GUIDANCE TO DUMPING OF MATERIALS AT SEA

SPREP
Secretariat of the Pacific Regional Environment Programme

INTERNATIONAL MARITIME ORGANIZATION

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SPREP Vision: The Pacific environment, sustaining our livelihoods and natural heritage in harmony with our cultures.

GUIDANCE TO DUMPING OF MATERIALS AT SEA

Secretariat of the Pacific Regional Environment Programme (SPREP), aims to assist the Pacific Nations with the relevant information and guidance required to assist Nations in relation to the assessment of dumping of materials at sea. The guidance offers no judgment on the type of method best suited to any particular Nation, but identifies some of the options available for consideration. These guidelines deal only with aspects under the purview of the London Convention 1972 and the 1996 Protocol. Nations are to be aware that environmental impacts may result from the disposal of materials at sea.

The "Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972" (the "London Convention") is an international treaty that limits the discharge of wastes that are generated on land and disposed of at sea.

The London Convention 1972 was one of the first global conventions to protect the marine environment from human activities and has been in force since 1975. Its objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes. Under the Protocol all dumping is prohibited, but Parties may issue permits to allow the dumping of the following specified materials, subject to certain conditions:

- dredged material;
- sewage sludge;
- fish wastes;
- vessels and platforms;
- inert, inorganic geological material (e.g., mining wastes);
- organic material of natural origin;
- bulky items primarily comprising iron, steel and concrete; and
- carbon dioxide streams from carbon dioxide capture processes for sequestration (CCS).

The purpose of this guide is to make available the guide lines for the assessment of dumping of materials at sea, Attachments A through L. The approach recommended in this guide combines standard IMO policy that are commonly used elsewhere around the world.

For the purpose of this guide:

- "Dumping" **means**:

  (i) any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea;

  (ii) any deliberate disposal at sea of vessels, aircraft, platforms or other man-made structures at sea.

- "Dumping" **does not** include:

  (i) the disposal at sea of wastes or other matter incidental to, or derived from the normal operations of vessels, aircraft, platforms or other man-made structures at sea and their equipment, other than wastes or other matter transported by or to vessels, aircraft, platforms or other man-made structures at sea, operating for the purpose of disposal of such matter or derived from the treatment of such wastes or other matter on such vessels, aircraft, platforms or structures;

(ii) placement of matter for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of this Convention.

Note: The disposal of wastes or other matter directly arising from, or related to the exploration, exploitation and associated offshore processing of sea-bed mineral resources will not be covered by the London Convention 1972.

This guidance paper is an interim measure as SPREP is currently in the process of developing complete, comprehensive environmental guide lines for each industry sector, including the Marine sector.

ATTACHMENTS

- Attachment A - Implementation guidance;
- Attachment B - Generic guidance on "*de minimis";*
- Attachment C - Dredged material;
- Attachment D - Sewage sludge;
- Attachment E - Fish wastes;
- Attachment F- Vessels;
- Attachment G - Platforms;
- Attachment H - Inert, inorganic geological material (e.g., mining wastes);
- Attachment I - Organic material of natural origin;
- Attachment J - Bulky items primarily comprising iron, steel and concrete;
- Attachment K - Carbon dioxide streams from carbon dioxide capture processes for sequestration (CCS); and
- Attachment L - Dredged material action list.

GUIDANCE ON THE NATIONAL IMPLEMENTATION OF THE 1996 PROTOCOL TO THE LONDON CONVENTION 1972

EXPLANATORY NOTE

1 The 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Convention 1972) was adopted in 1996 at the Special Meeting of Contracting Parties to the London Convention 1972. Eventually, the 1996 Protocol will supersede the London Convention 1972 as between Contracting Parties to the Protocol, which are also Contracting Parties to the Convention (Article 23).

2 The attached "Guidance on the National Implementation of the 1996 Protocol to the London Convention 1972" ("The Guidance"), adopted by the Contracting Parties to the Convention at their Twenty-third Consultative Meeting, is offered for the consideration of States which may be interested in becoming Party to the Protocol. Its purpose is to provide an outline of the types of action which States need to take, or consider taking, at the national level in order to implement the provisions of the Protocol. The Consultative Meeting expressed the hope that this Guidance would be found useful by those concerned, and furthermore, it was accepted that Contracting Parties to the Protocol would need to decide how best to implement their obligations in their national systems.

3 The Guidance covers only those provisions of the Protocol which require national action by individual Contracting Parties. It omits reference to provisions which refer to action to be taken collectively or by others, such as those providing for Meetings of Contracting Parties and the duties of the IMO.

4 The Guidance is set out in two columns: in Column I the principal provisions of the Protocol which are addressed to individual Contracting Parties are summarized. In Column II an outline is given of the content of national implementation action to be considered, including an indication of different possible approaches.

5 The Guidance is based upon recognition of the well-established rules of international treaty law that every treaty in force is binding upon the parties to it and must be performed by them in good faith and that a party may not invoke the provisions of its internal law as justification for its failure to perform a treaty[1].

6 The Consultative Meeting also acknowledged that it is for each Contracting Party to decide the most appropriate form and method for implementing its treaty obligations. It is not possible to formulate one type of model legislative or other kind of measure for implementing the Protocol. The nature of legislative, regulatory, administrative and policy measures suitable for each Contracting Party may depend on a variety of factors, for example:

- whether there is existing national legislation capable of adaptation or amendment or whether completely new legislation is needed;

- whether that Contracting Party wishes to develop legislation solely for implementation of this Protocol or also to cover obligations under other international or regional treaties;

[1] Vienna Convention on the Law of Treaties, Articles 26 and 27.

- the legal tradition of that country, e.g., common law or civil law, the mode of incorporation of treaties into national law; and

- whether that Contracting Party has any marine waters, etc.

7 The Guidance offers no judgment on the type of method best suited to any particular Contracting Party, but identifies some of the options available for consideration, based on the existing experience of States, particularly those which have already implemented the Protocol in their national systems.

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ATTACHMENT

GUIDANCE ON THE NATIONAL IMPLEMENTATION OF THE 1996 PROTOCOL TO THE LONDON CONVENTION 1972

I PROTOCOL PROVISION[2]	II NATIONAL IMPLEMENTATION
Article 1 - Definitions of: • Dumping • Incineration at sea • Vessels and aircraft • Sea • Wastes or other matter • Permit • Pollution	In the preparation of legislation and/or regulations, Contracting Parties should consider defining the concepts set out in the Protocol definitions in a manner consistent with the scope of the Protocol.

[2] Except for the Definitions and Annexes 1 and 2, the relevant Protocol provisions are included verbatim. Definitions and Annexes 1 and 2 are appended hereto.

I PROTOCOL PROVISION	II NATIONAL IMPLEMENTATION
Article 2 - Objectives: Contracting Parties shall individually and collectively protect and preserve the marine environment from all sources of pollution and take effective measures, according to their scientific, technical and economic capabilities, to prevent, reduce and where practicable eliminate pollution caused by dumping or incineration at sea of wastes or other matter. Where appropriate, they shall harmonize their policies in this regard.	Contracting Parties may wish to consider incorporating language reflecting the Objectives in their legislation to guide their administrative authorities; Contracting Parties should consider whether further legal, policy or administrative measures are appropriate to achieve the Objectives.
Article 3.1 - General Obligations: In implementing this Protocol, Contracting Parties shall apply a precautionary approach to environmental protection from dumping of wastes or other matter whereby appropriate preventative measures are taken when there is reason to believe that wastes or other matter introduced into the marine environment are likely to cause harm even when there is no conclusive evidence to prove a causal relation between inputs and their effects.	Formulate a policy objective of applying a precautionary approach to environmental protection from the dumping of wastes or other matter. Ensure that legislation, regulations, and/or administrative measures adopted to implement the Protocol apply this precautionary approach. For example, Annexes 1 and 2 reflect this precautionary approach.
Article 3.2: Taking into account the approach that the polluter should, in principle, bear the cost of pollution, each Contracting Party shall endeavour to promote practices whereby those it has authorized to engage in dumping or incineration at sea bear the cost of meeting the pollution prevention and control requirements for the authorized activities, having due regard to the public interest.	Promote legal and/or administrative measures reflecting the polluter pays approach (e.g., pollution prevention and management activities, which could include cost-recovery for a waste prevention audit, sampling, analysis, supervision, inspection and monitoring to be borne by the applicant of permits).
Article 3.3: In implementing the provisions of this Protocol, Contracting Parties shall act so as not to transfer, directly or indirectly, damage or likelihood of damage from one part of the environment to another or transform one type of pollution into another.	Apply an integrated environmental approach which evaluates the potential effects on different environmental components through the application of Annex 2 and a comparative risk assessment of all environmental media such as land, air, water, groundwater, etc. The approach can be expressed through environmental legislation and/or regulations.
Article 4 - Dumping of Wastes or Other Matter: **Article 4.1.1:** Contracting Parties shall prohibit the dumping of any wastes or other matter with the exception of those listed in Annex 1.	Prepare legislation and/or regulations prohibiting the dumping of wastes or other matter, with the exception of those listed in Annex 1. Annex 1 identifies wastes or other matter that may be considered for dumping (including application of guidance developed under the Protocol). (The full text of Annex 1 is appended at the end of this document.)

I PROTOCOL PROVISION	II NATIONAL IMPLEMENTATION
Article 4.1.2: The dumping of wastes or other matter listed in Annex 1 shall require a permit. Contracting Parties shall adopt administrative or legislative measures to ensure that issuance of permits and permit conditions comply with provisions of Annex 2. Particular attention shall be paid to opportunities to avoid dumping in favour of environmentally preferable alternatives.	Establish a permit-system including: • designation or establishment of an appropriate authority or authorities responsible for the issuance of permits (see Article 9.1); • establishment of administrative procedures for the issuance of permits; • establishment of procedures to review permits at regular intervals; • setting of monitoring and surveillance conditions (see Article 9.1.3); • designation of approved sites Annex 2 outlines a precautionary procedure for considering disposal at sea (including guidance on waste prevention, pollution prevention, application review, permit issuance, monitoring and assessment). (The full text of Annex 2 is appended at the end of this document.) In addition the following support elements warrant attention: • certification of equipment and vessels involved in dumping operations; • quality assurance for sampling and analysis; • training/education of officers involved; • establishment of contacts with all involved parties.
Article 4.2: No provision of this Protocol shall be interpreted as preventing a Contracting Party from prohibiting, insofar as that Contracting Party is concerned, the dumping of wastes or other matter mentioned in Annex 1. That Contracting Party shall notify the Organization of such measures.	If the Contracting Party opts to prohibit the dumping of wastes or other matter mentioned in Annex 1, legislation and/or regulations should be prepared setting forth such prohibitions. The authority established under Article 9.1 could be selected as a national focal point for notification of this and all other measures required under the Protocol.
Article 5 - Incineration at Sea: Contracting Parties shall prohibit incineration at sea of wastes or other matter.	Prepare legislation or regulations prohibiting incineration at sea.
Article 6 - Export of wastes or other matter: Contracting Parties shall not allow the export of wastes or other matter to other countries for dumping or incineration at sea.	Prepare legislation and/or regulations prohibiting the export of wastes to other countries for dumping or incineration at sea[3]; due account should be given to the requirements under the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

[3] Contracting Parties may wish to consider the logic of banning import for disposal at sea at the same time they ban export.

I PROTOCOL PROVISION	II NATIONAL IMPLEMENTATION
Article 7 - Internal Waters: **Article 7.2:** Each Contracting Party shall at its discretion either apply the provisions of this Protocol or adopt other effective permitting and regulatory measures to control the deliberate disposal of wastes or other matter in marine internal waters where such disposal would be "dumping" or "incineration at sea" within the meaning of article 1, if conducted at sea.	Identify marine internal waters. Prepare legislation and/or regulations where necessary regarding the rules applicable to the dumping of wastes or other matter in marine internal waters (i.e. either the Protocol rules or "other effective permitting and regulatory measures").
Article 7.3: Each Contracting Party should provide the Organization with information on legislation and institutional mechanisms regarding implementation, compliance and enforcement in marine internal waters. Contracting Parties should also use their best efforts to provide on a voluntary basis summary reports on the type and nature of the materials dumped in marine internal waters.	Consider utilizing the designated authority or national focal point for notification of this and all other reporting required under the protocol (see Article 9.1). Consider the establishment of mechanisms for the voluntary reporting of wastes or other matter dumped in marine internal waters.
Article 8 – Exceptions: **Article 8.1:** The provisions of articles 4.1 and 5 shall not apply when it is necessary to secure the safety of human life or of vessels, aircraft, platforms or other man-made structures at sea in cases of force majeure caused by stress of weather, or in any case which constitutes a danger to human life or a real threat to vessels, aircraft, platforms or other man-made structures at sea, if dumping or incineration at sea appears to be the only way of averting the threat and if there is every probability that the damage consequent upon such dumping or incineration at sea will be less than would otherwise occur. Such dumping or incineration at sea shall be conducted so as to minimize the likelihood of damage to human or marine life and shall be reported forthwith to the Organization.	Develop legislation and/or regulations regarding force majeure dumping or incineration at sea, addressing inter alia: • the Article 8.1 conditions, (including the requirement to minimize the likelihood of damage to human or marine life) • Contracting Parties should consider appropriate legal or administrative means within their respective jurisdictions for obtaining this information for such reporting. Establish administrative mechanisms to report force majeure dumping and incineration at sea to the IMO.

I PROTOCOL PROVISION	II NATIONAL IMPLEMENTATION
Article 8.2: A Contracting Party may issue a permit as an exception to articles 4.1 and 5, in emergencies posing an unacceptable threat to human health, safety, or the marine environment and admitting of no other feasible solution. Before doing so the Contracting Party shall consult any other country or countries that are likely to be affected and the Organization which, after consulting other Contracting Parties, and competent international organizations as appropriate, shall, in accordance with article 18.6 promptly recommend to the Contracting Party the most appropriate procedures to adopt. The Contracting Party shall follow these recommendations to the maximum extent feasible consistent with the time within which action must be taken and with the general obligation to avoid damage to the marine environment and shall inform the Organization of the action it takes. The Contracting Parties pledge themselves to assist one another in such situations.	Develop legislation and/or regulations instituting procedures regarding emergency dumping or incineration at sea under the conditions set out in Article 8.2, including inter alia: • establishment of an emergency permit system; • establishment of a consultation procedure with IMO and other Contracting Parties.
Article 9 - Issuance of Permits and Reporting: **Article 9.1:** Each Contracting Party shall designate an appropriate authority or authorities to: .1 issue permits in accordance with this Protocol; .2 keep records of the nature and quantities of all wastes or other matter for which dumping permits have been issued and where practicable the quantities actually dumped and the location, time and method of dumping; and .3 monitor individually, or in collaboration with other Contracting Parties and competent international organizations, the condition of the sea for the purposes of this Protocol.	Prepare legislation and/or regulations authorizing the designated authority to issue permits in accordance with Articles 4.1.2 and 8.2 of the Protocol and enabling the designated authority to, inter alia: • inventory current sea disposal operations; • assess applications for dumping permits (including application of guidance developed under Annex 2); • designate and monitor disposal sites. Identify national capability to assess marine scientific data, and collaborate with other Contracting Parties as needed.
Article 9.2: The appropriate authority or authorities of a Contracting Party shall issue permits in accordance with this Protocol in respect of wastes or other matter intended for dumping or, as provided for in article 8.2, incineration at sea: .1 loaded in its territory; and .2 loaded onto a vessel or aircraft registered in its territory or flying its flag, when the loading occurs in the territory of a State not a Contracting Party to this Protocol.	Issue permits for wastes loaded in its territory or loaded on vessels registered in its territory when the loading occurs in the territory of a non-Contracting Party.
Article 9.3: In issuing permits, the appropriate authority or authorities shall comply with the requirements of article 4, together with such additional criteria, measures and requirements as they may consider relevant.	Apply Article 4 of the Protocol and other additional criteria considered relevant.

I PROTOCOL PROVISION	II NATIONAL IMPLEMENTATION
Article 9.4: Each Contracting Party, directly or through a secretariat established under a regional agreement, shall report to the Organization and where appropriate to other Contracting Parties: .1 the information specified in paragraphs 1.2 and 1.3; .2 the administrative and legislative measures taken to implement the provisions of this Protocol, including a summary of enforcement measures; and .3 the effectiveness of the measures referred to in paragraph 4.2 and any problems encountered in their application. The information referred to in paragraphs 1.2 and 1.3 shall be submitted on an annual basis. The information referred to in paragraphs 4.2 and 4.3 shall be submitted on a regular basis.	Report to the IMO permit and dumping information, administrative and legislative measures taken to implement the Protocol.
Article 10 - Application and Enforcement: **Article 10.1:** Each Contracting Party shall apply the measures required to implement this Protocol to all: .1 vessels and aircraft registered in its territory or flying its flag; .2 vessels and aircraft loading in its territory the wastes or other matter which are to be dumped or incinerated at sea; and .3 vessels, aircraft and platforms or other man-made structures believed to be engaged in dumping or incineration at sea in areas within which it is entitled to exercise jurisdiction in accordance with international law.	Each Contracting Party is required to apply the measures required to implement the Protocol to its vessels and aircraft, those loading in its territory, and those engaged in dumping or incineration at sea in areas within which it is entitled to exercise jurisdiction in accordance with international law. Some Contracting Parties may need to extend the scope of their legislative and enforcement jurisdiction in order to implement these provisions. Those Contracting Parties which have not established an Exclusive Economic Zone as permitted by the UN Convention on the Law of the Sea may wish to consider doing so.

I PROTOCOL PROVISION	II NATIONAL IMPLEMENTATION
Article 10.2: Each Contracting Party shall take appropriate measures in accordance with international law to prevent and if necessary punish acts contrary to the provisions of this Protocol.	Prepare legislation and/or regulations required to establish offences and penalties for infringements of national laws implementing the 1996 Protocol. Such penalties could include fines, compensation, or restitution for environmental damage. Designate an authority or authorities responsible for compliance with and enforcement of permit conditions whose duties could include inter alia: • inspection of dumping vessels; • compliance monitoring of permit conditions; • networking with national inspection services at sea such as fisheries inspection, customs, navy, coast guard, and maritime administrations; • networking with private sector operating at sea (offshore industry, tourist industry, fisheries) in order to create public support for the observance of Protocol rules; • review of disposal site monitoring.
Article 10.4: This Protocol shall not apply to those vessels and aircraft entitled to sovereign immunity under international law. However, each Contracting Party shall ensure by the adoption of appropriate measures that such vessels and aircraft owned or operated by it act in a manner consistent with the object and purpose of this Protocol and shall inform the Organization accordingly.	• Develop appropriate measures to ensure that those vessels and aircraft entitled to sovereign immunity act in a manner consistent with the object and purpose of Protocol; • Identify a national focal point for notification of this and all other reporting required under the Protocol; • Inform the IMO about measures applicable to such vessels and aircraft.
Article 10.5: A State may, at the time it expresses its consent to be bound by this Protocol, or at any time thereafter, declare that it shall apply the provisions of this Protocol to its vessels and aircraft referred to in paragraph 4, recognising that only that State may enforce those provisions against such vessels and aircraft.	Inform the Secretary-General that it will apply the Protocol provisions to its vessels and aircraft entitled to sovereign immunity.

I PROTOCOL PROVISION	II NATIONAL IMPLEMENTATION
Article 13: Contracting Parties shall, through collaboration within the Organization and in co-ordination with other competent international organizations, promote bilateral and multilateral support for the prevention, reduction and where practicable elimination of pollution caused by dumping as provided for in this Protocol to those Contracting Parties that request it for: .1 training of scientific and technical personnel for research, monitoring and enforcement, including as appropriate the supply of necessary equipment and facilities, with a view to strengthening national capabilities; .2 advice on implementation of this Protocol; .3 information and technical co-operation relating to waste minimization and clean production processes; .4 information and technical co-operation relating to the disposal and treatment of waste and other measures to prevent, reduce and where practicable eliminate pollution caused by dumping; and .5 access to and transfer of environmentally sound technologies and corresponding know-how, in particular to developing countries and countries in transition to market economies, on favourable terms, including on concessional and preferential terms, as mutually agreed, taking into account the need to protect intellectual property rights as well as the special needs of developing countries and countries in transition to market economies. The Organization shall perform the following functions: .1 forward requests from Contracting Parties for technical co-operation to other Contracting Parties, taking into account such factors as technical capabilities; .2 co-ordinate requests for assistance with other competent international organizations, as appropriate; and .3 subject to the availability of adequate resources, assist developing countries and those in transition to market economies, which have declared their intention to become Contracting Parties to this Protocol, to examine the means necessary to achieve full implementation.	Prepare policy and administrative procedures for handling requests for technical co-operation and assistance to complement the responsibilities of IMO in this regard.

I PROTOCOL PROVISION	II NATIONAL IMPLEMENTATION
Article 14.1: Contracting Parties shall take appropriate measures to promote and facilitate scientific and technical research on the prevention, reduction and where practicable elimination of pollution by dumping and other sources of marine pollution relevant to this Protocol. In particular, such research should include observation, measurement, evaluation and analysis of pollution by scientific methods.	Adopt measures for promoting and facilitating scientific and technical research on the prevention, reduction and where practicable elimination of pollution by dumping and other sources of marine pollution; ongoing identification or designation of an authority responsible for the promotion and facilitation of scientific and technical research may contribute to the reliability of those measures.
Article 14.2: Contracting Parties shall, to achieve the objectives of this Protocol, promote the availability of relevant information to other Contracting Parties who request it on: .1 scientific and technical activities and measures undertaken in accordance with this Protocol; .2 marine scientific and technological programmes and their objectives; and .3 the impacts observed from the monitoring and assessment conducted pursuant to article 9.1.3.	Prepare policy and administrative procedures for handling requests for relevant information.
Article 26.1: Any State that was not a Contracting Party to the Convention before 31 December 1996 and that expresses its consent to be bound by this Protocol prior to its entry into force or within five years after its entry into force may, at the time it expresses its consent, notify the Secretary-General that, for reasons described in the notification, it will not be able to comply with specific provisions of this Protocol other than those provided in paragraph 2, for a transitional period that shall not exceed that described in paragraph 4.	• State to assess whether it is eligible to claim a transitional period. • Specify the provisions of the Protocol with which it will not be able to comply during the permitted transitional period. • Describe the reasons for non-compliance. • Notify the Secretary-General.
Article 26.2: No notification made under paragraph 1 shall affect the obligations of a Contracting Party to this Protocol with respect to incineration at sea or the dumping of radioactive wastes or other radioactive matter.	Prepare legislation and/or regulations prohibiting incineration at sea (Article 5) and the dumping of radioactive wastes or other radioactive matter (Article 4).
Article 26.3: Any Contracting Party to this Protocol that has notified the Secretary-General under paragraph 1 that, for the specified transitional period, it will not be able to comply, in part or in whole, with article 4.1 or article 9 shall nonetheless during that period prohibit the dumping of wastes or other matter for which it has not issued a permit, use its best efforts to adopt administrative or legislative measures to ensure that issuance of permits and permit conditions comply with the provisions of Annex 2, and notify the Secretary-General of any permits issued.	Prepare legislation or regulations during the transitional period to prohibit: • the dumping of wastes or other matter at sea for which no permits have been issued ; • establish a permit system as far as achievable. Notify the Secretary-General.

I PROTOCOL PROVISION	II NATIONAL IMPLEMENTATION
Article 26.5: Contracting Parties that have made a notification under paragraph 1 shall submit to the first Meeting of Contracting Parties occurring after deposit of their instrument of ratification, acceptance, approval or accession a programme and timetable to achieve full compliance with this Protocol, together with any requests for relevant technical co-operation and assistance in accordance with article 13 of this Protocol.	Appoint a national authority responsible for reporting a programme and timetable of efforts to achieve full compliance with the Protocol. These reports may include requests for technical assistance.
Article 26.6: Contracting Parties that have made a notification under paragraph 1 shall establish procedures and mechanisms for the transitional period to implement and monitor submitted programmes designed to achieve full compliance with this Protocol. A report on progress toward compliance shall be submitted by such Contracting Parties to each Meeting of Contracting Parties held during their transitional period for appropriate action.	Designate an authority to: • establish procedures and mechanisms regarding the implementation and monitoring of submitted programmes; • prepare the reports to be submitted to the Meeting of Contracting Parties.

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DEFINITIONS AS CONTAINED IN ARTICLE 1 OF THE 1996 PROTOCOL

For the purposes of this Protocol:

1 "Convention" means the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, as amended.

2 "Organization" means the International Maritime Organization.

3 "Secretary-General" means the Secretary-General of the Organization.

4 .1 "Dumping" means:

.1 any deliberate disposal into the sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea;

.2 any deliberate disposal into the sea of vessels, aircraft, platforms or other man-made structures at sea;

.3 any storage of wastes or other matter in the seabed and the subsoil thereof from vessels, aircraft, platforms or other man-made structures at sea; and

.4 any abandonment or toppling at site of platforms or other man-made structures at sea, for the sole purpose of deliberate disposal.

.2 "Dumping" does not include:

.1 the disposal into the sea of wastes or other matter incidental to, or derived from the normal operations of vessels, aircraft, platforms or other man-made structures at sea and their equipment, other than wastes or other matter transported by or to vessels, aircraft, platforms or other man-made structures at sea, operating for the purpose of disposal of such matter or derived from the treatment of such wastes or other matter on such vessels, aircraft, platforms or other man-made structures;

.2 placement of matter for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of this Protocol; and

.3 notwithstanding paragraph 4.1.4, abandonment in the sea of matter (e.g., cables, pipelines and marine research devices) placed for a purpose other than the mere disposal thereof.

.3 The disposal or storage of wastes or other matter directly arising from, or related to the exploration, exploitation and associated off-shore processing of seabed mineral resources is not covered by the provisions of this Protocol.

5 .1 "Incineration at sea" means the combustion on board a vessel, platform or other man-made structure at sea of wastes or other matter for the purpose of their deliberate disposal by thermal destruction.

.2 "Incineration at sea" does not include the incineration of wastes or other matter on board a vessel, platform, or other man-made structure at sea if such wastes or other matter were generated during the normal operation of that vessel, platform or other man-made structure at sea.

6 "Vessels and aircraft" means waterborne or airborne craft of any type whatsoever. This expression includes air-cushioned craft and floating craft, whether self-propelled or not.

7 "Sea" means all marine waters other than the internal waters of States, as well as the seabed and the subsoil thereof; it does not include sub-seabed repositories accessed only from land.

8 "Wastes or other matter" means material and substance of any kind, form or description.

9 "Permit" means permission granted in advance and in accordance with relevant measures adopted pursuant to article 4.1.2 or 8.2.

10 "Pollution" means the introduction, directly or indirectly, by human activity, of wastes or other matter into the sea which results or is likely to result in such deleterious effects as harm to living resources and marine ecosystems, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.

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FULL TEXT OF ANNEX 1 TO THE 1996 PROTOCOL

WASTES OR OTHER MATTER THAT MAY BE CONSIDERED FOR DUMPING

1 The following wastes or other matter are those that may be considered for dumping being mindful of the Objectives and General Obligations of this Protocol set out in articles 2 and 3:

.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; and
.7 bulky items primarily comprising iron, steel, concrete and similarly non-harmful 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.

2 The wastes or other matter listed in paragraphs 1.4 and 1.7 may be considered for dumping, provided that material capable of creating floating debris or otherwise contributing to pollution of the marine environment has been removed to the maximum extent and provided that the material dumped poses no serious obstacle to fishing or navigation.

3 Notwithstanding the above, materials listed in paragraphs 1.1 to 1.7 containing levels of radioactivity greater than *de minimis* (exempt) concentrations as defined by the IAEA and adopted by Contracting Parties, shall not be considered eligible for dumping; provided further that within 25 years of 20 February 1994, and at each 25 year interval thereafter, Contracting Parties shall complete a scientific study relating to all radioactive wastes and other radioactive matter other than high level wastes or matter, taking into account such other factors as Contracting Parties consider appropriate and shall review the prohibition on dumping of such substances in accordance with the procedures set forth in article 22.

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FULL TEXT OF ANNEX 2 TO THE 1996 PROTOCOL

ASSESSMENT OF WASTES OR OTHER MATTER THAT MAY BE CONSIDERED FOR DUMPING

GENERAL

1 The acceptance of dumping under certain circumstances shall not remove the obligations under this Annex to make further attempts to reduce the necessity for dumping.

WASTE PREVENTION AUDIT

2 The initial stages in assessing alternatives to dumping should, as appropriate, include an evaluation of:

.1 types, amounts and relative hazard of wastes generated;
.2 details of the production process and the sources of wastes within that process; and
.3 feasibility of the following waste reduction/prevention techniques:

    .1 product reformulation;
    .2 clean production technologies;
    .3 process modification;
    .4 input substitution; and
    .5 on-site, closed-loop recycling.

3 In general terms, if the required audit reveals that opportunities exist for waste prevention at source, an applicant is expected to formulate and implement a waste prevention strategy, in collaboration with relevant local and national agencies, which includes specific waste reduction targets and provision for further waste prevention audits to ensure that these targets are being met. Permit issuance or renewal decisions shall assure compliance with any resulting waste reduction and prevention requirements.

4 For dredged material and sewage sludge, the goal of waste management should be to identify and control the sources of contamination. This should be achieved through implementation of waste prevention strategies and requires collaboration between the relevant local and national agencies involved with the control of point and non-point sources of pollution. Until this objective is met, the problems of contaminated dredged material may be addressed by using disposal management techniques at sea or on land.

CONSIDERATION OF WASTE MANAGEMENT OPTIONS

5 Applications to dump wastes or other matter shall demonstrate that appropriate consideration has been given to the following hierarchy of waste management options, which implies an order of increasing environmental impact:

.1 re-use;
.2 off-site recycling;
.3 destruction of hazardous constituents;
.4 treatment to reduce or remove the hazardous constituents; and
.5 disposal on land, into air and in water.

6 A permit to dump wastes or other matter shall be refused if the permitting authority determines that appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to human health or the environment or disproportionate costs. The practical availability of other means of disposal should be considered in the light of a comparative risk assessment involving both dumping and the alternatives.

CHEMICAL, PHYSICAL AND BIOLOGICAL PROPERTIES

7 A detailed description and characterization of the waste is an essential precondition for the consideration of alternatives and the basis for a decision as to whether a waste may be dumped. If a waste is so poorly characterized that proper assessment cannot be made of its potential impacts on human health and the environment, that waste shall not be dumped.

8 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.

ACTION LIST

9 Each Contracting Party shall develop a national Action List to provide a mechanism for screening candidate wastes and their constituents on the basis of their potential effects on human health and the marine environment. In selecting substances for consideration in an Action List, priority shall be given to toxic, persistent and bioaccumulative substances from anthropogenic sources (e.g., cadmium, mercury, organohalogens, petroleum hydrocarbons, and, whenever relevant, arsenic, lead, copper, zinc, beryllium, chromium, nickel and vanadium, organosilicon compounds, cyanides, fluorides and pesticides or their by-products other than organohalogens). An Action List

can also be used as a trigger mechanism for further waste prevention considerations.

10 An Action List shall specify an upper level and may also specify a lower level. The upper level should be set so as to avoid acute or chronic effects on human health or on sensitive marine organisms representative of the marine ecosystem. Application of an Action List will result in three possible categories of waste:

.1 wastes which contain specified substances, or which cause biological responses, exceeding the relevant upper level shall not be dumped, unless made acceptable for dumping through the use of management techniques or processes;
.2 wastes which contain specified substances, or which cause biological responses, below the relevant lower levels should be considered to be of little environmental concern in relation to dumping; and
.3 wastes which contain specified substances, or which cause biological responses, below the upper level but above the lower level require more detailed assessment before their suitability for dumping can be determined.

DUMP-SITE SELECTION

11 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.

ASSESSMENT OF POTENTIAL EFFECTS

12 Assessment of potential effects should lead to a concise statement of the expected consequences of the sea or land disposal options, i.e., the "Impact Hypothesis". It provides a basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements.

13 The assessment for dumping should integrate information on waste characteristics, conditions at the proposed dump-site(s), fluxes, and proposed disposal techniques and specify the potential effects on human health, living resources, amenities and other legitimate uses of the sea. It should define the nature, temporal and spatial scales and duration of expected impacts based on reasonably conservative assumptions.

14 An analysis of each disposal option should be considered in the light of a comparative assessment of the following concerns: human health risks, environmental costs, hazards, (including accidents), economics and exclusion of future uses. If this assessment reveals that adequate information is not available to determine the likely effects of the proposed disposal option then this option should not be considered further. In addition, if the interpretation of the comparative assessment shows the dumping option to be less preferable, a permit for dumping should not be given.

15 Each assessment should conclude with a statement supporting a decision to issue or refuse a permit for dumping.

MONITORING

16 Monitoring is used to verify that permit conditions are met - compliance monitoring - and that the assumptions made during the permit review and site selection process were correct and sufficient to protect the environment and human health - field monitoring. It is essential that such monitoring programmes have clearly defined objectives.

PERMIT AND PERMIT CONDITIONS

17 A decision to issue a permit should only be made if all impact evaluations are completed and the monitoring requirements are determined. The provisions of the permit shall ensure, as far as practicable, that environmental disturbance and detriment are minimized and the benefits maximized. Any permit issued shall contain data and information specifying:

.1 the types and sources of materials to be dumped;
.2 the location of the dump-site(s);
.3 the method of dumping; and
.4 monitoring and reporting requirements.

18 Permits should be reviewed at regular intervals, taking into account the results of monitoring and the objectives of monitoring programmes. Review of monitoring results will indicate whether field programmes need to be continued, revised or terminated and will contribute to informed decisions regarding the continuance, modification or revocation of permits. This provides an important feedback mechanism for the protection of human health and the marine environment.

GUIDELINES FOR THE APPLICATION OF THE *DE MINIMIS* CONCEPT UNDER THE LONDON CONVENTION 1972

(adopted in 1999, amended in 2003)

1 INTRODUCTION

1.1 The London Convention 1972 prohibits the disposal at sea of radioactive wastes and other radioactive matter. However, all materials, including natural and inert materials, contain natural radionuclides and are frequently contaminated with artificial radionuclides from such anthropogenic sources as fallout due to past atmospheric nuclear testing. Therefore, the Contracting Parties to the London Convention 1972 recognized the need to develop definitions and guidelines whereby candidate materials (those wastes or other matter not otherwise prohibited from disposal at sea in accordance with Annex I to the Convention) containing *de minimis* levels of radionuclides could be disposed of pursuant to the provisions of this Convention. The full text of Annex I to the London Convention 1972, as amended in 1993, is attached in an appendix to these Guidelines.

1.2 The concept of "*de minimis*" for radioactive substances was initially discussed in 1976 at the First Consultative Meeting of Contracting Parties to the London Convention 1972. Since that time, the International Atomic Energy Agency (IAEA) has prepared several reports on the subject, all of which reflect contemporary development of the concept at the time of publication. Parallel to progress in the field of radiation protection, there have been developments in the framework of the Convention itself. In 1993, the Annexes I and II to the London Convention 1972 were amended to prohibit the dumping at sea of radioactive wastes or other radioactive matter. At the Nineteenth Consultative Meeting in 1997, Contracting Parties agreed to request the IAEA to develop further the concept of *de minimis* and, in particular, to "provide guidance for making judgements on whether materials planned to be dumped could be exempted from radiological control or whether a specific assessment was needed" (LC 19/10, paragraph 6.31). This paragraph continues: "The IAEA would then further be requested to provide guidance to national authorities responsible for conducting specific assessments."

1.3 In 1998, the IAEA presented its advice on *de minimis* in a draft document (LC 20/7) to the Twentieth Consultative Meeting of Contracting Parties. The Consultative Meeting requested the IAEA to revise this document based on comments made by Contracting Parties. The Consultative Meeting agreed that in further developing the concept of *de minimis*, the following issues should be considered in detail (LC 20/14, paragraph 7.9):

".1 to ensure that the de minimis concept applies only to those wastes or other matter not otherwise prohibited from disposal under the Convention;

.2 the protection of the marine environment including human health, flora and fauna of the marine environment as well as legitimate uses of the sea; and

.3 *the need for practical and uniform guidance to national authorities responsible for authorizing sea disposal activities."*

1.4 The revised text of the IAEA report has been distributed as IAEA-TECDOC-1068 entitled: "Application of Radiological Exclusion and Exemption Principles to Sea Disposal".

1.5 The following text provides specific guidance[1] regarding the definition and application of the *de minimis* concept only to candidate materials. **Section 2** of this guidance reproduces relevant sections of the work of the International Atomic Energy Agency (IAEA) to develop a concept of *de minimis* for the purposes of the London Convention 1972, set forth in IAEA-TECDOC-1068, March 1999.

1.6 **Section 3** of this guidance sets forth a clarification of this IAEA advice, with relevant examples of how the IAEA would apply the "*de minimis*" concept under the London Convention 1972.

1.7 **Section 4** of this guidance sets forth a stepwise evaluation procedure for use under the London Convention 1972 for determining whether candidate materials can be treated as *de minimis.*

2 THE IAEA ADVICE ON " '*DE MINIMIS*' (EXEMPTION[5]) CRITERIA FOR CANDIDATE MATERIALS FOR SEA DUMPING UNDER THE LONDON CONVENTION"

2.1 In IAEA-TECDOC-1068, page 10, the first paragraph under this heading, deals with the criteria for exemption without further consideration as follows:

" Materials eligible for consideration for dumping at sea under the London Convention that can be assigned as 'de minimis' (exempt[5]) without further consideration from the perspective of their radionuclide content are therefore those containing only:

(1) natural radionuclides in environmental and raw materials, unless there is concern on the part of the national regulatory authority that the radiation field would be substantially modified;

(2) radionuclides in materials derived from activities involving some modification of the natural radionuclide composition that has been considered by the national regulatory authority, and deemed not to warrant radiological control, having taken proper account of the marine environmental and other conditions relevant to the disposal, re-use and relocation of such materials;

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1 This guidance is meant specifically for implementation of the *de minimis* aspects of Annex I to the London Convention 1972, and may have to be adapted for implementing the 1996 Protocol to the London Convention 1972 upon its entry into force.

(3) *widely-distributed radionuclides resulting from global fallout from nuclear weapons tests, satellite burnup in the stratosphere, and accidents, that have led to widespread dispersion of radionuclides that are deemed by the national regulatory authority not to warrant intervention; and*

(4) *radionuclides arising from sources and practices that have been exempted or cleared nationally from radiological control, pursuant to the application of the international criteria for exemption and clearance, where proper account has been taken of the marine environmental and other conditions relevant to potential disposal, re-use and relocation of such materials.*"

Footnote 5 of IAEA-TECDOC-1068 reads as follows:

"The term 'exemption for the purposes of the London Convention' is taken to mean 'de minimis', that is, it includes both the radiological concepts of exclusion and exemption."

2.2 The concluding text of the final section of IAEA-TECDOC-1068 deals with materials that cannot be exempted without further consideration for the purposes of the London Convention 1972 (note that footnote 5 of IAEA-TECDOC-1068 applies equally here also). This text reads as follows:

"Candidate materials that cannot be exempted[5] *without further consideration may then be subjected to a specific assessment to determine if they still qualify as exempt*[5] *for the purposes of the London Convention. Such specific assessments would need to be carried out by national regulatory authorities using the radiological criteria for exemption set out in Section 3* (of IAEA-TECDOC-1068). *It should be noted in this context that assessments are required for proposed dumping activities in relation to other characteristics and properties of candidate materials than radioactivity pursuant to the provisions of Article IV and Annex III of the Convention. The specific assessment required to consider further exemption*[5] *of materials for determining if they can be treated as 'non-radioactive', would include an evaluation of the radiological implications for human health and the environment (see Section 3* of IAEA-TECDOC-1068).

In cases where candidate materials are either contaminated by, or derived from, authorized or unauthorized releases, each situation would have to be reviewed in its specific context. The need for intervention may also be a relevant consideration in certain cases."

