because:

- the material was considered suitable for sea dumping (both chemically and physically) within the estuary;
- the location of the dredge was taking place adjacent to the estuary, which experiences high tidal currents;
- the location of the proposed dump-site was in an area of high tidal action to allow dispersion;
- the dredging activity has been taking place for a long time period (just not licensed) with no reported issues;
- the dredging activity would not result in suspended sediment levels significantly above background levels and cause any significant impacts to other areas in the creek or in the Humber Estuary.

Name of Disposal Site: TH027 Harwich Haven

The applicant applied for a new dump-site for the dumping of material from maintenance dredging closer to the dredging works than the existing dump-site to serve Felixstowe, Harwich, Ipswich, Harwich Navyard and Mistley. The application was based on the new dump-site receiving 2.6 to 3 million m^3 of material annually. Due to the volume of material proposed to be dumped of at site, as well as the location of the site being closer inshore than the existing, the applicant carried out a full characterization study of the site. Full modelling was carried out to determine the fate of material once dumped to assess the potential impacts of increased suspended sediment and smothering on the marine environment. The study considered the dumping operations (not dredging, as these operations had been ongoing for many years) on other seabed users namely offshore wind farms and aggregate extraction sites due to the conflict for space and the potential for suspended sediment plumes to have the potential to reach aggregate extraction sites and affect operation. While the assessment was based on the modelling work undertaken to consider the extent, magnitude and longevity of the plumes, the assessment was carried out using expert judgement. The main concerns raised in the cumulative impact assessment between the dumping operations and offshore wind farms were regarding increased suspended sediments and deposition from cable installations; however, due to the limited spatial extent and temporal duration, this was considered negligible. The potential impacts from the dumping operations and aggregate extraction were from the interaction between the sediment plumes from both activities. Literature and results from monitoring studies of other aggregate extraction sites informed the assessment and it was concluded that due to the limited spatial extent of the sediment plumes generated by aggregate extraction activities, there is not expected to be any overlap between plumes generated from aggregate extraction activities and from dumping activities.

Overall, the cumulative effects assessment (CEA) looked at those activities within a reasonable spatial extent (likely to have interacting plumes) and while the assessment was carried out in a single point in time, the assessment was based on a worst case scenario (i.e. if both activities were being carried out at the same time).

Name of Disposal Site: PL035 Plymouth Deep

This site was designated due to the existing site being deemed no longer suitable. The site was to receive dredged material from the River Tamar, Plymouth Sound, and the associated ports, harbours, berths and marinas. Although the principal locations for dredging are in the River Tamar at Devonport Naval Dockyard and associated Defence Infrastructure Organisation (DIO) areas, dredging also takes place at the commercial wharves of Cattewater and a number of marinas. The amount of material licensed for dumping since 1994 has ranged from 5,515 to 1,000,500 tonnes for maintenance material and 9,000 to 500,000 tonnes for capital material. Due to the volume of material proposed to be dumped at the dump-site, as well as the public interest, a full characterization study of the site was carried out. The CEA was based on the fact that the disposal of dredged material to existing site had been an ongoing activity for over one hundred years, therefore the modelled disposal operations to the proposed new site did not constitute an increase in activity in the marine environment, rather the relocation of an existing activity. The assessment identified other seabed users in the vicinity of the dump-site. It was assessed that trawling and dredging from the benthic surveys and fishing activities can give rise to an increase in suspended sediment; however, these increases were considered to be of limited spatial extent and temporal duration. Therefore, any adverse effects as a result of the interaction of sediment plumes were expected to be negligible.

Additional information about cumulative effect can be found in the following references:

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ANNEX D: CASE STUDIES TO DEMONSTRATE THE SELECTION OF DREDGED MATERIAL DUMP-SITES AT SEA

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Contents

Case study Barrow Dump-site

Background

An application for a permit to deposit approximately 4.5 million m^3 of dredged material at sea at Barrow-in-Furness was received in March 1989. The dredged material was to come from the proposed lengthening and deepening of an access channel to Barrow docks and was to consist of capital and maintenance material.

A preliminary assessment was made based on the information submitted by the applicant and other relevant data held by the Licensing Authority. The material to be excavated was described as consisting mainly of cohesive clay (60%) with the remainder made up of sand/gravel and silt. It was concluded that further information was required on the waste characteristics and that a thorough assessment of alternatives to sea dumping was required. However, if land-based alternatives were not available, it was likely that a new dump-site would be required.

Geophysical and vibrocore surveys were carried out at the proposed dredged area and the sediment samples were characterized physically and chemically. The sediment texture varied considerably from very soft clays and loose sands/gravels through to very stiff and hard silts and clays. Concentrations of trace metals in the clay (60% of the total) were very low (below action levels) with only slightly higher concentrations in muddy surface material from within the docks.

In view of the low contamination levels, the material was deemed acceptable for dumping at sea if the project met other criteria.

Assessment of the need for a new dump-site

An evaluation of other waste management options for this material concluded that there were no viable land-based options for either the unconsolidated silts from the dock area or the larger volumes of the coarser/consolidated material. Other alternative/beneficial use options were investigated for the coarser material (e.g. use in construction or coastal protection). However, after consultation with other management authorities, no alternative uses could be found. Therefore, the project moved to the dump-site selection phase.

Two existing dump-sites, IS180 and IS210 (see Figure 1) that were used by the port were considered and assessed as to their suitability to take part or all of the material;

- IS180 was a dispersive site with an average depth of five metres and maximum tidal currents of around one knot. It was used for dumping of material from maintenance dredging projects, and in the previous five years it had received between 160,000 and 240,000 tonnes per annum. It was concluded that the deposit of the cohesive material which would not disperse readily on dumping would lead to shoaling, causing interference to both navigation and fishing activity.

- IS210 had similar tidal currents but was sited in deeper water at around 14 metres. This site had been used for capital dredging previously but only received 130,000 tonnes in one dumping campaign in the previous five years. Again, it was concluded that the cohesive material would lead to shoaling and interference with navigation, and any dispersive material was likely to return to the dredged channel.

No other dump-sites suitable for the large volumes of cohesive material were within a reasonable distance and therefore it was decided that a new dredged material dump-site was required.

Identification of suitable areas

Only one area could be selected within the zone of siting feasibility (ZSF) (area 'D' in Figure 1) after determining the uses of the seabed, which were principally fishing, shipping lanes and engineering uses (pipelines and cables).

Determination of requirements in relation to dredge material characteristics

Cohesiveness was the most important characteristic of the material, and shoaling was identified as one of the most important effects of dumping. Therefore, the new dump-site had to be able to accommodate the volume of material without unacceptable shoaling.

Selection of candidate dump-sites

Only one area had been selected and there was only space for one dump-site within that area.

Assessment of potential adverse effects

All available data on the area was collated and reviewed, and where gaps in the data were identified, field studies were commissioned.

Sediment transport pathways in the area were complex, but offshore transport was dominant. The sediments in the proposed dump-site were hard packed muddy sands with stones and shell. Benthic surveys indicated a relatively low biomass on a tide-swept stony ground.

Chemical contamination of the dredged material was so low that there were no concerns over increases in the flux of either natural or synthetic substances to the area or with any chemical effects on biota.

The main predicted environmental effects of depositing this material were the physical blanketing and burial of the existing sediments in the dump-site, the consequent loss of benthic fauna and significant shoaling. It was predicted that the dispersible material would mostly be transported offshore but that under certain conditions some might be carried into Morecambe Bay. This suggested that some of the material could be carried back into the dredged channel in some circumstances but that this could be minimized by depositing this material in the southern part of the area. The cohesive material (60% of the volume dumped) was expected to remain in the dump-site for a considerable period.

Following cessation of dumping, recolonization of the newly deposited sediment by benthos was expected to occur. Little or no interference from fisheries was expected since the site had been chosen to be remote from fishing activity.