2.3 The principles and criteria for exemption are described in section 3 of IAEA-TECDOC-1068 and summarized in the concluding section of that report as follows:

"A practice, or source within a practice, may be exempted without further consideration provided that the following radiological criteria are met in all feasible situations:

(a) *the effective dose expected to be incurred by any member of the public due to the exempted practice or source is of the order of 10 μSv or less in a year; and*

(b) *either the collective dose committed by one year of performance of the practice is not more than about 1 man·Sv or an assessment for the optimization of protection shows that exemption is the optimum option.*"

3 MEANING AND IMPLICATIONS OF THE IAEA ADVICE

3.1 The IAEA advice presented in Section 2 above may require some clarification for an audience unfamiliar with the terminology used in the field of radiological protection. Such explanation is provided here as a basis for developing appropriate definitions and guidelines under the London Convention 1972. It should be noted that all reference to the 'national regulatory authority' in the IAEA's advice quoted in Section 2 above refers to the national radiation protection authority.

3.2 All materials contain natural radionuclides. Sometimes human activities can result in changes to their concentrations, thus potentially increasing radiation doses. If this occurs, an activity could be subjected to radiological control. Previous human activities, particularly nuclear weapons testing in the atmosphere, have also introduced new radionuclides to the environment and slightly enhanced the overall concentrations of radionuclides.

3.3 The current system of radiological protection is based entirely on the protection of human health. This has been developed over many decades and there are now internationally accepted guidelines and standards for national radiation protection authorities. There is currently no internationally-accepted basis for the protection of the environment, including flora and fauna, from the effects of radiation. Accordingly, the IAEA advice with regard to the *de minimis* issue is based on the protection of human health.

3.4 The IAEA advice provides for two distinct categories in relation to the *de minimis* question:

- first, cases in which the radionuclide constituents of a candidate material fall within the provisions of Section 2.1 above and can be automatically (i.e., without further consideration) defined as *de minimis* under the London Convention 1972; and

- second, cases in which a specific assessment is required to determine whether the candidate materials are *de minimis* or not (see Section 2.2 above).

Automatic Exemption Criteria

3.5 The paragraph of the IAEA advice quoted in Section 2.1 above deals with materials eligible for dumping at sea under the London Convention 1972 without further consideration from the perspective of radiological protection. The provisions of this paragraph correspond to 'automatic' or 'default' assignment of *de minimis*, that is exempted from any concerns regarding the radioactive content of the candidate materials (i.e., materials eligible for dumping at sea) from the perspective of radiological protection. The following subparagraphs need to be considered before this assignment can be made. Each of the sub-paragraphs specifies classes of constituent radionuclides that according to the IAEA advice can be considered as *de minimis* for the purposes of the London Convention 1972.

.1 Sub-paragraph 2.1(1) specifies that natural radionuclides in naturally-occurring materials are *de minimis* unless the national radiation protection authority has registered concern, from radiological perspectives, about the radiation field being substantially increased. In most cases, movement of such materials from one location in the marine environment to another presents relatively minor modification of the prevailing radiation fields in both the original and destination (dump)site. Thus, such cases are not regarded as of concern. The kind of natural materials over which such concerns might be registered by the national radiation protection authority could include the deliberate relocation of natural materials that are naturally enriched in naturally-occurring radionuclides (e.g., monazite sands) to an environment in which the natural radiation field is low. Unless such concerns have been raised, natural radionuclides in unmodified natural environmental materials can be assigned as *de minimis* and automatically exempted without further consideration or assessment. In instances in which concerns had been expressed by the national radiation protection authority, a specific assessment would be required to determine their suitability for *de minimis* assignment.

.2 Sub-paragraph 2.1(2) deals with natural radionuclides associated with materials derived from human activities that have resulted in some redistribution of natural radionuclides such that the concentrations in otherwise natural materials may have been changed. For some countries such activities could include application to soil of phosphate fertilizer. For other countries, such activities could include the processing of minerals, e.g., fertilizer production from phosphate-rich geological materials. In this case the distribution of natural radionuclides (e.g., phosphorus-31, uranium and thorium decay radionuclides) is altered in the process. It should be noted that some countries regard processing of such materials as a regulated practice, not one from which the exposures are excluded. Wastes from the process may be discharged into the aquatic environment and incorporated into sediments that may need to be dredged. The national regulatory authority may have evaluated this practice and made a judgement regarding its inclusion or exclusion from regulatory control.

If a decision on the exclusion of exposures associated with the practice has been made based on evaluations of the entire practice taking into account marine pathways of exposure, the decision translates into automatic exemption for the purposes of the London Convention 1972. No further account would then need to be taken of the radioactive constituents or radiological effects of materials derived from or affected by that practice. If such is not the case, a specific assessment would be needed to determine if the candidate material could be assigned as *de minimis* or not.

.3 Sub-paragraph 2.1(3) deals predominantly with artificial radionuclides stemming from nuclear weapons testing in the atmosphere, from satellite radiothermal power unit burnup in the stratosphere and nuclear accidents. Atmospheric fallout is a collective term but primarily comprises radionuclides, particularly fission products, from nuclear weapons tests that were conducted in the atmosphere in the period 1945 - 1981. These have been augmented by specific radionuclides such as plutonium-238 from thermonuclear generators that have burnt up during re-entry to the atmosphere and the more widely-dispersed radionuclides (i.e., radionuclides distributed globally rather than locally or regionally) from nuclear accidents. Global fallout results in the contamination of soils and sediments throughout the surface of the Earth. The relocation of aquatic sediments contaminated by global fallout over relatively small distances, as is effected by dredging and dumping activities, for example, neither significantly alters the distribution of such radionuclides nor significantly changes their environmental concentrations. In cases where contamination by radionuclides from such sources has been judged by the national radiation protection authority not to warrant intervention to reduce associated human exposures, the materials so contaminated can be assigned as *de minimis* and exempted without further consideration or assessment. In other circumstances a specific assessment would be needed to determine if the candidate material could be assigned as *de minimis* or not.

.4 Sub-paragraph 2.1(4) deals with radionuclides derived from sources and practices that have been exempted or cleared from radiological control by the national radiation protection authority, consistent with applicable international criteria. If the national radiation protection authority has exempted a practice, or cleared from radiological control a previously regulated practice, based on an assessment of the practice and any disposal, re-use and relocation of materials from the practice, including taking account of marine environmental exposure pathways, the radionuclides derived from that practice can be assigned as *de minimis* and automatically exempted from radiological concerns without further consideration. In instances in which these conditions are not fulfilled, a specific assessment would be needed to determine if the candidate materials could be assigned as *de minimis* or not.

3.6 Assignment of materials as *de minimis* based on the above criteria merely relieves the permitting authority of any requirement to further consider the radioactive properties of such materials and the radiological consequences of their disposal. The other characteristics and properties of candidate materials still remain to be assessed in the context of the suitability of the candidate materials for disposal at sea under the London Convention 1972 through application of the provisions of Article IV and Annexes I and III of the Convention and their suitability for disposal at sea through application of the Guidelines for the Assessment of Wastes or Other Matter, that May be Considered for Dumping.

Specific Assessments

3.7 The two paragraphs of the IAEA advice quoted in Section 2.2 above deal with the situation that applies if the assignment of *de minimis* cannot be made automatically (i.e., without further consideration). The first paragraph defines the nature of a 'specific assessment' that would be required to be undertaken by the national regulatory authority using the international radiological criteria for exemption as quoted in Section 2.3 above and other considerations relating to the radiological implications for the environment.

3.8 The second paragraph quoted in Section 2.2 above deals specifically with contamination of candidate materials by authorized discharges or unauthorized releases of radionuclides to the environment. Authorized discharges are those from regulated practices such as nuclear power reactor operations and nuclear fuel reprocessing. Unauthorized releases are either illicit or unintentional. In such cases, a specific assessment using relevant international radiological criteria for exemption would also be needed regarding the suitability of the material for assignment as *de minimis.*

3.9 Again, as in the case of *de minimis* assignment without further consideration (see paragraph 3.6 above), irrespective of any determination that a candidate material is *de minimis* from the perspective of its radionuclide content or radioactive properties, that material would still be subject to the provisions of the London Convention 1972, in particular, Article IV and Annexes I and III and its suitability for disposal at sea would require to be assessed through the application of the Guidelines for the Assessment of Wastes or Other Matter, that May be Considered for Dumping.

4 EVALUATION PROCEDURE FOR DEFINING *DE MINIMIS*

Introduction

4.1 This Section describes the application of the IAEA *de minimis* definition when assessing candidate materials under the London Convention 1972. The intent is to assess candidate materials to determine if they contain *de minimis* levels of radioactivity or if a specific assessment is required[2]. This evaluation procedure is

[2] The text in this evaluation procedure refers to the national radiation protection authority and the national permitting authority. It is recognized that these authorities could be the same agency in some countries, could be called by other titles, or could encompass more than two agencies.

intended to be implemented through judgements based on available information regarding the provenance of candidate materials and sediments in the receiving marine environment, specifically at the dump-site. The questions posed at each of the first five steps are designed to be answered without the need for direct measurements of radionuclides in either the candidate material or the marine environment. Indeed, had such a requirement been a prerequisite to the first five steps of this procedure, it would run entirely counter to the intent and interpretation of *de minimis*.

4.2 In cases when there is insufficient existing information on which to base such judgements a specific assessment would be required.

4.3 The field of radiological protection is evolving. Parties should take all relevant advances into account when applying the guidelines. For example, criteria for evaluating the impacts of radioactivity on the marine environment are advancing, and should, when available and as relevant, be expeditiously utilized.

STEPWISE EVALUATION PROCEDURE

STEP 1: CANDIDATE MATERIALS

Decision Criteria: Candidate materials are those wastes or other matter not otherwise prohibited from disposal by Annex I of the London Convention 1972.

1 Are the proposed materials eligible for dumping under the provisions of the London Convention 1972?

2 If **NO**, the material is not allowed to be dumped and no further consideration is warranted.

3 If **YES**, go to Step 2.

STEP 2: INITIAL SCREEN FOR SOURCES OF CONTAMINATION

Decision Criteria: Virtually all candidate materials are likely to have some level of radioactivity due to natural radionuclides at background levels and artificial radionuclides derived from global fallout. Global atmospheric fallout is a collective term but primarily comprises radionuclides, particularly fission products, from nuclear weapons tests that were conducted in the atmosphere in the period 1945 - 1981. These have been augmented by specific radionuclides such as plutonium-238 from thermonuclear generators that have burnt up during re-entry into the atmosphere. If candidate materials for dumping at sea contain only such natural radionuclides at locally prevailing background levels in the vicinity of the proposed dump-site and artificial radionuclides from global fallout, they can be immediately assigned as *de minimis*.

If the result of the initial screen leads to a conclusion that there is no reason to believe that the candidate material is a modified natural material or contaminated from other sources, the material is considered *de minimis*, unless there is concern on the part of the regulatory authority that the radiation field in the vicinity of the dump-site would be substantially modified. (this latter situation is dealt with at Step 4 of this procedure).

1 Is there reason to believe that the candidate material contains anything other than unmodified natural radionuclides at background comparable with that in the receiving environment and artificial radionuclides derived from global fallout?

2 If **NO**, the materials are *de minimis*.

3 If **YES**, go to Step 3.

STEP 3: ASSESSMENT OF ADDITIONAL CAUSES/SOURCES

Decision Criteria: If there are additional radionuclides in the candidate material, it is important to discriminate between the causes/sources of the presence of these additional radionuclides. Increases in the presence of radionuclides at the dump-site could result from two causes: (1) differences in the concentrations of natural radionuclides in the candidate material and in sediments at the dump-site, and; (2) human activities that increase the concentrations of natural radionuclides in candidate materials. The permitting authority should address both possibilities before determining if levels of radioactivity in the materials are *de minimis*. The first of these causes is addressed in Step 4 of this procedure. The second is considered in Step 5.

This Step is intended to determine the nature of causes/sources responsible for any additional radioactivity in the candidate material.

1 What are the likely additional causes/sources contributing to the radioactivity in the materials?

2 If only unmodified natural causes/sources, go to Step 4.

3 If only anthropogenic causes/sources, go to Step 5.

4 If both anthropogenic and natural causes/sources, go to Step 5

STEP 4: NATURAL CAUSES/SOURCES

Decision Criteria: Candidate materials of natural origin unmodified by human activities are *de minimis*, unless the national permitting authority is concerned that the radioactivity would be substantially increased at the dump-site as a result of the dumping action.

This Step addresses the issue of whether the radiation field at the dump-site will be substantially altered by dumping of a candidate material containing natural radionuclides at unusual concentrations as a result of natural processes.

Information pertinent to this determination would include any assessment conducted by the national radiation protection authority.

1 If the material were to be dumped, would it substantially increase radioactivity at the dump-site?

2 If **NO**, the materials are *de minimis.*

3 If **YES**, go to Step 6.

STEP 5: ANTHROPOGENIC CAUSES/SOURCES

Decision Criteria: For candidate materials containing artificial radionuclides (other than from global fallout that is referred to in Step 2) and/or altered natural radionuclides stemming from human activities, the national permitting authority should consider previous decisions and action taken by the national radiation protection authority. The national permitting authority should assess whether the human activity contributing to the radioactivity in the candidate material is from an activity that has been exempted or cleared or one from which radiation exposures have been excluded by the national radiation protection authority based upon international radiological criteria. The pertinent question in such cases is whether the decisions on exclusion, exemption, or clearance were made considering marine environmental pathways of exposure and whether these are suitable to an assessment of the proposed dumping operation. If this is the case, the materials are *de minimis*.

1 Were the likely anthropogenic causes/sources part of exempted or cleared practices or excluded exposures?

2 If **NO**, go to Step 6.

3 If **YES**, were the marine environmental exposure pathways considered by the national radiation protection authority and are these suitable to an assessment of the proposed dumping operation?

3.1 If **YES**, the materials are *de minimis*.

3.2 If **NO**, go to Step 6.

STEP 6: SPECIFIC ASSESSMENT

Materials not determined to be *de minimis* through the evaluation in Steps 1 - 5 above could also be determined to be *de minimis* by the application of a specific assessment. The foregoing Steps of this evaluation procedure lead to initial perspectives on the nature and requirements of a specific assessment as follows.

A specific assessment should provide an evaluation of the potential adverse impacts to the marine environment including effects upon human health and to flora and fauna, and to other legitimate uses of the sea. The nature and extent of the specific assessment should be determined in accordance with existing knowledge of the sources and likely extent of any radioactive contamination of the candidate material. For example, candidate dredged material containing only minor amounts of radionuclides may not need to be subjected to an unnecessarily detailed or unnecessarily complex assessment process. International radiological exemption criteria based on the protection of human health should be used for part of this assessment. Until complementary international radiological criteria for the protection of flora and fauna are developed, permitting authorities should use appropriate scientific information and a precautionary approach (as provided for in resolution LDC.44(14)) in conducting assessments of the potential impacts on the marine environment.

Guidance for the conduct of specific assessments has been developed by the IAEA in IAEA-TECDOC-1375, entitled "*Determining the Suitability of Materials for Disposal at Sea Under the London Convention 1972: A Radiological Assessment Procedure*". When the Twenty-fifth Consultative Meeting adopted this guidance in 2003, it was noted that IAEA-TECDOC-1375 addressed only effects on human health. The Meeting, therefore, urged the IAEA to continue its work on the development of a mechanism for environmental protection from the effects of ionizing radiation so that the protection of the environment could be adequately addressed in this Step. The Meeting stressed the need for Contracting Parties to use a precautionary approach and to ensure that an assessment of potential effects on marine flora and fauna, and legitimate uses of the sea, be included in specific assessments using contemporary scientific information (LC 25/16, paragraph 8.20).

Application of the Waste Assessment Guidance

Candidate materials that are determined to be *de minimis* through the evaluation in Steps 1 - 6 above must then be evaluated through application of the generic Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping, and/or the waste-specific guidance developed thereunder. No further evaluation of the radionuclide content of the candidate materials that are *de minimis* is needed.

The present Guidelines have been developed on the basis of existing scientific knowledge of the radiation protection considerations and on a knowledge of current technology. Scientific work and technical development is, however, proceeding and consequently these Guidelines should be kept under review as the results of further research and investigation become available.

***

APPENDIX

Annex I to the London Convention 1972, as amended in 1993

1 Organohalogen compounds.

2 Mercury and mercury compounds.

3 Cadmium and cadmium compounds.

4 Persistent plastics and other persistent synthetic materials, for example, netting and ropes, which may float or may remain in suspension in the sea in such a manner as to interfere materially with fishing, navigation or other legitimate uses of the sea.

5 Crude oil and its wastes, refined petroleum products, petroleum, distillate residues, and any mixtures containing any of these, taken on board for the purpose of dumping.

6 Radioactive wastes or other radioactive matter.

7 Materials in whatever form (e.g. solids, liquids, semi-liquids, gases or in a living state) produced for biological and chemical warfare.

8 With the exception of paragraph 6 above, the preceding paragraphs of this Annex do not apply to substances which are rapidly rendered harmless by physical, chemical or biological processes in the sea provided they do not:

(i) make edible marine organisms unpalatable, or
(ii) endanger human health or that of domestic animals.

The consultative procedure provided for under article XIV should be followed by a Party if there is doubt about the harmlessness of the substance.

9 Except for industrial waste as defined in paragraph 11 below, this Annex does not apply to wastes or other materials (e.g. sewage sludge and dredged material) containing the matters referred to in paragraphs 1 - 5 above as trace contaminants. Such wastes shall be subject to the provisions of Annexes II and III as appropriate.

Paragraph 6 does not apply to wastes or other materials (e.g. sewage sludge and dredged material) containing de minimis (exempt) levels of radioactivity as defined by the IAEA and adopted by the Contracting Parties. Unless otherwise prohibited by Annex I, such wastes shall be subject to the provisions of Annexes II and III as appropriate.

10 (a) Incineration at sea of industrial waste, as defined in paragraph 11 below, and sewage sludge is prohibited.

(b) The incineration at sea of any other wastes or other matter requires the issue of a special permit.

(c) In the issue of special permits for incineration at sea Contracting Parties shall apply regulations as are developed under this Convention.

(d) For the purpose of this Annex:

(i) "Marine incineration facility" means a vessel, platform, or other man-made structure operating for the purpose of incineration at sea.

(ii) "Incineration at sea" means the deliberate combustion of wastes or other matter on marine incineration facilities for the purpose of their thermal destruction. Activities incidental to the normal operation of vessels, platforms or other man-made structures are excluded from the scope of this definition.

11 Industrial waste as from 1 January 1996.

For the purposes of this Annex:

"Industrial waste" means waste materials generated by manufacturing or processing operations and does not apply to:

(a) dredged material;

(b) sewage sludge;

(c) fish waste, or organic materials resulting from industrial fish processing operations;

(d) vessels and platforms or other man-made structures at sea, provided that material capable of creating floating debris or otherwise contributing to pollution of the marine environment has been removed to the maximum extent;

(e) uncontaminated inert geological materials the chemical constituents of which are unlikely to be released into the marine environment;

(f) uncontaminated organic materials of natural origin.

Dumping of wastes and other matter specified in subparagraphs (a) - (f) above shall be subject to all other provisions of Annex I, and to the provisions of Annexes II and III.

This paragraph shall not apply to the radioactive wastes or any other radioactive matter referred to in paragraph 6 of this Annex.

12 Within 25 years from the date on which the amendment to paragraph 6 enters into force and at each 25 year interval thereafter, the Contracting Parties shall complete a scientific study relating to all radioactive wastes and other radioactive matter other than high level wastes or matter, taking into account such other factors as the Contracting Parties consider appropriate, and shall review the position of such substances on Annex I in accordance with the procedures set forth in article XV.

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SPECIFIC GUIDELINES FOR ASSESSMENT OF

DREDGED MATERIAL

1 INTRODUCTION

1.1 Dredging is essential to maintain navigation in ports, harbours, marinas and inland waterways; for the development of port facilities; for flood mitigation; and for removal of sediments from structures, basins and water intakes. Much of the material removed during these necessary activities may require disposal at sea. The greater proportion of the total amount of material dredged worldwide is, by nature, similar to undisturbed sediments in inland and coastal waters. A smaller proportion of dredged material, however, is contaminated by human activity to an extent that major environmental constraints need to be applied when considering disposal or use of these sediments.

1.2 Environmental impacts may result from both dredging activities and the disposal of dredged material. These specific Guidelines, however, deal only with aspects under the purview of the London Convention 1972 and the 1996 Protocol, that is, the disposal of dredged material.

Evaluation of need for dredging and disposal

1.3 There are a number of dredging activities, which may give rise to the need to relocate or dispose of sediments. These include:

.1 *Capital dredging* - for navigation, to enlarge or deepen existing channel and port areas or to create new ones; and for engineering purposes; e.g., trenches for pipes, cables, immersed tube tunnels, removal of material unsuitable for foundations, removal of overburden for aggregate extractions;

.2 *Maintenance dredging* - to ensure that channels, berths or construction works, etc., are maintained at their designed dimensions; and

.3 *Clean up dredging* - deliberate removal of contaminated material for human health and environmental protection purposes.

Before beginning a full assessment of the material and the disposal options the question should be asked, “Is dredging necessary?” In the event of a subsequent full assessment indicating no acceptable options for disposal it will be necessary to re-address this question in a broader context.

1.4 The Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping[1], referred to in short as the “Generic Guidelines”, as well as the Specific Guidelines for Assessment of Dredged Material addressed in this document are intended for use by national authorities responsible for regulating dumping of wastes and embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention 1972 or the 1996 Protocol thereto. Annex 2 to the 1996 Protocol places emphasis on progressively reducing the need to use the sea for dumping of wastes. Furthermore, it recognizes that avoidance of pollution demands rigorous controls on the emission and dispersion of contaminating substances and the use of scientifically based procedures for selecting appropriate options for waste disposal. When applying these Guidelines uncertainties in relation to assessments of impacts on the marine environment will need to be considered and a precautionary approach applied in addressing these uncertainties. They should be applied with a view that acceptance of dumping under certain circumstances does not remove the obligation to make further attempts to reduce the necessity for dumping.

1.5 The 1996 Protocol to the London Convention 1972 follows an approach under which dumping of wastes or other matter is prohibited except for those materials specifically enumerated in Annex I, and in the context of that Protocol, these Guidelines would apply to the materials listed in that Annex. The London Convention 1972 prohibits the dumping of certain wastes or other matter specified therein and in the context of that Convention these Guidelines meet the requirements of its Annexes for wastes not prohibited for dumping at sea. When applying these Guidelines under the London Convention 1972, 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 1972.

1.6 The schematic shown in Figure 1 provides a clear indication of the stages in the application of this guidance where important decisions should be made. In general, national authorities should use this schematic in an iterative manner ensuring that all steps receive consideration before a decision is made to issue a permit. Figure 1 illustrates the relationship between the operational components of Annex 2 of the 1996 Protocol and contains the following elements:

- .1 Dredged Material Characterization (Chapter 4);
- .2 Waste Prevention Audit and Evaluation of Disposal Options (Chapters 2 and 3);
- .3 Is Material Acceptable (Chapter 5) (Action List);
- .4 Identify and Characterize Dump-site (Chapter 6) (Dump-site Selection);
- .5 Determine Potential Impacts and Prepare Impact Hypothesis(es) (Chapter 7) (Assessment of Potential Effects);
- .6 Issue Permit (Chapter 9) (Permit and Permit Conditions);
- .7 Implement Project and Monitor Compliance (Chapter 8) (Monitoring); and
- .8 Field Monitoring and Assessment (Chapter 8) (Monitoring).

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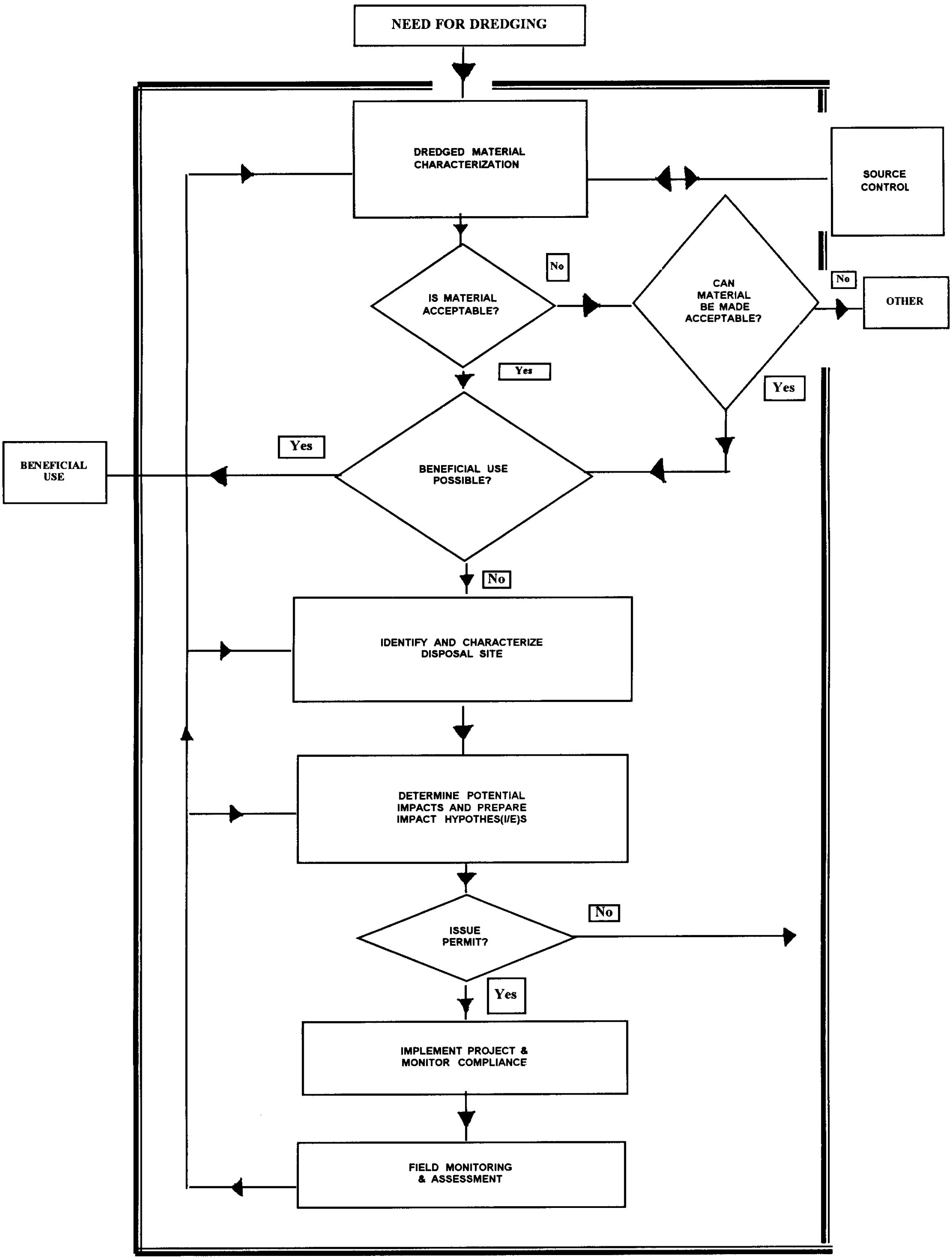
[1] The Nineteenth Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these Guidelines in 1997.

Figure 1

DREDGED MATERIAL ASSESSMENT FRAMEWORK



REPRESENTATION OF THE JURISDICTIONAL BOUNDARY OF THE CONVENTION

1.7 These Guidelines, which were adopted in 2000 by the Twenty-second Consultative Meeting, are specific to dredged material. They are based on the generic Guidelines of 1997 and replace the "Dredged Material Assessment Framework" adopted in 1995 by the Eighteenth Consultative Meeting (resolution LC.52 (18)), which, in turn, replaced the "Guidelines for the Application of the Annexes to the Disposal of Dredged Material", adopted in 1986 by the Tenth Consultative Meeting (resolution LDC.23 (10)). Adherence to the following represents neither a more restrictive nor a less restrictive regime than that of the generic Guidelines of 1997.

2 WASTE PREVENTION AUDIT

2.1 For dredged material, the goal of waste management should be to identify and control the sources of contamination. Contaminant source evaluation and control should be carried out as follows:

.1 contamination of estuarine and coastal marine sediments both as a consequence of historical and present day inputs presents a continuing problem for the management of dredged material. High priority should be given to the identification of sources, reduction and prevention of further contamination of sediments and should address both point and diffuse sources. Successful implementation of prevention strategies will require collaboration among agencies with responsibility for the control of point and diffuse sources of contamination;

.2 in developing and implementing the source control strategy, appropriate agencies should take into account:

- .1 the continuing need for dredging;
- .2 the hazards posed by contaminants and the relative contributions of the individual sources to these hazards;
- .3 existing source control programmes and other regulations or legal requirements;
- .4 technical and economic feasibility;
- .5 the evaluation of the effectiveness of measures taken; and
- .6 consequences of not implementing contaminant reduction;

.3 in cases where there has been historical contamination or where control measures are not fully effective in reducing contamination to acceptable levels, disposal management techniques, including the use of containment or treatment methods may be required.

3 EVALUATION OF DISPOSAL OPTIONS

3.1 The results of the physical/chemical/biological characterization will indicate whether the dredged material, in principle, is suitable for disposal at sea. Where sea disposal is identified as an acceptable option it is nonetheless important, recognizing the potential value of dredged material as a resource, to consider the availability of beneficial uses.

Beneficial Uses

3.2 There is a wide variety of beneficial uses depending on the physical and chemical characteristics of the material. Generally, a characterization carried out in accordance with Chapter 4 of these Guidelines will be sufficient to match a material to possible uses such as:

.1 *Engineered uses* - land creation and improvement, beach nourishment, offshore berms, capping material and fill;
.2 *Agriculture and product uses* - aquaculture, construction material, liners; and
.3 *Environmental enhancement* - restoration and establishment of wetlands, upland habitats, nesting islands, and fisheries.

The technical aspects of beneficial uses are well established and described in the literature.

Management Options

3.3 Where the characteristics of the dredged material are such that its disposal would not meet the requirements of the Convention, treatment or other management options should be considered. These options can be used to reduce or control impacts to a level that will not constitute an unacceptable risk to human health, or harm living resources, damage amenities or interfere with legitimate uses of the sea.

3.4 Treatment, such as separation of contaminated fractions, can make the material suitable for a beneficial use and should be considered before opting for sea disposal. Disposal management techniques include placement on or burial in the sea floor followed by clean sediment capping, utilization of geo-chemical interactions and transformations of substances in dredged material when combined with sea water or bottom sediment, selection of special sites such as abiotic zones, or methods of containing dredged material in a stable manner.

3.5 A permit to dump wastes or other matter shall be refused if the permitting authority determines that appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to human health or the environment or disproportionate costs. The practical availability of other means of disposal should be considered in the light of a comparative risk assessment involving both dumping and the alternatives.

4 DREDGED MATERIAL CHARACTERIZATION[2]

Physical characterization

4.1 Evaluation of the physical characteristics of sediments for disposal is necessary to determine potential environmental impact and the need for chemical and/or biological testing.

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[2] A good perspective for managing sediments is contained in the GIPME Report entitled: "Guidance on Assessment of Sediment Quality". This report describes various approaches to assessing anthropogenic impacts on marine sediments and associated risks to marine life and human health. It is concluded that numerical sediment quality criteria are unsuitable for widespread application because chemical measurements alone cannot reliably predict sediment toxicity. The report does not provide a rigid framework for assessment of sediment quality but does identify empirical procedures that can be used to distinguish among natural sedimentary conditions, anthropogenically disturbed (e.g., contaminated) sediments and sediment conditions causing adverse effects (i.e., pollution). This report can be obtained from IMO free of charge.

The basic physical characteristics required are the amount of material, particle size distribution and specific gravity of solids.

Exemptions from detailed characterization

4.2 Dredged material may be exempted from the full characterization requested in paragraphs 4.3 to 4.9 below if it meets *one* of the criteria listed below:

.1 dredged material is excavated from a site away from existing and historical sources of appreciable pollution, so as to provide reasonable assurance that the dredged material has not been contaminated, *or*
.2 dredged material is composed predominantly of sand, gravel and/or rock, *or*
.3 dredged material is composed of previously undisturbed geological materials.

Dredged material that does not meet one of these criteria will require a full characterization to assess its potential impact.

Chemical characterization

4.3 Sufficient information for chemical characterization may be available from existing sources: in such cases new measurements may not be required of the potential impact of similar material at similar sites.

4.4 Considerations for additional chemical characterization of dredged material are as follows:

.1 major geo-chemical characteristics of the sediment including redox status;
.2 potential routes by which contaminants could reasonably have been introduced to the sediments;
.3 data from previous sediment chemical characterization and other tests of the material or other similar material in the vicinity, provided this information is still reliable;
.4 probability of contamination from agricultural and urban surface runoff;
.5 spills of contaminants in the area to be dredged;
.6 industrial and municipal waste discharges (past and present);
.7 source and prior use of dredged materials (e.g., beach nourishment); and
.8 substantial natural deposits of minerals and other natural substances.

4.5 Sampling of sediments from the proposed dredging site should represent the vertical and horizontal distribution and variability of properties of the materials to be dredged.

4.6 Further information may also be useful in interpreting the results of chemical testing, such as grain size distribution, total organic carbon (TOC), and other normalizing constituents.

Biological characterization

4.7 If the potential impacts of the dredged material to be dumped cannot be assessed on the basis of the chemical and physical characterization and available biological information, biological testing should be conducted.

4.8 It is important to ascertain whether an adequate scientific basis exists on the characteristics and composition of the material to be dumped and on the potential impacts on marine life and human health. In this context, it is important to consider information about species known to occur in the area of the disposal site and the effects of the material to be dumped and of its constituents on organisms.

4.9 Biological tests should incorporate species that are considered appropriately sensitive and representative and exposures should be to representative materials so as to determine the potential for:

.1 acute toxicity;
.2 chronic toxicity such as long-term sub-lethal effects, covering an entire life cycle;
.3 the potential for bioaccumulation; and
.4 the potential for tainting

at and in the vicinity of the disposal site.

4.10 If dredged material is so poorly characterized that proper assessment cannot be made of its potential impacts on human health and the environment, it shall not be dumped.

5 ACTION LIST

5.1 The Action List provides a screening mechanism for determining whether a material is considered acceptable for dumping. It constitutes a crucial part of Annex 2 to the 1996 Protocol and the Scientific Group will continuously review all aspects of it to assist Contracting Parties with its application. It may also be used in meeting the requirements of Annexes I and II to the London Convention 1972.

5.2 Each Contracting Party shall develop a national Action List to provide a mechanism for screening candidate wastes and their constituents on the basis of their potential effects on human health and the marine environment. In selecting substances for consideration in an Action List, priority shall be given to toxic, persistent and bio-accumulative substances from anthropogenic sources (e.g., cadmium, mercury, organohalogens, petroleum hydrocarbons and, whenever relevant, arsenic, lead, copper, zinc, beryllium, chromium, nickel and vanadium, organosilicon compounds, cyanides, fluorides and pesticides or their by-products other than organohalogens). An Action List can also be used as a trigger mechanism for further waste prevention considerations.

5.3 For an individual waste category, it may be possible to define national action levels on the basis of concentration limits, biological responses, environmental quality standards, flux considerations or other reference values.

5.4 An Action List shall specify an upper level and may also specify a lower level. The upper level should be set so as to avoid acute or chronic effects on human health or on sensitive marine organisms representative of the marine ecosystem. Application of an Action List will result in three possible categories of waste:

.1 wastes which contain specified substances, or which cause biological responses, *exceeding* the relevant upper level shall not be dumped, unless made acceptable for dumping through the use of management techniques or processes.

Management options, for dredged material that would not meet the requirements of the Convention, are given in paragraphs 3.3 and 3.4 above;

.2 wastes which contain specified substances, or which cause biological responses, *below* the relevant lower levels should be considered to be of little environmental concern in relation to dumping; and

.3 wastes, which contain specified substances, or which cause biological responses, *below* the upper level but *above* the lower level require more detailed assessment before their suitability for dumping can be determined.

6 DUMP-SITE SELECTION

Site selection considerations

6.1 Proper selection of a dump-site at sea for the reception of waste is of paramount importance.

6.2 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.

6.3 Guidance for procedures to be followed in dump-site selection can be found in a report of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP Reports and Studies No. 16 - Scientific Criteria for the Selection of Waste Disposal Sites at Sea). Prior to selecting a dump-site, it is essential that data be available on the oceanographic characteristics of the general area in which the site is to be located. This information can be obtained from the literature but fieldwork should be undertaken to fill the gaps. Required information includes:

.1 the nature of the seabed, including its topography, geo-chemical and geological characteristics, its biological composition and activity, and prior dumping activities affecting the area;

.2 the physical nature of the water column, including temperature, depth, possible existence of a thermocline/pycnocline and how it varies in depth with season and weather conditions, tidal period and orientation of the tidal ellipse, mean direction and velocity of the surface and bottom drifts, velocities of storm-wave induced bottom currents, general wind and wave characteristics, and the average number of storm days per year, suspended matter; and

.3 the chemical and biological nature of the water column, including pH, salinity, dissolved oxygen at surface and bottom, chemical and biochemical oxygen demand, nutrients and their various forms and primary productivity.

6.4 Some of the important amenities, biological features and uses of the sea to be considered in determining the specific location of the dump-site are:

- .1 the shoreline and bathing beaches;
- .2 areas of beauty or significant cultural or historical importance;
- .3 areas of special scientific or biological importance, such as sanctuaries;
- .4 fishing areas;
- .5 spawning, nursery and recruitment areas;
- .6 migration routes;
- .7 seasonal and critical habitats;
- .8 shipping lanes;
- .9 military exclusion zones; and
- .10 engineering uses of the seafloor, including mining, undersea cables, desalination or energy conversion sites.

Size of the dump-site

6.5 Size of the dump-site is an important consideration for the following reasons:

- .1 it should be large enough, unless it is an approved dispersion site, to have the bulk of the material remain either within the site limits or within a predicted area of impact after dumping;

- .2 it should be large enough to accommodate anticipated volumes of solid waste and/or liquid wastes to be diluted to near background levels before or upon reaching site boundaries;

- .3 it should be large enough in relation to anticipated volumes for dumping so that it would serve its function for many years; and

- .4 it should not be so large that monitoring would require undue expenditure of time and money.

Site capacity

6.6 In order to assess the capacity of a site, especially for solid wastes, the following should be taken into consideration:

- .1 the anticipated loading rates per day, week, month or year;
- .2 whether or not it is a dispersive site; and
- .3 the allowable reduction in water depth over the site because of mounding of material.

Evaluation of potential impacts

6.7 An important consideration in determining the suitability of a waste for dumping at a specific site is the degree to which this results in increased exposures of organisms to substances that may cause adverse effects.

6.8 The extent of adverse effects of a substance is a function of the exposures of organisms (including humans). Exposure, in turn, is a function, *inter alia*, of input flux and the physical, chemical and biological processes that control the transport, behaviour, fate and distribution of a substance.

6.9 The presence of natural substances and the ubiquitous occurrence of contaminants mean that there will always be some pre-existing exposures of organisms to all substances contained in any waste that might be dumped. Concerns about exposures to hazardous substances thus relate to additional exposures as a consequence of dumping. This, in turn, can be translated back to the relative magnitude of the input fluxes of substances from dumping compared with existing input fluxes from other sources.

6.10 Accordingly, due consideration needs to be given to the relative magnitude of the substance fluxes associated with dumping in the local and regional area surrounding the dump-site. In cases where it is predicted that dumping will substantially augment existing fluxes associated with natural processes, dumping at the site under consideration should be deemed inadvisable.

6.11 In the case of synthetic substances, the relationship between fluxes associated with dumping and pre-existing fluxes in the vicinity of the site may not provide a suitable basis for decisions.

6.12 Temporal characteristics should be considered to identify potentially critical times of the year (e.g., for marine life) when dumping should not take place. This consideration leaves periods when it is expected that dumping operations will have less impact than at other times. If these restrictions become too burdensome and costly, there should be some opportunity for compromise in which priorities may have to be established concerning species to be left wholly undisturbed. Examples of such biological considerations are:

.1 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 and breeding periods;
.2 periods when marine organisms are hibernating on or are buried in the sediments; and
.3 periods when particularly sensitive and possibly endangered species are exposed.

Contaminant mobility

6.13 Contaminant mobility is dependent upon several factors, among which are:

.1 type of matrix;
.2 form of contaminant;
.3 contaminant partitioning;
.4 physical state of the system, e.g., temperature, water flow, suspended matter;
.5 physico-chemical state of the system;
.6 length of diffusion and advection pathways; and
.7 biological activities e.g., bioturbation.

7 ASSESSMENT OF POTENTIAL EFFECTS

7.1 Assessment of potential effects should lead to a concise statement of the expected consequences of the sea or land disposal options, i.e., the "Impact Hypothesis". It provides a basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements. As far as possible, waste management options causing dispersion and dilution of contaminants in the environment should be avoided and preference given to techniques that prevent the input of the contaminants to the environment.

7.2 The assessment for dumping should integrate information on waste characteristics, conditions at the proposed dump-site(s), fluxes and proposed disposal techniques and specify the potential effects on human health, living resources, amenities and other legitimate uses of the sea. It should define the nature, temporal and spatial scales and duration of expected impacts based on reasonably conservative assumptions.

7.3 The assessment should be as comprehensive as possible. The primary potential impacts should be identified during the dump-site selection process. These are considered to pose the most serious threats to human health and the environment. Alterations to the physical environment, risks to human health, devaluation of marine resources and interference with other legitimate uses of the sea are often seen as primary concerns in this regard.

7.4 In constructing an impact hypothesis, particular attention should be given to, but not limited to, potential impacts on amenities (e.g., presence of floatables), sensitive areas (e.g., spawning, nursery or feeding areas), habitat (e.g., biological, chemical and physical modification), migratory patterns and marketability of resources. Consideration should also be given to potential impacts on other uses of the sea including: fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea.

7.5 Even the least complex and most innocuous wastes may have a variety of physical, chemical and biological effects. Impact hypotheses cannot attempt to reflect them all. It must be recognized that even the most comprehensive impact hypotheses may not address all possible scenarios such as unanticipated impacts. It is therefore imperative that the monitoring programme be linked directly to the hypotheses and serve as a feedback mechanism to verify the predictions and review the adequacy of management measures applied to the dumping operation and at the dump-site. It is important to identify the sources and consequences of uncertainty.

7.6 The expected consequences of dumping should be described in terms of affected habitats, processes, species, communities and uses. The precise nature of the predicted effect (e.g., change, response, or interference) should be described. The effect should be quantified in sufficient detail so that there would be no doubt as to the variables to be measured during field monitoring. In the latter context, it would be essential to determine "where" and "when" the impacts can be expected.

7.7 Emphasis should be placed on biological effects and habitat modification as well as physical and chemical change. However, if the potential effect is due to substances, the following factors should be addressed:

.1 estimates of statistically significant increases of the substance in seawater, sediments, or biota in relation to existing conditions and associated effects; and

.2 estimate of the contribution made by the substance to local and regional fluxes and the degree to which existing fluxes pose threats or adverse effects on the marine environment or human health.

7.8 In the case of repeated or multiple dumping operations, impact hypotheses should take into account the cumulative effects of such operations. It will also be important to consider the possible interactions with other waste dumping practices in the area, both existing and planned.

7.9 An analysis of each disposal option should be considered in light of a comparative assessment of the following concerns: human health risks, environmental costs, hazards (including accidents), economics and exclusion of future uses. If this assessment reveals that adequate information is not available to determine the likely effects of the proposed disposal option, including potential long-term harmful consequences, then this option should not be considered further. In addition, if the interpretation of the comparative assessment shows the dumping option to be less preferable, a permit for dumping should not be given.

7.10 Each assessment should conclude with a statement supporting a decision to issue or refuse a permit for dumping.

7.11 Where monitoring is required, the effects and parameters described in the hypotheses should help to guide field and analytical work so that relevant information can be obtained in the most efficient and cost-effective manner.

8 MONITORING

8.1 Monitoring is used to verify that permit conditions are met - compliance monitoring - and that the assumptions made during the permit review and site selection process were correct and sufficient to protect the environment and human health - field monitoring. It is essential that such monitoring programmes have clearly defined objectives.

8.2 The Impact Hypothesis forms the basis for defining field monitoring. The measurement programme should be designed to ascertain that changes in the receiving environment are within those predicted. The following questions must be answered:

.1 What testable hypotheses can be derived from the Impact Hypothesis?
.2 What measurements (type, location, frequency, performance requirements) are required to test these hypotheses?
.3 How should the data be managed and interpreted?

8.3 It may usually be assumed that suitable specifications of existing (pre-disposal) conditions in the receiving area are already contained in the application for dumping. If the specification of such conditions is inadequate to permit the formulation of an Impact Hypothesis, the licensing authority will require additional information before any final decision on the permit application is made.

8.4 The permitting authority is encouraged to take account of relevant research information in the design and modification of monitoring programmes. The measurements can be divided into two types - those within the zone of predicted impact and those outside.

8.5 Measurements should be designed to determine whether the zone of impact and the extent of change outside the zone of impact differ from those predicted. The former can be answered by designing a sequence of measurements in space and time that ensures that the projected spatial scale of change is not exceeded. The latter can be answered by the acquisition of measurements that provide information on the extent of change that occurs outside the zone of impact as a result of the dumping operation. Frequently, these measurements will be based on a null hypothesis - that no significant change can be detected.

8.6 The results of monitoring (or other related research) should be reviewed at regular intervals in relation to the objectives and can provide a basis to:

.1 modify or terminate the field-monitoring programme;
.2 modify or revoke the permit;
.3 redefine or close the dump-site; and
.4 modify the basis on which applications to dump wastes are assessed.

9 PERMIT AND PERMIT CONDITIONS

9.1 A decision to issue a permit should only be made if all impact evaluations are completed and the monitoring requirements are determined. The provisions of the permit shall ensure, as far as practicable, that environmental disturbance and detriment are minimized and the benefits maximized. Any permit issued shall contain data and information specifying:

.1 the types, amounts and sources of materials to be dumped;
.2 the location of the dump-site(s);
.3 the method of dumping; and
.4 monitoring and reporting requirements.

9.2 If dumping is the selected option, then a permit authorizing dumping must be issued in advance. It is recommended that opportunities be provided for public review and participation in the permitting process. In granting a permit, the hypothesized impact occurring within the boundaries of the dump-site, such as alterations to the physical, chemical and biological compartments of the local environment is accepted by the permitting authority.

9.3 Regulators should strive at all times to enforce procedures that will result in environmental changes as far below the limits of allowable environmental change as practicable, taking into account technological capabilities as well as economic, social and political concerns.

9.4 Permits should be reviewed at regular intervals, taking into account the results of monitoring and the objectives of monitoring programmes. Review of monitoring results will indicate whether field programmes need to be continued, revised or terminated, and will contribute to informed decisions regarding the continuance, modification or revocation of permits. This provides an important feedback mechanism for the protection of human health and the marine environment.

SPECIFIC GUIDELINES FOR ASSESSMENT OF

SEWAGE SLUDGE

1 INTRODUCTION

1.1 The Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping[1], referred to in short as the "Generic Guidelines", as well as the Specific Guidelines for Assessment of Sewage Sludge addressed in this document are intended for use by national authorities responsible for regulating dumping of wastes and embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention 1972 or the 1996 Protocol thereto. Annex 2 to the 1996 Protocol places emphasis on progressively reducing the need to use the sea for dumping of wastes. Furthermore, it recognizes that avoidance of pollution demands rigorous controls on the emission and dispersion of contaminating substances and the use of scientifically based procedures for selecting appropriate options for waste disposal. When applying these Guidelines uncertainties in relation to assessments of impacts on the marine environment will need to be considered and a precautionary approach applied in addressing these uncertainties. They should be applied with a view that acceptance of dumping under certain circumstances does not remove the obligation to make further attempts to reduce the necessity for dumping.

1.2 The 1996 Protocol to the London Convention 1972 follows an approach under which dumping of wastes or other matter is prohibited except for those materials specifically enumerated in Annex I, and in the context of that Protocol, these Guidelines would apply to the materials listed in that Annex. The London Convention 1972 prohibits the dumping of certain wastes or other matter specified therein and in the context of that Convention these Guidelines meet the requirements of its Annexes for wastes not prohibited for dumping at sea. When applying these Guidelines under the London Convention 1972, 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 1972.

1.3 The schematic shown in Figure 1 provides a clear indication of the stages in the application of the Guidelines where important decisions should be made and is not designed as a conventional "decision tree". In general, national authorities should use the schematic in an iterative manner ensuring that all steps receive consideration before a decision is made to issue a permit. Figure 1 illustrates the relationship between the operational components of Annex 2 of the 1996 Protocol and contains the following elements:

- .1 Waste Characterization (Chapter 4) (Chemical, Physical and Biological Properties)
- .2 Waste Prevention Audit and Waste Management Options (Chapters 2 and 3)

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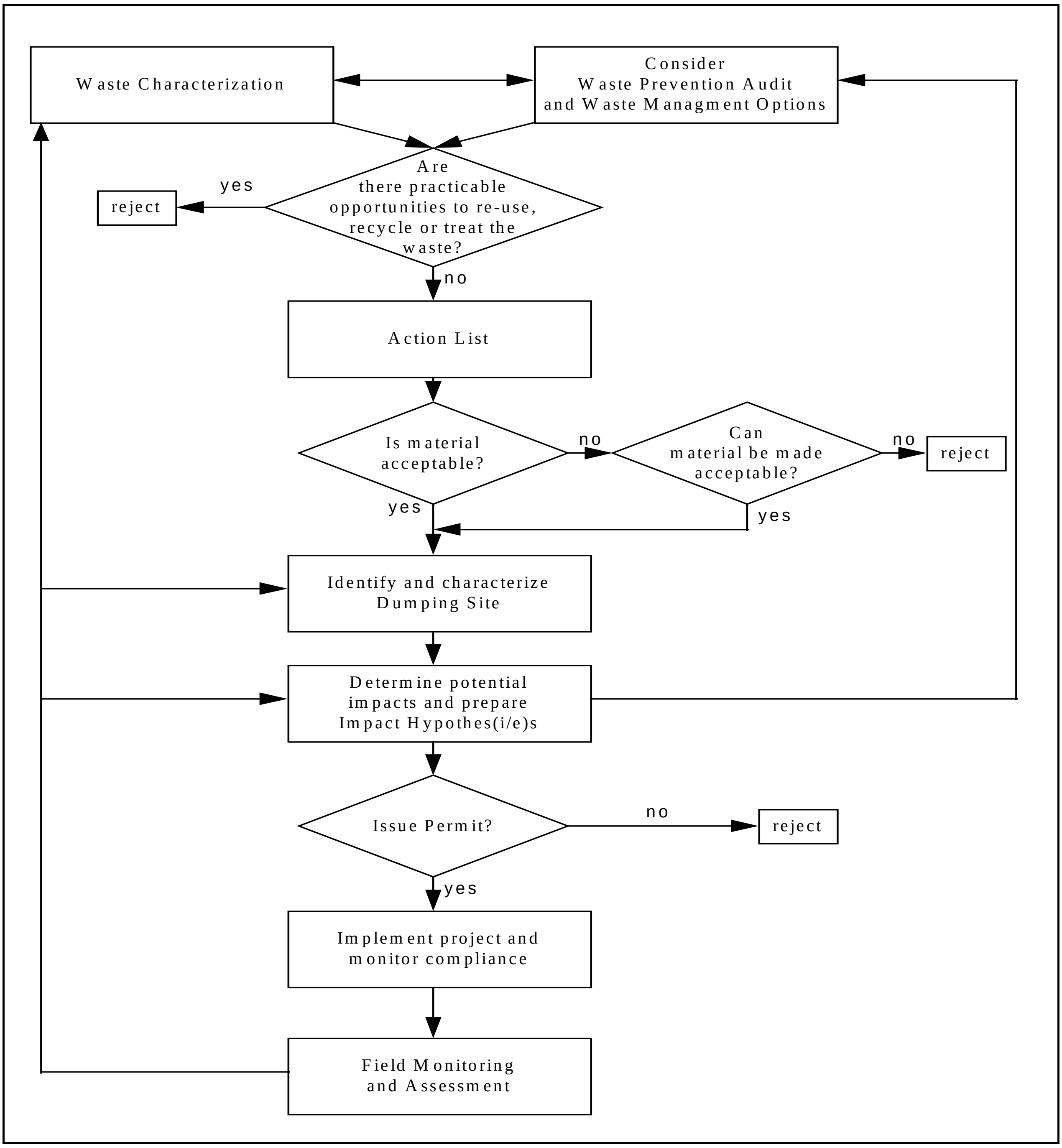
[1] The Nineteenth Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these Guidelines in 1997.

.3 Action List (Chapter 5)
.4 Identify and Characterize Dump-site (Chapter 6) (Dump-site Selection)

.5 Determine Potential Impacts and Prepare Impact Hypothesis(es) (Chapter 7) (Assessment of Potential Effects)
.6 Issue Permit (Chapter 9) (Permit and Permit Conditions)
.7 Implement Project and Monitor Compliance (Chapter 8) (Monitoring)
.8 Field Monitoring and Assessment (Chapter 8) (Monitoring)

Figure 1



1.4 These Guidelines are specific to (human) sewage sludge[2]. Adherence to the following represents neither a more restrictive nor a less restrictive regime than that of the generic Guidelines of 1997.

2 The Twenty-second Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these specific Guidelines in 2000.

1.5 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 involving 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. 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. The purification process allows reclaimed water to be discharged to freshwater courses or coastal waters or used in other applications, such as irrigation, under conditions that pose a greatly reduced risk to the receiving environment and human health. Sewage sludge is, however, an unavoidable product from sewage treatment and increased levels of waste water purification lead, inevitably, to greater quantities of sludge for which environmentally sound management strategies are required.

2 WASTE PREVENTION AUDIT

2.1 The initial stages in assessing alternatives to dumping should, as appropriate, include an evaluation of:

.1 types, amounts and relative hazards of wastes generated;

.2 the sources of the wastes, which contribute to sewage contamination within the catchment areas; and

.3 feasibility of the waste reduction/prevention techniques described in paragraphs 2.3 and 2.4 below.

2.2 In general terms, if the required audit reveals that opportunities exist for waste prevention at source, an applicant is expected to formulate and implement a waste prevention strategy in collaboration with relevant local and national agencies which includes specific waste reduction targets and provision for further waste prevention audits to ensure that these targets are being met. Permit issuance or renewal decisions shall assure compliance with any resulting waste reduction and prevention requirements[3].

2.3 For sewage sludge, a goal of waste management should be the identification and control of sources of contamination, both point and diffuse, in particular from industrial sources, which will improve the range of management options, not least those associated with a beneficial use.

2.4 In developing source control strategies, appropriate agencies should take into account:

.1 the hazards posed by contaminants and the relative contributions of the individual sources of these contaminants. A high proportion of contaminants in wastewater can be removed by biodegradation and sorption or precipitation processes. Persistent lipophilic organic contaminants, including pharmacological agents mainly from human use, and heavy metals tend to be sorbed on sewage sludge;

[3] This paragraph is not directly applicable to sewage sludge but should be considered in conjunction with paragraphs 2.3 and 2.4 of these Guidelines.

.2 existing source control programmes and their regulatory or legal requirements;

.3 technical and economic feasibility;

.4 the evaluation of the effectiveness of measures taken; and

.5 the consequences of implementing or not implementing controls should consider the differing demands that rural, urban and industrial areas place upon waste treatment and the options for sewage sludge use or disposal.

3 CONSIDERATION OF WASTE MANAGEMENT OPTIONS

3.1 Alternatives to dumping of sewage sludge at sea that require consideration include (implying an order of increasing environmental impact):

.1 beneficial use: For sewage sludge several beneficial uses need to be considered:

.1 in agriculture, horticulture, silviculture etc. Sewage sludge contains a number of nutrients and mineral constituents which give a beneficial enrichment to soils. Depending on the waste water sources, sewage sludge may contain contaminants which set limitations on its agricultural use; and

.2 production of energy through the use of sewage sludge as a raw material for producing liquid or gaseous fuels;

.2 off-site recycling;

.3 thermal destruction by incineration. Flue gas cleaning procedures and prescribed emission limit values for such processes and plants should ensure that hazardous constituents do not contaminate the land and marine environment;

.4 treatment to reduce or remove the hazardous constituents, so that another option becomes feasible; and

.5 disposal on land e.g., in suitably designed landfills.

3.2 A permit to dump wastes or other matter shall be refused if the permitting authority determines that appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to human health or the environment or disproportionate costs. The practical availability of other means of disposal should be considered in the light of a comparative risk assessment involving both dumping and the alternatives.

4 CHEMICAL, PHYSICAL AND BIOLOGICAL PROPERTIES

4.1 A detailed description and characterization of the waste is an essential precondition for the consideration of alternatives and the basis for a decision as to whether a waste may be dumped. If a waste is so poorly characterized that proper assessment cannot be made of its potential impacts on human health and the environment, that waste shall not be dumped.

4.2 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. Particular consideration should be given to biological constituents such as pathogenic bacteria, viruses and parasites;
- .3 toxicity;
- .4 persistence: physical, chemical and biological; and
- .5 accumulation and biotransformation in biological materials or sediments.

5 ACTION LIST

5.1 The Action List provides a screening mechanism for determining whether a material is considered acceptable for dumping. It constitutes a crucial part of Annex 2 to the 1996 Protocol and the Scientific Group will continuously review all aspects of it to assist Contracting Parties with its application. It may also be used in meeting the requirements of Annexes I and II to the London Convention 1972.

5.2 Each Contracting Party shall develop a national Action List to provide a mechanism for screening candidate wastes and their constituents on the basis of their potential effects on human health and the marine environment. In selecting substances for consideration in an Action List, priority shall be given to toxic, persistent and bio-accumulative substances from anthropogenic sources (e.g., cadmium, mercury, organohalogens, petroleum hydrocarbons and, whenever relevant, arsenic, lead, copper, zinc, beryllium, chromium, nickel and vanadium, organosilicon compounds, cyanides, fluorides and pesticides or their by-products other than organohalogens). An Action List can also be used as a trigger mechanism for further waste prevention considerations.

5.3 For an individual waste category, it may be possible to define national action levels on the basis of concentration limits, biological responses, environmental quality standards, flux considerations or other reference values.

5.4 An Action List shall specify an upper level and may also specify a lower level. The upper level should be set so as to avoid acute or chronic effects on human health or on sensitive marine organisms representative of the marine ecosystem. Application of an Action List will result in three possible categories of waste:

- .1 wastes which contain specified substances, or which cause biological responses, *exceeding* the relevant upper level shall not be dumped, unless made acceptable for dumping through the use of management techniques or processes;

- .2 wastes which contain specified substances, or which cause biological responses, *below* the relevant lower levels should be considered to be of little environmental concern in relation to dumping; and

- .3 wastes, which contain specified substances, or which cause biological responses, *below* the upper level but *above* the lower level require more detailed assessment before their suitability for dumping can be determined.

6 DUMP-SITE SELECTION

Site selection considerations

6.1 Proper selection of a dump-site at sea for the reception of waste is of paramount importance. With sewage sludge, it is important to consider the proximity of site(s) to recreational and shellfish areas with special consideration being given to human exposures to pathogens.

6.2 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. Particular consideration should be given to the organic matter flux and associated changes in oxygen demand. Particular consideration should also be given to nutrient fluxes and potential eutrophication; and
.4 economic and operational feasibility.

6.3 Guidance for procedures to be followed in dump-site selection can be found in a report of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP Reports and Studies No. 16 - Scientific Criteria for the Selection of Waste Disposal Sites at Sea). Prior to selecting a dump-site, it is essential that data be available on the oceanographic characteristics of the general area in which the site is to be located. This information can be obtained from the literature but fieldwork should be undertaken to fill the gaps. Required information includes:

.1 the nature of the seabed, including its topography, geo-chemical and geological characteristics, its biological composition and activity, and prior dumping activities affecting the area;

.2 the physical nature of the water column, including temperature, depth, possible existence of a thermocline/pycnocline and how it varies in depth with season and weather conditions, tidal period and orientation of the tidal ellipse, mean direction and velocity of the surface and bottom drifts, velocities of storm-wave induced bottom currents, general wind and wave characteristics, and the average number of storm days per year, suspended matter; and

.3 the chemical and biological nature of the water column, including pH, salinity, dissolved oxygen at surface and bottom, chemical and biochemical oxygen demand, nutrients and their various forms and primary productivity.

6.4 Some of the important amenities, biological features and uses of the sea to be considered in determining the specific location of the dump-site are:

.1 the shoreline and bathing beaches;
.2 areas of beauty or significant cultural or historical importance;
.3 areas of special scientific or biological importance, such as sanctuaries;

.4 fishing areas;
.5 spawning, nursery and recruitment areas;
.6 migration routes;
.7 seasonal and critical habitats;
.8 shipping lanes;
.9 military exclusion zones; and
.10 engineering uses of the seafloor, including mining, undersea cables, desalination or energy conversion sites.

Size of the dump-site

6.5 Size of the dump-site is an important consideration for the following reasons:

.1 it should be large enough, unless it is an approved dispersion site, to have the bulk of the material remain either within the site limits or within a predicted area of impact after dumping;

.2 it should be large enough to accommodate anticipated volumes of solid waste and/or liquid wastes to be diluted to near background levels before or upon reaching site boundaries;

.3 it should be large enough in relation to anticipated volumes for dumping so that it would serve its function for many years; and

.4 it should not be so large that monitoring would require undue expenditure of time and money.

Site capacity

6.6 In order to assess the capacity of a site, especially for solid wastes, the following should be taken into consideration:

.1 the anticipated loading rates per day, week, month or year;
.2 whether or not it is a dispersive site; and
.3 the allowable reduction in water depth over the site because of mounding of material.

Particular attention needs to be paid to the reduction in dissolved oxygen in the water column and changes in sediment oxidation-reduction (REDOX) conditions.

Evaluation of potential impacts

6.7 An important consideration in determining the suitability of a waste for dumping at a specific site is the degree to which this results in increased exposures of organisms to substances that may cause adverse effects.

6.8 The extent of adverse effects of a substance is a function of the exposures of organisms (including humans). Exposure, in turn, is a function, *inter alia*, of input flux and the physical, chemical and biological processes that control the transport, behaviour, fate and distribution of a substance.

6.9 The presence of natural substances and the ubiquitous occurrence of contaminants means that there will always be some pre-existing exposures of organisms to all substances contained in any waste that might be dumped. Concerns about exposures to hazardous substances thus relate to additional exposures as a consequence of dumping. This, in turn, can be translated back to the relative magnitude of the input fluxes of substances from dumping compared with existing input fluxes from other sources.

6.10 Accordingly, due consideration needs to be given to the relative magnitude of the substance fluxes associated with dumping in the local and regional area surrounding the dump-site. In cases where it is predicted that dumping will substantially augment existing fluxes associated with natural processes, dumping at the site under consideration should be deemed inadvisable.

6.11 In the case of synthetic substances, the relationship between fluxes associated with dumping and pre-existing fluxes in the vicinity of the site may not provide a suitable basis for decisions.

6.12 Temporal characteristics should be considered to identify potentially critical times of the year (e.g., for marine life) when dumping should not take place. This consideration leaves periods when it is expected that dumping operations will have less impact than at other times. If these restrictions become too burdensome and costly, there should be some opportunity for compromise in which priorities may have to be established concerning species to be left wholly undisturbed. Examples of such biological considerations are:

.1 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 and breeding periods;
.2 periods when marine organisms are hibernating on or are buried in the sediments; and
.3 periods when particularly sensitive and possibly endangered species are exposed.

Contaminant mobility

6.13 Contaminant mobility is dependent upon several factors, among which are:

.1 type of matrix;
.2 form of contaminant;
.3 contaminant partitioning;
.4 physical state of the system, e.g., temperature, water flow, suspended matter;
.5 physico-chemical state of the system;
.6 length of diffusion and advection pathways; and
.7 biological activities e.g., bioturbation.

7 ASSESSMENT OF POTENTIAL EFFECTS

7.1 Assessment of potential effects should lead to a concise statement of the expected consequences of the sea or land disposal options, i.e., the "Impact Hypothesis". It provides a basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements. As far as possible, waste management options causing dispersion and dilution of contaminants in the environment should be avoided and preference given to techniques that prevent the input of the contaminants to the environment.

7.2 The assessment for dumping should integrate information on waste characteristics, conditions at the proposed dump-site(s), fluxes and proposed disposal techniques and specify the potential effects on human health, living resources, amenities and other legitimate uses of the sea. It should define the nature, temporal and spatial scales and duration of expected impacts based on reasonably conservative assumptions.

7.3 The assessment should be as comprehensive as possible. The primary potential impacts should be identified during the dump-site selection process. These are considered to pose the most serious threats to human health and the environment. Alterations to the physical environment, risks to human health, devaluation of marine resources and interference with other legitimate uses of the sea are often seen as primary concerns in this regard.

7.4 In constructing an impact hypothesis, particular attention should be given to, but not limited to, potential impacts on amenities (e.g., presence of floatables), sensitive areas (e.g., spawning, nursery or feeding areas), habitat (e.g., biological, chemical and physical modification), migratory patterns and marketability of resources. Consideration should also be given to potential impacts on other uses of the sea including: fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea.

7.5 Even the least complex and most innocuous wastes may have a variety of physical, chemical and biological effects. Impact hypotheses cannot attempt to reflect them all. It must be recognized that even the most comprehensive impact hypotheses may not address all possible scenarios such as unanticipated impacts. It is therefore imperative that the monitoring programme be linked directly to the hypotheses and serve as a feedback mechanism to verify the predictions and review the adequacy of management measures applied to the dumping operation and at the dump-site. It is important to identify the sources and consequences of uncertainty.

7.6 The expected consequences of dumping should be described in terms of affected habitats, processes, species, communities and uses. The precise nature of the predicted effect (e.g., change, response, or interference) should be described. The effect should be quantified in sufficient detail so that there would be no doubt as to the variables to be measured during field monitoring. In the latter context, it would be essential to determine "where" and "when" the impacts can be expected.

7.7 Emphasis should be placed on biological effects and habitat modification as well as physical and chemical change. However, if the potential effect is due to substances, the following factors should be addressed:

.1 estimates of statistically significant increases of the substance in seawater, sediments, or biota in relation to existing conditions and associated effects; and

.2 estimate of the contribution made by the substance to local and regional fluxes and the degree to which existing fluxes pose threats or adverse effects on the marine environment or human health. Particular consideration needs to be given to organic carbon fluxes imposing additional oxygen demand and to nutrient fluxes that may cause eutrophication.

7.8 In the case of repeated or multiple dumping operations, impact hypotheses should take into account the cumulative effects of such operations. It will also be important to consider the possible interactions with other waste dumping practices in the area, both existing and planned.

7.9 An analysis of each disposal option should be considered in light of a comparative assessment of the following concerns: human health risks, environmental costs, hazards (including accidents), economics and exclusion of future uses. If this assessment reveals that adequate information is not available to determine the likely effects of the proposed disposal option, including potential long-term harmful consequences, then this option should not be considered further. In addition, if the interpretation of the comparative assessment shows the dumping option to be less preferable, a permit for dumping should not be given.

7.10 Each assessment should conclude with a statement supporting a decision to issue or refuse a permit for dumping.

7.11 Where monitoring is required, the effects and parameters described in the hypotheses should help to guide field and analytical work so that relevant information can be obtained in the most efficient and cost-effective manner.

8 MONITORING

8.1 Monitoring is used to verify that permit conditions are met - compliance monitoring - and that the assumptions made during the permit review and site selection process were correct and sufficient to protect the environment and human health - field monitoring. It is essential that such monitoring programmes have clearly defined objectives.

8.2 The Impact Hypothesis forms the basis for defining field monitoring. The measurement programme should be designed to ascertain that changes in the receiving environment are within those predicted. The following questions must be answered:

.1 What testable hypotheses can be derived from the Impact Hypothesis?
.2 What measurements (type, location, frequency, performance requirements) are required to test these hypotheses?
.3 How should the data be managed and interpreted?

8.3 It may usually be assumed that suitable specifications of existing (pre-disposal) conditions in the receiving area are already contained in the application for dumping. If the specification of such conditions is inadequate to permit the formulation of an Impact Hypothesis, the licensing authority will require additional information before any final decision on the permit application is made.

8.4 The permitting authority is encouraged to take account of relevant research information in the design and modification of monitoring programmes. The measurements can be divided into two types - those within the zone of predicted impact and those outside.

8.5 Measurements should be designed to determine whether the zone of impact and the extent of change outside the zone of impact differ from those predicted. The former can be answered by designing a sequence of measurements in space and time that ensures that the projected spatial scale of change is not exceeded. The latter can be answered by the acquisition of measurements that provide information on the extent of change that occurs outside the zone of impact as a result of the dumping operation. Frequently, these measurements will be based on a null hypothesis - that no significant change can be detected.

8.6 The results of monitoring (or other related research) should be reviewed at regular intervals in relation to the objectives and can provide a basis to:

.1 modify or terminate the field-monitoring programme;
.2 modify or revoke the permit;
.3 redefine or close the dump-site; and
.4 modify the basis on which applications to dump wastes are assessed.

9 PERMIT AND PERMIT CONDITIONS

9.1 A decision to issue a permit should only be made if all impact evaluations are completed and the monitoring requirements are determined. The provisions of the permit shall ensure, as far as practicable, that environmental disturbance and detriment are minimized and the benefits maximized. Any permit issued shall contain data and information specifying:

.1 the types, amounts and sources of materials to be dumped;
.2 the location of the dump-site(s);
.3 the method of dumping; and
.4 monitoring and reporting requirements.

9.2 If dumping is the selected option, then a permit authorizing dumping must be issued in advance. It is recommended that opportunities be provided for public review and participation in the permitting process. In granting a permit, the hypothesized impact occurring within the boundaries of the dump-site, such as alterations to the physical, chemical and biological compartments of the local environment is accepted by the permitting authority.

9.3 Regulators should strive at all times to enforce procedures that will result in environmental changes as far below the limits of allowable environmental change as practicable, taking into account technological capabilities as well as economic, social and political concerns.

9.4 Permits should be reviewed at regular intervals, taking into account the results of monitoring and the objectives of monitoring programmes. Review of monitoring results will indicate whether field programmes need to be continued, revised or terminated, and will contribute to informed decisions regarding the continuance, modification or revocation of permits. This provides an important feedback mechanism for the protection of human health and the marine environment.

SPECIFIC GUIDELINES FOR ASSESSMENT OF

FISH WASTE, OR MATERIAL RESULTING FROM INDUSTRIAL FISH PROCESSING OPERATIONS

1 INTRODUCTION

1.1 The Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping[1], referred to in short as the "Generic Guidelines", as well as the Specific Guidelines for Assessment of Fish Waste, or Material resulting from Industrial Fish Processing Operations addressed in this document are intended for use by national authorities responsible for regulating dumping of wastes and embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention 1972 or the 1996 Protocol thereto. Annex 2 to the 1996 Protocol places emphasis on progressively reducing the need to use the sea for dumping of wastes. Furthermore, it recognizes that avoidance of pollution demands rigorous controls on the emission and dispersion of contaminating substances and the use of scientifically based procedures for selecting appropriate options for waste disposal. When applying these Guidelines uncertainties in relation to assessments of impacts on the marine environment will need to be considered and a precautionary approach applied in addressing these uncertainties. They should be applied with a view that acceptance of dumping under certain circumstances does not remove the obligation to make further attempts to reduce the necessity for dumping.

1.2 The 1996 Protocol to the London Convention 1972 follows an approach under which dumping of wastes or other matter is prohibited except for those materials specifically enumerated in Annex I, and in the context of that Protocol, these Guidelines would apply to the materials listed in that Annex. The London Convention 1972 prohibits the dumping of certain wastes or other matter specified therein and in the context of that Convention these Guidelines meet the requirements of its Annexes for wastes not prohibited for dumping at sea. When applying these Guidelines under the London Convention 1972, 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 1972.

1.3 The schematic shown in Figure 1 provides a clear indication of the stages in the application of the Guidelines where important decisions should be made and is not designed as a conventional "decision tree". In general, national authorities should use the schematic in an iterative manner ensuring that all steps receive consideration before a decision is made to issue a permit. Figure 1 illustrates the relationship between the operational components of Annex 2 of the 1996 Protocol and contains the following elements:

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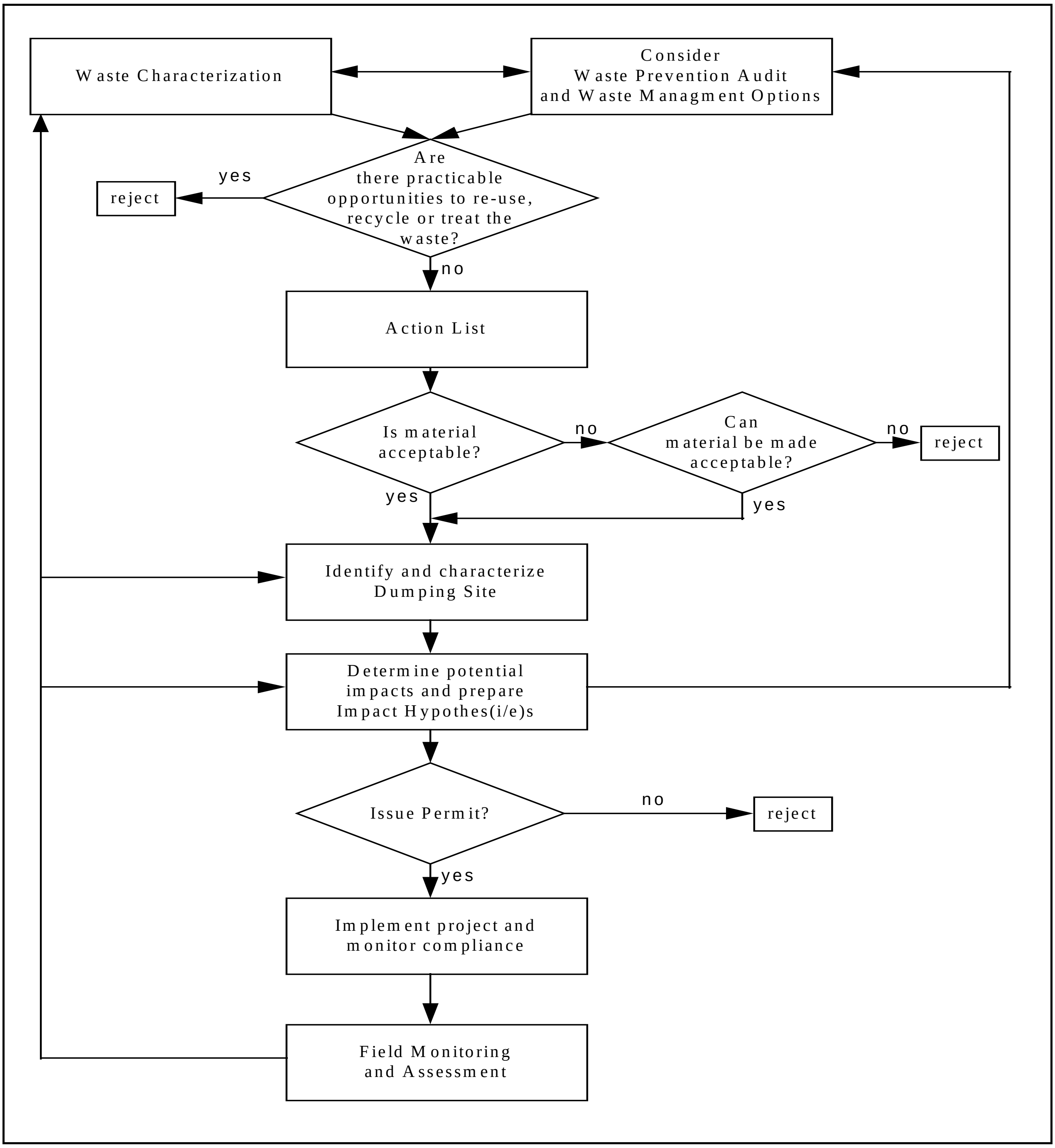
[1] The Nineteenth Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these Guidelines in 1997.

.1 Waste Characterization (Chapter 4) (Chemical, Physical and Biological Properties)
.2 Waste Prevention Audit and Waste Management Options (Chapters 2 and 3)
.3 Action List (Chapter 5)
.4 Identify and Characterize Dump-site (Chapter 6) (Dump-site Selection)
.5 Determine Potential Impacts and Prepare Impact Hypothesis(es) (Chapter 7) (Assessment of Potential Effects)
.6 Issue Permit (Chapter 9) (Permit and Permit Conditions)
.7 Implement Project and Monitor Compliance (Chapter 8) (Monitoring)
.8 Field Monitoring and Assessment (Chapter 8) (Monitoring)

Figure 1



1.4 These Guidelines are specific to fish waste, or material resulting from industrial fish processing operations[2]. They address only primary and secondary fish processing wastes and are not intended for application to discharges from ships actively fishing. Adherence to the following represents neither a more restrictive nor a less restrictive regime than that of the generic Guidelines of 1997.

1.5 Fish waste or material resulting from industrial fish processing operations from either wild stocks or aquaculture consists of particles of flesh, skin, bones entrails, shells or liquid stick water. The organic components of the waste have a high biological oxygen demand and, if not managed properly, can pose environmental and health problems. Generally, the solid wastes make up 30% to 40% of total production, depending on the species processed. It is imperative to consider the time frame between production of the waste and its ultimate disposal. Most fish wastes degrade rapidly in warm weather and can cause aesthetic problems and strong odours as a result of bacterial decomposition if not stored properly or disposed of quickly. If further processing of the waste to fishmeal is considered a viable alternative, it is essential that the waste be fresh.

2 WASTE PREVENTION AUDIT

2.1 The initial stages in assessing alternatives to dumping should, as appropriate, include an evaluation of:

- .1 types, amounts and relative hazards of wastes generated;
- .2 the quantity of waste generated on a daily/weekly basis and the seasonal variability of production should be considered; and
- .3 feasibility of the following waste reduction/prevention techniques:
  - .1 product reformulation;
  - .2 clean production technologies;
  - .3 process modification;
  - .4 input substitution; and
  - .5 on-site, closed-loop recycling.

2.2 In general terms, if the required audit reveals that opportunities exist for waste prevention at source, an applicant is expected to formulate and implement a waste prevention strategy in collaboration with relevant local and national agencies which includes specific waste reduction targets and provision for further waste prevention audits to ensure that these targets are being met. Permit issuance or renewal decisions shall assure compliance with any resulting waste reduction and prevention requirements.

3 CONSIDERATION OF WASTE MANAGEMENT OPTIONS

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2 The Twenty-second Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these specific Guidelines in 2000.

3.1 Applications to dump wastes or other matter shall demonstrate that appropriate consideration has been given to the following hierarchy of waste management options, which implies an order of increasing environmental impact. For fish wastes, these options include:

.1 reprocessing to fishmeal;

.2 production of silage; use as food for domestic animals/aquaculture; and use in biochemical industry products; and

.3 use as fertilizer in land farming and reduction of liquid wastes by evaporation.

The practical availability of these options is always a primary concern. If land farming is selected a suitable area of application must be available and there must be a demand for the waste as fertilizer. If fishmeal production is selected, the distance to the meal plant in relation to the quantity and quality of the waste produced should be considered in the economic analysis. The marketability of the silage production may be a major concern.

3.2 A permit to dump wastes or other matter shall be refused if the permitting authority determines that appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to human health or the environment or disproportionate costs. The practical availability of other means of disposal should be considered in the light of a comparative risk assessment involving both dumping and the alternatives.

4 CHEMICAL, PHYSICAL AND BIOLOGICAL PROPERTIES

4.1 A detailed description and characterization of the waste is an essential precondition for the consideration of alternatives and the basis for a decision as to whether a waste may be dumped. If a waste is so poorly characterized that proper assessment cannot be made of its potential impacts on human health and the environment, that waste shall not be dumped.

4.2 The origin of the waste and species (e.g., location and nature of wild harvest or hatchery); total quantity and form produced; potential changes in oxidation-reduction conditions at the dump-site, and the potential for eutrophication should be considered.

4.3 Evaluation criteria can be established based on potential alteration of oxidation-reduction conditions (e.g., resulting from increased BOD).

4.4 Fish wastes may be considered suitable for dumping if the fish received at the plant was considered fit for human consumption according to national standards and no significant subsequent degradation has occurred.

4.5 Raw fish considered unsuitable for human consumption on delivery to the processing plant will require evaluation on a case-by-case basis. Determination of its suitability for dumping should consider the reason for its rejection by the processing plant.

4.6 Consideration should be given to the potential for introduction of disease vectors including non-indigenous parasites to the wild stocks. Wastes from aquaculture operations can pose some particular problems in this regard.