Evaluation of the acceptability of potentially adverse effects

The potential adverse impacts associated with the dumping of the dredged material to the new site were deemed acceptable by the Licensing Authority.

Site selection

Site selection was straightforward; the two existing sites were deemed unsuitable to receive the material while the new site was suitable, therefore no comparison with candidate sites was required. In discussions with the applicant, it was evident that the different types of material associated with the dredge campaign would be removed separately and by different methods. The unconsolidated silty material from the dock and dock entrances was to be removed first using grab dredgers. Then, from the approach channel, the sands and gravels would be removed using trailer suction dredgers and bucket dredgers would be employed to excavate the more consolidated, mainly clay, material. This meant that there was an opportunity to explore dumping the different materials to different sites. The two existing sites, originally rejected due to the large amount of consolidated material, were then reconsidered. It was decided that for the first stage of the dredging campaign the dispersive materials from the docks and dock entrances would be dumped to site IS180, with any smaller amounts of consolidated material removed taken to IS210. The consolidated material from the approach channel, which made up around 60% of the material overall, would be dumped at the new site.

Licence conditions

Having made the decision to grant a licence for the dredged material to be dumped at the new site, ways in which the detrimental effects of the dumping could be minimized were considered.

The principal effect predicted was the physical blanketing of the seabed and smothering of flora and fauna. Restricting the size of the dump-site would minimize this effect but would give rise to another: the interference with navigation through shoaling. Consultation with the Navigational Authority identified the minimum depth required and the size of the dump-site was calculated to comply with this while ensuring the minimum spatial footprint. Finally, to minimize the possible return of the mobile fraction of dredged material to the approach channel, the southern section of the area was selected and designated as a disposal site and was named Barrow Site D with a code of IS205 (see Figure 1).

Because of the importance attached to dumping of the dredged material in the correct position within the site, techniques that allowed the tracking of the vessels and plotting of individual vessels' tracks on each dumping trip were investigated with the applicant. Appropriate equipment was installed on the dumping vessels.

The following supplementary conditions were included on the licence:

- The dredged material was to be spread evenly over the site IS205 and nowhere within this spoil ground should depths be reduced to less than 7.0 metres below Admiralty Chart datum (the water level that depths displayed on a nautical chart are measured from) to ensure navigational safety.
- Hydrographic surveys at the site IS205 were to be conducted quarterly from the commencement of dumping in that site until dumping was complete. Copies of the surveys were to be supplied to the regulator and to the Hydrographer of the Navy.

The total quantity of dredged material was not accurately known at the start of the consultation, as it depended on channel design and the stability of the channel sides. Final quantities were only established after some dredging had been undertaken and further studies were undertaken to optimize channel design. Therefore, a licence was issued for the dumping of 5,700,000 tonnes of dredged material which was consequently amended in early 1991 to permit the dumping of a total of 8,600,000 tonnes in the 12-month period up to 31 January 1992.

Monitoring

Since the primary effect of the dumping was predicted to be a physical one of blanketing the seabed, it was a priority to map the physical extent of the dumped material. A licence condition requiring monitoring of depth during the dumping process formed the first part of this monitoring process. Additionally, independent monitoring was required, as a check on the self-monitoring and to monitor sediment movements subsequent to dumping and any associated biological changes.

Subsequently, the Licensing Authority carried out a survey at the new site using echo sounder, side-scan sonar, underwater photography and bottom sampling techniques. The results confirmed the predictions of the impact made in the permitting and site selection processes.

The data from the vessel tracking equipment showed that the dredged material had been dumped within the boundaries of the new site and this was confirmed by the hydrographic surveys carried out by the licensee.