4.7 Characterization of the wastes and their constituents shall also take into account:

.1 toxicity;
.2 persistence: physical, chemical and biological; and
.3 accumulation and biotransformation in biological materials or sediments.

5 ACTION LIST

5.1 The Action List provides a screening mechanism for determining whether a material is considered acceptable for dumping. It constitutes a crucial part of Annex 2 to the 1996 Protocol and the Scientific Group will continuously review all aspects of it to assist Contracting Parties with its application. It may also be used in meeting the requirements of Annexes I and II to the London Convention 1972. With regard to fish waste, the potential presence of chemicals used in aquaculture and their residues should be considered. The presence of contaminants may also be of concern for any fish wastes subjected to chemical treatment. Otherwise the provisions contained in this chapter do not require detailed consideration for wastes generated from wild fish harvest.

5.2 Each Contracting Party shall develop a national Action List to provide a mechanism for screening candidate wastes and their constituents on the basis of their potential effects on human health and the marine environment. In selecting substances for consideration in an Action List, priority shall be given to toxic, persistent and bio-accumulative substances from anthropogenic sources (e.g., cadmium, mercury, organohalogens, petroleum hydrocarbons and, whenever relevant, arsenic, lead, copper, zinc, beryllium, chromium, nickel and vanadium, organosilicon compounds, cyanides, fluorides and pesticides or their by-products other than organohalogens). An Action List can also be used as a trigger mechanism for further waste prevention considerations.

5.3 For an individual waste category, it may be possible to define national action levels on the basis of concentration limits, biological responses, environmental quality standards, flux considerations or other reference values.

5.4 An Action List shall specify an upper level and may also specify a lower level. The upper level should be set so as to avoid acute or chronic effects on human health or on sensitive marine organisms representative of the marine ecosystem. Application of an Action List will result in three possible categories of waste:

.1 wastes which contain specified substances, or which cause biological responses, *exceeding* the relevant upper level shall not be dumped, unless made acceptable for dumping through the use of management techniques or processes;

.2 wastes which contain specified substances, or which cause biological responses, *below* the relevant lower levels should be considered to be of little environmental concern in relation to dumping; and

.3 wastes, which contain specified substances, or which cause biological responses, *below* the upper level but *above* the lower level require more detailed assessment before their suitability for dumping can be determined.

6 DUMP-SITE SELECTION

Site selection considerations

6.1 Proper selection of a dump-site at sea for the reception of waste is of paramount importance. 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). 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.

6.2 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.

6.3 Guidance for procedures to be followed in dump-site selection can be found in a report of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP Reports and Studies No. 16 - Scientific Criteria for the Selection of Waste Disposal Sites at Sea). Prior to selecting a dump-site, it is essential that data be available on the oceanographic characteristics of the general area in which the site is to be located. This information can be obtained from the literature but fieldwork should be undertaken to fill the gaps. Required information includes:

- .1 the nature of the seabed, including its topography, geo-chemical and geological characteristics, its biological composition and activity, and prior dumping activities affecting the area;

- .2 the physical nature of the water column, including temperature, depth, possible existence of a thermocline/pycnocline and how it varies in depth with season and weather conditions, tidal period and orientation of the tidal ellipse, mean direction and velocity of the surface and bottom drifts, velocities of storm-wave induced bottom currents, general wind and wave characteristics, and the average number of storm days per year, suspended matter; and

- .3 the chemical and biological nature of the water column, including pH, salinity, dissolved oxygen at surface and bottom, chemical and biochemical oxygen demand, nutrients and their various forms and primary productivity.

6.4 Some of the important amenities, biological features and uses of the sea to be considered in determining the specific location of the dump-site are:

- .1 the shoreline and bathing beaches;
- .2 areas of beauty or significant cultural or historical importance;
- .3 areas of special scientific or biological importance, such as sanctuaries;
- .4 fishing areas;
- .5 spawning, nursery and recruitment areas;
- .6 migration routes;
- .7 seasonal and critical habitats;

.8 shipping lanes;
.9 military exclusion zones; and
.10 engineering uses of the seafloor, including mining, undersea cables, desalination or energy conversion sites.

Size of the dump-site

6.5 Size of the dump-site is an important consideration for the following reasons:

.1 it should be large enough, unless it is an approved dispersion site, to have the bulk of the material remain either within the site limits or within a predicted area of impact after dumping;

.2 it should be large enough to accommodate anticipated volumes of solid waste and/or liquid wastes to be diluted to near background levels before or upon reaching site boundaries;

.3 it should be large enough in relation to anticipated volumes for dumping so that it would serve its function for many years; and

.4 it should not be so large that monitoring would require undue expenditure of time and money.

Site capacity

6.6 In order to assess the capacity of a site, especially for solid wastes, the following should be taken into consideration:

.1 the anticipated loading rates per day, week, month or year;
.2 whether or not it is a dispersive site (see paragraph 6.1 above); and
.3 the allowable reduction in water depth over the site because of mounding of material.

With regard to fish waste, particular attention needs to be paid to the possible reduction in dissolved oxygen in the water column and changes in sediment oxidation-reduction conditions, taking into account the likely rate of waste consumption by marine organisms.

Evaluation of potential impacts

6.7 In those cases in which the overriding concern is biological oxygen demand and associated oxygen depletion in the marine environment, the provisions of paragraphs 6.8 - 6.12 below do not require detailed consideration.

6.8 An important consideration in determining the suitability of a waste for dumping at a specific site is the degree to which this results in increased exposures of organisms to substances that may cause adverse effects.

6.9 The extent of adverse effects of a substance is a function of the exposures of organisms (including humans). Exposure, in turn, is a function, *inter alia*, of input flux and the physical, chemical and biological processes that control the transport, behaviour, fate and distribution of a substance.

6.10 The presence of natural substances and the ubiquitous occurrence of contaminants means that there will always be some pre-existing exposures of organisms to all substances contained in any waste that might be dumped. Concerns about exposures to hazardous substances thus relate to additional exposures as a consequence of dumping. This, in turn, can be translated back to the relative magnitude of the input fluxes of substances from dumping compared with existing input fluxes from other sources.

6.11 Accordingly, due consideration needs to be given to the relative magnitude of the substance fluxes associated with dumping in the local and regional area surrounding the dump-site. In cases where it is predicted that dumping will substantially augment existing fluxes associated with natural processes, dumping at the site under consideration should be deemed inadvisable.

6.12 In the case of synthetic substances, the relationship between fluxes associated with dumping and pre-existing fluxes in the vicinity of the site may not provide a suitable basis for decisions.

6.13 Temporal characteristics should be considered to identify potentially critical times of the year (e.g., for marine life) when dumping should not take place. This consideration leaves periods when it is expected that dumping operations will have less impact than at other times. If these restrictions become too burdensome and costly, there should be some opportunity for compromise in which priorities may have to be established concerning species to be left wholly undisturbed. Examples of such biological considerations are:

- .1 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 and breeding periods;
- .2 periods when marine organisms are hibernating on or are buried in the sediments; and
- .3 periods when particularly sensitive and possibly endangered species are exposed.

Contaminant mobility

6.14 Contaminant mobility is dependent upon several factors, among which are:

- .1 type of matrix;
- .2 form of contaminant;
- .3 contaminant partitioning;
- .4 physical state of the system, e.g., temperature, water flow, suspended matter;
- .5 physico-chemical state of the system[3];
- .6 length of diffusion and advection pathways[4]; and
- .7 biological activities e.g., bioturbation.

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3 This provision does not require detailed consideration for fish waste generated from the harvesting of wild stocks.

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In those cases in which the overriding concern is biological oxygen demand and associated oxygen depletion in the marine environment, the provisions of this paragraph do not require detailed consideration.

7 ASSESSMENT OF POTENTIAL EFFECTS

7.1 Assessment of potential effects should lead to a concise statement of the expected consequences of the sea or land disposal options, i.e., the "Impact Hypothesis". It provides a basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements. As far as possible, waste management options causing dispersion and dilution of contaminants in the environment should be avoided and preference given to techniques that prevent the input of the contaminants to the environment. In relation to this chapter, potential environmental impacts include: eutrophication; oxygen reduction in the marine environment; and the introduction of disease vectors and non-indigenous species. Fish wastes that sink may in addition have a physical impact such as covering of the seabed and interference with fishing gear.

7.2 The assessment for dumping should integrate information on waste characteristics, conditions at the proposed dump-site(s), fluxes and proposed disposal techniques and specify the potential effects on human health, living resources, amenities and other legitimate uses of the sea. It should define the nature, temporal and spatial scales and duration of expected impacts based on reasonably conservative assumptions.

7.3 The assessment should be as comprehensive as possible. The primary potential impacts should be identified during the dump-site selection process. These are considered to pose the most serious threats to human health and the environment. Alterations to the physical environment, risks to human health, devaluation of marine resources and interference with other legitimate uses of the sea are often seen as primary concerns in this regard.

7.4 In constructing an impact hypothesis, particular attention should be given to, but not limited to, potential impacts on amenities (e.g., presence of floatables), sensitive areas (e.g., spawning, nursery or feeding areas), habitat (e.g., biological, chemical and physical modification), migratory patterns and marketability of resources. Consideration should also be given to potential impacts on other uses of the sea including: fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea.

7.5 Even the least complex and most innocuous wastes may have a variety of physical, chemical and biological effects. Impact hypotheses cannot attempt to reflect them all. It must be recognized that even the most comprehensive impact hypotheses may not address all possible scenarios such as unanticipated impacts. It is therefore imperative that the monitoring programme be linked directly to the hypotheses and serve as a feedback mechanism to verify the predictions and review the adequacy of management measures applied to the dumping operation and at the dump-site. It is important to identify the sources and consequences of uncertainty.

7.6 The expected consequences of dumping should be described in terms of affected habitats, processes, species, communities and uses. The precise nature of the predicted effect (e.g., change, response, or interference) should be described. The effect should be quantified in sufficient detail so that there would be no doubt as to the variables to be measured during field monitoring. In the latter context, it would be essential to determine "where" and "when" the impacts can be expected.

7.7 Emphasis should be placed on biological effects and habitat modification as well as physical and chemical change. However, if the potential effect is due to substances, the following factors should be addressed:

.1 estimates of statistically significant increases of the substance in seawater, sediments, or biota in relation to existing conditions and associated effects; and

.2 estimate of the contribution made by the substance to local and regional fluxes and the degree to which existing fluxes pose threats or adverse effects on the marine environment or human health.

7.8 In the case of repeated or multiple dumping operations, impact hypotheses should take into account the cumulative effects of such operations. It will also be important to consider the possible interactions with other waste dumping practices in the area, both existing or planned.

7.9 An analysis of each disposal option should be considered in light of a comparative assessment of the following concerns: human health risks, environmental costs, hazards (including accidents), economics and exclusion of future uses. If this assessment reveals that adequate information is not available to determine the likely effects of the proposed disposal option, including potential long-term harmful consequences, then this option should not be considered further. In addition, if the interpretation of the comparative assessment shows the dumping option to be less preferable, a permit for dumping should not be given.

7.10 Each assessment should conclude with a statement supporting a decision to issue or refuse a permit for dumping.

7.11 Where monitoring is required, the effects and parameters described in the hypotheses should help to guide field and analytical work so that relevant information can be obtained in the most efficient and cost-effective manner.

8 MONITORING

8.1 Monitoring is used to verify that permit conditions are met - compliance monitoring - and that the assumptions made during the permit review and site selection process were correct and sufficient to protect the environment and human health - field monitoring. It is essential that such monitoring programmes have clearly defined objectives.

8.2 The Impact Hypothesis forms the basis for defining field monitoring. The measurement programme should be designed to ascertain that changes in the receiving environment are within those predicted. The following questions must be answered:

.1 What testable hypotheses can be derived from the Impact Hypothesis?
.2 What measurements (type, location, frequency, performance requirements) are required to test these hypotheses?
.3 How should the data be managed and interpreted?

8.3 It may usually be assumed that suitable specifications of existing (pre-disposal) conditions in the receiving area are already contained in the application for dumping. If the specification of such conditions is inadequate to permit the formulation of an Impact Hypothesis, the licensing authority will require additional information before any final decision on the permit application is made.

8.4 The permitting authority is encouraged to take account of relevant research information in the design and modification of monitoring programmes. The measurements can be divided into two types - those within the zone of predicted impact and those outside.

8.5 Measurements should be designed to determine whether the zone of impact and the extent of change outside the zone of impact differ from those predicted. The former can be answered by designing a sequence of measurements in space and time that ensures that the projected spatial scale of change is not exceeded. The latter can be answered by the acquisition of measurements that provide information on the extent of change that occurs outside the zone of impact as a result of the dumping operation. Frequently, these measurements will be based on a null hypothesis - that no significant change can be detected.

8.6 The results of monitoring (or other related research) should be reviewed at regular intervals in relation to the objectives and can provide a basis to:

- .1 modify or terminate the field-monitoring programme;
- .2 modify or revoke the permit;
- .3 redefine or close the dump-site; and
- .4 modify the basis on which applications to dump wastes are assessed.

9 PERMIT AND PERMIT CONDITIONS

9.1 A decision to issue a permit should only be made if all impact evaluations are completed and the monitoring requirements are determined. The provisions of the permit shall ensure, as far as practicable, that environmental disturbance and detriment are minimized and the benefits maximized. Any permit issued shall contain data and information specifying:

- .1 the origin, amounts and species to be dumped;
- .2 the location of the dump-site(s);
- .3 the method of dumping; and
- .4 monitoring and reporting requirements.

9.2 If dumping is the selected option, then a permit authorizing dumping must be issued in advance. It is recommended that opportunities be provided for public review and participation in the permitting process. In granting a permit, the hypothesized impact occurring within the boundaries of the dump-site, such as alterations to the physical, chemical and biological compartments of the local environment is accepted by the permitting authority.

9.3 Regulators should strive at all times to enforce procedures that will result in environmental changes as far below the limits of allowable environmental change as practicable, taking into account technological capabilities as well as economic, social and political concerns.

9.4 Permits should be reviewed at regular intervals, taking into account the results of monitoring and the objectives of monitoring programmes. Review of monitoring results will indicate whether field programmes need to be continued, revised or terminated, and will contribute to informed decisions regarding the continuance, modification or revocation of permits. This provides an important feedback mechanism for the protection of human health and the marine environment.

SPECIFIC GUIDELINES FOR ASSESSMENT OF *VESSELS*

1 INTRODUCTION

1.1 The Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping[1], referred to in short as the "Generic Guidelines", as well as the Specific Guidelines for Assessment of Vessels addressed in this document are intended for use by national authorities responsible for regulating dumping of wastes and embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention 1972 or the 1996 Protocol thereto. Annex 2 to the 1996 Protocol places emphasis on progressively reducing the need to use the sea for dumping of wastes. Furthermore, it recognizes that avoidance of pollution demands rigorous controls on the emission and dispersion of contaminating substances and the use of scientifically based procedures for selecting appropriate options for waste disposal. When applying these Guidelines uncertainties in relation to assessments of impacts on the marine environment will need to be considered and a precautionary approach applied in addressing these uncertainties. They should be applied with a view that acceptance of dumping under certain circumstances does not remove the obligation to make further attempts to reduce the necessity for dumping.

1.2 The 1996 Protocol to the London Convention 1972 follows an approach under which dumping of wastes or other matter is prohibited except for those materials specifically enumerated in Annex I, and in the context of that Protocol, these Guidelines would apply to the materials listed in that Annex. The London Convention 1972 prohibits the dumping of certain wastes or other matter specified therein and in the context of that Convention these Guidelines meet the requirements of its Annexes for wastes not prohibited for dumping at sea. When applying these Guidelines under the London Convention 1972, 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 1972.

1.3 The schematic shown in Figure 1 provides a clear indication of the stages in the application of the Guidelines where important decisions should be made and is not designed as a conventional "decision tree". In general, national authorities should use the schematic in an iterative manner ensuring that all steps receive consideration before a decision is made to issue a permit. Figure 1 illustrates the relationship between the operational components of Annex 2 of the 1996 Protocol and contains the following elements:

.1 Waste Prevention Audit (Chapter 2)
.2 Vessels: Waste Management Options (Chapter 3)
.3 Waste Characterization: Chemical/Physical Properties (Chapter 4)

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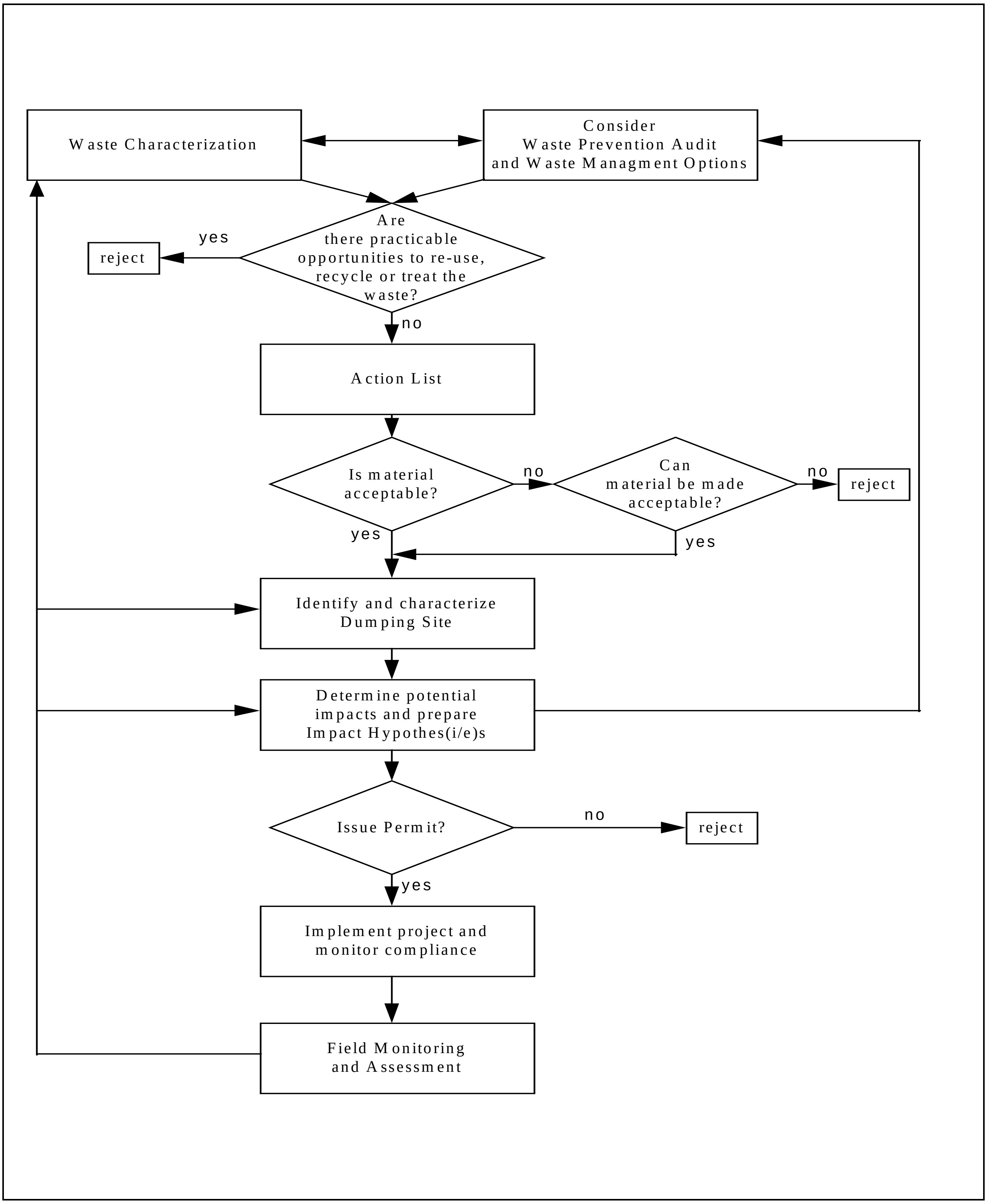
[1] The Nineteenth Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these Guidelines in 1997.

.4 Disposal at Sea: Best Environmental Practices (Chapter 5) – (Action List)
.5 Identify and Characterize Dump-site (Chapter 6) (Dump-site Selection)
.6 Determine Potential Impacts and Prepare Impact Hypothesis(es) (Chapter 7) (Assessment of Potential Effects)
.7 Issue Permit (Chapter 9) (Permit and Permit Conditions)
.8 Implement Project and Monitor Compliance (Chapter 8) (Monitoring)
.9 Field Monitoring and Assessment (Chapter 8) (Monitoring).

Figure 1



1.4 These Guidelines[2] refer to "vessels at sea" as specified in Annex I (11)(d) to the London Convention 1972 and in Annex 1(1.4) to the 1996 Protocol. Adherence to the following represents neither a more restrictive nor a less restrictive regime than that of the generic Guidelines of 1997. For purposes of these Guidelines, vessels are defined as any waterborne or airborne craft of any type whatsoever. This includes submersibles, air-cushioned craft and floating craft whether self-propelled or not. The assessment of platforms or other man-made structures at sea is covered in separate specific Guidelines.

1.5 These Guidelines set out the factors to be addressed when considering disposal of vessels at sea, with particular emphasis on the need to evaluate alternatives to sea disposal prior to sea disposal being determined the preferred alternative.

1.6 There are a large number of different types of vessels, which may be considered for disposal in the ocean. Permitting authorities should determine the minimum size vessel to which these Guidelines apply.

2 WASTE PREVENTION AUDIT

2.1 The initial stages in assessing alternatives to dumping should, as appropriate, include an evaluation of the types, amounts and relative hazards of wastes generated (See also Chapter 4 below).

2.2 In general terms, if the required audit reveals that opportunities exist for waste prevention at source, an applicant is expected to formulate and implement a waste prevention strategy in collaboration with relevant local and national agencies which includes specific waste reduction targets and provision for further waste prevention audits to ensure that these targets are being met. Permit issuance or renewal decisions shall assure compliance with any resulting waste reduction and prevention requirements. *(Note: This paragraph is not directly pertinent to the disposal of vessels at sea. However, it is important to acknowledge the obligation to take steps to prevent waste arising thereby reducing the need for disposal at sea.)*

3 VESSELS: WASTE MANAGEMENT OPTIONS

3.1 When vessels are no longer needed, there are several options for their disposition, ranging from re-use of the vessel or parts of the vessel, to recycling or scrapping, to final disposal on land or at sea. A comprehensive evaluation of alternatives including engineering/safety, economic, and environmental analyses should be carried out as follows:

.1 re-use of the vessel, or re-use of parts removed from the vessel (e.g., generators, machines, pumps, cranes, and furniture);

.2 recycling (such as use for scrap (e.g., ferrous or non-ferrous metals – copper/aluminium/nickel scrap metals), assuming that proper ship-breaking is taking place under controlled conditions, in a harbour and wharf where de-construction and the collection and disposal of hazardous constituents, such as

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[2] The Twenty-second Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these specific Guidelines in 2000.

oils, sludges and other materials, can be managed in an environmentally sound manner);

.3 destruction of hazardous constituents using environmentally sound techniques (e.g., in certain cases, on-shore incineration of liquid wastes from the vessel or wastes generated during the cleaning of the vessel);

.4 cleaning of the vessel or its components, removal of components, or treatment in order to reduce or remove the hazardous constituents (such as removal of transformers and storage tanks) and treatment of hazardous constituents, such as oils, sludges and other materials, in an environmentally sound manner; and

.5 disposal on land and into water.

3.2 A permit to dump wastes or other matter shall be refused if the permitting authority determines that appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to human health or the environment or disproportionate costs. The practical availability of other means of disposal should be considered in the light of a comparative risk assessment involving both dumping and the alternatives.

3.3 The comparative risk assessment should take into account factors such as the following:

.1 Potential impact upon the environment:

- effect upon marine habitats and marine communities;
- effects upon other legitimate uses of the sea;
- effect of on-shore re-use, recycling, or disposal, including potential impacts upon land, surface and ground water, and air pollution; and
- effect of energy and materials usage (including overall assessment of energy and materials use and savings) of each of the re-use recycling or disposal options including transportation and resultant impacts to the environment (i.e., secondary impacts);

.2 Potential impact upon human health:

- identification of routes of exposure and analysis of potential impacts upon human health of sea and land re-use, recycling, and disposal options including potential secondary impacts of energy usage; and
- quantification and evaluation of safety risks associated with re-use, recycling and disposal;

.3 Technical and practical feasibility:

- evaluation of the technical and practical feasibility (e.g., evaluation of engineering aspects per specific types and sizes of vessels) for re-use or for ship-breaking and recycling.

.4 Economic considerations:

- analysis of the full cost of vessel re-use, recycling, or disposal alternatives, including secondary impacts; and
- review of costs in view of benefits, such as resource conservation and economic benefits of steel recycling.

4 WASTE CHARACTERIZATION: CHEMICAL/PHYSICAL PROPERTIES

4.1 A pollution prevention plan should be developed that includes specific actions regarding identification of 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.

4.2 A detailed description and characterization of the potential sources of contamination (including chemical and biological) is an essential precondition for a decision as to whether a permit may be issued for disposal at sea of a vessel. Characterization by biological or chemical testing is not needed if the required pollution prevention plans are developed and implemented as well as the best environmental practices described below in paragraph 5.2.

4.3 An analysis of the potential for adverse effects to the marine environment from vessels proposed for disposal at sea should take into account characterization of the dump-site including ecological resources and oceanographic characteristics (see Chapter 6 of these Guidelines, Dump-site Selection).

4.4 The pollution prevention plan should consider the following:

.1 details of the vessel's operational equipment and potential sources, amounts and relative hazards of potential contaminants (including chemical and biological) that may be released to the marine environment; and

.2 feasibility of the following pollution prevention/reduction techniques:

- cleaning of pipes, tanks, and components of the vessel (including environmentally sound management of resultant wastes); and

- re-use/recycling/disposal of all or some vessel components. Besides ferrous scrap materials, there may be high value components available, such as non-ferrous metals, (e.g., copper, aluminium, nickel) and re-usable equipment such as generators, machines, pumps and cranes. Removal from the vessel for re-use should be based on a balance between their age, condition, demand, and cost of removal.

4.5 The principal components of a vessel (e.g., steel/iron/aluminium) are not an overriding concern from the standpoint of marine pollution. However, there are a number of potential sources of pollution that should be addressed when considering management options. These may include:

.1 fuel, lubricants, and coolants;
.2 electrical equipment;

.3 stored paints, solvents, and other chemical stocks;
.4 floatable materials (e.g., plastics, styrofoam insulation);
.5 sludges;
.6 cargo; and
.7 harmful aquatic organisms.

4.6 Items on vessels that potentially contain substances of concern include:

.1 electrical equipment (e.g., trans-formers, batteries, accumulators);
.2 coolers;
.3 scrubbers;
.4 separators;
.5 heat exchangers;
.6 tanks;
.7 storage facilities for production and other chemicals;
.8 diesel tanks including bulk storage tanks;
.9 paints;
.10 sacrificial anodes;
.11 fire extinguishing/fighting equipment;
.12 piping;
.13 pumps;
.14 engines;
.15 generators;
.16 oil sumps;
.17 tanks;
.18 hydraulic systems;
.19 piping, valves and fittings;
.20 compressors;
.21 light fittings/fixtures; and
.22 cables.

4.7 Materials remaining in tanks, piping, or holds should be removed from the vessel to the maximum extent possible (including, for example, fuel, lubricating oils, hydraulic fluids, cargoes and their residues, and grease). All drummed, tanked, or canned liquids or gaseous materials should be removed from the vessel. All materials removed should be managed on land in an environmentally sound manner (e.g., recycling and, in certain cases, on-shore incineration). Removal of equipment containing liquid PCBs should be a priority.

4.8 As far as practicable, consideration should be given to avoiding the transfer of harmful aquatic organisms, on or in ballast water on board the vessel.

4.9 The standard requirement to characterize wastes and their constituents is not directly pertinent to the disposal of vessels at sea because the general characterization of chemical, physical, and biological properties can be accomplished for vessels without actual chemical or biological testing (see paragraphs 4.1 to 4.7 above and Chapter 5 below).

5 DISPOSAL AT SEA: BEST ENVIRONMENTAL PRACTICES (ACTION LIST)

5.1 Contaminants that are likely to cause harm to the marine environment should be removed from vessels prior to disposal at sea. Because vessels disposed at sea should have contaminants removed prior to disposal, action limits for vessels are to be met through the implementation of the pollution prevention plan (see Chapter 4) and the best environmental practices (paragraph 5.2), in order to ensure that it has been cleaned to the maximum extent possible. The best environmental practices, specifically identified for vessels in the next paragraph, should be followed.

5.2 The pollution prevention and cleanup techniques described below should be implemented for vessels that are to be disposed at sea. Within technical and economic feasibility and taking into consideration the safety of workers, to the maximum extent, (1) vessels shall be cleaned of potential sources of pollution as described in paragraphs 4.5 - 4.8 above, and of fuel or other substances that are likely to cause harm to the marine environment, and (2) materials capable of creating floating debris shall be removed, as described below. Resulting wastes or materials should be re-used, recycled or disposed on land in an environmentally sound manner, among other measures:

.1 floatable materials that could adversely impact safety, human health, or the ecological or aesthetic value of the marine environment are to be removed;

.2 fuels, stocks of industrial or commercial chemicals, or wastes that may pose an adverse risk to the marine environment are to be removed (including consideration of harmful aquatic organisms);

.3 remove any capacitors and transformers containing dielectric fluid from the vessel to the maximum extent possible;

.4 if any part of the vessel was used for storage of fuel or chemical stocks such as in tanks, these areas shall be flushed, cleaned, and, as appropriate, sealed or plugged; and

.5 to prevent release of substances that could cause harm to the marine environment, cleaning of tanks, pipes and other vessel equipment and surfaces shall be accomplished in an environmentally sound manner prior to disposal using appropriate techniques, such as high pressure washing techniques with detergents. The resulting wash water should be handled in an environmentally sound manner consistent with national or regional standards to address potential pollutants.

6 DUMP-SITE SELECTION

Site selection considerations

6.1 Proper selection of a dump-site at sea for the reception of waste is of paramount importance.

6.2 Information required to select a dump-site shall include:

.1 physical and biological characteristics of the seabed and surrounding area, and oceanographic characteristics of the general area in which the site is to be located;
.2 consideration of the potential implications of the vessel's presence on amenities, values and other uses of the sea in the area of 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.

6.3 Guidance for procedures to be followed in dump-site selection can be found in a report of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP Reports and Studies No. 16 - Scientific Criteria for the Selection of Waste Disposal Sites at Sea). Prior to selecting a dump-site, it is essential that data be available on the oceanographic characteristics of the general area in which the site is to be located. This information can be obtained from the literature but fieldwork should be undertaken to fill the gaps. The information requirements for the selection of a site for disposal of vessels are much less rigorous in terms of oceanographic characteristics but do include that information found in paragraph 6.4. Generally, required information includes:

.1 the nature of the seabed, including its topography, geo-chemical and geological characteristics, its biological composition and activity, identification of hard or soft bottom habitats, and prior dumping activities affecting the area;

.2 the physical nature of the water column, including temperature, depth, possible existence of a thermocline/pycnocline and how it varies in depth with season and weather conditions, tidal period and orientation of the tidal ellipse, mean direction and velocity of the surface and bottom drifts, velocities of storm-wave induced bottom currents, general wind and wave characteristics, and the average number of storm days per year, suspended matter; and

.3 the chemical and biological nature of the water column, including pH, salinity, dissolved oxygen at surface and bottom, chemical and biochemical oxygen demand, nutrients and their various forms and primary productivity.

6.4 Some of the important amenities, biological features and uses of the sea to be considered in determining the specific location of the dump-site are:

.1 the shoreline and bathing beaches;
.2 areas of beauty or significant cultural or historical importance;
.3 areas of special scientific or biological importance, such as sanctuaries;
.4 fishing areas;
.5 spawning, nursery and recruitment areas;
.6 migration routes;
.7 seasonal and critical habitats;
.8 shipping lanes;
.9 military exclusion zones; and
.10 engineering uses of the seafloor, including mining, undersea cables, desalination or energy conversion sites.

Size of the dump-site

6.5 Size of the dump-site is an important consideration for anticipating the possible disposal of more than one vessel at the site:

.1 it should be large enough to have the bulk of the material remain either within the site limits or within a predicted area of impact after dumping;

.2 it should be large enough in relation to anticipated volumes for dumping so that it would serve its function for many years; and

.3 it should not be so large that monitoring would require undue expenditure of time and money.

Site capacity

6.6 In order to assess the capacity of a site, especially for solid wastes, the following should be taken into consideration:

.1 the anticipated loading rates per day, week, month or year;
.2 whether or not it is a dispersive site; and
.3 the allowable reduction in water depth over the site because of mounding of material.

Evaluation of potential impacts

6.7 An important consideration in determining the suitability for sea disposal of vessels at a specific site is to predict the extent to which there may be impacts on existing and adjacent habitats and marine communities (e.g., coral reefs and soft bottom communities).

(Note: Paragraphs 6.8 to 6.13 below are concerns about impacts, but if the pollution prevention plan (see Chapter 4) and the best environmental practices (see paragraph 5.2 above) are followed, these paragraphs are not directly pertinent.)

6.8 The extent of adverse effects of a substance is a function of the exposures of organisms (including humans). Exposure, in turn, is a function, *inter alia*, of input flux and the physical, chemical and biological processes that control the transport, behaviour, fate and distribution of a substance.

6.9 The presence of natural substances and the ubiquitous occurrence of contaminants means that there will always be some pre-existing exposures of organisms to all substances contained in any waste that might be dumped. Concerns about exposures to hazardous substances thus relate to additional exposures as a consequence of dumping. This, in turn, can be translated back to the relative magnitude of the input fluxes of substances from dumping compared with existing input fluxes from other sources.

6.10 Accordingly, due consideration needs to be given to the relative magnitude of the substance fluxes associated with dumping in the local and regional area surrounding the dump-site. In cases where it is predicted that dumping will substantially augment existing fluxes associated with natural processes, dumping at the site under consideration should be deemed inadvisable.

6.11 In the case of synthetic substances, the relationship between fluxes associated with dumping and pre-existing fluxes in the vicinity of the site may not provide a suitable basis for decisions.

6.12 Temporal characteristics should be considered to identify potentially critical times of the year (e.g., for marine life) when dumping should not take place. This consideration leaves periods when it is expected that dumping operations will have less impact than at other times. If these restrictions become too burdensome and costly, there should be some opportunity for compromise in which priorities may have to be established concerning species to be left wholly undisturbed. Examples of such biological considerations are:

- .1 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 and breeding periods;
- .2 periods when marine organisms are hibernating on or are buried in the sediments; and
- .3 periods when particularly sensitive and possibly endangered species are exposed.

Contaminant mobility

6.13 Contaminant mobility is dependent upon several factors, among which are:

- .1 type of matrix;
- .2 form of contaminant;
- .3 contaminant partitioning;
- .4 physical state of the system, e.g., temperature, water flow, suspended matter;
- .5 physico-chemical state of the system;
- .6 length of diffusion and advection pathways; and
- .7 biological activities e.g., bioturbation.

7 ASSESSMENT OF POTENTIAL EFFECTS

7.1 Assessment of potential effects should lead to a concise statement of the expected consequences of the sea or land disposal options, i.e., the "Impact Hypothesis". It provides a basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements. As far as possible, waste management options causing dispersion and dilution of contaminants in the environment should be avoided and preference given to techniques that prevent the input of the contaminants to the environment.

7.2 The assessment of disposal options should integrate information on vessel characteristics and conditions at the proposed dump-site, specify the economic and technical feasibility of the options being considered, and evaluate the potential effects on human health, living resources, amenities, other legitimate uses of the sea, and the environment in general. For vessels, this assessment should be based upon the underlying premise that with implementation of the pollution prevention plan in Chapter 4 and of best environmental practices in paragraph 5.2, any adverse impacts will be minimized and will primarily be those resulting from the physical presence of the vessel on the sea floor because the disposed vessels will have had contaminants removed to the maximum extent.

7.3 The assessment should be as comprehensive as possible. The primary potential impacts should be identified during the dump-site selection process. These are considered to pose the most serious threats to human health and the environment. Alterations to the physical environment, risks to human health, devaluation of marine resources and interference with other legitimate uses of the sea are often seen as primary concerns in this regard.

7.4 In constructing an impact hypothesis, particular attention should be given to, but not limited to, potential impacts on amenities (e.g., presence of floatables), sensitive areas (e.g., spawning, nursery or feeding areas), habitat (e.g., biological, chemical and physical modification), migratory patterns and marketability of resources. Consideration should also be given to potential impacts on other uses of the sea including: fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea.

(Note to paragraphs 7.5 to 7.8 below: The disposal of vessels at sea, where the "waste" is a solid, does not present the same types of potential environmental concerns as the disposal of other wastes, such as liquids, where the waste materials can be readily distributed into the environment; and thereby does not necessarily fit the standard paradigm of rigorous biological or chemical monitoring due to contaminants in the waste. Potential sources of pollution as described above in paragraphs 4.5 to 4.8, other substances that are likely to cause harm to the environment, and materials capable of creating floating debris shall be removed to the maximum extent possible prior to disposal. When developing the monitoring plan, these factors should be considered.)

7.5 Even the least complex and most innocuous wastes may have a variety of physical, chemical and biological effects. Impact hypotheses cannot attempt to reflect them all. It must be recognized that even the most comprehensive impact hypotheses may not address all possible scenarios such as unanticipated impacts. It is therefore imperative that the monitoring programme be linked directly to the hypotheses and serve as a feedback mechanism to verify the predictions and review the adequacy of management measures applied to the dumping operation and at the dump-site. It is important to identify the sources and consequences of uncertainty.

7.6 The expected consequences of dumping should be described in terms of affected habitats, processes, species, communities and uses. The precise nature of the predicted effect (e.g., change, response, or interference) should be described. The effect should be quantified in sufficient detail so that there would be no doubt as to the variables to be measured during field monitoring. In the latter context, it would be essential to determine "where" and "when" the impacts can be expected.

7.7 Emphasis should be placed on biological effects and habitat modification as well as physical and chemical change. However, if the potential effect is due to substances, the following factors should be addressed:

.1 estimates of statistically significant increases of the substance in seawater, sediments, or biota in relation to existing conditions and associated effects; and

.2 estimate of the contribution made by the substance to local and regional fluxes and the degree to which existing fluxes pose threats or adverse effects on the marine environment or human health.

7.8 In the case of repeated or multiple dumping operations, impact hypotheses should take into account the cumulative effects of such operations. It will also be important to consider the possible interactions with other waste dumping practices in the area, both existing or planned.

7.9 An analysis of each disposal option should be considered in light of a comparative assessment of the following concerns: human health risks, environmental costs, hazards (including accidents), economics and exclusion of future uses. If this assessment reveals that adequate information is not available to determine the likely effects of the proposed disposal option, including potential long-term harmful consequences, then this option should not be considered further. In addition, if the interpretation of the comparative assessment shows the dumping option to be less preferable, a permit for dumping should not be given.

7.10 Each assessment should conclude with a statement supporting a decision to issue or refuse a permit for dumping.

7.11 Where monitoring is required, the effects and parameters described in the hypotheses should help to guide field and analytical work so that relevant information can be obtained in the most efficient and cost-effective manner.

8 MONITORING

8.1 Monitoring is used to verify that permit conditions are met - compliance monitoring - and that the assumptions made during the permit review and site selection process were correct and sufficient to protect the environment and human health - field monitoring. It is essential that such monitoring programmes have clearly defined objectives.

8.2 The Impact Hypothesis forms the basis for defining field monitoring. The measurement programme should be designed to ascertain that changes in the receiving environment are within those predicted. The following questions must be answered:

.1 What testable hypotheses can be derived from the Impact Hypothesis?
.2 What measurements (type, location, frequency, performance requirements) are required to test these hypotheses?
.3 How should the data be managed and interpreted?

8.3 It may usually be assumed that suitable specifications of existing (pre-disposal) conditions in the receiving area are already contained in the application for dumping. If the specification of such conditions is inadequate to permit the formulation of an Impact Hypothesis, the licensing authority will require additional information before any final decision on the permit application is made.

8.4 The permitting authority is encouraged to take account of relevant research information in the design and modification of monitoring programmes. The measurements can be divided into two types - those within the zone of predicted impact and those outside.