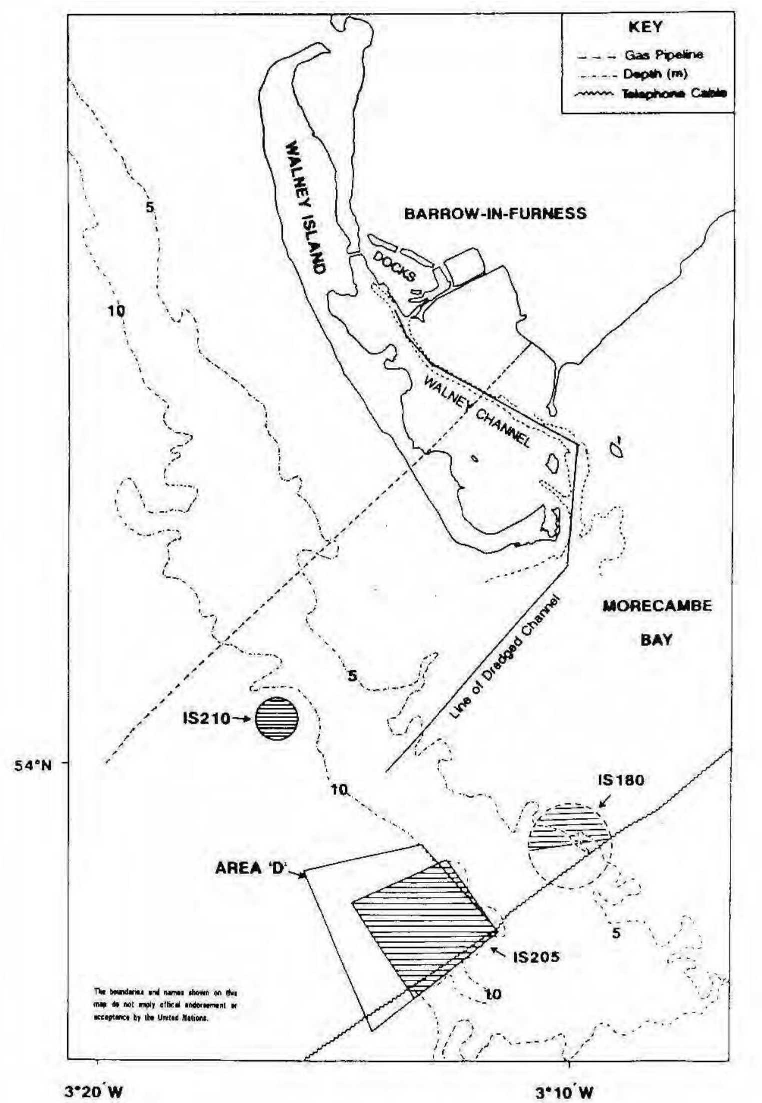

Figure 1. Map of Barrow Docks and sea area offshore.

Case study: Inner Gabbard East

Background

In order to satisfy the increasing growth in demand for container handling at UK ports, two developments were proposed in the Harwich Haven by Hutchinson Ports (UK) Ltd. These were to build a new container port at Bathside Bay and reconfigure part of the port at Felixstowe (Felixstowe South Reconfiguration (FSR)). Both developments would require modern deep-water container handling facilities and need to offer berths and access of no less than 14.5 below chart datum.

The Harwich Haven Authority (HHA) submitted applications for consents for the Bathside Bay development in 2001. This included application for consent to dump approximately 2.5 million m^3 of consolidated capital dredge material (stiff clay) at sea resulting from the dredge to widen and deepen the approach channel. A new dump-site was required for the material arising from this development, and therefore work was carried out to characterize a new site. Subsequently, in 2003, before Bathside Bay had received a decision on its applications, HHA submitted applications for consents for the work for the FSR. This included the dredging and dumping of the following quantities of capital material: stiff clay (2.59 million m^3), sand (170,000m^3) and some rock (110,000m^3) and gravel (90,000m^3). While these were two separate applications, both ports use the same approach channel and intend to utilize the new dump-site.

The dump-site characterization, which is summarized below, initially took place for the Bathside Bay development; however, due to the delay in receiving consents, mainly land planning consents associated with the development, a dump-site was not designated before the Felixstowe development came online. Therefore, the dump-site information collected was used to support the FSR application.