8.5 Measurements should be designed to determine whether the zone of impact and the extent of change outside the zone of impact differ from those predicted. The former can be answered by designing a sequence of measurements in space and time that ensures that the projected spatial scale of change is not exceeded. The latter can be answered by the acquisition of measurements that provide information on the extent of change that occurs outside the zone of impact as a result of the dumping operation. Frequently, these measurements will be based on a null hypothesis - that no significant change can be detected.

8.6 The results of monitoring (or other related research) should be reviewed at regular intervals in relation to the objectives and can provide a basis to:

.1 modify or terminate the field-monitoring programme;
.2 modify or revoke the permit;
.3 redefine or close the dump-site; and
.4 modify the basis on which applications to dump wastes are assessed.

9 PERMIT AND PERMIT CONDITIONS

9.1 The permitting process should include the following essential elements: (1) a description of the best environmental practices (see paragraph 5.2) for the disposal option selected; (2) cleaning of the vessel; (3) inspection/verification by relevant authorities that adequate cleaning has taken place; and (4) permit issuance. The national permitting authority should ensure that the appropriate hydrographic surveying authority is notified of the longitude and latitude co-ordinates, depth, and dimensions of the dumped vessel on the sea bottom. The national permitting authority should also ensure that advance notice of the dumping is issued to national shipping, fisheries, and hydrographic surveying authorities. Any permit issued shall contain data and information specifying:

.1 name, type, or tonnage of the vessel;
.2 the location of the dump-site(s);
.3 the method of dumping; and
.4 monitoring and reporting requirements.

9.2 If dumping is the selected option, then a permit authorizing dumping must be issued in advance. It is recommended that opportunities be provided for public review and participation in the permitting process. In granting a permit, the hypothesized impact occurring within the boundaries of the dump-site, such as alterations to the physical, chemical and biological compartments of the local environment is accepted by the permitting authority.

9.3 Regulators should strive at all times to enforce procedures that will result in environmental changes as far below the limits of allowable environmental change as practicable, taking into account technological capabilities as well as economic, social and political concerns.

9.4 Permits should be reviewed at regular intervals, taking into account the results of monitoring and the objectives of monitoring programmes. Review of monitoring results will indicate whether field programmes need to be continued, revised or terminated, and will contribute to informed decisions regarding the continuance, modification or revocation of permits. This provides an important feedback mechanism for the protection of human health and the marine environment.

SPECIFIC GUIDELINES FOR ASSESSMENT OF

PLATFORMS OR OTHER MAN-MADE STRUCTURES AT SEA

1 INTRODUCTION

1.1 The Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping[1], referred to in short as the "Generic Guidelines", as well as the Specific Guidelines for Assessment of Platforms or Other Man-Made Structures at Sea addressed in this document are intended for use by national authorities responsible for regulating dumping of wastes and embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention 1972 or the 1996 Protocol thereto. Annex 2 to the 1996 Protocol places emphasis on progressively reducing the need to use the sea for dumping of wastes. Furthermore, it recognizes that avoidance of pollution demands rigorous controls on the emission and dispersion of contaminating substances and the use of scientifically based procedures for selecting appropriate options for waste disposal. When applying these Guidelines uncertainties in relation to assessments of impacts on the marine environment will need to be considered and a precautionary approach applied in addressing these uncertainties. They should be applied with a view that acceptance of dumping under certain circumstances does not remove the obligation to make further attempts to reduce the necessity for dumping.

1.2 The 1996 Protocol to the London Convention 1972 follows an approach under which dumping of wastes or other matter is prohibited except for those materials specifically enumerated in Annex I, and in the context of that Protocol, these Guidelines would apply to the materials listed in that Annex. The London Convention 1972 prohibits the dumping of certain wastes or other matter specified therein and in the context of that Convention these Guidelines meet the requirements of its Annexes for wastes not prohibited for dumping at sea. When applying these Guidelines under the London Convention 1972, 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 1972.

1.3 The schematic shown in Figure 1 provides a clear indication of the stages in the application of the Guidelines where important decisions should be made and is not designed as a conventional "decision tree". In general, national authorities should use the schematic in an iterative manner ensuring that all steps receive consideration before a decision is made to issue a permit. Figure 1 illustrates the relationship between the operational components of Annex 2 of the 1996 Protocol and contains the following elements:

.1 Waste Prevention Audit (Chapter 2)

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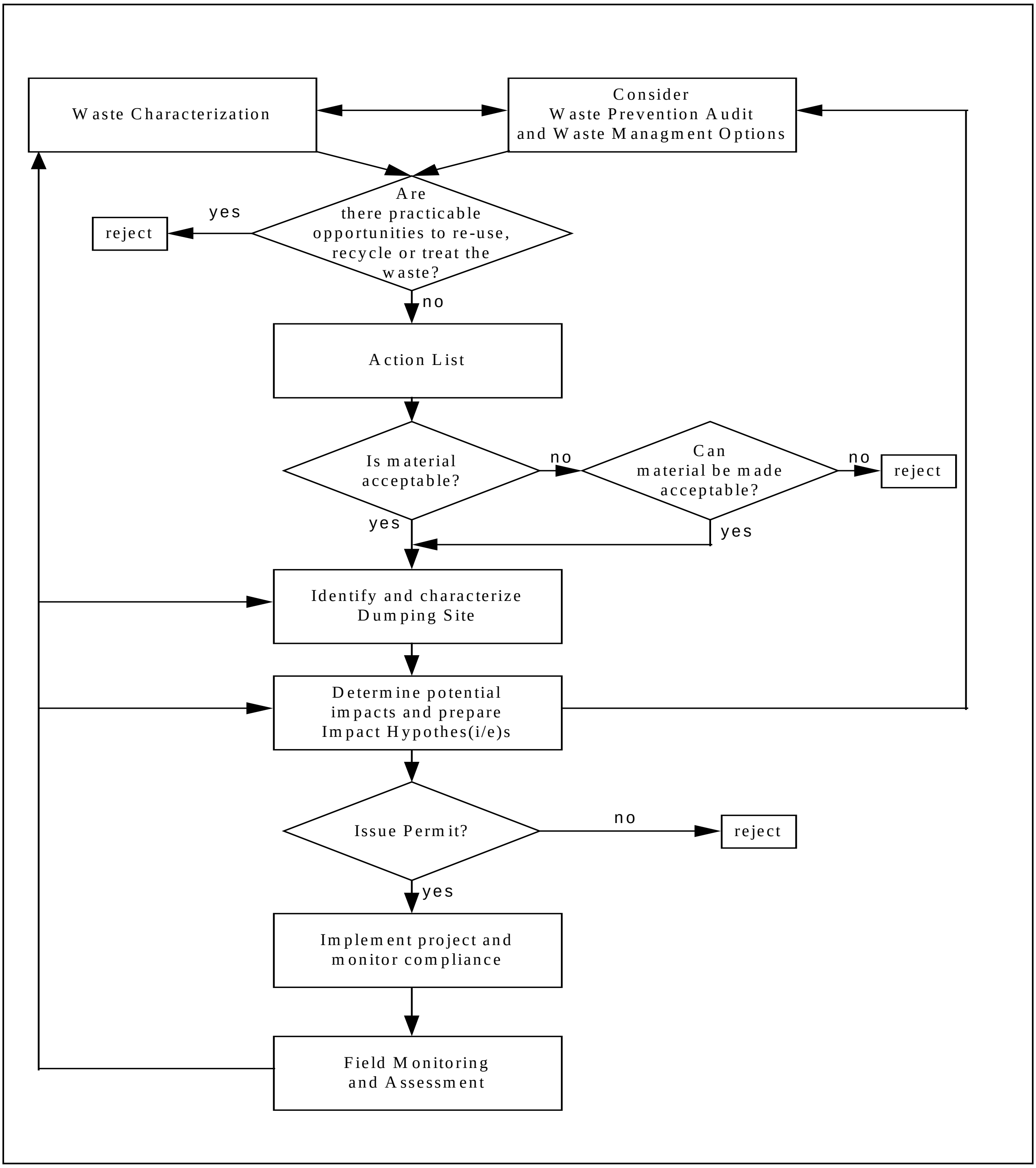
[1] The Nineteenth Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these Guidelines in 1997.

.2 Platforms/Structures: Waste Management Options (Chapter 3)
.3 Waste Characterization: Chemical / Physical Properties (Chapter 4)
.4 Disposal at Sea: Best Environmental Practices (Chapter 5) – (Action List)
.5 Identify and Characterize Dump-site (Chapter 6) (Dump-site Selection)
.6 Determine Potential Impacts and Prepare Impact Hypothesis(es) (Chapter 7) (Assessment of Potential Effects)
.7 Issue Permit (Chapter 9) (Permit and Permit Conditions)
.8 Implement Project and Monitor Compliance (Chapter 8) (Monitoring)
.9 Field Monitoring and Assessment (Chapter 8) (Monitoring).

Figure 1



1.4 These Guidelines[2] refer to "....platforms or other man-made structures at sea" as specified in Annex I (11) to the London Convention 1972 and in Annex 1(1.4) to the 1996 Protocol. Adherence to the following represents neither a more restrictive nor a less restrictive regime than that of the generic Guidelines of 1997. However, much of these specific Guidelines are targeted specifically to oil and gas platforms, since these platforms are likely to constitute the majority of platforms and other man-made structures that may be considered for disposal at sea. Consideration of other types of platforms or man-made structures should involve similar assessments as conducted for oil and gas platforms in determining if a permit should be issued for sea disposal.

1.5 These Guidelines set out the factors to be addressed when considering disposal of platforms or other man-made structures at sea, with particular emphasis on the need to evaluate alternatives to sea disposal prior to sea disposal being determined the preferred alternative.

1.6 For purposes of these Guidelines, platforms are defined as facilities designed and operated for the purpose of producing, processing, storing, or supporting the production of mineral resources.

1.7 The category of "other man-made structures at sea" is not defined under the London Convention 1972 nor under the 1996 Protocol but could include lighthouses, buoys, and offshore transfer facilities. The assessment of vessels at sea is covered in separate specific Guidelines.

2 WASTE PREVENTION AUDIT

2.1 The initial stages in assessing alternatives to dumping should, as appropriate, include an evaluation of the types, amounts and relative hazards of wastes generated (See also Chapter 4 below).

2.2 In general terms, if the required audit reveals that opportunities exist for waste prevention at source, an applicant is expected to formulate and implement a waste prevention strategy in collaboration with relevant local and national agencies which includes specific waste reduction targets and provision for further waste prevention audits to ensure that these targets are being met. Permit issuance or renewal decisions shall assure compliance with any resulting waste reduction and prevention requirements. *(Note: This paragraph is not directly pertinent to the disposal of platforms or other man-made structures at sea. However, it is important to acknowledge the obligation to take steps to prevent waste arising thereby reducing the need for disposal at sea.)*

3 PLATFORMS/STRUCTURES: WASTE MANAGEMENT OPTIONS

3.1 When platforms or other man-made structures are no longer needed, there are several options for their disposition, ranging from re-use at sea or on shore, to recycling or scrapping, to final disposal on land or at sea. Topsides, containing the production, processing, power plant/machinery, storage, transportation, and accommodation facilities, are generally taken ashore for recycling or re-use.

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2 The Twenty-second Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these specific Guidelines in 2000.

3.2 Applications to dispose of platforms or other man-made structures at sea shall demonstrate that consideration has been given to a number of different management options. In general, preparing the platform for disposal at sea involves planning and conducting shutdown operations on an oil or gas platform and the re-use, recycling, or disposal of the platform. Applying a hierarchy of waste management options, the basic steps include the following:

.1 planning, including engineering/safety, economic, and environmental analyses;
.2 removing all or part of the platform from the site;
.3 re-using, recycling, or disposing those parts removed from the site;
.4 cleaning, where needed, of parts not removed; and
.5 site clearance, as appropriate.

3.3 A permit to dump wastes or other matter shall be refused if the permitting authority determines that appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to human health or the environment or disproportionate costs. The practical availability of other means of disposal should be considered in the light of a comparative risk assessment involving both dumping and the alternatives.

3.4 The comparative risk assessment should take into account factors such as the following:

.1 Potential impact upon the environment:

- effect upon marine habitats and marine communities;
- effects upon other legitimate uses of the sea;
- effect of onshore re-use, recycling, or disposal, including potential impacts upon land, surface and ground water, and air pollution; and
- effect of energy and materials usage (including overall assessment of energy and materials use and savings) of each of the re-use, recycling or disposal options including transportation and resultant impacts to the environment (i.e., secondary impacts);

.2 Potential impact upon human health:

- identification of routes of exposure and analysis of potential impacts of sea and land re-use, recycling, and disposal options including potential secondary impacts of energy usage; and
- quantification and evaluation of safety risks associated with onshore re-use, recycling, and disposal, and disposal at sea;

.3 Technical and practical feasibility:

- evaluation of engineering capabilities per specific types, sizes, and weights of platforms; and
- identification of practical limitations of disposal alternatives considering characteristics of the platform and oceanographic considerations;

.4 Economic considerations:

- analysis of the full cost of platform re-use, recycling, or disposal alternatives, including secondary impacts; and

- review of costs in view of benefits, such as resource conservation and economic benefits of steel recycling.

4 WASTE CHARACTERIZATION CHEMICAL AND PHYSICAL PROPERTIES

4.1 A pollution prevention plan should be developed that includes specific actions regarding identification of potential sources of pollution. The purpose of this plan is to assure that wastes (or other matter and materials capable of creating floating debris) contributing to pollution of the marine environment have been removed to the maximum extent.

4.2 A detailed description and characterization of the potential sources of contamination is an essential precondition for a decision as to whether a permit may be issued for disposal at sea of a platform or other man-made structure. Characterization by biological or chemical testing is not needed if the required pollution prevention plans are developed and implemented as well as the best environmental practices described in paragraph 5.2.

4.3 An analysis of the potential for adverse effects to the marine environment from platforms or other man-made structures proposed for disposal at sea should take into account characterization of the disposal site including ecological resources and oceanographic characteristics (see Chapter 6 of these Guidelines, Dump-site Selection).

4.4 The pollution prevention plan should consider the following:

.1 the platform/structure production, processing, and transportation facilities in regard to potential sources, amounts and relative potential hazards of wastes; and

.2 feasibility of the following pollution prevention/reduction techniques:

- cleaning of pipes, tanks, and structures (including environmentally sound management of resultant wastes); and
- re-use, recycling, disposal on land of all or some platform components with special attention to topsides and its components.

4.5 The principal components of a platform or other man-made structure (steel and concrete) are not an overriding concern from the standpoint of marine pollution. In the case of platforms, however, there are a number of potential sources of pollution that should be addressed when considering management options. These are associated with platform production processes and related operations and may include:

.1 the quantities of hydrocarbons, low specific activity scale, and other contaminants in pipe work and tankage, including drilling mud holding/reprocessing tanks;
.2 stocks of chemicals used in connection with oil and gas production, e.g., corrosion inhibitors, biocides, defoamers, and de-emulsifiers;
.3 lubricants and coolants in platform equipment; and
.4 fuel.

4.6 Items on platforms that potentially contain substances of concern include:

.1 electrical equipment (e.g., transformers, batteries, accumulators);
.2 coolers;

.3 scrubbers;
.4 separators;
.5 heat exchangers;
.6 tanks for drilling consumables including bulk storage of muds;
.7 storage facilities for production and other chemicals;
.8 diesel tanks including bulk storage tanks;
.9 paints;
.10 sacrificial anodes;
.11 fire extinguishing/fighting equipment;
.12 piping;
.13 pumps;
.14 engines;
.15 generators;
.16 oil sumps;
.17 tanks;
.18 hydraulic systems;
.19 tubing and drill string;
.20 gas dehydrators;
.21 gas-sweetening units;
.22 helicopter fuelling systems;
.23 piping, valves and fittings;
.24 compressors; and
.25 insulations systems.

4.7 The evaluation of potential sources of pollution from other man-made structures should include an appropriate assessment similar to the general considerations in the paragraphs 4.1 to 4.6 above for platforms.

4.8 The standard requirement to characterize wastes and their constituents is not directly pertinent to the disposal of platforms/structures at sea because the general characterization of chemical, physical, and biological properties can be accomplished for platforms/structures without actual chemical or biological testing (see paragraphs 4.1 to 4.6 above and Chapter 5 below).

5 DISPOSAL AT SEA: BEST ENVIRONMENTAL PRACTICES (ACTION LIST)

5.1 Contaminants that are likely to cause harm to the marine environment should be removed from the platforms/structures prior to disposal at sea. Because platforms/structures disposed at sea should have contaminants removed prior to disposal, action limits for platforms/structures are to be met through the implementation of the pollution prevention plan (see Chapter 4) and the best environmental practices (paragraph 5.2), in order to ensure that it has been cleaned to the maximum extent possible. The best environmental practices, specifically identified for platforms/structures in the next paragraph, should be followed.

5.2 The pollution prevention and cleanup techniques described below should be implemented for platforms/structures that are to be disposed at sea. Within technical and economic feasibility and taking into consideration the safety of workers, to the maximum extent, (1) platforms/structures shall be cleaned of petroleum hydrocarbons or other substances that are likely to cause harm to the marine environment, and (2) materials capable of creating floating debris shall be removed, as described below:

.1 floatable materials that could adversely impact safety, human health, or the ecological or aesthetic value of the marine environment are to be removed;

.2 hydrocarbons, stocks of industrial or commercial chemicals, drilling muds, or wastes that may pose an adverse risk to the marine environment are to be removed;

.3 if any part of the platform jacket was used for storage of hydrocarbons or chemical stocks such as in tanks integrated into the legs of the jacket, these areas shall be flushed, cleaned and, as appropriate, sealed or plugged; and

.4 to prevent the release of substances that could cause harm to the marine environment, cleaning of tanks, pipes and other platform equipment and surfaces shall be accomplished in an environmentally sound manner prior to disposal using appropriate techniques, such as high pressure washing techniques with detergents. The resulting wash water should either be taken ashore for treatment or be treated offshore consistent with national or regional standards to address potential pollutants.

5.3 While outside the jurisdiction of this guidance, the vicinity of the platform or other man-made structure should be cleared of debris that may interfere with other legitimate uses of the sea, within reasonable and technically feasible expectations.

6 DUMP-SITE SELECTION

Site selection considerations

6.1 Proper selection of a dump-site at sea for the reception of waste is of paramount importance.

6.2 Information required to select a dump-site shall include:

.1 physical and biological characteristics of the sea-bed and surrounding area, including the potential for providing environmental benefits, and oceanographic characteristics of the general area in which the site is to be located;

.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.

6.3 Guidance for procedures to be followed in dump-site selection can be found in a report of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP Reports and Studies No. 16 - Scientific Criteria for the Selection of Waste Disposal Sites at Sea). Prior to selecting a dump-site, it is essential that data be available on the oceanographic characteristics of the general area in which the site is to be located. This information can be obtained from the literature but fieldwork should be undertaken to fill the gaps. The information requirements for the selection of a site for disposal of platforms/structures are much less rigorous in terms of oceanographic characteristics but do include that information found in paragraph 6.4. Generally, required information includes:

.1 the nature of the seabed, including its topography, geo-chemical and geological characteristics, its biological composition and activity, identification of hard or soft bottom habitats, and prior dumping activities affecting the area;

.2 the physical nature of the water column, including temperature, depth, possible existence of a thermocline/pycnocline and how it varies in depth with season and weather conditions, tidal period and orientation of the tidal ellipse, mean direction and velocity of the surface and bottom drifts, velocities of storm-wave induced bottom currents, general wind and wave characteristics, and the average number of storm days per year, suspended matter; and

.3 the chemical and biological nature of the water column, including pH, salinity, dissolved oxygen at surface and bottom, chemical and biochemical oxygen demand, nutrients and their various forms and primary productivity.

6.4 Some of the important amenities, biological features and uses of the sea to be considered in determining the specific location of the dump-site are:

.1 the shoreline and bathing beaches;
.2 areas of beauty or significant cultural or historical importance;
.3 areas of special scientific or biological importance, such as sanctuaries;
.4 fishing areas;
.5 spawning, nursery and recruitment areas;
.6 migration routes;
.7 seasonal and critical habitats;
.8 shipping lanes;
.9 military exclusion zones; and
.10 engineering uses of the seafloor, including mining, undersea cables, desalination or energy conversion sites.

Size of the dump-site

6.5 Size of the dump-site is an important consideration for anticipating the possible disposal of more than one platform at the site:

.1 it should be large enough to have the bulk of the material remain either within the site limits or within a predicted area of impact after dumping;

.2 it should be large enough in relation to anticipated volumes for dumping so that it would serve its function for many years; and

.3 it should not be so large that monitoring would require undue expenditure of time and money.

Site capacity

6.6 In order to assess the capacity of a site, especially for solid wastes, the following should be taken into consideration:

.1 the anticipated loading rates per day, week, month or year;
.2 whether or not it is a dispersive site; and

.3 the allowable reduction in water depth over the site because of mounding of material.

Evaluation of potential impacts

6.7 An important consideration in determining the suitability for sea disposal of platforms or other man-made structures at a specific site is to predict the extent to which there may be impacts on existing and adjacent habitats and marine communities (e.g., coral reefs and soft bottom communities).

(Note: Paragraphs 6.8 to 6.13 below are concerns about impacts, but if the pollution prevention plan (see Chapter 4) and the best environmental practices (see paragraph 5.2 above) were followed, these paragraphs are not directly pertinent.)

6.8 The extent of adverse effects of a substance is a function of the exposures of organisms (including humans). Exposure, in turn, is a function, *inter alia*, of input flux and the physical, chemical and biological processes that control the transport, behaviour, fate and distribution of a substance.

6.9 The presence of natural substances and the ubiquitous occurrence of contaminants means that there will always be some pre-existing exposures of organisms to all substances contained in any waste that might be dumped. Concerns about exposures to hazardous substances thus relate to additional exposures as a consequence of dumping. This, in turn, can be translated back to the relative magnitude of the input fluxes of substances from dumping compared with existing input fluxes from other sources.

6.10 Accordingly, due consideration needs to be given to the relative magnitude of the substance fluxes associated with dumping in the local and regional area surrounding the dump-site. In cases where it is predicted that dumping will substantially augment existing fluxes associated with natural processes, dumping at the site under consideration should be deemed inadvisable.

6.11 In the case of synthetic substances, the relationship between fluxes associated with dumping and pre-existing fluxes in the vicinity of the site may not provide a suitable basis for decisions.

6.12 Temporal characteristics should be considered to identify potentially critical times of the year (e.g., for marine life) when dumping should not take place. This consideration leaves periods when it is expected that dumping operations will have less impact than at other times. If these restrictions become too burdensome and costly, there should be some opportunity for compromise in which priorities may have to be established concerning species to be left wholly undisturbed. Examples of such biological considerations are:

.1 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 and breeding periods;

.2 periods when marine organisms are hibernating on or are buried in the sediments; and

.3 periods when particularly sensitive and possibly endangered species are exposed.

Contaminant mobility

6.13 Contaminant mobility is dependent upon several factors, among which are:

.1 type of matrix;
.2 form of contaminant;
.3 contaminant partitioning;
.4 physical state of the system, e.g., temperature, water flow, suspended matter;
.5 physico-chemical state of the system;
.6 length of diffusion and advection pathways; and
.7 biological activities e.g., bioturbation.

7 ASSESSMENT OF POTENTIAL EFFECTS

7.1 Assessment of potential effects should lead to a concise statement of the expected consequences of the sea or land disposal options, i.e., the "Impact Hypothesis". It provides a basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements. As far as possible, waste management options causing dispersion and dilution of contaminants in the environment should be avoided and preference given to techniques that prevent the input of the contaminants to the environment.

7.2 The assessment of disposal options should integrate information on platform and other man-made structure characteristics and conditions at the proposed dump-site, specify the economic and technical feasibilities of the options being considered, and evaluate the potential effects on human health, living resources, amenities, other legitimate uses of the sea, and the environment in general. For platforms or other man-made structures, this assessment should be based upon the underlying premise that with implementation of the pollution prevention plan in Chapter 4 and of best environmental practices in paragraph 5.2, any adverse impacts will be minimized and will be limited to those resulting from the physical presence of the platform/structure on the sea floor because the disposed platforms/structures will essentially be composed primarily of steel and, in certain instances, concrete.

7.3 The assessment should be as comprehensive as possible. The primary potential impacts should be identified during the dump-site selection process. These are considered to pose the most serious threats to human health and the environment. Alterations to the physical environment, risks to human health, devaluation of marine resources and interference with other legitimate uses of the sea are often seen as primary concerns in this regard.

7.4 In constructing an impact hypothesis, particular attention should be given to, but not limited to, potential impacts on amenities (e.g., presence of floatables), sensitive areas (e.g., spawning, nursery or feeding areas), habitat (e.g., biological, chemical and physical modification), migratory patterns and marketability of resources. Consideration should also be given to potential impacts on other uses of the sea including: fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea.

(Note to paragraphs 7.5 to 7.8 below: The disposal of platforms/ structures at sea, where the "waste" is a solid, does not present the same types of potential environmental concerns as the disposal of other wastes, such as liquids, where the waste materials can be readily distributed into the environment; and thereby does not necessarily fit the standard paradigm of rigorous biological or chemical monitoring due to contaminants in the waste. Significant sources of

potential contaminants should be removed from the platforms/structures prior to disposal. When developing the monitoring plan, these factors should be considered.)

7.5 Even the least complex and most innocuous wastes may have a variety of physical, chemical and biological effects. Impact hypotheses cannot attempt to reflect them all. It must be recognized that even the most comprehensive impact hypotheses may not address all possible scenarios such as unanticipated impacts. It is therefore imperative that the monitoring programme be linked directly to the hypotheses and serve as a feedback mechanism to verify the predictions and review the adequacy of management measures applied to the dumping operation and at the dump-site. It is important to identify the sources and consequences of uncertainty.

7.6 The expected consequences of dumping should be described in terms of affected habitats, processes, species, communities and uses. The precise nature of the predicted effect (e.g., change, response, or interference) should be described. The effect should be quantified in sufficient detail so that there would be no doubt as to the variables to be measured during field monitoring. In the latter context, it would be essential to determine "where" and "when" the impacts can be expected.

7.7 Emphasis should be placed on biological effects and habitat modification as well as physical and chemical change. However, if the potential effect is due to substances, the following factors should be addressed:

.1 estimates of statistically significant increases of the substance in seawater, sediments, or biota in relation to existing conditions and associated effects; and

.2 estimate of the contribution made by the substance to local and regional fluxes and the degree to which existing fluxes pose threats or adverse effects on the marine environment or human health.

7.8 In the case of repeated or multiple dumping operations, impact hypotheses should take into account the cumulative effects of such operations. It will also be important to consider the possible interactions with other waste dumping practices in the area, both existing or planned.

7.9 An analysis of each disposal option should be considered in light of a comparative assessment of the following concerns: human health risks, environmental costs, hazards (including accidents), economics and exclusion of future uses. If this assessment reveals that adequate information is not available to determine the likely effects of the proposed disposal option, including potential long-term harmful consequences, then this option should not be considered further. In addition, if the interpretation of the comparative assessment shows the dumping option to be less preferable, a permit for dumping should not be given.

7.10 Each assessment should conclude with a statement supporting a decision to issue or refuse a permit for dumping.

7.11 Where monitoring is required, the effects and parameters described in the hypotheses should help to guide field and analytical work so that relevant information can be obtained in the most efficient and cost-effective manner.

8 MONITORING

8.1 Monitoring is used to verify that permit conditions are met - compliance monitoring - and that the assumptions made during the permit review and site selection process were correct and sufficient to protect the environment and human health - field monitoring. It is essential that such monitoring programmes have clearly defined objectives.

8.2 The Impact Hypothesis forms the basis for defining field monitoring. The measurement programme should be designed to ascertain that changes in the receiving environment are within those predicted. The following questions must be answered:

.1 What testable hypotheses can be derived from the Impact Hypothesis?
.2 What measurements (type, location, frequency, performance requirements) are required to test these hypotheses?
.3 How should the data be managed and interpreted?

8.3 It may usually be assumed that suitable specifications of existing (pre-disposal) conditions in the receiving area are already contained in the application for dumping. If the specification of such conditions is inadequate to permit the formulation of an Impact Hypothesis, the licensing authority will require additional information before any final decision on the permit application is made.

8.4 The permitting authority is encouraged to take account of relevant research information in the design and modification of monitoring programmes. The measurements can be divided into two types - those within the zone of predicted impact and those outside.

8.5 Measurements should be designed to determine whether the zone of impact and the extent of change outside the zone of impact differ from those predicted. The former can be answered by designing a sequence of measurements in space and time that ensures that the projected spatial scale of change is not exceeded. The latter can be answered by the acquisition of measurements that provide information on the extent of change that occurs outside the zone of impact as a result of the dumping operation. Frequently, these measurements will be based on a null hypothesis - that no significant change can be detected.

8.6 The results of monitoring (or other related research) should be reviewed at regular intervals in relation to the objectives and can provide a basis to:

.1 modify or terminate the field-monitoring programme;
.2 modify or revoke the permit;
.3 redefine or close the dump-site; and
.4 modify the basis on which applications to dump wastes are assessed.

9 PERMIT AND PERMIT CONDITIONS

9.1 A decision to issue a permit should only be made if all impact evaluations are completed and the monitoring requirements are determined. The provisions of the permit shall ensure, as far as practicable, that environmental disturbance and detriment are minimized and the benefits maximized. Any permit issued shall contain data and information specifying:

.1 a description of the best environmental practices (see paragraph 5.2) for the disposal option selected whether for a platform that is to be left in place, either standing or toppled in place, or for platforms that will be removed to another dump-site at sea;

.2 the location of the dump-site(s);

.3 the method of dumping; and

.4 a notification of the appropriate national authority of the co-ordinates of the platform/structure on the sea bottom after disposal.

9.2 If dumping is the selected option, then a permit authorizing dumping must be issued in advance. It is recommended that opportunities be provided for public review and participation in the permitting process. In granting a permit, the hypothesized impact occurring within the boundaries of the dump-site, such as alterations to the physical, chemical and biological compartments of the local environment is accepted by the permitting authority.

9.3 Regulators should strive at all times to enforce procedures that will result in environmental changes as far below the limits of allowable environmental change as practicable, taking into account technological capabilities as well as economic, social and political concerns.

9.4 Permits should be reviewed at regular intervals, taking into account the results of monitoring and the objectives of monitoring programmes. Review of monitoring results will indicate whether field programmes need to be continued, revised or terminated, and will contribute to informed decisions regarding the continuance, modification or revocation of permits. This provides an important feedback mechanism for the protection of human health and the marine environment.

SPECIFIC GUIDELINES FOR ASSESSMENT OF *INERT, INORGANIC GEOLOGICAL MATERIAL*

1 INTRODUCTION

1.1 The Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping[1], referred to in short as the "Generic Guidelines", as well as the Specific Guidelines for Assessment of Inert, Inorganic Geological Material addressed in this document are intended for use by national authorities responsible for regulating dumping of wastes and embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention 1972 or the 1996 Protocol thereto. Annex 2 to the 1996 Protocol places emphasis on progressively reducing the need to use the sea for dumping of wastes. Furthermore, it recognizes that avoidance of pollution demands rigorous controls on the emission and dispersion of contaminating substances and the use of scientifically based procedures for selecting appropriate options for waste disposal. When applying these Guidelines uncertainties in relation to assessments of impacts on the marine environment will need to be considered and a precautionary approach applied in addressing these uncertainties. They should be applied with a view that acceptance of dumping under certain circumstances does not remove the obligation to make further attempts to reduce the necessity for dumping.

1.2 The 1996 Protocol to the London Convention 1972 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, these Guidelines would apply to the materials listed in that Annex. The London Convention 1972 prohibits the dumping of certain wastes and other matter specified therein and in the context of that Convention these Guidelines meet the requirements of its Annexes for wastes not prohibited for dumping at sea. When applying these Guidelines under the London Convention 1972, 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 1972.

1.3 The schematic shown in Figure 1 provides a clear indication of the stages in the application of the Guidelines where important decisions should be made and is not designed as a conventional "decision tree". In general, national authorities should use the schematic in an iterative manner ensuring that all steps receive consideration before a decision is made to issue a permit. Figure 1 illustrates the relationship between the operational components of Annex 2 of the 1996 Protocol and contains the following elements:

.1 Waste Characterization (Chapter 4) (Chemical, Physical and Biological Properties);

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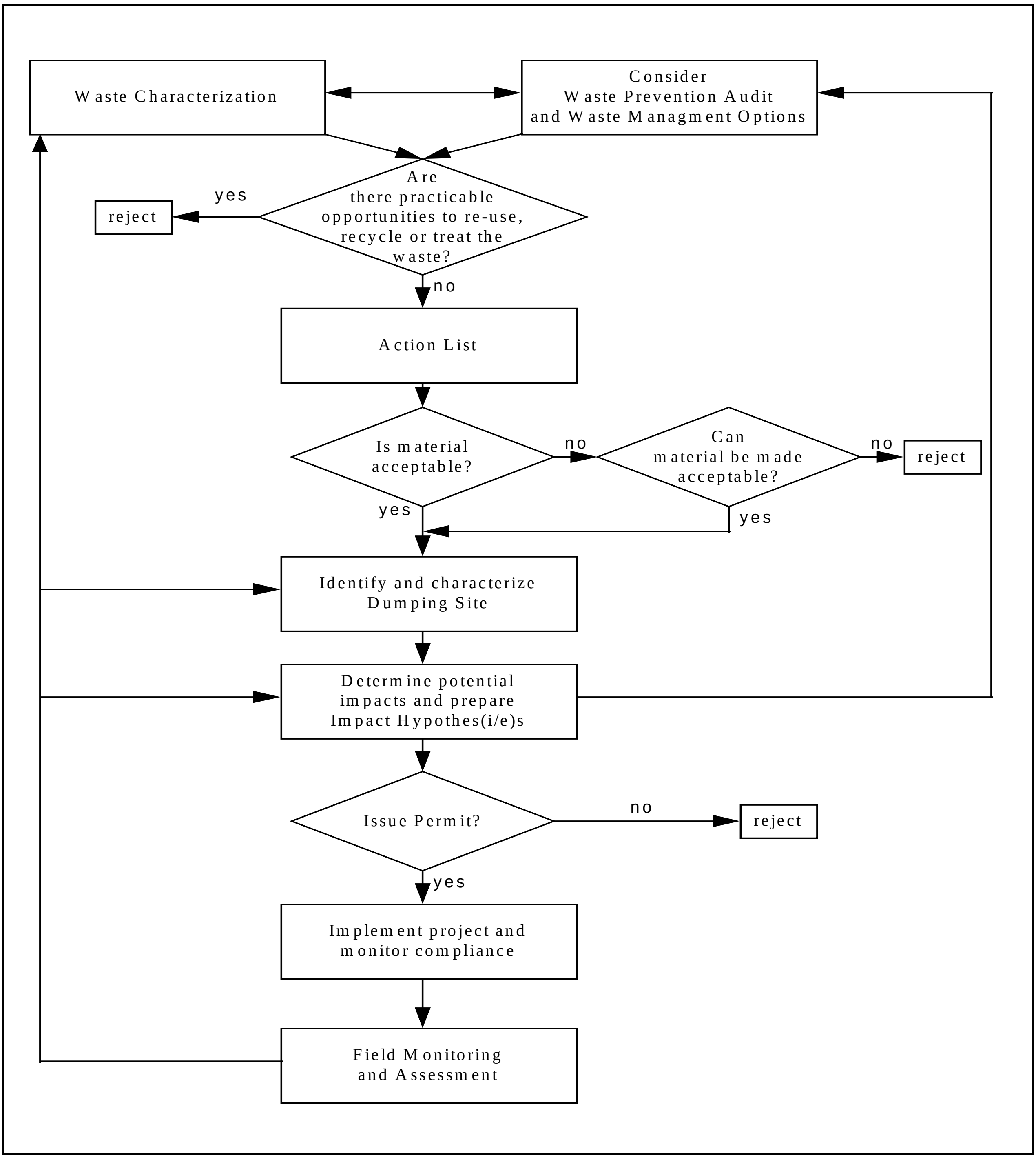
[1] The Nineteenth Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these Guidelines in 1997.

.2 Waste Prevention Audit and Waste Management Options (Chapters 2 and 3);
.3 Action List (Chapter 5);
.4 Identify and Characterize Dump-site (Chapter 6) (Dump-site Selection);
.5 Determine Potential Impacts and Prepare Impact Hypothesis(es) (Chapter 7) (Assessment of Potential Effects);
.6 Issue Permit (Chapter 9) (Permit and Permit Conditions);
.7 Implement Project and Monitor Compliance (Chapter 8) (Monitoring); and
.8 Field Monitoring and Assessment (Chapter 8) (Monitoring).

Figure 1



1.4 These Guidelines are specific to inert, inorganic geological material[2]. Adherence to the following represents neither a more restrictive nor a less restrictive regime than that of the generic Guidelines of 1997.

2 WASTE PREVENTION AUDIT

2.1 The initial stages in assessing alternatives to dumping should, as appropriate, include an evaluation of:

- .1 types, amounts and relative hazards of wastes generated. As the material is inert, the relative hazards are confined to physical impacts;

- .2 details of the production process and the sources of wastes within that process; and

- .3 feasibility of the following waste reduction/prevention techniques:

  - .1 clean production technologies;
  - .2 process modification;
  - .3 input substitution; and
  - .4 on-site, closed-loop recycling.

2.2 In general terms, if the required audit reveals that opportunities exist for waste prevention at source, an applicant is expected to formulate and implement a waste prevention strategy in collaboration with relevant local and national agencies which includes specific waste reduction targets and provision for further waste prevention audits to ensure that these targets are being met. Permit issuance or renewal decisions shall assure compliance with any resulting waste reduction and prevention requirements.

2.3 For this category of material the most pertinent issue will be waste minimization.

3 CONSIDERATION OF WASTE MANAGEMENT OPTIONS

3.1 Applications to dump wastes or other matter shall demonstrate that appropriate consideration has been given to the following hierarchy of waste management options, which implies an order of increasing environmental impact:

- .1 re-use, such as refilling of mines;
- .2 recycling such as road construction and building materials; and
- .3 disposal on land, and into water.

3.2 A permit to dump wastes or other matter shall be refused if the permitting authority determines that appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to human health or the environment or disproportionate costs. The practical availability of other means of disposal should be considered in the light of a comparative risk assessment involving both dumping and the alternatives.

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[2] The Twenty-second Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these specific Guidelines in 2000.

4 CHEMICAL, PHYSICAL AND BIOLOGICAL PROPERTIES

4.1 The character and form of the material and the basis on which it is characterized as geological and inert in the marine environment should be specified. From this specification, it should be demonstrated that 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. Thus, the assessment of the environmental impacts will be based solely upon origin, mineralogy, and the total amount and physical nature of the material.

4.2 Characterization of the material and its constituents shall take into account:

.1 origin**,** including mineralogy, total amount, and the form in which it is intended to be dumped; and
.2 physical persistence.

5 ACTION LIST

5.1 The Action List provides a screening mechanism for determining whether a material is considered acceptable for dumping. It constitutes a crucial part of Annex 2 to the 1996 Protocol and the Scientific Group will continuously review all aspects of it to assist Contracting Parties with its application. It may also be used in meeting the requirements of Annexes I and II to the London Convention 1972. However, as inert materials will not interact with biological systems other than through physical processes, Action List considerations do not require detailed consideration.

6 DUMP-SITE SELECTION

Site selection considerations

6.1 Proper selection of a dump-site at sea for the reception of waste is of paramount importance.

6.2 Information required to select a dump-site shall include:

.1 physical 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 sediment fluxes; and
.4 economic and operational feasibility.

6.3 Guidance for procedures to be followed in dump-site selection can be found in a report of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP Reports and Studies No. 16 - Scientific Criteria for the Selection of Waste Disposal Sites at Sea). Prior to selecting a dump-site, it is essential that data be available on the oceanographic characteristics of the general area in which the site is to be located. This information can be obtained from the literature but fieldwork should be undertaken to fill the gaps. Only those biological features relevant to physical effects such as turbidity and sediment transport require detailed consideration.

6.4 Some of the important amenities, biological features and uses of the sea to be considered in determining the specific location of the dump-site are:

.1 the shoreline and bathing beaches;
.2 areas of beauty or significant cultural or historical importance;
.3 areas of special scientific or biological importance, such as sanctuaries;
.4 fishing areas;
.5 spawning, nursery and recruitment areas;
.6 migration routes;
.7 seasonal and critical habitats;
.8 shipping lanes;
.9 military exclusion zones;
.10 engineering uses of the seafloor, including mining, undersea cables, desalination or energy conversion sites.

Size of the dump-site

6.5 Size of the dump-site is an important consideration for the following reasons:

.1 it should be large enough, unless it is an approved dispersion site, to have the bulk of the material remain either within the site limits or within a predicted area of impact after dumping;

.2 it should be large enough to accommodate anticipated volumes of solid waste and/or liquid wastes to be diluted to near background levels before or upon reaching site boundaries;

.3 it should be large enough in relation to anticipated volumes for dumping so that it would serve its function for many years; and

.4 it should not be so large that monitoring would require undue expenditure of time and money.

Site capacity

6.6 In order to assess the capacity of a site, especially for solid wastes, the following should be taken into consideration:

.1 the anticipated loading rates per day, week, month or year;
.2 whether or not it is a dispersive site; and
.3 the allowable reduction in water depth over the site because of mounding of material.

Evaluation of potential impacts

6.7 Due consideration needs to be given to the relative magnitude of the substance fluxes associated with dumping in the local and regional area surrounding the dump-site. In cases where it is predicted that dumping will substantially augment existing fluxes associated with natural processes, dumping at the site under consideration should be deemed inadvisable. The only fluxes that are relevant to inert, inorganic geological material are sediment transport fluxes in the water column and at the sediment-water interface. Particular attention needs to be paid to the degree to which deposition of material may result in effects on marine benthos (e.g., smothering, changes in benthos diversity, habitat modification).

6.8 Temporal characteristics should be considered to identify potentially critical times of the year (e.g., for marine life) when dumping should not take place. This consideration leaves periods when it is expected that dumping operations will have less impact than at other times. If these restrictions become too burdensome and costly, there should be some opportunity for compromise in which priorities may have to be established concerning species to be left wholly undisturbed. Examples of such biological considerations are:

.1 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 and breeding periods;
.2 periods when marine organisms are hibernating on or are buried in the sediments; and
.3 periods when particularly sensitive and possibly endangered species are exposed.

The primary consideration relevant to these provisions is the physical effects of inert, inorganic geological materials on biota in the water column and benthos and habitat modification.

Contaminant mobility

6.9 Contaminant mobility is dependent upon several factors, among which are:

.1 type of matrix;
.2 form of contaminant;
.3 physical state of the system, e.g., temperature, water flow, suspended matter; and
.4 biological activities, e.g., bioturbation.

7 ASSESSMENT OF POTENTIAL EFFECTS

7.1 Assessment of potential effects should lead to a concise statement of the expected consequences of the sea or land disposal options, i.e., the "Impact Hypothesis". It provides a basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements. As far as possible, waste management options causing dispersion and dilution of contaminants in the environment should be avoided and preference given to techniques that prevent the input of the contaminants to the environment.

7.2 The assessment for dumping should integrate information on waste characteristics, conditions at the proposed dump-site(s), fluxes and proposed disposal techniques and specify the potential effects on human health, living resources, amenities and other legitimate uses of the sea. It should define the nature, temporal and spatial scales and duration of expected impacts based on reasonably conservative assumptions.

7.3 The assessment should be as comprehensive as possible. The primary potential impacts should be identified during the dump-site selection process. These are considered to pose the most serious threats to human health and the environment. Alterations to the physical environment, risks to human health, devaluation of marine resources and interference with other legitimate uses of the sea are often seen as primary concerns in this regard.

7.4 In constructing an impact hypothesis, particular attention should be given to, but not limited to, potential impacts on amenities (e.g., presence of floatables), sensitive areas (e.g., spawning, nursery or feeding areas), habitat (e.g., biological, chemical and physical modification), migratory patterns and marketability of resources. Consideration should also be given to potential impacts on other uses of the sea including: fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea.

7.5 Even the least complex and most innocuous wastes may have a variety of physical, chemical and biological effects. Impact hypotheses cannot attempt to reflect them all. It must be recognized that even the most comprehensive impact hypotheses may not address all possible scenarios such as unanticipated impacts. It is therefore imperative that the monitoring programme be linked directly to the hypotheses and serve as a feedback mechanism to verify the predictions and review the adequacy of management measures applied to the dumping operation and at the dump-site. It is important to identify the sources and consequences of uncertainty. The only effects requiring detailed consideration in this context are physical impacts on biota.

7.6 The expected consequences of dumping should be described in terms of affected habitats, processes, species, communities and uses. The precise nature of the predicted effect (e.g., change, response, or interference) should be described. The effect should be quantified in sufficient detail so that there would be no doubt as to the variables to be measured during field monitoring. In the latter context, it would be essential to determine "where" and "when" the impacts can be expected.

7.7 Emphasis should be placed on biological effects and habitat modification as well as physical and chemical change. The following factors should be addressed:

.1 physical changes and physical effects on biota; and
.2 effects on sediment transport.

7.8 In the case of repeated or multiple dumping operations, impact hypotheses should take into account the cumulative effects of such operations. It will also be important to consider the possible interactions with other waste dumping practices in the area, both existing or planned.

7.9 An analysis of each disposal option should be considered in light of a comparative assessment of the following concerns: human health risks, environmental costs, hazards (including accidents), economics and exclusion of future uses. If this assessment reveals that adequate information is not available to determine the likely effects of the proposed disposal option, including potential long-term harmful consequences, then this option should not be considered further. In addition, if the interpretation of the comparative assessment shows the dumping option to be less preferable, a permit for dumping should not be given.

7.10 Each assessment should conclude with a statement supporting a decision to issue or refuse a permit for dumping.

7.11 Where monitoring is required, the effects and parameters described in the hypotheses should help to guide field and analytical work so that relevant information can be obtained in the most efficient and cost-effective manner.

8 MONITORING

8.1 Monitoring is used to verify that permit conditions are met - compliance monitoring - and that the assumptions made during the permit review and site selection process were correct and sufficient to protect the environment and human health - field monitoring. It is essential that such monitoring programmes have clearly defined objectives.

8.2 The Impact Hypothesis forms the basis for defining field monitoring. The measurement programme should be designed to ascertain that changes in the receiving environment are within those predicted. The following questions must be answered:

.1 What testable hypotheses can be derived from the Impact Hypothesis?
.2 What measurements (type, location, frequency, performance requirements) are required to test these hypotheses?
.3 How should the data be managed and interpreted?

8.3 It may usually be assumed that suitable specifications of existing (pre-disposal) conditions in the receiving area are already contained in the application for dumping. If the specification of such conditions is inadequate to permit the formulation of an Impact Hypothesis, the licensing authority will require additional information before any final decision on the permit application is made.

8.4 The permitting authority is encouraged to take account of relevant research information in the design and modification of monitoring programmes. The measurements can be divided into two types - those within the zone of predicted impact and those outside.

8.5 Measurements should be designed to determine whether the zone of impact and the extent of change outside the zone of impact differ from those predicted. The former can be answered by designing a sequence of measurements in space and time that ensures that the projected spatial scale of change is not exceeded. The latter can be answered by the acquisition of measurements that provide information on the extent of change that occurs outside the zone of impact as a result of the dumping operation. Frequently, these measurements will be based on a null hypothesis - that no significant change can be detected.

8.6 The results of monitoring (or other related research) should be reviewed at regular intervals in relation to the objectives and can provide a basis to:

.1 modify or terminate the field-monitoring programme;
.2 modify or revoke the permit;
.3 redefine or close the dump-site; and
.4 modify the basis on which applications to dump wastes are assessed.

9 PERMIT AND PERMIT CONDITIONS

9.1 A decision to issue a permit should only be made if all impact evaluations are completed and the monitoring requirements are determined. The provisions of the permit shall ensure, as far as practicable, that environmental disturbance and detriment are minimized and the benefits maximized. Any permit issued shall contain data and information specifying:

.1 the types, amounts and sources of materials to be dumped;
.2 the location of the dump-site(s);
.3 the method of dumping; and
.4 monitoring and reporting requirements.

9.2 If dumping is the selected option, then a permit authorizing dumping must be issued in advance. It is recommended that opportunities are provided for public review and participation in the permitting process. In granting a permit, the hypothesized impact occurring within the boundaries of the dump-site, such as alterations to the physical, chemical and biological compartments of the local environment is accepted by the permitting authority.

9.3 Regulators should strive at all times to enforce procedures that will result in environmental changes as far below the limits of allowable environmental change as practicable, taking into account technological capabilities as well as economic, social and political concerns.

9.4 Permits should be reviewed at regular intervals, taking into account the results of monitoring and the objectives of monitoring programmes. Review of monitoring results will indicate whether field programmes need to be continued, revised or terminated, and will contribute to informed decisions regarding the continuance, modification or revocation of permits. This provides an important feedback mechanism for the protection of human health and the marine environment.

SPECIFIC GUIDELINES FOR ASSESSMENT OF

ORGANIC MATERIAL OF NATURAL ORIGIN

1 INTRODUCTION

1.1 The Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping[1], referred to in short as the "Generic Guidelines", as well as the Specific Guidelines for Assessment of Organic Material of Natural Origin addressed in this document are intended for use by national authorities responsible for regulating dumping of wastes and embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention 1972 or the 1996 Protocol thereto. Annex 2 to the 1996 Protocol places emphasis on progressively reducing the need to use the sea for dumping of wastes. Furthermore, it recognizes that avoidance of pollution demands rigorous controls on the emission and dispersion of contaminating substances and the use of scientifically based procedures for selecting appropriate options for waste disposal. When applying these Guidelines uncertainties in relation to assessments of impacts on the marine environment will need to be considered and a precautionary approach applied in addressing these uncertainties. They should be applied with a view that acceptance of dumping under certain circumstances does not remove the obligation to make further attempts to reduce the necessity for dumping.

1.2 The 1996 Protocol to the London Convention 1972 follows an approach under which dumping of wastes or other matter is prohibited except for those materials specifically enumerated in Annex I, and in the context of that Protocol, these Guidelines would apply to the materials listed in that Annex. The London Convention 1972 prohibits the dumping of certain wastes or other matter specified therein and in the context of that Convention these Guidelines meet the requirements of its Annexes for wastes not prohibited for dumping at sea. When applying these Guidelines under the London Convention 1972, 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 1972.

1.3 The schematic shown in Figure 1 provides a clear indication of the stages in the application of the Guidelines where important decisions should be made and is not designed as a conventional "decision tree". In general, national authorities should use the schematic in an iterative manner ensuring that all steps receive consideration before a decision is made to issue a permit. Figure 1 illustrates the relationship between the operational components of Annex 2 of the 1996 Protocol and contains the following elements:

.1 Waste Characterization (Chapter 4) (Chemical, Physical and Biological Properties)

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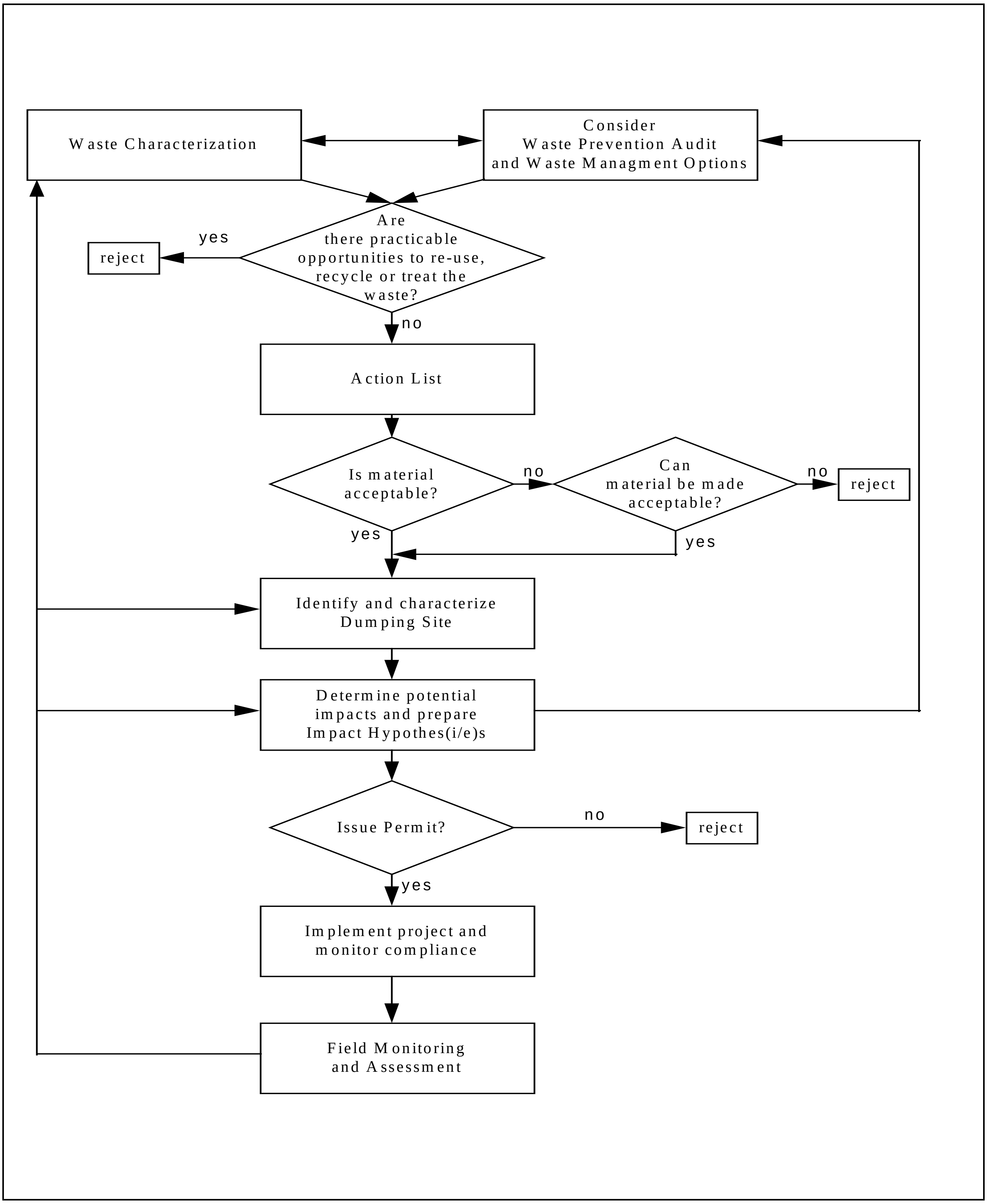
[1] The Nineteenth Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these Guidelines in 1997.

.2 Waste Prevention Audit and Waste Management Options (Chapter 2 and 3)
.3 Action List (Chapter 5)
.4 Identify and Characterize Dump-site (Chapter 6) (Dump-site Selection)
.5 Determine Potential Impacts and Prepare Impact Hypothesis(es) (Chapter 7) (Assessment of Potential Effects)
.6 Issue Permit (Chapter 9) (Permit and Permit Conditions)
.7 Implement Project and Monitor Compliance (Chapter 8) (Monitoring)
.8 Field Monitoring and Assessment (Chapter 8) (Monitoring).

Figure 1



1.4 These Guidelines apply to animal and vegetable matter predominantly of agricultural origin[2], but will also be relevant to the dumping of spoilt cargoes at sea when such cargoes consist of organic material of natural origin. In recent years, dumped spoilt cargoes included beef; agricultural crops e.g., potatoes, rice, corn, beans, grain and bananas, as well as sugar.

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2 The Twenty-second Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these specific Guidelines in 2000.

2 WASTE PREVENTION AUDIT

2.1 The initial stages in assessing alternatives to dumping should, as appropriate, include an evaluation of:

.1 types, amounts and relative hazards of wastes generated, the nature of any packaging associated with the material; and

.2 details of the production process and the sources of wastes within that process, only in case there is reason to believe the material has been unusually contaminated or contains preservative or treatment agents.

3 CONSIDERATION OF WASTE MANAGEMENT OPTIONS

3.1 Applications to dump wastes or other matter shall demonstrate that appropriate consideration has been given to the following hierarchy of waste management options, which implies an order of increasing environmental impact:

.1 re-use, e.g., use as animal feed, fertilizer, or composting etc., where practical;
.2 off-site recycling;
.3 destruction of hazardous constituents;
.4 treatment to reduce or remove the hazardous constituents; and
.5 disposal on land, e.g., in suitably designed landfills, or combustion/incineration.

Paragraphs 3.1.3 and 3.1.4 can be discounted from detailed consideration unless there is reason to believe the material has been unusually contaminated.

3.2 A permit to dump wastes or other matter shall be refused if the permitting authority determines that appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to human health or the environment or disproportionate costs. The practical availability of other means of disposal should be considered in the light of a comparative risk assessment involving both dumping and the alternatives.

4 CHEMICAL, PHYSICAL AND BIOLOGICAL PROPERTIES

4.1 A detailed description and characterization of the waste is an essential precondition for the consideration of alternatives and the basis for a decision as to whether a waste may be dumped. If a waste is so poorly characterized that proper assessment cannot be made of its potential impacts on human health and the environment, that waste shall not be dumped. Because it is material of natural origin, a detailed characterization of the constituents of organic material of natural origin is not usually warranted. However, the characterization of the waste should include a description of its nature and the circumstances leading to its production and for spoilt cargoes an evaluation of the presence of preservative or treatment agents.

4.2 Characterization of the wastes and their constituents shall take into account:

.1 origin, total amount, form and average composition, and the nature of any packaging associated with the material;
.2 properties: physical, chemical, biochemical and biological. The specific gravity and oxygen demand of the material are of particular relevance to the behaviour of

the material when dumped. Consideration should also be given to biological constituents such as pathogenic bacteria, viruses and parasites;

.3 toxicity;

.4 persistence: physical, chemical and biological; and

.5 accumulation and bio-transformation in biological materials or sediments.

5 ACTION LIST

5.1 The Action List provides a screening mechanism for determining whether a material is considered acceptable for dumping. It constitutes a crucial part of Annex 2 to the 1996 Protocol and the Scientific Group will continuously review all aspects of it to assist Contracting Parties with its application. It may also be used in meeting the requirements of Annexes I and II to the London Convention 1972. Given that the materials under consideration are of natural origin, only in cases where material is suspected, because of the circumstances of production, to be abnormally contaminated by hazardous substances, including preservatives or treatment agents will the provisions of the Action List in this Chapter be relevant.

5.2 Each Contracting Party shall develop a national Action List to provide a mechanism for screening candidate wastes and their constituents on the basis of their potential effects on human health and the marine environment. In selecting substances for consideration in an Action List, priority shall be given to toxic, persistent and bio-accumulative substances from anthropogenic sources (e.g., cadmium, mercury, organohalogens, petroleum hydrocarbons and, whenever relevant, arsenic, lead, copper, zinc, beryllium, chromium, nickel and vanadium, organosilicon compounds, cyanides, fluorides and pesticides or their by-products other than organohalogens). An Action List can also be used as a trigger mechanism for further waste prevention considerations.

5.3 For an individual waste category, it may be possible to define national action levels on the basis of concentration limits, biological responses, environmental quality standards, flux considerations or other reference values.

5.4 An Action List shall specify an upper level and may also specify a lower level. The upper level should be set so as to avoid acute or chronic effects on human health or on sensitive marine organisms representative of the marine ecosystem. Application of an Action List will result in three possible categories of waste:

.1 wastes which contain specified substances, or which cause biological responses, *exceeding* the relevant upper level shall not be dumped, unless made acceptable for dumping through the use of management techniques or processes;

.2 wastes which contain specified substances, or which cause biological responses, *below* the relevant lower levels should be considered to be of little environmental concern in relation to dumping; and

.3 wastes, which contain specified substances, or which cause biological responses, *below* the upper level but *above* the lower level require more detailed assessment before their suitability for dumping can be determined.

6 DUMP-SITE SELECTION

Site selection considerations

6.1 Proper selection of a dump-site at sea for the reception of waste is of paramount importance.

6.2 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. The most relevant consideration is organic matter flux that imposes changes in oxygen demand; and
- .4 economic and operational feasibility.

6.3 Guidance for procedures to be followed in dump-site selection can be found in a report of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP Reports and Studies No. 16 - Scientific Criteria for the Selection of Waste Disposal Sites at Sea). Prior to selecting a dump-site, it is essential that data be available on the oceanographic characteristics of the general area in which the site is to be located. This information can be obtained from the literature but fieldwork should be undertaken to fill the gaps. Required information includes:

- .1 the nature of the seabed, including its topography, geo-chemical and geological characteristics, its biological composition and activity, and prior dumping activities affecting the area;

- .2 the physical nature of the water column, including temperature, depth, possible existence of a thermocline/pycnocline and how it varies in depth with season and weather conditions, tidal period and orientation of the tidal ellipse, mean direction and velocity of the surface and bottom drifts, velocities of storm-wave induced bottom currents, general wind and wave characteristics, and the average number of storm days per year, suspended matter; and

- .3 the chemical and biological nature of the water column, including pH, salinity, dissolved oxygen at surface and bottom, chemical and biochemical oxygen demand, nutrients and their various forms and primary productivity.

6.4 Some of the important amenities, biological features and uses of the sea to be considered in determining the specific location of the dump-site are:

- .1 the shoreline and bathing beaches;
- .2 areas of beauty or significant cultural or historical importance;
- .3 areas of special scientific or biological importance, such as sanctuaries;
- .4 fishing areas;
- .5 spawning, nursery and recruitment areas;
- .6 migration routes;
- .7 seasonal and critical habitats;
- .8 shipping lanes;
- .9 military exclusion zones; and

.10 engineering uses of the seafloor, including mining, undersea cables, desalination or energy conversion sites.

Size of the dump-site

6.5 Size of the dump-site is an important consideration for the following reasons:

.1 it should be large enough, unless it is an approved dispersion site, to have the bulk of the material remain either within the site limits or within a predicted area of impact after dumping;

.2 it should be large enough to accommodate anticipated volumes of solid waste and/or liquid wastes to be diluted to near background levels before or upon reaching site boundaries;

.3 it should be large enough in relation to anticipated volumes for dumping so that it would serve its function for many years; and

.4 it should not be so large that monitoring would require undue expenditure of time and money.

Site capacity

6.6 In order to assess the capacity of a site, especially for solid wastes, the following should be taken into consideration:

.1 the anticipated loading rates per day, week, month or year;
.2 whether or not it is a dispersive site; and
.3 the allowable reduction in water depth over the site because of mounding of material.

Particular attention needs to be paid to the reduction in dissolved oxygen in the water column and changes in sediment oxidation-reduction (REDOX) conditions.

Evaluation of potential impacts

6.7 An important consideration in determining the suitability of a waste for dumping at a specific site is the degree to which this results in increased exposures of organisms to substances that may cause adverse effects. In those cases where the overriding concern is biological oxygen demand and associated oxygen depletion in the marine environment, the provisions of paragraphs 6.7 - 6.11 do not need detailed consideration.

6.8 The extent of adverse effects of a substance is a function of the exposures of organisms (including humans). Exposure, in turn, is a function, *inter alia*, of input flux and the physical, chemical and biological processes that control the transport, behaviour, fate and distribution of a substance.

6.9 The presence of natural substances and the ubiquitous occurrence of contaminants means that there will always be some pre-existing exposures of organisms to all substances contained in any waste that might be dumped. Concerns about exposures to hazardous substances thus relate to additional exposures as a consequence of dumping. This, in turn, can be translated back to the relative magnitude of the input fluxes of substances from dumping compared with existing input fluxes from other sources.

6.10 Accordingly, due consideration needs to be given to the relative magnitude of the substance fluxes associated with dumping in the local and regional area surrounding the dump-site. In cases where it is predicted that dumping will substantially augment existing fluxes associated with natural processes, dumping at the site under consideration should be deemed inadvisable.

6.11 In the case of synthetic substances, the relationship between fluxes associated with dumping and pre-existing fluxes in the vicinity of the site may not provide a suitable basis for decisions. This paragraph can be discounted from detailed consideration unless there is reason to believe the material has been abnormally contaminated or preserved/treated.

6.12 Temporal characteristics should be considered to identify potentially critical times of the year (e.g., for marine life) when dumping should not take place. This consideration leaves periods when it is expected that dumping operations will have less impact than at other times. If these restrictions become too burdensome and costly, there should be some opportunity for compromise in which priorities may have to be established concerning species to be left wholly undisturbed. Examples of such biological considerations are:

- .1 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 and breeding periods;
- .2 periods when marine organisms are hibernating on or are buried in the sediments; and
- .3 periods when particularly sensitive and possibly endangered species are exposed.

Contaminant mobility

6.13 Contaminant mobility is dependent upon several factors, among which are:

- .1 type of matrix;
- .2 form of contaminant;
- .3 contaminant partitioning;
- .4 physical state of the system, e.g., temperature, water flow, suspended matter;
- .5 physico-chemical state of the system;
- .6 length of diffusion and advection pathways; and
- .7 biological activities e.g., bioturbation.

In those cases where the overriding concern is biological oxygen demand and associated oxygen depletion in the marine environment, the provisions of this paragraph do not need detailed consideration.

7 ASSESSMENT OF POTENTIAL EFFECTS

7.1 Assessment of potential effects should lead to a concise statement of the expected consequences of the sea or land disposal options, i.e., the "Impact Hypothesis". It provides a basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements. As far as possible, waste management options causing dispersion and dilution of contaminants in the environment should be avoided and preference given to techniques that prevent the input of the contaminants to the environment. In relation to this Chapter, potential environmental impacts include:

.1 fate of the material on the basis of its density and buoyancy; and
.2 the effects of any preservative or treatment agents.

7.2 The assessment for dumping should integrate information on waste characteristics, conditions at the proposed dump-site(s), fluxes and proposed disposal techniques and specify the potential effects on human health, living resources, amenities and other legitimate uses of the sea. It should define the nature, temporal and spatial scales and duration of expected impacts based on reasonably conservative assumptions.

7.3 The assessment should be as comprehensive as possible. The primary potential impacts should be identified during the dump-site selection process. These are considered to pose the most serious threats to human health and the environment. Alterations to the physical environment, risks to human health, devaluation of marine resources and interference with other legitimate uses of the sea are often seen as primary concerns in this regard.

7.4 In constructing an impact hypothesis, particular attention should be given to, but not limited to, potential impacts on amenities (e.g., presence of floatables), sensitive areas (e.g., spawning, nursery or feeding areas), habitat (e.g., biological, chemical and physical modification), migratory patterns and marketability of resources. Consideration should also be given to potential impacts on other uses of the sea including: fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea.

7.5 Even the least complex and most innocuous wastes may have a variety of physical, chemical and biological effects. Impact hypotheses cannot attempt to reflect them all. It must be recognized that even the most comprehensive impact hypotheses may not address all possible scenarios such as unanticipated impacts. It is therefore imperative that the monitoring programme be linked directly to the hypotheses and serve as a feedback mechanism to verify the predictions and review the adequacy of management measures applied to the dumping operation and at the dump-site. It is important to identify the sources and consequences of uncertainty.

7.6 The expected consequences of dumping should be described in terms of affected habitats, processes, species, communities and uses. The precise nature of the predicted effect (e.g., change, response, or interference) should be described. The effect should be quantified in sufficient detail so that there would be no doubt as to the variables to be measured during field monitoring. In the latter context, it would be essential to determine "where" and "when" the impacts can be expected.

7.7 Emphasis should be placed on biological effects and habitat modification as well as physical and chemical change. However, if the potential effect is due to substances, the following factors should be addressed:

.1 estimates of statistically significant increases of the substance in seawater, sediments, or biota in relation to existing conditions and associated effects; and

.2 estimate of the contribution made by the substance to local and regional fluxes and the degree to which existing fluxes pose threats or adverse effects on the marine environment or human health. Particular consideration needs to be given to organic carbon fluxes imposing additional oxygen demand.

7.8 In the case of repeated or multiple dumping operations, impact hypotheses should take into account the cumulative effects of such operations. It will also be important to consider the possible interactions with other waste dumping practices in the area, both existing or planned.

7.9 An analysis of each disposal option should be considered in light of a comparative assessment of the following concerns: human health risks, environmental costs, hazards (including accidents), economics and exclusion of future uses. If this assessment reveals that adequate information is not available to determine the likely effects of the proposed disposal option, including potential long-term harmful consequences, then this option should not be considered further. In addition, if the interpretation of the comparative assessment shows the dumping option to be less preferable, a permit for dumping should not be given.

7.10 Each assessment should conclude with a statement supporting a decision to issue or refuse a permit for dumping.

7.11 Where monitoring is required, the effects and parameters described in the hypotheses should help to guide field and analytical work so that relevant information can be obtained in the most efficient and cost-effective manner.

8 MONITORING

8.1 Monitoring is used to verify that permit conditions are met - compliance monitoring - and that the assumptions made during the permit review and site selection process were correct and sufficient to protect the environment and human health - field monitoring. It is essential that such monitoring programmes have clearly defined objectives.

8.2 The Impact Hypothesis forms the basis for defining field monitoring. The measurement programme should be designed to ascertain that changes in the receiving environment are within those predicted. The following questions must be answered:

.1 What testable hypotheses can be derived from the Impact Hypothesis?
.2 What measurements (type, location, frequency, performance requirements) are required to test these hypotheses?
.3 How should the data be managed and interpreted?

8.3 It may usually be assumed that suitable specifications of existing (pre-disposal) conditions in the receiving area are already contained in the application for dumping. If the specification of such conditions is inadequate to permit the formulation of an Impact Hypothesis, the licensing authority will require additional information before any final decision on the permit application is made.

8.4 The permitting authority is encouraged to take account of relevant research information in the design and modification of monitoring programmes. The measurements can be divided into two types - those within the zone of predicted impact and those outside.

8.5 Measurements should be designed to determine whether the zone of impact and the extent of change outside the zone of impact differ from those predicted. The former can be answered by designing a sequence of measurements in space and time that ensures that the projected spatial scale of change is not exceeded. The latter can be answered by the acquisition of measurements that provide information on the extent of change that occurs outside the zone of impact as a result of the dumping operation. Frequently, these measurements will be based on a null hypothesis - that no significant change can be detected.

8.6 The results of monitoring (or other related research) should be reviewed at regular intervals in relation to the objectives and can provide a basis to:

- .1 modify or terminate the field-monitoring programme;
- .2 modify or revoke the permit;
- .3 redefine or close the dump-site; and
- .4 modify the basis on which applications to dump wastes are assessed.

9 PERMIT AND PERMIT CONDITIONS

9.1 A decision to issue a permit should only be made if all impact evaluations are completed and the monitoring requirements are determined. The provisions of the permit shall ensure, as far as practicable, that environmental disturbance and detriment are minimized and the benefits maximized. Any permit issued shall contain data and information specifying:

- .1 the origin, amounts and types/species of organic matter of natural origin to be dumped and any associated packaging;
- .2 the location of the dump-site(s);
- .3 the method of dumping; and
- .4 monitoring and reporting requirements.

9.2 If dumping is the selected option, then a permit authorizing dumping must be issued in advance. It is recommended that opportunities be provided for public review and participation in the permitting process. In granting a permit, the hypothesized impact occurring within the boundaries of the dump-site, such as alterations to the physical, chemical and biological compartments of the local environment is accepted by the permitting authority.

9.3 Regulators should strive at all times to enforce procedures that will result in environmental changes as far below the limits of allowable environmental change as practicable, taking into account technological capabilities as well as economic, social and political concerns.

9.4 Permits should be reviewed at regular intervals, taking into account the results of monitoring and the objectives of monitoring programmes. Review of monitoring results will indicate whether field programmes need to be continued, revised or terminated, and will contribute to informed decisions regarding the continuance, modification or revocation of permits. This provides an important feedback mechanism for the protection of human health and the marine environment.

SPECIFIC GUIDELINES FOR ASSESSMENT OF

BULKY ITEMS PRIMARILY COMPRISING 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

1 INTRODUCTION

1.1 The Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping[1], referred to in short as the "Generic Guidelines", as well as the Specific Guidelines for Assessment of Bulky items primarily comprising steel, etc., addressed in this document are intended for use by national authorities responsible for regulating dumping of wastes and embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention 1972 or the 1996 Protocol thereto. Annex 2 to the 1996 Protocol places emphasis on progressively reducing the need to use the sea for dumping of wastes. Furthermore, it recognizes that avoidance of pollution demands rigorous controls on the emission and dispersion of contaminating substances and the use of scientifically based procedures for selecting appropriate options for waste disposal. When applying these Guidelines uncertainties in relation to assessments of impacts on the marine environment will need to be considered and a precautionary approach applied in addressing these uncertainties. They should be applied with a view that acceptance of dumping under certain circumstances does not remove the obligation to make further attempts to reduce the necessity for dumping.

1.2 The 1996 Protocol to the London Convention 1972 follows an approach under which dumping of wastes or other matter is prohibited except for those materials specifically enumerated in Annex I, and in the context of that Protocol, these Guidelines would apply to the materials listed in that Annex. The London Convention 1972 prohibits the dumping of certain wastes or other matter specified therein and in the context of that Convention these Guidelines meet the requirements of its Annexes for wastes not prohibited for dumping at sea. When applying these Guidelines under the London Convention 1972, they should not be viewed as a

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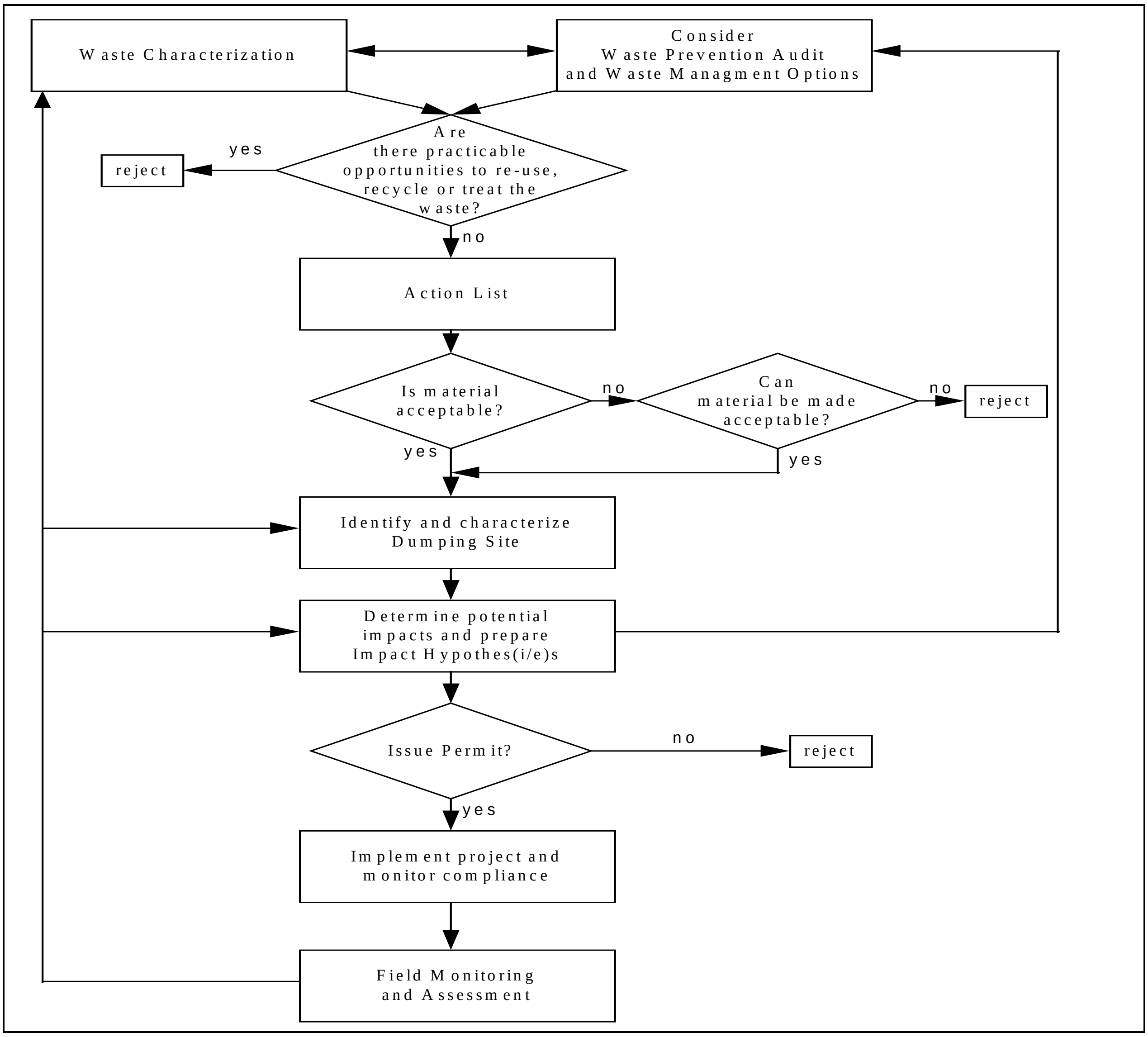
1 The Nineteenth Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these Guidelines in 1997.

tool for the reconsideration of dumping of wastes or other matter in contravention of Annex I to the London Convention 1972.

1.3 The schematic shown in Figure 1 provides a clear indication of the stages in the application of the Guidelines where important decisions should be made and is not designed as a conventional "decision tree". In general, national authorities should use the schematic in an iterative manner ensuring that all steps receive consideration before a decision is made to issue a permit. Figure 1 illustrates the relationship between the operational components of Annex 2 of the 1996 Protocol and contains the following elements:

.1 Waste Characterization (Chapter 4) (Chemical, Physical and Biological Properties)
.2 Waste Prevention Audit and Waste Management Options (Chapter 2 and 3)
.3 Action List (Chapter 5)
.4 Identify and Characterize Dump-site (Chapter 6) (Dump-site Selection)
.5 Determine Potential Impacts and Prepare Impact Hypothesis(es) (Chapter 7) (Assessment of Potential Effects)
.6 Issue Permit (Chapter 9) (Permit and Permit Conditions)
.7 Implement Project and Monitor Compliance (Chapter 8) (Monitoring)
.8 Field Monitoring and Assessment (Chapter 8) (Monitoring).

Figure 1



1.4 These Guidelines are specific to bulky items primarily comprising iron, steel, concrete and similarly non-harmful 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[2]. Adherence to the following represents neither a more restrictive nor a less restrictive regime than that of the generic Guidelines of 1997.

2 WASTE PREVENTION AUDIT

2.1 The initial stages in assessing alternatives to dumping should, as appropriate, include an evaluation of:

.1 types, amounts and relative hazards of wastes generated; and

[2] The Twenty-second Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these specific Guidelines in 2000.

.2 details of the sources of the wastes.

2.2 In general terms, if the required audit reveals that opportunities exist for waste prevention at source, an applicant is expected to formulate and implement a waste prevention strategy in collaboration with relevant local and national agencies which includes specific waste reduction targets and provision for further waste prevention audits to ensure that these targets are being met. Permit issuance or renewal decisions shall assure compliance with any resulting waste reduction and prevention requirements.

2.3 For this category of material the most pertinent issue will be waste minimization.

3 CONSIDERATION OF WASTE MANAGEMENT OPTIONS

3.1 Applications to dump wastes or other matter shall demonstrate that appropriate consideration has been given to the following hierarchy of waste management options, which implies an order of increasing environmental impact:

.1 re-use, including return to supplier, disassembly and use of components;
.2 off-site recycling;
.3 treatment to reduce or remove the hazardous constituents. For wastes addressed in these Guidelines cleaning and preparation should include: removal of contaminants including lubricants, floatable materials, and soluble matter; cleaning of all surfaces, verification of cleanliness; and proper disposal of wastes including disposal of cleaning agents and residues. Consideration should also be given to reduction of bulk; and
.4 disposal on land, and into water.

3.2 A permit to dump wastes or other matter shall be refused if the permitting authority determines that appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to human health or the environment or disproportionate costs. The practical availability of other means of disposal should be considered in the light of a comparative risk assessment involving both dumping and the alternatives.

4 CHEMICAL, PHYSICAL AND BIOLOGICAL PROPERTIES

4.1 Materials to be considered under this category will be bulky items for which the concern is physical impact. The specific gravity of such materials should exceed 1.2 when allowance for the ingress of water into internal and void spaces has been made to ensure that the material reaches the sea floor relatively rapidly.