Assessment of the need for a new dump-site

Previous capital dredging from the Harwich Haven area had been dumped at the Roughs Tower dump-site, but this option was no longer available as the site was closed after it had reached capacity as a result of material dumped there from a major channel deepening between 1998 and 2000. The preferred option was to dump the clay to an existing site at the Inner Gabbard (TH052); however, this site was dispersive, licensed to receive material from maintenance dredging projects only and fisheries organizations raised objections to the dumping of clay to this site following submission of the Environmental Statement (ES). Therefore, a new site was required to receive the clay material.

Additional dredge material would result from the channel deepening; the silty material would be dumped at the existing Inner Gabbard site and the sand and gravel would be utilized in the reclamation works associated with the development.

Identification of suitable areas

Two sites were identified in the ZSF, which was located broadly in the area of the existing dump-site. These sites were situated in deeper water to the north and east of the Inner Gabbard; they were called Inner Gabbard North (IGN) and Inner Gabbard East (IGE) (see Figure 2). Following submission of the ES for the works, HHA undertook a through consultation with the Centre for Environment, Fisheries and Aquaculture Science (Cefas (scientific advisers to the regulatory authority)) and fisheries organizations. As a result of that consultation and based on existing knowledge of the area, it was proposed to dump the dredged material at IGE. However, given the lack of detailed information on the characteristics of the site (particularly seabed characteristics, biological resource and potential fisheries interest), the Licensing Authority requested characterization of the site be undertaken in order to progress the application for dumping.

The proposed dump-site was broadly similar in terms of wave and tidal flow climates and bed conditions to the existing Inner Gabbard dump-site, being characterized as fairly featureless flat sand and gravel beds. The bed sediments were mixed and contained material types from cobbles through to silt and clay. The main difference was the depth, with the proposed site at around 55 metres in an elongated depression in the seabed, compared to 30 metres at the Inner Gabbard site.

Surveys were carried out to characterize the benthic communities. Results showed that all of the species present at the proposed dump-site were widespread within the adjacent (surveyed) areas, and faunal assemblages were not unique to the site but found throughout the area.

In terms of fisheries resources, consultations with Cefas, Eastern Sea Fisheries Joint Committee and the commercial fishing industry identified that the area was of limited value. This was supported by data on the commercial activity within the vicinity of the proposed dump-site. The Harwich Fisherman's Association suggested that this was their preferred site to receive the material.

Determination of requirements in relation to dredge material characteristics

The cohesiveness of the capital clay material was the most important characteristic in terms of the dumping operation and site. Following further site investigation, the quantity of stiff clay requiring dumping was revised to 1.5 million m^3.

Selection of candidate dump-sites

Two candidate sites were identified but only one, IGE, was chosen for characterization due to fisheries interests.

Assessment of potential adverse effects

Data was collated and field and modelling studies undertaken to characterize the IGE site and assess the potential impacts of the dumping of the dredged material at the site.

One of the main predicted environmental effects related to the impact on subtidal communities. The deposition of material at the dump-site would result in localized smothering of the seabed and loss of benthic communities within the footprint of the dumping. There would therefore be a significant localized effect; however, as the species present are typical of the wider area, the effect was not considered significant.

It was also predicted that benthic communities would be impacted through the migration of clay balls outside the dump-site. The dredged clay would form lumps and clay balls as it reached the seabed and these may be mobile under certain conditions, impacting benthic communities and adversely impacting trawling activities in the wider area. The location of the dump-site, in an elongated depression north to south, would minimize mobility. However, mitigation was proposed to stop possible movement of the clay balls by forming bunds to the northern and southern ends of the site, preventing downslope movement of clay placed subsequently. Bunds to contain material were used previously at Roughs Tower dump-site, the site that was previously used for capital material from Harwich Haven; these proved effective, with monitoring carried out by Cefas showing they were still intact two years after dumping.