4.2 The basis on which the material is characterized as bulky items primarily comprising iron, steel, etc. should be specified. If a waste is so poorly characterized that proper assessment cannot be made of its potential impacts on human health and the environment, that waste shall not be dumped.

4.3 Characterization of material should take into account the composition of the waste, its structural form and the possibility of reaction with seawater.

5 ACTION LIST

5.1 The Action List provides a screening mechanism for determining whether a material is considered acceptable for dumping. It constitutes a crucial part of Annex 2 to the 1996 Protocol and the Scientific Group will continuously review all aspects of it to assist Contracting Parties with its application. It may also be used in meeting the requirements of Annexes I and II to the London Convention 1972. However, as bulky items etc., will not interact with biological systems other than through physical processes, Action List considerations do not require detailed consideration.

6 DUMP-SITE SELECTION

Site selection considerations

6.1 Proper selection of a dump-site at sea for the reception of waste is of paramount importance.

6.2 Information required to select a dump-site shall include:

- .1 physical 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; and
- .3 economic and operational feasibility.

6.3 Guidance for procedures to be followed in dump-site selection can be found in a report of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP Reports and Studies No. 16 - Scientific Criteria for the Selection of Waste Disposal Sites at Sea). Prior to selecting a dump-site, it is essential that data be available on the oceanographic characteristics of the general area in which the site is to be located. This information can be obtained from the literature but fieldwork should be undertaken to fill the gaps. Only those biological features relevant to physical effects, e.g., benthic sediment transport, require detailed consideration.

6.4 Some of the important amenities, biological features and uses of the sea to be considered in determining the specific location of the dump-site are:

- .1 the shoreline and bathing beaches;
- .2 areas of beauty or significant cultural or historical importance;
- .3 areas of special scientific or biological importance, such as sanctuaries;
- .4 fishing areas;
- .5 spawning, nursery and recruitment areas;
- .6 migration routes;
- .7 seasonal and critical habitats;
- .8 shipping lanes;
- .9 military exclusion zones; and
- .10 engineering uses of the seafloor, including mining, undersea cables, desalination or energy conversion sites.

Size of the dump-site

6.5 Size of the dump-site is an important consideration for the following reasons:

.1 it should be large enough, unless it is an approved dispersion site, to have the bulk of the material remain either within the site limits or within a predicted area of impact after dumping;

.2 it should be large enough to accommodate anticipated volumes of solid waste and/or liquid wastes to be diluted to near background levels before or upon reaching site boundaries;

.3 it should be large enough in relation to anticipated volumes for dumping so that it would serve its function for many years; and

.4 it should not be so large that monitoring would require undue expenditure of time and money.

Site capacity

6.6 In order to assess the capacity of a site, especially for solid wastes, the following should be taken into consideration:

.1 the anticipated loading rates per day, week, month or year;
.2 whether or not it is a dispersive site; and
.3 the allowable reduction in water depth over the site because of mounding of material.

Evaluation of potential impacts

(Note: After appropriate cleaning and preparation of the bulky items under consideration, the only potential impacts of concern in relation to the paragraphs 6.7 to 6.13 below are physical impacts.)

6.7 An important consideration in determining the suitability of a waste for dumping at a specific site is the degree to which this results in increased exposures of organisms to substances that may cause adverse effects.

6.8 The extent of adverse effects of a substance is a function of the exposures of organisms (including humans). Exposure, in turn, is a function, *inter alia*, of input flux and the physical, chemical and biological processes that control the transport, behaviour, fate and distribution of a substance.

6.9 The presence of natural substances and the ubiquitous occurrence of contaminants means that there will always be some pre-existing exposures of organisms to all substances contained in any waste that might be dumped. Concerns about exposures to hazardous substances thus relate to additional exposures as a consequence of dumping. This, in turn, can be translated back to the relative magnitude of the input fluxes of substances from dumping compared with existing input fluxes from other sources.

6.10 Accordingly, due consideration needs to be given to the relative magnitude of the substance fluxes associated with dumping in the local and regional area surrounding the dump-site. In cases where it is predicted that dumping will substantially augment existing fluxes associated with natural processes, dumping at the site under consideration should be deemed inadvisable.

6.11 In the case of synthetic substances, the relationship between fluxes associated with dumping and pre-existing fluxes in the vicinity of the site may not provide a suitable basis for decisions.

6.12 Temporal characteristics should be considered to identify potentially critical times of the year (e.g., for marine life) when dumping should not take place. This consideration leaves periods when it is expected that dumping operations will have less impact than at other times. If these restrictions become too burdensome and costly, there should be some opportunity for compromise in which priorities may have to be established concerning species to be left wholly undisturbed. Examples of such biological considerations are:

- .1 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 and breeding periods;
- .2 periods when marine organisms are hibernating on or are buried in the sediments; and
- .3 periods when particularly sensitive and possibly endangered species are exposed.

Contaminant mobility

6.13 Contaminant mobility is dependent upon several factors, among which are:

- .1 type of matrix;
- .2 form of contaminant;
- .3 contaminant partitioning;
- .4 physical state of the system, e.g., temperature, water flow, suspended matter;
- .5 physico-chemical state of the system;
- .6 length of diffusion and advection pathways; and
- .7 biological activities e.g., bioturbation.

7 ASSESSMENT OF POTENTIAL EFFECTS

7.1 Assessment of potential effects should lead to a concise statement of the expected consequences of the sea or land disposal options, i.e., the "Impact Hypothesis". It provides a basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements. As far as possible, waste management options causing dispersion and dilution of contaminants in the environment should be avoided and preference given to techniques that prevent the input of the contaminants to the environment.

7.2 The assessment for dumping should integrate information on waste characteristics, conditions at the proposed dump-site(s), fluxes and proposed disposal techniques and specify the potential effects on human health, living resources, amenities and other legitimate uses of the sea. It should define the nature, temporal and spatial scales and duration of expected impacts based on reasonably conservative assumptions.

7.3 The assessment should be as comprehensive as possible. The primary potential impacts should be identified during the dump-site selection process. These are considered to pose the most serious threats to human health and the environment. Alterations to the physical environment, risks to human health, devaluation of marine resources and interference with other legitimate uses of the sea are often seen as primary concerns in this regard.

7.4 In constructing an impact hypothesis, particular attention should be given to, but not limited to, potential impacts on amenities (e.g., presence of floatables), sensitive areas (e.g., spawning, nursery or feeding areas), habitat (e.g., biological, chemical and physical modification), migratory patterns and marketability of resources. Consideration should also be given to potential impacts on other uses of the sea including: fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea.

7.5 Even the least complex and most innocuous wastes may have a variety of physical, chemical and biological effects. Impact hypotheses cannot attempt to reflect them all. It must be recognized that even the most comprehensive impact hypotheses may not address all possible scenarios such as unanticipated impacts. It is therefore imperative that the monitoring programme be linked directly to the hypotheses and serve as a feedback mechanism to verify the predictions and review the adequacy of management measures applied to the dumping operation and at the dump-site. It is important to identify the sources and consequences of uncertainty.

7.6 The expected consequences of dumping should be described in terms of affected habitats, processes, species, communities and uses. The precise nature of the predicted effect (e.g., change, response, or interference) should be described. The effect should be quantified in sufficient detail so that there would be no doubt as to the variables to be measured during field monitoring. In the latter context, it would be essential to determine "where" and "when" the impacts can be expected.

7.7 Emphasis should be placed on biological effects and habitat modification as well as physical and chemical change. The following factors should be addressed:

.1 physical changes and physical effects on biota; and
.2 effects on sediment transport

7.8 In the case of repeated or multiple dumping operations, impact hypotheses should take into account the cumulative effects of such operations. It will also be important to consider the possible interactions with other waste dumping practices in the area, both existing or planned.

7.9 An analysis of each disposal option should be considered in light of a comparative assessment of the following concerns: human health risks, environmental costs, hazards (including accidents), economics and exclusion of future uses. If this assessment reveals that adequate information is not available to determine the likely effects of the proposed disposal option, including potential long-term harmful consequences, then this option should not be considered further. In addition, if the interpretation of the comparative assessment shows the dumping option to be less preferable, a permit for dumping should not be given.

7.10 Each assessment should conclude with a statement supporting a decision to issue or refuse a permit for dumping.

7.11 Where monitoring is required, the effects and parameters described in the hypotheses should help to guide field and analytical work so that relevant information can be obtained in the most efficient and cost-effective manner.

8 MONITORING

8.1 Monitoring is used to verify that permit conditions are met - compliance monitoring - and that the assumptions made during the permit review and site selection process were correct and sufficient to protect the environment and human health - field monitoring. It is essential that such monitoring programmes have clearly defined objectives.

8.2 The Impact Hypothesis forms the basis for defining field monitoring. The measurement programme should be designed to ascertain that changes in the receiving environment are within those predicted. The following questions must be answered:

.1 What testable hypotheses can be derived from the Impact Hypothesis?
.2 What measurements (type, location, frequency, performance requirements) are required to test these hypotheses?
.3 How should the data be managed and interpreted?

8.3 It may usually be assumed that suitable specifications of existing (pre-disposal) conditions in the receiving area are already contained in the application for dumping. If the specification of such conditions is inadequate to permit the formulation of an Impact Hypothesis, the licensing authority will require additional information before any final decision on the permit application is made.

8.4 The permitting authority is encouraged to take account of relevant research information in the design and modification of monitoring programmes. The measurements can be divided into two types - those within the zone of predicted impact and those outside.

8.5 Measurements should be designed to determine whether the zone of impact and the extent of change outside the zone of impact differ from those predicted. The former can be answered by designing a sequence of measurements in space and time that ensures that the projected spatial scale of change is not exceeded. The latter can be answered by the acquisition of measurements that provide information on the extent of change that occurs outside the zone of impact as a result of the dumping operation. Frequently, these measurements will be based on a null hypothesis - that no significant change can be detected.

8.6 The results of monitoring (or other related research) should be reviewed at regular intervals in relation to the objectives and can provide a basis to:

.1 modify or terminate the field-monitoring programme;
.2 modify or revoke the permit;
.3 redefine or close the dump-site; and
.4 modify the basis on which applications to dump wastes are assessed.

9 PERMIT AND PERMIT CONDITIONS

9.1 A decision to issue a permit should only be made if all impact evaluations are completed and the monitoring requirements are determined. The provisions of the permit shall ensure, as far as practicable, that environmental disturbance and detriment are minimized and the benefits maximized. Any permit issued shall contain data and information specifying:

.1 the types, amounts and sources of materials to be dumped;
.2 the location of the dump-site(s);
.3 the method of dumping; and
.4 monitoring and reporting requirements.

9.2 If dumping is the selected option, then a permit authorizing dumping must be issued in advance. It is recommended that opportunities are provided for public review and participation in the permitting process. In granting a permit, the hypothesized impact occurring within the boundaries of the dump-site, such as alterations to the physical, chemical and biological compartments of the local environment is accepted by the permitting authority.

9.3 Regulators should strive at all times to enforce procedures that will result in environmental changes as far below the limits of allowable environmental change as practicable, taking into account technological capabilities as well as economic, social and political concerns.

9.4 Permits should be reviewed at regular intervals, taking into account the results of monitoring and the objectives of monitoring programmes. Review of monitoring results will indicate whether field programmes need to be continued, revised or terminated, and will contribute to informed decisions regarding the continuance, modification or revocation of permits. This provides an important feedback mechanism for the protection of human health and the marine environment.

LONDON PROTOCOL:
SPECIFIC GUIDELINES FOR ASSESSMENT OF *CARBON DIOXIDE STREAMS FOR DISPOSAL INTO SUB-SEABED GEOLOGICAL FORMATIONS*[1]

1 INTRODUCTION

1.1 Carbon dioxide sequestration in sub-seabed geological formations is a process consisting of separation of carbon dioxide from industrial and energy-related sources, transport to an offshore geological formation, and long-term isolation from the atmosphere[2]. This process is one option in a portfolio of mitigation actions for stabilization of atmospheric greenhouse gas concentrations with the potential for significant benefits at the local, regional and global levels over both the short and long terms. The intent of carbon dioxide sequestration in sub-seabed geological formations is to prevent release into the biosphere of substantial quantities of carbon dioxide derived from human activities. The aim is to retain the carbon dioxide streams within these geological formations permanently.

1.2 The risks associated with carbon dioxide sequestration in sub-seabed geological formations include those associated with leakage into the marine environment of the carbon dioxide and any other substances in or mobilized by the carbon dioxide stream. In general, there are different levels of concern regarding potential leakage that range from the local to the global over both the short- and long-terms. These Specific Guidelines deal with risks posed by carbon dioxide sequestration in sub-seabed geological formations over all timescales and primarily at the local and regional scale and thus focus on the potential effects on the marine environment in the proximity of the receiving formations.

1.3 For the purpose of these Guidelines, the following categories of substances are distinguished:

- .1 the CO_2 stream, consisting of:
  - .1 CO_2;
  - .2 incidental associated substances derived from the source material and the capture and sequestration processes used:
    - .1 source- and process-derived substances; and
    - .2 added substances (i.e., substances added to the CO_2 stream to enable or improve the capture and sequestration processes); and
- .2 substances mobilized as a result of the disposal of the CO_2 stream.

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1 These Specific Guidelines were adopted by the 2nd Meeting of Contracting Parties in November 2007.

2 Article 1.4.3 of the Protocol states that "the disposal or storage of wastes or other matter directly arising from, or related to the exploration, exploitation and associated offshore processing of seabed mineral resources is not covered by the provisions of this Protocol".

1.4 Annex 2 to the 1996 Protocol to the London Convention 1972, which contains the assessment of wastes or other matter that may be considered for dumping as a binding obligation to Contracting Parties, places emphasis on progressively reducing the need to use the sea for dumping of wastes. Furthermore, it recognizes that avoidance of pollution demands rigorous controls on the emission and dispersion of contaminating substances and the use of scientifically-based procedures for selecting appropriate options for waste disposal. Using Annex 2 as the basis, the "*Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping*"[3], as well as these Specific Guidelines were developed and are intended for use by national authorities responsible for regulating the dumping of wastes. Together they embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention 1972 or the 1996 Protocol thereto. When applying these Guidelines, uncertainties in relation to assessments of impacts on the marine environment will need to be considered and a precautionary approach applied in addressing these uncertainties.

1.5 The Guidelines should be applied with a view that acceptance of the disposal of carbon dioxide streams into sub-seabed geological formations does not remove the obligation under the 1996 Protocol to the London Convention 1972 to reduce the need for such disposal. This should be considered within the context of approaches to reducing greenhouse gas emissions and mitigating climate change.

1.6 The 1996 Protocol to the London Convention 1972 follows an approach under which dumping of wastes or other matter is prohibited except for those materials specifically listed in its Annex 1, and in the context of that Protocol, the Generic Guidelines apply to the materials listed in that Annex. When applying these Guidelines, they should not be viewed as a tool for the reconsideration of dumping of other wastes or other matter in contravention of that Annex 1.

1.7 Contracting Parties should strive at all times to enforce procedures that minimize the potential for adverse consequences for the marine environment, human health, and other legitimate uses of the sea, taking into account technological capabilities as well as economic, social and political concerns.

1.8 These Guidelines are specific to the assessment of carbon dioxide streams for disposal into sub-seabed geological formations. Adherence to the following represents neither a more restrictive nor a less restrictive regime than that of Annex 2 to the Protocol. The relations between the elements of Annex 2 and these Guidelines are as follows:

.1 Carbon Dioxide Stream Characterization (Chapter 4, Chemical and Physical Properties);

.2 Waste Prevention Audit and Consideration of Waste Management Options (Chapters 2 and 3);

.3 Action List (Chapter 5);

.4 Identify and Characterize a Sub-seabed Geological Formation and the Surrounding Environment (Chapter 6, Site Selection and Characterization);

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[3] The 19th Consultative Meeting of Contracting Parties to the London Convention 1972 adopted these Guidelines in 1997 and are referred to in this document as the "Generic Guidelines".

.5 Determine Potential Impacts and Prepare Impact Hypothesis(es) (Chapter 7, Assessment of Potential Effects);

.6 Issue Permit (Chapter 9, Permit and Permit Conditions);

.7 Implement Project and Monitor Compliance (Chapter 8, Monitoring and Risk Management);

.8 Field Monitoring and Assessment (Chapter 8, Monitoring and Risk Management); and

.9 Mitigation or Remediation Plan (Chapter 8, Monitoring and Risk Management).

1.9 Further advice on a process of risk assessment and management of carbon dioxide streams proposed for sequestration into sub-seabed geological formations is provided in the "*Risk Assessment and Management Framework for CO_2 Sequestration in Sub-seabed Geological Structures*" that was adopted under the London Protocol in 2006.

2 WASTE PREVENTION AUDIT

2.1 The initial stages in assessing alternatives to sequestration of CO_2 streams into sub-seabed geological formations should, as appropriate, include an evaluation of:

.1 amount and form of the CO_2 streams and their associated hazards; and

.2 the sources of CO_2 streams.

2.2 In general terms, if the required audit reveals that opportunities exist for waste prevention at source, an applicant is expected to formulate and implement a waste prevention strategy, in collaboration with relevant local and national agencies, which includes specific waste reduction targets and provision for further waste prevention audits to ensure that these targets are being met. Permit issuance or renewal decisions shall assure compliance with any resulting waste reduction and prevention requirements. *(Note: This paragraph is not directly pertinent to the disposal of carbon dioxide streams into sub-seabed geological formations. However, it is important to acknowledge the obligation under the 1996 Protocol to the London Convention 1972 to reduce the need for such disposal. This should be considered within the context of approaches to reducing greenhouse gas emissions and mitigating climate change.)*

3 CONSIDERATION OF WASTE MANAGEMENT OPTIONS

3.1 Carbon dioxide sequestration in sub-seabed geological formations is a management option to be considered within the context of Contracting Parties' approaches to reducing greenhouse gas emissions and mitigating climate change.

3.2 Applications for disposal of carbon dioxide streams from carbon dioxide capture processes for sequestration into sub-seabed geological formations shall demonstrate that appropriate consideration has been given to:

.1 the incidental associated substances in the carbon dioxide stream and, if necessary, options for treatment to reduce or remove those substances; and

.2 other disposal and/or sequestration options, e.g., land-based underground storage.

3.3 Annex 2 to the 1996 Protocol identifies reuse and off-site recycling as options to be considered in this context. *(Note: These options are not directly pertinent to the disposal of carbon dioxide streams into sub-seabed geological formations.)*

3.4 According to paragraph 6 of Annex 2 to the 1996 Protocol, a permit to dump wastes or other matter shall be refused if the permitting authority determines that appropriate opportunities exist to reuse, recycle, or treat the waste without undue risks to human health or the environment or disproportionate costs. As stated in paragraph 3.3 above, reuse and recycling are not directly pertinent to the disposal of CO_2 streams into sub-seabed geological formations. The practical availability of other means of disposal and/or sequestration should be considered in light of a comparative risk assessment involving both sequestration in sub-seabed geological formations and the alternatives.

4 CHEMICAL AND PHYSICAL PROPERTIES

4.1 Proper characterization of the carbon dioxide stream is essential. If the carbon dioxide stream is so poorly characterized that proper assessment cannot be made of the risks of potential impacts on human health and the environment, that carbon dioxide stream shall not be dumped.

4.2 Specific characterization of the carbon dioxide stream, including any incidental associated substances, shall take into account the chemical and physical characteristics and the potential for interaction among stream components. Such interactions could potentially affect the reactivity of the stream with the geological formation. This analysis should include as appropriate:

.1 origin, amount, form and composition;

.2 properties: physical and chemical; and

.3 toxicity, persistence, potential for bio-accumulation.

5 ACTION LIST

5.1 The Action List provides a screening mechanism for determining whether a material is considered acceptable for dumping. Each Contracting Party shall develop a national Action List to provide a mechanism for screening candidate wastes and their constituents on the basis of their potential effects on human health and the marine environment. An Action List can also be used as a trigger mechanism for further waste prevention or management considerations.

5.2 For carbon dioxide streams, this Action List will provide a screening tool to assess acceptability for disposal into sub-seabed geological formations taking into consideration the presence and magnitude of incidental associated substances derived from the source material and the capture and sequestration processes used.

5.3 Incidental associated substances could have operational implications on CO_2 transport, injection, and storage. If released, incidental associated substances could also have potential impacts on human health, safety, and the marine environment. Therefore, acceptable concentrations of incidental associated substances should be related to their potential impacts on the integrity of the storage sites and relevant transport infrastructure and the risk they may pose to human health and the marine environment.

5.4 Carbon dioxide streams must consist overwhelmingly of carbon dioxide consistent with the purpose of reducing greenhouse gas emissions. However, CO_2 streams may contain low concentrations of incidental associated substances derived from the source material and the capture and sequestration processes used. Actual types and concentrations of incidental associated substances vary depending mainly on the basic process (e.g., gasification, combustion, natural gas clean-up), source material and the type of capture, transport and injection process[4].

5.5 It should be stressed that no wastes or other matter may be added for the purpose of disposing of those wastes or other matter.

6 SITE SELECTION AND CHARACTERIZATION

6.1 Proper selection of a sub-seabed geological formation for the disposal of carbon dioxide streams is of paramount importance.[5] According to paragraph 11 of Annex 2 to the 1996 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.

The requirements pertaining to the dumping of CO_2 streams differ from those applicable to the other wastes listed in Annex 1 to the 1996 Protocol because CO_2 streams are restricted to sequestration in sub-seabed geological formations. Accordingly, the following specific guidance is provided in relation to the selection of sites for the disposal of carbon dioxide streams into sub-seabed geological formations.

[4] Types and concentrations of incidental associated substances will vary on a case-by-case basis and over time as new technologies are developed and applied. For informational purposes, Sections 3.6.1.1 and 3.4.1 of the IPCC Special Report on Carbon Dioxide Capture and Storage (2005) provide currently available information regarding some impurities in CO_2 streams arising from capture processes related to fuel combustion systems including: SO_2, NO, H_2S, H_2, CO, CH_4, N_2, Ar, O_2, HCl and heavy metals. It should be noted that these substances may be different for CO_2 streams from other sources such as refineries, steel plants, etc. Substances may be added to the CO_2 streams to enable or improve the efficiency or reliability of the capture and sequestration processes, e.g., corrosion inhibitors.

[5] Observations from engineered and natural analogues as well as models suggest that the fraction retained in appropriately selected and managed geological reservoirs is very likely to exceed 99% over 100 years and is likely to exceed 99% over 1,000 years. For well-selected, designed and managed geological storage sites, the vast majority of the CO_2 will gradually be immobilized by various trapping mechanisms and, in that case, could be retained for up to millions of years. Because of these mechanisms, storage could become more secure over longer time-frames. (IPCC SRCCS (2005), Summary for Policymakers, paragraph 25.) The expression "very likely" used in this statement indicates a probability between 90 – 99%, whereas the expression "likely" indicates a probability between 66 – 90%.

Characterization of the sub-seabed geological formation

6.2 Information required to select a sub-seabed geological formation shall include a geological assessment based on a characterization of the site[6]. The following are important considerations in selecting a sub-seabed geological formation for the disposal of carbon dioxide streams:

.1 water depth and injection and storage depth;

.2 storage capacity, injectivity and permeability of the geological formation;

.3 long-term storage integrity of the geological formation;

.4 the surrounding geology, including the tectonic setting;

.5 potential migration and leakage pathways over time and potential effects to the marine environment of leakage of CO_2;

.6 potential interactions of the injected carbon dioxide stream with the geological formation and the impacts on the relevant infrastructures and the surrounding geology, including potential mobilization of hazardous substances;

.7 possibilities for monitoring;

.8 mitigation and remediation possibilities; and

.9 economic and operational feasibility.

6.3 A significant amount of data will be needed to establish both the feasibility of a CO_2 injection site and also to provide evidence of the integrity of the site. Most data will be integrated into geological models that will be used to simulate and predict the performance of the site.

6.4 Capacity and injectivity of the sub-seabed geological formation are important considerations. The capacity and injectivity should be large enough compared to the total anticipated volume and injection rates in order to retain the carbon dioxide stream within the sub-seabed geological formation. The capacity of the storage site should be estimated on the basis of methodologies that are acceptable to the competent authorities.

Characterization of the marine area under consideration

6.5 Information should be given about location of amenities, values and other uses of the sea in the area under consideration, including the injection and storage site, and transport infrastructure where relevant, and the surrounding potentially affected area. This will include physical, hydrological, hydro-dynamical, chemical and biological characteristics of the water-column and the seabed.

[6] See further Appendix 1 of the "*Risk Assessment and Management Framework for CO_2 Sequestration in Sub-seabed Geological Structures*".

6.6 Some of the important amenities, biological features and uses of the sea which may require consideration in determining the specific location of the site may include:

.1 coastal and marine areas of environmental, scientific, cultural or historical importance, such as marine protected areas or vulnerable ecosystems, e.g.,coral reefs;

.2 fishing and mariculture areas;

.3 spawning, nursery and recruitment areas;

.4 migration routes;

.5 seasonal and critical habitats;

.6 shipping lanes;

.7 military exclusion zones; and

.8 engineering uses of the seafloor, including mining, undersea cables, desalination or energy conversion sites.

Evaluation of potential exposure

6.7 An important consideration in determining the suitability of a carbon dioxide stream for disposal at a specific site is the degree to which potential leakage from the sub-seabed geological formation may result in increased exposures of organisms to substances that may cause adverse effects. Risk characterization for injection of a carbon dioxide stream into a specific sub-seabed geological formation would typically be based on site-specific considerations of the potential exposure pathways, the probabilities of leakage and associated effects of the CO_2 stream, including substances mobilized as a result of the disposal of the CO_2 stream on the marine environment.

6.8 Potential migration or leakage pathways from sub-seabed geological formations include:

.1 the injection well, other abandoned or active wells in the same geological formation;

.2 areas where permeable rock reaches the surface of the seabed (e.g., seabed outcrop);

.3 transmissive fractures of, or high-permeability zones within, the cap rock;

.4 the pore system in low-permeability cap rocks (e.g., if the capillary entry pressure at which carbon dioxide streams may enter the cap rock is exceeded) or degradation of the cap rock caused by reaction with acidified formation waters;

.5 areas where the cap rock is locally absent; and

.6 lateral migration along the storage formation (e.g., if a storage structure is overfilled beyond the spill point).

6.9 Simulation of the short- and long-term fate of stored carbon dioxide streams should be performed in order to identify potential migration and flux rates through potential leakage pathways and to assess the likelihood of leakage.

7 ASSESSMENT OF POTENTIAL EFFECTS

7.1 For the disposal of carbon dioxide streams into sub-seabed geological formations, the assessment should address risks posed by a leak from the carbon dioxide stream sequestration process. While the mechanisms resulting in risks from this process may differ from other wastes under the 1996 Protocol, the possible impacts can be identified and assessed within the framework of this Protocol. Further advice on a process of risk assessment and management of carbon dioxide streams proposed for sequestration in sub-seabed geological formations is provided in the *"Risk Assessment and Management Framework for CO_2 Sequestration in Sub-seabed Geological Structures"*, as adopted in 2006 under the 1996 Protocol.

Evaluation of potential effects

7.2 The main effects to consider in relation to a leakage of a carbon dioxide stream are those that result from the dissolution of carbon dioxide in the overlying water and sediments. The effects of carbon dioxide released to water bodies depend upon the magnitude and rate of release, the chemical buffer capacities of the water body and sediment, and transport and dispersion processes. High carbon dioxide levels and changes in marine chemistry may have profound effects on metabolism of various marine organisms. Changes of pH in sediments and seawater due to carbon dioxide leakage could lead to effects on speciation, mobility or bio-availability of metals, nutrients and other compounds. It is also important that the effects of exposure to incidental associated substances, any substances mobilized by the carbon dioxide stream and displacement of saline water by the carbon dioxide stream, are considered in the effects assessment.

7.3 The extent of adverse effects of a substance is a function of the level of exposure of organisms (including humans). Exposure, in turn, is a function, *inter alia*, of the physical, chemical and biological processes that control the transport, behaviour, fate and distribution of a substance.

7.4 The presence of natural substances and the ubiquitous occurrence of contaminants mean that there will always be some pre-existing exposures of organisms to all substances contained in any waste that might be dumped. Concerns about exposures to hazardous substances thus relate to additional exposures as a consequence of dumping. This in turn can be translated back to the increase in concentration of substances from dumping compared with the previous concentration before injection.

7.5 In the assessment for disposal, particular attention should be given, but not necessarily limited to sensitive ecosystems or species, sensitive areas and habitats (e.g., spawning, nursery or feeding areas, coral reefs), migratory species and marketable resources. There may also be potential impacts on other amenities or uses of the sea including: fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea.

7.6 The assessment should be comprehensive. The primary potential effects should be identified during the site selection process. The assessment for disposal should integrate information on characteristics of the carbon dioxide stream, conditions at the proposed sub-seabed geological formation, injection operations and proposed disposal techniques and specify the potential effects on human health, living resources, amenities and other legitimate uses of the sea. It should define the nature, temporal and spatial scales and duration of potential impacts based on reasonably conservative assumptions. It can be helpful to summarize these relationships in the form of a conceptual model as described in figure 2 of the "*Risk Assessment and Management Framework for CO_2 Sequestration in Sub-seabed Geological Structures*". When evaluating the spatial aspects of risk characterization, various factors are relevant to the potential area impacted, including injection volumes, the location of the CO_2 injection point and the geological characteristics of the storage reservoir and overlying structures (including potential monitoring activities).

Risk assessment

7.7 The risks of disposal should be described in terms of the likelihood of exposure, i.e., leakage of the carbon dioxide streams and associated effects on habitats, processes, species, communities and uses. The precise nature of the assessment will differ from project to project depending on disposal site characteristics and the surrounding environment. It should also take account of the capacity to intervene or mitigate in the event of leakage. This depends on the availability of relevant infrastructure at, or near to, the site to reduce the extent of exposure and concomitant effects. Emphasis should be placed on biological effects and habitat modification as well as physical and chemical change. The risks should be sufficiently described or quantified so that it is clear what variables should be assessed during monitoring.

7.8 When evaluating exposures and effects from incidental associated substances and substances mobilized as a result of the disposal of the CO_2 stream, the following factors should be considered:

.1 magnitude to which the release increases the concentration of the substance in seawater, sediments or biota in relation to existing conditions and associated effects, and

.2 the degree to which the substance can produce adverse effects on the marine environment or human health.

7.9 Given the time-scales associated with carbon dioxide sequestration in sub-seabed geological formations, it may be necessary to consider characterization of the risks at different stages of a project. The risks during injection and in the short-term may be different to the longer term risks depending upon site-specific considerations. Consideration of risks over time will be important in the design of monitoring programmes.

7.10 Paragraph 14 of Annex 2 to the 1996 Protocol requires an analysis of each waste disposal option to be considered in the light of a comparative assessment of human health risks, environmental costs, hazards, economics and exclusion of future uses. If this assessment reveals that adequate information is not available to determine the likely effects of a proposed option, then this option should not be considered further. In addition, if the interpretation of the comparative assessment shows the sequestration option to be less preferable, a permit for this option should not be given. *(Note: This paragraph will not be directly pertinent to the disposal of carbon dioxide streams into sub-seabed geological formations when there are no alternative options and then justification of such activities should be considered within the context of approaches to reduce greenhouse gas emissions and mitigating climate change.)*

Impact Hypothesis

7.11 The risk characterization should lead to the development of an "*Impact Hypothesis*". This is a concise statement of the expected consequences of disposal. It provides the basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements. Key elements in the development and testing of the Impact Hypothesis are:

.1 characterization of the CO_2 stream;

.2 conditions at the proposed storage site(s);

.3 preventive and/or mitigating measures (with appropriate performance standards);

.4 injection rates and techniques;

.5 potential release rates and exposure pathways;

.6 the potential impacts on amenities, sensitive areas, habitat, migratory patterns, biological communities and marketability of resources and other legitimate uses of the seas, including fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea; and

.7 the nature, temporal and spatial scales and duration of expected impacts.

7.12 The aim of sequestration of carbon dioxide streams is to ensure their permanent containment in sub-seabed geological formations in a manner that avoids significant adverse consequences for the marine environment, human health and other legitimate uses of the sea. Qualitative and quantitative elements could be defined to test the Impact Hypothesis such that – as a whole – these are consistent with that aim.

7.13 In the case of multiple carbon dioxide sequestration projects, Impact Hypotheses should take into account the potential cumulative effects of such operations. It is also important to consider the possible interactions with other uses of the sea, either existing or planned.

7.14 Each assessment should conclude with a statement supporting a decision to issue or refuse a permit for disposal.

7.15 Monitoring programmes will need to be designed to test the Impact Hypothesis(es).

8 MONITORING AND RISK MANAGEMENT

8.1 Monitoring is used to verify that permit conditions are met and that the assumptions made during the permit review and site selection process were correct and sufficient to protect the marine environment and human health. Monitoring also allows for effective management of sequestration sites. It is essential that such monitoring programmes have clearly defined objectives which may then be used to trigger mitigation or remediation plans.

8.2 Monitoring during the injection phase of CO_2 streams should be conducted to evaluate operational aspects of the sequestration process. Aspects that should be monitored include but are not limited to:

.1 injection rates;

.2 injection and formation pressures;

.3 mechanical integrity; and

.4 properties and composition of the CO_2 streams.

Monitoring during the injection phase may contribute to significantly reducing risks both during injection and over the long-term.

8.3 The Impact Hypotheses form a basis for defining the monitoring programme and should be designed to ascertain that changes in and around the receiving environment are within those predicted. The following questions must be answered:

.1 What testable hypotheses can be derived from the Impact Hypothesis?

.2 What measurements (type, location, frequency, performance requirements) are required to test these hypotheses, and determine the levels and consequences of any deviations from the expected outcome?

.3 How should the data be managed and interpreted?

8.4 For sequestration of carbon dioxide streams in sub-seabed geological formations, baseline information is required such that changes that arise due to sequestration of carbon dioxide streams can be monitored. Suitable specifications of existing (pre-disposal) conditions in the receiving area should already be contained in the application for a permit.

8.5 Due to the potentially large area of prospective sequestration sites, there will be a need to give serious consideration to the strategic design of monitoring programmes that use modelling and direct and indirect monitoring tools in a way that makes detection of CO_2 migration and potential leaks over a large area possible[7]. Moreover, long-term monitoring of potential migration or leakage of carbon dioxide streams from sub-seabed geological formations, including substances mobilized by these streams, should be undertaken over a time-scale which will allow effective verification of predictive models (performance-based system). As confidence grows that CO_2 is not migrating from the reservoir, the frequency of monitoring can be decreased.

8.6 Site-specific monitoring programmes can be designed to track the potential migration of CO_2 and, as appropriate, other substances at sequestration sites based on the initial risk characterization and sub-surface modelling. The choice of type of monitoring tool will be dependant on the size and other characteristics of the project (e.g., type of geological formation, type of injection scheme, etc.). Monitoring programmes should reflect the need for different technologies, measurements and time-frames for monitoring at the various stages of a project. Additional monitoring may be required in the case of emergency situations such as leaks.

8.7 The monitoring programme should confirm the integrity of the sequestration site and contribute to safeguarding human health and the marine environment. Monitoring programmes

7 A risk-based and performance-based methodology for monitoring the CO_2 retention of geological storage sites is provided in the IPCC Guidelines for National Greenhouse Gas Inventories (2006). This will be used by countries for their greenhouse gas inventories, and provides advice for monitoring of sequestration sites in sub-seabed geological formations.

should also be designed to minimize the impact of monitoring on the marine environment. The monitoring of sequestration of carbon dioxide streams may include:

.1 performance monitoring that correlates to how well the injected carbon dioxide stream is retained within the intended sub-seabed geological formation;

.2 monitoring the surrounding geological layers to detect migration of the carbon dioxide stream and the substances mobilized as a result of the disposal of the CO_2 stream, as appropriate, within and beyond the intended sub-seabed geological formation;

.3 monitoring the seafloor and overlaying water to detect leakage of the carbon dioxide stream, or substances mobilized as a result of the disposal of the CO_2 stream, into the marine environment. In this context, special attention should be given to abandoned wells and faults that intersect the sub-seabed geological formation or to any changes in the security of the cap rock during and after injection (faults, cracks, seismicity); and

.4 monitoring marine communities (benthic and water column) to detect effects of leaking carbon dioxide streams and mobilized substances on marine organisms.

8.8 The permitting authority is encouraged to take account of relevant research information in the design and modification of monitoring programmes. New and more efficient monitoring techniques and practices are likely to evolve and should be considered as monitoring programmes evolve. In any case, the (modified) monitoring programme should relate to the baseline information and the Impact Hypotheses.

8.9 Monitoring should be designed to determine whether impacts differ from those predicted over the short- and long-terms. This can be achieved through the acquisition of data that provide information on the extent of change that occurs as a result of the sequestration operation. Monitoring the seafloor and marine communities may be included, especially if it is suspected that migration of CO_2 above the formation could extend to the seafloor and in the event that the storage site is in the proximity of sensitive or endangered habitats and species. In order to determine the impacts, monitoring of the seafloor or of the marine community should take into account CO_2, the incidental associated substances, and the substances mobilized as a result of the disposal of the CO_2 stream.

8.10 The results of monitoring (or other related research) should be reviewed at regular intervals in relation to the objectives and can provide a basis to:

.1 modify the monitoring programme;

.2 implement, when necessary, the measures included in the mitigation or remediation plan;

.3 modify the operation, or close the site;

.4 update risk assessments;

.5 modify or revoke the permit; and

.6 modify the basis on which permit applications to sequester CO_2 streams in sub-seabed geological formations are assessed.

Mitigation or Remediation Plan

8.11 Although the aim of disposal of carbon dioxide streams into sub-seabed geological formations is to have no leakage, a mitigation or remediation plan should be in place to enable a rapid and effective response to leakage to the marine environment. Seismicity in the area, which could potentially lead to leakage, should be considered in these plans. The mitigation or remediation plan should consider the likelihood that carbon dioxide streams will migrate or leak as well as the types and magnitudes of potential effects of such migration or leakage over time. The requirements of the mitigation or remediation plan and the corresponding preventive and corrective measures are determined by national authorities on the basis of the potential impact of the migration or leakage on human health and the marine environment both in the short- and long-terms. If leakage poses a significant risk to the marine environment and cannot be controlled by any mitigation or remediation operation, injection should be ceased, or be modified, or the CO_2 may be transferred to a more suitable location depending upon site-specific factors.

9 PERMIT AND PERMIT CONDITIONS

9.1 A decision to issue a permit should only be made if all impact evaluations are completed and the monitoring requirements are determined. This includes an adequate site characterization, an assessment of the likelihood for migration and leakage and associated impacts, and a suitable risk management plan. The provisions of the permit shall ensure, as far as practicable, that marine environmental disturbance and detriment are minimized and the benefits maximized. This includes reporting and documentation of the characteristics of the sequestration site and injection and closure operations after injection ceases. Any permit issued shall contain data and information specifying:

.1 purpose of the permit;

.2 the types, amounts and sources of materials in the carbon dioxide stream, including incidental associated substances, to be disposed into the sub-seabed geological formation;

.3 the location of the injection facility and sub-seabed geological formation;

.4 the method of carbon dioxide stream transport; and

.5 a risk management plan that includes:

  .1 monitoring (both operational and long-term) and reporting requirements;

  .2 a mitigation or remediation plan as discussed under paragraph 8.11 above; and

  .3 a site closure plan including a description of post-closure monitoring and mitigation or remediation options.

9.2 If disposal of carbon dioxide streams into sub-seabed geological formations is the selected option, then a permit authorizing this activity must be issued in advance. It is recommended that opportunities are provided for public review and participation in the permitting process. In granting a permit, the hypothesized impact occurring within the boundaries of the dump-site, such as alterations to the physical, chemical and biological compartments of the local environment is accepted by the permitting authority. If the information provided is inadequate to determine whether a project would pose significant risks to human health or the marine environment, the permitting authority should request additional information before taking a decision on issuing a permit. If it becomes evident that a project would pose significant risks to human health or the marine environment, a permit should not be issued.

9.3 Regulators should strive at all times to enforce procedures that minimize the potential for adverse consequences for the marine environment, human health, and other legitimate uses of the sea, taking into account technological capabilities as well as economic, social and political concerns.