Hydrodynamic studies were also undertaken to identify the potential impact of the deposit of clay at the site. The scenario investigated was for the placement of 40 million m^3 of clay, with mounds of up to 8 metres high and a footprint over an area 2.5km by 500 metres. The studies concluded that (i) the placement would have negligible impacts on tidal currents outside the placement area; (ii) the depths at the site would be too great to effect wave propagation; and (iii) any local accretion of bedload sediment would be minimal, as would any change to sand transport.

Dispersion modelling was also carried out to assess the effects of sediment plumes created by fine-grained material. The models used assumed that 5% of the placed sediment would be released into the water column (as the bulk of the material would be consolidated). Results showed that suspended sediment concentrations above background of above 10mg/L would only be predicted to last for less than one hour on every tide and would not lead to permanent deposition (other than the placed material at the dump-site). Plumes from the proposed site and the existing Inner Gabbard dump-site would not interact to any significant degree.

The impact on water and sediment quality was predicted to be negligible as there would be minimal fine material lost during the dumping operation, and the dredged material from the proposed dredging locations was sampled, analysed, and found to be relatively free of contaminants and therefore suitable for sea dumping.

Evaluation of the acceptability of potentially adverse effects

The information above on potential adverse effects was carried out for the Bathside Bay development. However, as this was still ongoing, the FSR application was submitted and the information was utilized in that ES. The original scenario investigated (40 million m^3) was much greater than the proposed deposit from FSR (2.5 million m^3), and therefore the impacts from the FSR placement were expected to be much reduced. Additionally, the proposed eight metre high bunds of clay to be deposited at the dump-site were intended to enable material to be deposited there from both developments and to also incorporate capacity for any material from future schemes. Therefore, the potential adverse effects associated with the dumping at the new site were deemed acceptable.

Site Selection

The selection of the site intended to receive the consolidated clay material from the Bathside Bay and FSR port projects was straightforward. The existing dump-site at the Inner Gabbard (TH052) was unsuitable as it only accepted unconsolidated fine-grained material. Two candidate sites were identified but after initial consultation only the IGE was selected and characterized.

Licence conditions

At the time of writing, both developments had yet to receive licences for the dumping of the dredged material associated with the developments. However, throughout the characterization process, mitigation has been considered to minimize the detrimental effects and supplementary licence conditions considered, some of which are outlined below:

- The placement of material at the Inner Gabbard East (IGE) dump-site shall be undertaken in line with the following:

  - The dredging operator shall initially place material to form embankments at the northern and southern extremity of the dump-site, extending across the dump-site, approximately 50 metres wide at the crest, to a height of approximately 6.0 metres above the existing bed level.

  - These and all subsequent loads are to deposited within a grid of defined blocks, sized to accommodate the vessels carrying material to be dumped, and dumping will be undertaken when the vessel is stationary (as far as is practical).

  - Following substantial completion of the North and South embankments, dumping of material in the area between may commence, working across the full area to raise the level evenly.

Measures must be adopted and maintained throughout the project to prevent stone pieces or clay lumps being dumped or washed from the side decks of dredgers or vessels conducting dumping in any location other than the dredge area or the dump-site.

Monitoring

Monitoring proposals were outlined in both of the developments' ESs and discussed with regulatory authorities. It has been agreed that when/if licences are issued, the licence holder must agree to a package of monitoring with the Licensing Authority for the IGE dump-site prior to the commencement of any dumping operations. This monitoring is to include the following;

- Establishment of six monitoring stations around the dump-site for infaunal species and particle size distribution, undertaken 6-, 12- and 24-months following completion.

- Bathymetric survey of the dump-site before any dumping operation commences and 6 months after completion.

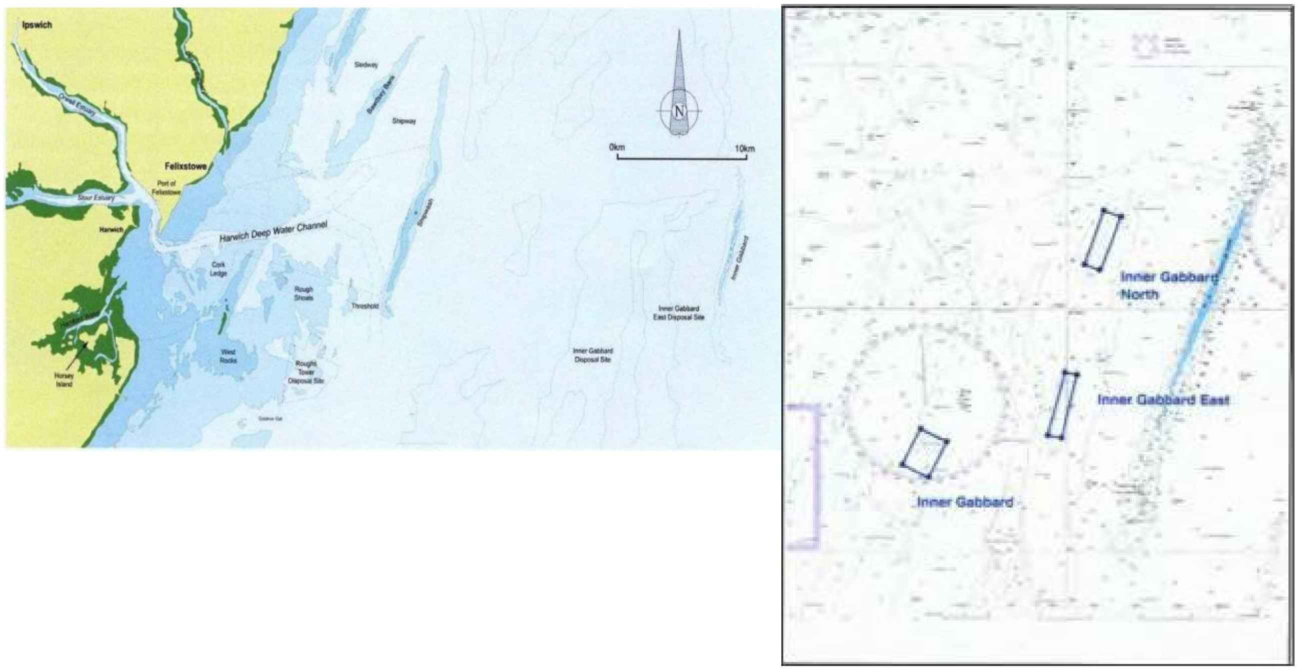

Figure 2. Location map of Harwich Haven and sea dump-sites offshore

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ANNEX E: SITE SELECTION GLOSSARY

Bathymetry

The measurement of the depths of a body of water.

Benthic

A region at the bottom level of a body of water (including surface and sub-surface sediments) and/or the organisms that reside within this region.

Benthos

The organisms and materials associated with or residing within the benthic region of a body of water.

Bioaccumulation

The accumulation of a substance from an environmental source within the tissue(s) of an exposed organism.

Biochemical oxygen demand (BOD)

A measurement of the oxygen required by aerobic microorganisms to decompose organic matter within a body of water.

Contaminant

A substance present within wastes, sediment, porewater or tissues at levels that has the potential to harm the marine environment. Substances are considered contaminants when they are present in concentrations greater than naturally expected or contained in areas where they would not be naturally present.

Dispersal

The spreading or movement of material from one area to another.

Dump-site

A site or area where aquatic disposal of a material is permitted in accordance with the terms and conditions of a valid dumping permit. A dump-site is comprised of a release zone, and any associated footprint and area of influence.

Dissolved oxygen

A measure of the level of oxygen that is available for use by organisms within a body of water, and an indicator of the ability of a body of water to support aquatic life.

Erodability

The tendency of a disposed material to be worn away by natural forces within the water body (versus its tendency to remain in place, despite the presence of natural forces that have the potential to disperse it).

Estuary

A partially enclosed coastal body of brackish water with one or more rivers or streams flowing into it, and with a free connection to the open sea.

High molecular weight hydrocarbons

Hydrocarbons are a class of organic compounds that consist of carbon and hydrogen bonds only. A hydrocarbon is considered to have a high molecular weight when it has five or more carbon rings. High molecular weight hydrocarbons are generally introduced into the environment as a result of industrial activities such as manufacturing, expending fossil fuels, or burning municipal and industrial waste.

In situ

In place or on-site.

Littoral zone

Refers to the zone of water near or along the shoreline.

Macrofauna

For the purposes of disposal at sea, macrofauna are benthic organisms that are larger than 0.5 mm.

Meiofauna

For the purposes of disposal at sea, meiofauna are benthic organisms between 0.5 mm and 0.062 mm in size.

Microfauna

For the purposes of disposal at sea, microfauna are benthic organisms that are smaller than 0.062 mm.[16]

Nutrients

Substances considered to promote the growth of organisms (e.g. nitrogen or phosphorus), but that can have

[16] Nybakken, J. W. 1993. Marine Biology: An Ecological Approach, Third Edition, HarperCollins College Publishers, New York.

adverse effects on the marine environment when present at elevated levels.

pH

For the purposes of disposal at sea, pH is a numeric value that measures the acidity or alkalinity of the sediment or water at the load or dump-site. pH values range on a scale of 0 to 14, with values less than 7 generally considered acidic and values greater than 7 generally considered alkaline or basic. pH is one factor that affects the bioavailability of contaminants present in water or sediment.

Pycnocline

Refers to the layer of water in the ocean where the water density increases rapidly with depth due to changes in salinity and/or temperature. When the change in density is a result of temperature then it is referred to as the thermocline.

Quality assurance and quality control (QA/QC)

The management, procedures and techniques used to assess and ensure that reliable, accurate and/or valid data are obtained.

Residual adverse effects

For the purpose of this document, a residual adverse effect is a harmful effect caused by the disposal of material after the act of disposal has occurred.

Salinity

A measure of the concentration of dissolved salts within a body of water.

Shoaling

A change in wave behaviour due to a change in the morphology of the seabed, such as the creation of a mound on the sea floor following the dumping of dredged material, or the creation of a depression in the sea floor following the dredging of sediments.

Substrate

For the purpose of dumping at sea, the substrate refers to the sediment layer at the bottom of a water body.

Suspended sediment

Inorganic and organic particles that are suspended in water. Fine particles of sand, silt and clay, as well as other biological or other solid materials, may be suspended in the water column.

Thermocline

Refers to the layer of water in the ocean where the water density increases rapidly with depth due to changes in salinity and/or temperature. When the change in density is a result of temperature then it is referred to as the thermocline. See Pycnocline.

Thin layer dumping

A method of dumping of dredged material in a controlled manner, typically involving high-pressure spraying over open water, resulting in a layer of sediment 30 cm thick or less, once settled, and often conducted to minimize the physical effects of dumping on biological resources.[17]

Tidal ellipse

A visual representation of the direction and magnitude (vectors) of tidal currents throughout one or more tidal cycles. The orientation of the tidal ellipse is measured in degrees, clockwise or counter-clockwise with respect to one of the four cardinal directions.

Total organic carbon (TOC)

A measurement of the total amount of organic material present within a body of sediment. TOC is often used as an indicator of potential sediment contamination, because many types of contaminants will bind preferentially to organic matter.

Toxicology

The study of toxicity, involving an analysis of the potential or ability of a contaminant to cause adverse effects in exposed organisms.

Turbidity

Turbidity is a measure of the transparency of a body of water. Variations in the amount of sediment that is suspended within the water column is one factor that can affect turbidity levels.

Turbidity plume

In the context of dumping at sea of wastes or other matter, a turbidity plume refers to a visible increase in turbidity above ambient conditions due to an increase in suspended sediments during dumping operations.

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17 http://www.dtic.mil/get-tr-doc/pdf?AD=ADA223136

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