9.4 Permits should be reviewed at regular intervals, taking into account any changes to the composition of the CO_2 stream, results of monitoring, and the objectives of monitoring programmes. Review of monitoring results and updated risk assessments will indicate whether field programmes need to be continued, revised or terminated, and will contribute to informed decisions regarding the continuance, modification or revocation of permits. This provides an important feedback mechanism for the protection of human health, the marine environment, and other uses of the sea.

9.5 Because the aim of disposal of carbon dioxide streams into sub-seabed geological formations is to store CO_2 permanently, permits and other supporting documentation, including site location, monitoring results and mitigation or remediation plans should be archived and retained for long periods of time.

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LONDON CONVENTION AND PROTOCOL:
GUIDANCE FOR THE DEVELOPMENT OF
ACTION LISTS AND ACTION LEVELS FOR DREDGED MATERIAL

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This document provides guidance to regulators and policy makers on the selection of Action Lists and the development of Action Levels for dredged material proposed for disposal at sea. An Action List is a set of chemicals of concern, biological responses of concern, or other characteristics that can be used for screening dredged material for their potential effects on human health and the marine environment. Action Levels establish thresholds that provide decision points that determine whether sediments can be disposed of at sea.

While the guidance is designed to assist with implementation of requirements under the *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972* (London Convention) and its *1996 Protocol* (London Protocol), the guidance is general and could be applied to the assessment of dredged material under other instruments. The guidance does not, however, cover the assessment of other wastes or other matter allowed under the London Convention and Protocol.

There is no universal mechanism for the selection of Action Lists and the development of Action Levels. As such, the document is not prescriptive. Instead the document provides guidance on the process of selecting Action Lists and Action Levels and proposes options that are available to regulators and policy makers.

The process begins with an identification of the chemical, biological, or physical characteristics that will make up the Action List. This can be done by surveying relevant sources of contaminants to dredged material, inventorying valued resources in proximity to disposal sites and their risk factors, and tracking best practices in the science of sediment assessment and management. Also, for the purposes of the London Convention and Protocol, *priority shall be given to toxic, persistent and bioaccumulative substances from anthropogenic sources*.

Next, benchmarks must be set for each characteristic on the Action List. Benchmarks are often developed using a reference-based approach (comparing to background or ambient conditions) or an effects-based approach (based on knowledge or direct observation of the effects of exposure). Appendix 1 goes into further detail providing options that can be used in setting benchmarks.

Finally, Action Levels are set by integrating the relevant characteristics and benchmarks to form a decision rule. This can be as simple as a pass/fail based on a single benchmark or it can be more complex such as combining multiple lines of evidence in a weight-of-evidence approach. An Upper Action Level can be created above which there would be concern due to increased potential for effects on human health and the marine environment, and if desired, a Lower Action Level can be created below which there would be little concern. The document concludes by providing guidance on formulating Action Levels in language suitable for developing National regulations and dealing with sediments that fall between the Upper and Lower Action Levels. Appendices 1A to 1D provide descriptions of different approaches and country examples.

1 INTRODUCTION

1A. PURPOSE OF GUIDANCE

1.1 This document is intended to assist regulators and policy makers in developing National **Action Lists** and **Action Levels** for the assessment of dredged material proposed for disposal at sea.

1B. WHAT ARE ACTION LISTS AND ACTION LEVELS?

1.2 In the context of disposal at sea:

.1 An **Action List** is defined as *a "mechanism for screening candidate wastes and their constituents on the basis of their potential effects on human health and the marine environment"*. The Action List can consist of chemicals of interest, biological responses of concern, or other characteristics that can provide insight into the potential for dredged material to cause adverse effects in the marine environment. An Action List can also be used as a trigger mechanism for further waste prevention considerations and could therefore have a role in controlling pollution at its source, in promoting cleaner technology, or in improving the efficiency of dredging to reduce the need for disposal.

.2 **Action Levels** are established as decision rules that identify dredged material that may be disposed because the risk for adverse effects is low and acceptable, those that may not be disposed without management controls because the risks for adverse effects would be considered too high, or to identify cases where additional information may be required to make a sound judgement about the potential for the dredged material to cause adverse effects. If developed for the purposes of meeting the requirements of disposal at sea treaties, the Action Level will specify an Upper Level and may also specify a Lower Level. The Upper Level should be set so as to avoid acute or chronic effects on human health or on sensitive marine organisms representative of the marine ecosystem. Below the Lower Level, there should be little concern for disposal at sea.

1C. WHY ARE ACTION LISTS AND LEVELS IMPORTANT?

1.3 The Action List is important to Contracting Parties, and prospective Contracting Parties, to the London Convention and Protocol as it is a key decision-enabling component of the Generic Guidelines. "*The **Guidelines for the Assessment of Wastes or Other Matter that May Be Considered for Dumping** guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention or Protocol*." A shortened form of these Guidelines appears in Annex 2 to the London Protocol and a more specific version of the Guidelines has been developed particularly for dredged material assessment. In each version of these Guidelines, the application of an Action List and its levels is used to enable authorities to categorize the dredged material as being: 1) of little concern for disposal at sea; 2) as requiring more detailed assessment; or 3) as not being suitable for disposal at sea without the use of management techniques or processes. A jurisdiction that has developed a National Action List and Action Levels will be in a better position to make sound permit decisions and to be in compliance with the requirements of these treaties. Action Levels can provide feedback for compliance efforts, for further assessment or for monitoring.

1.4 Action Lists and Levels may also be of use to non-parties that require a consistent and transparent scientific basis by which to categorize or assess dredged material based on the level of risk they may pose to the marine environment upon disposal.

1.5 This document provides guidance on the selection of an Action List and considerations for the development of Action Levels for dredged material. It is not a detailed technical manual, but rather provides an overview of the options for development and adoption of Action Lists and Levels, as well as examples from various jurisdictions. There is some discussion of the implementation of an Action List as part of the decision-making process for permitting disposal of dredged material at sea. Those jurisdictions with limited experience that wish to adopt an Action List and Levels will likely require additional guidance and support to select the most suitable approach and to adapt it as needed to their legal and environmental circumstances. Also, the guidance is given with a view to achieving a balance between the best level of assessment possible and the availability of resources and capacity in different countries. The jurisdiction is encouraged to begin with practices that are achievable in the short term, with a view to continuing improvement as capacity and expertise are acquired.

1.6 This is the first iteration of this document and it is recognized that as global experience with Action Lists and Levels increases, there will be a need to update and elaborate the information and examples provided. Comments on this guidance are welcomed and should be addressed to the IMO Secretariat for the London Convention and Protocol.

1D. Other wastes or matter

1.7 Fish waste, organic material of natural origin, inert, inorganic geological material, vessels and platforms, bulky items, etc., and carbon dioxide streams may also be considered for disposal at sea permits and the content of the Action List and the way that it is used may be different in each case. In future, separate documents will be produced for the development of Action Lists and Action Levels relevant to these wastes or other matter.

1E. Action Lists and Levels as Part of the Framework for Assessing Dredged Material for Disposal at Sea

1.8 The generic waste assessment guidance (WAG) framework under the London Convention and Protocol is shown in Figure 1. It is an iterative process meaning that steps do not necessarily have to be taken in order. Action Lists make use of physical, contaminant, or biological testing data collected during the characterization step. Following this characterization, Action Levels, which are one of the key decision-making points in the framework, are used to determine whether dredged material are acceptable for disposal at sea. For general understanding of Action Lists in the context of the framework, refer to the WAG Tutorial.

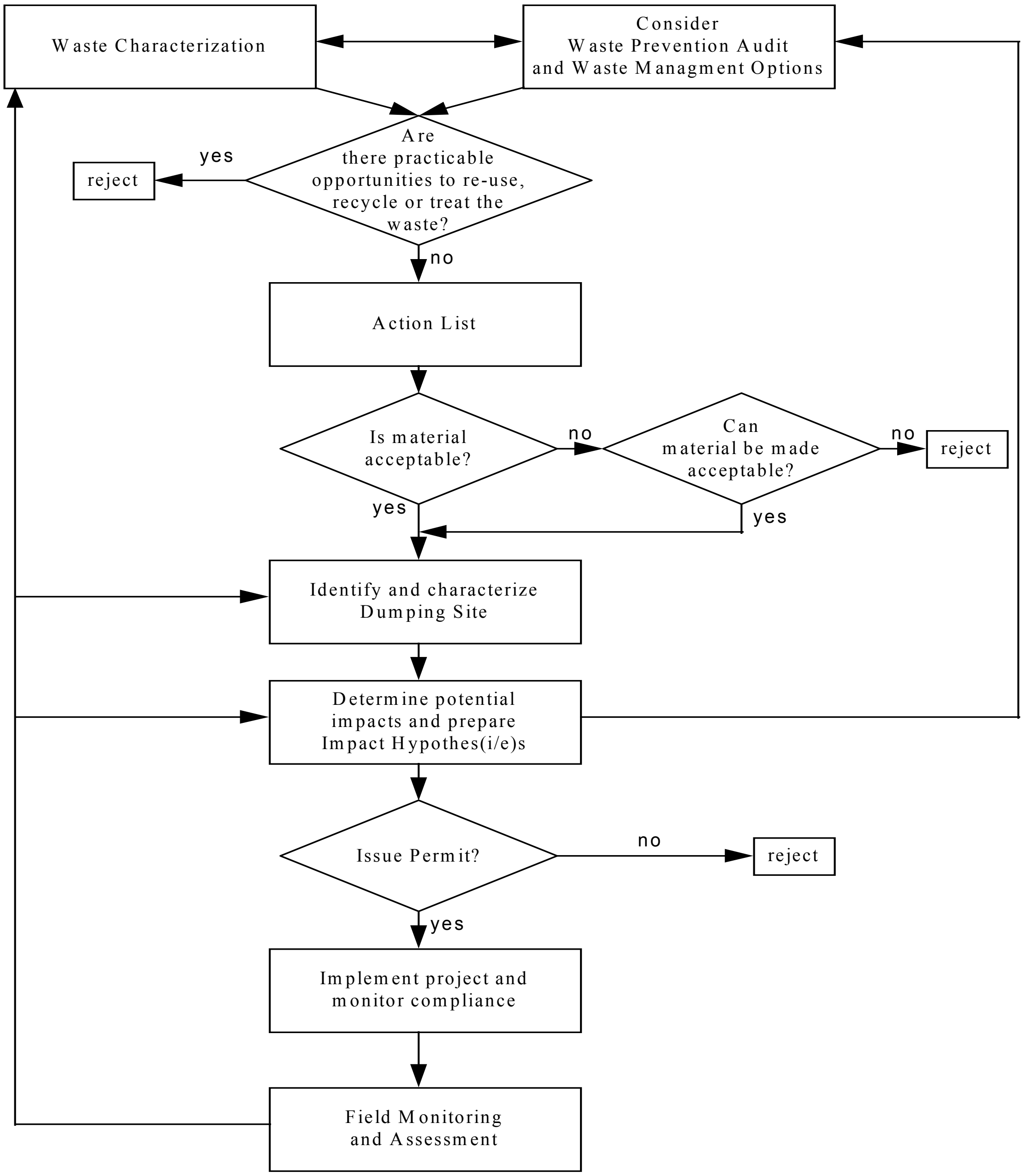

Figure 1. Assessment Framework for the London Convention and Protocol

2 SELECTION OF A NATIONAL ACTION LIST

2.1 A Dredged Material National Action List is a list or inventory of dredged material **characteristics** and their **metrics** that a jurisdiction decides are important to consider in order to make permit decisions. To arrive at this Action List, authorities will need to consider what potential concerns are created by the disposal of dredged material in their jurisdiction and what assets and resources need to be protected. This consideration should lead to a determination of what needs to be measured and assessed. In practice an Action List will be developed by assembling a list of characteristics that will be used to perform a regulatory evaluation of dredged material. **Benchmarks** for each characteristic are used for developing decision rules to define the Upper and Lower Action Levels.

Box 1. Definition of Major Terms

In this document the terms **characteristic, metric** and **benchmark** define the tools that are used to evaluate some aspect of the environment.

A **characteristic** is an attribute of the dredged material (e.g., copper, mercury, silt, petroleum compounds, pathogens) or a biological response to the dredged material (e.g., mortality, growth, bioaccumulation).

A **metric** is a measurement that can be made on the characteristic (e.g., concentration, percent survival).

A **benchmark** is a point on the range of the metric (e.g., 4 mg/kg copper, 20% amphipod mortality) that is used to identify where environmental concern may be low or high for that characteristic. These can be referred to as the lower benchmark and upper benchmark.

An Action List therefore comprises a number of characteristics to be considered for measurement in the dredged material.

An Action Level is a decision rule based on the findings of one or more characteristics in comparison to the respective benchmarks.

2.2 Selection of the characteristics and metrics in a National Action List should be based on knowledge concerning the nature of dredged material in the country where the list is to be used. For chemical characteristics, contaminants known to be in the material and those likely to have been deposited in the material from, *inter alia*, known point-source effluent discharges, tributaries, diffuse runoff, atmospheric deposition, accidents and spills, operational discharges and losses and direct dumping may need to be considered. Characteristics that give useful information on the potential for acute or chronic effects on sensitive marine organisms or on health should also be considered. For example, characteristics could include substances (particular chemicals of concern or interest); microbes, viruses or pathogens; biological responses or phenomena such as toxicity or bioaccumulation, and physical characteristics of the dredged material. See Appendix 2 for examples of lists developed by some of the London Convention and Protocol Parties.

Box 2. The Generic Guidelines specify the following with respect to developing Action Lists:

Action Lists of the London Convention and Protocol

Action Lists are an important part of Annex 2 to the London Protocol and may also be used in meeting the requirements of Annexes I and II to the London Convention. Details on such lists are further provided in the Revised Generic Guidelines (2008):

"National Action Lists will provide the mechanism for screening candidate wastes and their constituents on the basis of their potential effects on human health and the marine environment"… "In selecting substances for consideration in an Action List, priority shall be given to toxic, persistent and bio-accumulative substances from anthropogenic sources (e.g., cadmium, mercury, organohalogens, petroleum hydrocarbons and, whenever relevant, arsenic, lead, copper, zinc, beryllium, chromium, nickel and vanadium, organosilicon compounds, cyanides, fluorides and pesticides or their by-products other than organohalogens)."

"For an individual waste category, it may be possible to define national action levels on the basis of concentration limits, biological responses, environmental quality standards, flux considerations or other reference values."

2.3 Box 2 above outlines examples of chemical, biological and physical characteristics listed in the Revised Generic Guidelines which may be appropriate for inclusion in an Action List.

2.4 For those jurisdictions where little chemical or biological effects data are available, the authorities may wish to begin with an interim National Action List, either selected from another jurisdiction, or based on the guidance provided above within the London Convention and Protocol Guidelines. The commitment to refine an interim Action List could involve such follow-up actions as:

.1 *Conducting a survey of relevant sources of contaminants to the dredged material, including sources of industrial, agricultural, and urban run-off*. The purpose of such a survey is to ensure that the Action List is sufficiently comprehensive to support credible assessments of the potential for adverse effects. Sediment surveys can be used to confirm the presence and prevalence of characteristics.

.2 *Developing an inventory of valued resources in proximity to known or intended disposal sites* to provide the basis for Action Lists and Levels that will support sustainable management practices.

.3 *Tracking the development of relevant science*. The science that supports sediment assessment and management will evolve with time. Tracking advances in the relevant fields of study will enable authorities to benefit from updating their approaches.

2.5 The experience gained by authorities over time in applying Action Lists and levels, including the use of confirmatory monitoring, will support making updates and refinements to Action Lists and their application. Over time, the analysis of this information will help confirm or further refine the List.

2.6 Given that dredged material will often be influenced by site-specific sources of contamination, arriving at a National Action List that is representative of national concerns but not so large as to reduce the ability to conduct time- and cost-efficient assessments, is challenging for all jurisdictions. One approach is to set a smaller National Action List that includes only the most prevalent and critical characteristics that must be evaluated as minimum information in all cases and allow for the development and application of regionalized Action Lists that incorporate regional, local and site-specific knowledge of dredged material characteristics and valued resources. For example, when cadmium is widespread in the jurisdiction and of concern, it would appear on the National List. Whereas, chromium might only be prevalent in a limited number of areas associated with specific industries, and for that reason, would be included on relevant regional Action Lists.

3 ESTABLISHING UPPER AND LOWER BENCHMARKS

3.1 Following Section 2, a National Action List can be chosen. Each characteristic (e.g., cadmium, survival, etc.) will have a metric (what is being measured: mg/kg dry wt, % survival). The benchmarks are the levels for a particular characteristic below which there would be little concern (lower benchmark), or above which there would be concern due to increased risk or increased probability of effects (upper benchmark). Once benchmarks are established for the characteristics on the List they are used to establish the Upper, and if desired, may be used to establish Lower Action Levels (refer to section 1.2.2).

Relationship between Benchmarks and Action Levels

3.2 The application of Action Levels can range from relatively simple approaches to more complex formulations. In the simple approach (Table 1), the Action List consists of a series of contaminants (characteristics) that may be present in the material. By some means (see sections 3A, B and C below), lower and upper benchmarks are established for each characteristic on the List. Using the simple approach, exceedance of any *single* upper benchmark would be considered an exceedance of the Upper Action Level. In a complementary manner, following the simple approach, all characteristics of the sediment must be below the lower benchmarks to reach the conclusion that the material poses a low and acceptable level of risk to the marine environment and does not exceed the Lower Action Level. Sediments meeting neither of those situations would require additional investigation or evaluation before a decision could be reached.

Table 1. An Example of a Simple Action Level Approach

Single Characteristic Action Level Model				
Dredged material Characteristic	Dredged material passes Lower Action Level when:	Lower benchmark (LB) (mg/kg)	Upper benchmark (UB) (mg/kg)	Dredged material exceeds Upper Action Level when:
Contaminant A	All values below LB	120	340	Exceedance of any UB
Contaminant B		25	88	
Contaminant C		75	420	
Contaminant D		0.5	2.7	
Contaminant E		50	170	

3.3 More complex approaches use decision rules that rely on the exceedance of benchmarks by **multiple characteristics** to reach a determination that the Upper Action Level has been reached (Tables 2 and 3). In the first of these two examples (Table 2) the jurisdiction decided that the Action List of characteristics would consist solely of contaminants. In this case, the jurisdiction has determined that certain characteristics are of greater relevance to the decision process based on the nature of the information they provide. For example, some contaminants are of greater toxicological significance than others, or they may be more persistent and those factors may influence the use made of the benchmark in decision-making.

Table 2. Example 1 of a More Complex Action Level Approach

Weight of Evidence Action Level Model 1				
Dredged material Characteristic	Dredged mat. passes Lower Action Level	Lower benchmark (LB) (mg/kg)	Upper benchmark (UB) (mg/kg)	Dredged material exceeds Upper Action Level
Persistent Organic	No exceedance of any UB, all Organic values below LB, no more than 1 Metal between LB and UB			Exceedence of any Organic UB or 2 Metal UB
Organic A		2.5	15	
Organic B		0.5	7.5	
Organic C		0.5	2.7	
Organic D		0.1	2.2	
Heavy Metal				
Metal A		50	125	
Metal B		140	330	
Metal C		85	210	
Metal D		14	40	

3.4 In the second example (Table 3), the selected Action List of characteristics includes both contaminants and biological responses.

Table 3. Example 2 of a More Complex Action Level Approach

Weight of Evidence Action Level Model 2				
Dredged material Characteristic	Lower Action Level	Lower benchmark (LB)	Upper benchmark (UB)	Upper Action Level
Persistent Organic	No exceedance of any UB, no more than 1 Organic between LB and UB	(mg/kg)	(mg/kg)	Exceedence of any Organic UB or two Bioassay UB
Organic A		2.5	15	
Organic B		0.5	7.5	
Organic C		0.5	2.7	
Organic D		0.1	2.2	
Benthic Bioassay			% Mortality	
Species A			25	
Species B			30	
Species C			20	
Species D			30	

APPROACHES

3.5 This section discusses strategies to establish upper and lower benchmarks for the characteristics chosen to be part of the National Action List. Some jurisdictions have already used these approaches and set numerical levels or decision-making criteria for the characteristics that are relevant to their situations. When formulating or revising practice with the intent of establishing Action Levels, Contracting Parties are well served to review the practices of others and draw from existing approaches.

3.6 Benchmarks should be developed and applied with an understanding of what valued resources they are intended to protect and the technical argument linking the specific benchmark and the protection objective.

3.7 When reviewing the approaches it will be important to gain an understanding of the:

.1 *Theory and method of derivation* – Will this approach generate levels that are consistent with the objective?

.2 *Assumptions* – Will any of the assumptions built into the approach make it less relevant for use in developing the benchmarks for this jurisdiction?

.3 *Data needs and the uncertainties* – Does this approach require local data in order to be relevant? How much data would be needed to set a level for a given characteristic? What is the level of uncertainty associated with this approach for this characteristic? Is this approach equally useful for all characteristics and their metrics?

3.8 The Generic Guidelines are relatively clear in the description of what Upper and Lower Action Levels are intended to do:

> *"The Upper Level should be set so as to avoid acute or chronic effects on human health or on sensitive marine organisms representative of the marine ecosystem."*

and for the lower level the description is:

> *"... wastes which contain specified substances, or which cause biological responses, below the relevant Lower Levels should be considered to be of little environmental concern in relation to dumping."*

3.9 Given that the objective for Upper and Lower Action Levels is different, it is not essential that the same approach be applied to each upper and lower benchmark or to all the characteristics on a National Action List. It should be recognized that the use of different approaches might mean that benchmarks for the same characteristic may not be comparable across lists or jurisdictions. Approaches that have been used to derive benchmarks are described briefly below and in more detail in Appendices 1A to 1D.

3A. REFERENCE-BASED APPROACHES

3.10 Benchmarks for physical, chemical or biological characteristics can be set based on knowledge of background or ambient conditions in comparable areas that have not been impacted by dumping. This is a reference-based approach. For example, the Lower Action Level may be set at the background concentration for the chemical of interest. One approach for establishing lower benchmarks for an Action List would be to establish the lower benchmark as the 50th percentile of the background concentration distribution for each contaminant on the Action List. Alternatively, lower benchmarks could be established using the results of sediment toxicity tests by using reference conditions to compare the responses of test animals exposed to the dredged material and to reference sediment.

3.11 When using reference-based approaches to develop benchmarks for individual characteristics on the Action List, it is important to distinguish between man-made substances and naturally occurring substances, e.g., PCBs vs. ammonia. While PCBs are present in the environment as a direct result of industrial activity, ammonia is the natural product of protein diagenesis in sediments. Ammonia levels in sediment can be affected by human activity, e.g., through the introduction of nutrients and fertilizers; however, in most circumstances its presence in sediments does not evoke a level of concern comparable to PCBs. As a means of focusing regulatory attention on anthropogenic activities, chemical benchmarks using the reference approach have made use of information on contaminant levels in heavily industrialised harbours, lightly industrialized harbours, and recreational harbours to establish the distribution of data used to establish the Action Level for a contaminant.

3.12 Regardless of the characteristic chosen, the resulting benchmarks need to be indicative of the potential for effects in the field, which is the basis of the Generic Guidelines. An example of reference-based benchmarks is described in Appendix 1A of this document. The Generic Guidelines specify that Upper Action Levels should be set so as to avoid acute or chronic effects on human health, or on sensitive marine organisms. Therefore, any benchmarks used to establish Upper Action Levels should minimize, to the extent practical, likelihood that dredged material could exceed such values but produce no effects at a disposal site (false negatives). Reference-based levels are commonly used for setting lower benchmarks and Lower Action Levels, as it is reasonable to expect that levels that are similar to background levels would be unlikely to cause unacceptable effects.

3B. Effects-based Approaches

3.13 Benchmarks for physical, chemical or biological characteristics can also be based on knowledge of effects that can be produced following exposure to dredged material. Such limits can be based on information concerning the likelihood or magnitude for an effect.

3.14 The physical characteristics of the dredged material can be used to reach conclusions about whether the dredged material is unlikely to cause adverse effects on the environment, i.e. to establish lower benchmarks. For example, sediments found in areas of high current or wave energy and composed predominantly of coarse-grained sediments (e.g., rock, cobble and sand) have a low potential to carry significant amounts of chemical contaminants because of the relatively small surface area available for sorption of contaminants. Based on past experience, regulatory authorities may set quantitative or qualitative criteria to define when sediment will be judged to be predominantly composed of such coarse-grained material. Lower benchmarks for other physical characteristics that can be used in combination with the geotechnical data to establish Action Levels include the depth of dredging (e.g., will the material be dredged from sediment horizons that have had no contact with industrial chemicals) and geographic proximity to known or suspected sources of contaminants (PIANC 2006). Physical factors are also important additional pieces of information that can be used to adjust benchmarks set using other approaches. For example, if toxicity tests are used as one of the characteristics in the List, it will be important to know how physical characteristics can affect or confound the results of the toxicity test (PIANC 2006).

3.15 Chemical benchmarks are developed using an effects-based approach by making use of calculated or measured relationships between the concentration of the chemical(s) and some form of biological response. Such levels can be established using a variety of empirical and theoretical approaches and many examples are available. The chemical concentration that establishes the limiting benchmark can be based on concentrations in whole sediment, a sediment fraction, porewater, or the tissues of organisms exposed to sediments in a biological test (PIANC 2006). There may also be a desire to set levels that guard against unacceptable effects on human health (e.g., safe fish consumption levels). Appendix 1B to this document describes some of the major approaches to developing effects-based chemical benchmarks.

3.16 Biological benchmarks can be set using information to establish the likelihood that effects would be observed in the field, or to distinguish an acceptable from an unacceptable magnitude of effect. Biological benchmarks are generally expressed as some type of biological response (e.g., rates of survival, growth or reproduction in the test organism used in a toxicity test, changes in benthic community structure, etc.). Biological benchmarks have also been set by establishing a threshold for the magnitude of response that must be observed in a toxicity test before the Action Level is determined to have been exceeded, e.g. > 20% more mortality observed in a dredged material in comparison to a reference sediment (this specific example illustrates the use of an approach that combines both reference and effects-based approaches). Examples of biological tests which can be relevant to the development of biological effects based Action Levels are described in Appendix 1C to this document.

3.17 Where biological effects are used to set Action Levels, benchmarks concerning the likelihood for effects can be derived from the results of a battery of toxicity tests performed on dredged material, whereby the larger the number of tests in the battery that show evidence of toxicity the greater the confidence that effects are likely to occur. It is important to note that typical sediment toxicity testing with benthic organisms is not an appropriate means of assessing risk from chemicals whose primary effects are mediated through bioaccumulation, trophic transfer and subsequent effects in higher-level predators (e.g., dioxin-like chemicals). Where such chemicals are on the Action List, assessment should be based on methods directly addressing bioaccumulation pathways (Wenning *et al.*, 2005).

3C. SETTING BENCHMARKS

3.18 One of the considerations in evaluating the approaches described above will be meeting the data requirements and the cost, time, and capacity considerations associated with developing the benchmarks. Frequently, there will be insufficient data, time or funding to ensure that benchmarks are set on purely scientific grounds and that all uncertainties in the methods and the data can be addressed. In order to proceed with a functional decision-making system in a reasonable time it is often necessary to take interim measures. Many jurisdictions may have limited information and simply decide to apply safety factors to benchmarks derived for other purposes, or set one benchmark as a multiple of another benchmark in an arbitrary fashion to help overcome a lack of data, or allow consistent decisions to be made.

3.19 When data are insufficient within a jurisdiction to calculate or derive benchmarks for specific characteristics on the National Action List, upper and lower benchmarks can also be adopted directly from other jurisdictions as an interim measure.

3.20 However, such action should be combined with a broader strategy to evaluate the reliability of these levels within the subject jurisdiction and/or to derive levels that are more nationally or regionally applicable. A number of factors should be considered when evaluating the applicability of another jurisdiction's benchmarks. Most will have been developed using one or more of the approaches described above, but slight variations are common, so a full review should include those factors in section 3.7 as well as:

.1 Was the role of mineralogy or geochemistry considered in the development of naturally occurring substances such as metals? *(e.g., the spatial variation in metal concentrations caused by natural factors, i.e. unrelated to industrial activities, can be considerable)*;

.2 What ecological considerations played a role in the derivation of the level*? (e.g., how sensitive were the test organisms used and what is their relevance to the location and environmental conditions under consideration?)*;

.3 What types and sources of anthropogenic pollution were important in the area for which the level was designed? *(e.g., the relevance of contaminants can be expected to vary across regions)*; and

.4 What physical oceanographic conditions dominate the area for which the guideline was designed? (*e.g., the extent of exposure to any hazards will be related to the size of the area over which the material is dispersed and the concentrations of relevant substances*).

3.21 When considering these factors, it is important to determine the relevance of each to differences between local conditions and conditions in the jurisdiction where the benchmarks were developed. Careful thought and analysis should be undertaken to support decisions about whether and how to make use of levels developed by other jurisdictions. Technical expertise in sediment geochemistry, toxicology, statistics, as well as other disciplines will be needed to guide such decision-making.

3D. STRENGTHS AND WEAKNESSES OF VARIOUS DERIVATION APPROACHES

3.22 The use of any physical, chemical and biological benchmark to build Action Levels, whether reference or effects-based, will involve varying degrees of uncertainty. Stated plainly, no level is perfect. Credible use of each benchmark and resulting Action Level will require giving consideration to the uncertainties associated with its derivation and use to reach conclusions about the presence or absence of risks:

.1 The physical/chemical analyses needed to apply physical/chemical benchmarks can be relatively straightforward to conduct and the requirements for conducting these analyses can be readily met in many countries. These analyses are also amenable to inter-laboratory calibration and standardized quality assurance/quality control (QA/QC). However, using the results of such analyses as a basis for reaching conclusions about the potential for adverse effects involves uncertainties related to the fact that these metrics are not themselves a measure of effect but in some way related to the potential for an effect. For example, measurement of the presence and concentration of a specific contaminant can be related to a specific effect through empirical or mechanistic means. The role of unmeasured contaminants also presents a source of uncertainty in the application of chemical levels. It is not possible to analytically quantify the concentration of every chemical constituent in a sediment sample. This is a source of uncertainty when chemical characteristics are used to set Action Levels, whether the derivation of the benchmarks is based on empirical or mechanistic methods.

2. Biological benchmarks are intended to be indicators of potential impacts and provide for integrating across exposures and effects (i.e., the combined effects of mixtures of chemicals and/or effects of chemicals not measured/determined). Uncertainties related to the use of such levels include the relationship between exposure conditions in the laboratory, for the reference condition, and at the disposal site; inter-specific variation in tolerance or sensitivity to contaminants; and the relationship between effects on individual organisms, populations, and communities (PIANC 2006). The expertise and facilities required to set Action Levels based on biological characteristics may not be as commonly available as is the case for more routine physical and chemical analyses.

4 APPROACHES TO SETTING ACTION LEVELS

4.1 It is important to recognize the difference between Action Levels, which are intended to represent regulatory decision points, and the upper and lower benchmarks set for the individual characteristics. Some of the benchmarks, depending upon the derivation approaches selected, will have been developed to accomplish screening or to monitor environmental trends detached from a specific regulatory intent. The Upper Action Level is intended to provide a definitive decision point where the dredged material may not be dumped except in cases where control measures can be taken to manage the risks at acceptable levels. The Lower Action Level is that level below which a dredged material would be expected to have little potential to produce an adverse effect in the marine environment and for this reason can be disposed without the need for special management controls.

4.2 Action Levels should meet a number of general criteria including:

.1 they should be meaningful for the dredged material characteristics and valued resources at issue;

.2 should focus on characteristics caused by anthropogenic impacts;

.3 should be sufficiently protective to minimize the probability of false negatives at the Lower Level, i.e. reaching a conclusion that the dredged material poses no risk when in fact it does; and

.4 they should be sufficiently accurate to minimize the probability of false positives at the Upper Action Level, i.e. reaching the conclusion that a dredged material poses a risk when, in fact, it does not.

4.3 Once benchmarks are established for the characteristics on the Action List, their use to construct Action Levels must be defined.

4.4 Figure 2 below shows some of the different types of information that can be used in a complementary and additive manner to set benchmarks for the characteristics on the Action List. As more complementary information from different benchmarks is integrated into the decision rule for the Action Level, the confidence in the decision should improve as the weight of evidence accumulates to support a specific conclusion.

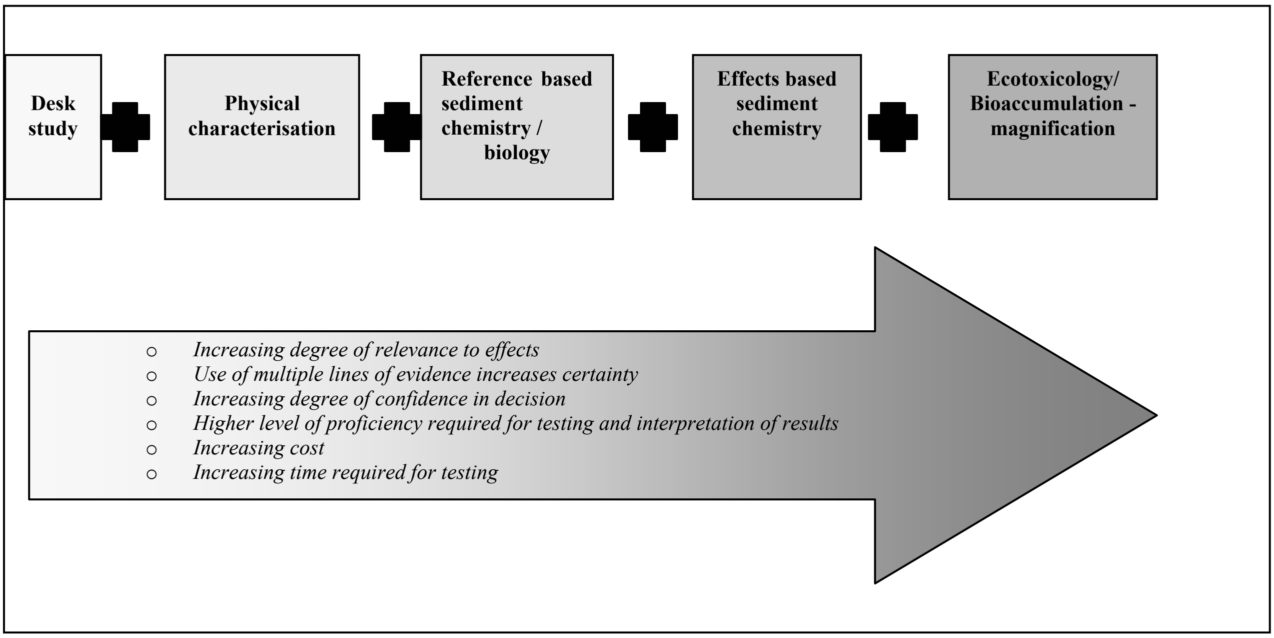

Figure 2. Action Level complexity vs. certainty

4.5 Action Levels can be integrated within a decision framework in a number of possible ways. It should be noted that there is no perfect mechanism for selecting Action Levels. Jurisdictions are encouraged to set Levels appropriate to their capacity to implement and administer them. A gradual increase in the level of sophistication and coverage can be achieved as experience and capacity increase.

4.6 The simple approach (see Table 1) is a simple pass/fail method. The more complex approaches (see Tables 2 and 3) include elements of weight-of-evidence approaches.

4A. PASS/FAIL APPROACH TO INTERPRETING ACTION LEVELS

4.7 Using Upper and Lower Action Levels as part of a simple pass/fail approach generally involves setting strict limits based on upper and lower benchmarks for each characteristic in the Action List. For example, if the dredged material is below all Lower benchmarks the material would be considered to pose a negligible risk to the marine environment and human health and is below the Lower Action Level (see Table 1 for an example). Exceeding any one upper benchmark would result in the material being classified as unsuitable for sea disposal without management. If the material is lower than all upper benchmarks, but exceeds any one lower benchmark, then additional assessment would be required to determine whether the material presents a negligible or significant risk – that is, it would fall between the Upper and Lower Action Levels.

4.8 Simple pass/fail Action Levels offer the advantage of enabling clear, transparent and repeatable decisions that can be implemented with relatively little training and experience by a permitting authority. The regulated community also has clarity about what is considered acceptable and can plan accordingly. The simplicity and standardization also mean that the Action Levels may not always fully describe the potential for impacts or adverse effects, or may be overprotective or under-protective in some cases because the real environment is complex, variable and uncertain. The simple pass/fail approach can lead to cases where increased costs are incurred by the dredger when dredged material posing a minimal risk to the environment is restricted from sea disposal or to cases where the approach fails to provide protection because all the available and relevant information on a material was not considered. Using a simple pass/fail approach would give no consideration to the magnitude of an exceedance; the case where a dredged material exceeds an Action Level by 0.01% would have an equivalent outcome to the case where the Action Level is exceeded by 1000%.

4B. WEIGHT-OF-EVIDENCE APPROACH

4.9 Another means of implementing Action Levels is through the use of a weight-of-evidence approach. This method can be more complex to implement, and requires a substantial amount of professional judgment in reaching decisions, but has the advantage of potentially integrating all the measured characteristics into the final decision.

4.10 In a weight-of-evidence approach, interpretation rules would be based on results from a number of "lines of evidence" (i.e. physical, biological and chemical data) including, if appropriate, consideration of relevant characteristics of a proposed disposal site. In such an approach, no one single benchmark would ordinarily determine that an Upper Action Level is exceeded (unless that single measurement was, in itself, of sufficient "weight" to indicate substantial concern for adverse effects (see Tables 2 and 3)). Rather, an Action Level would be considered to have been exceeded when a combination of several pre-determined "interpretation criteria" are met. The information being combined to reach this determination would consider the likelihood that valued resources would be exposed to characteristics of the material with the potential to cause harm and the nature and likelihood of the effects that could be produced. Such assessments would consider relevant characteristics of the material, including physical information, chemical properties of the sediment, as well as its biological attributes (e.g., a combination of contaminant concentrations, contaminant loads, toxicity tests, biomarkers, measures of bioaccumulation, etc.). Such information would be considered in light of the suitability and capacity of the disposal site, the patterns of sediment movement from the disposal site and the location of areas of conservation status or importance from the perspective of fisheries resources or fisheries activity.

4.11 In short, a number of the Action List chemical, biological and physical characteristics and their benchmarks can be considered in parallel, such that each characteristic provides part of the information required to determine whether a particular material is above or below an Action Level. For example, physical characteristics (e.g., grain size) could be used to predict the likelihood of a sediment retaining contaminants, chemical analysis provides information about rates of exposure that organisms could experience, and biological tests provide measures of the bioavailability and toxicity of the sediment. It must be stressed, however, that while a weight-of-evidence approach can utilize many additional lines of evidence and provide a means of reducing uncertainty concerning conclusions about environmental risks of disposal at sea, it does not eliminate uncertainty.

4.12 Providing that the necessary levels of professional expertise and experience are available, a weight-of-evidence approach can allow more informed and case-sensitive decision-making than the application of more simplified pass/fail Action Levels, and can also better serve the consideration of alternative management options. Nevertheless, the robustness of any weight-of-evidence-based decision to allow dumping, despite one or more upper benchmarks being exceeded, will depend on both a solid understanding of the methods used to derive the individual benchmarks and the ability to justify and defend the professional judgments made in coming to the decision that an Action Level is exceeded or is not exceeded.

4.13 A number of approaches have been applied to conducting sediment assessments using a weight-of-evidence approach. Describing the details of these approaches lies outside the scope of this document. However, those interested in learning more about such approaches are referred to other resources where these specifics are described and discussed (Burton *et al*., 2002; Adams *et al*., 2005; Bridges *et al*., 2005, PIANC 2006).

5 POSSIBLE FORMATS FOR UPPER AND LOWER ACTION LEVELS

5.1 The Upper or Lower Action Levels can be formulated in a number of ways. Below are several possible formats for formulating Action Levels. All these examples are for simple Pass/Fail Action Levels.

5A. LOWER ACTION LEVELS

5.2 Materials *below the relevant lower levels should be considered to be of little environmental concern in relation to dumping*. The purpose of establishing Lower Action Levels is to efficiently screen out materials that pose a negligible risk to the marine environment and human health. Lower Action Levels can be established using physical, chemical or biological data by the approaches discussed above.

5.3 Lower Action Levels can be simple and based on physical characteristics, e.g., "the material comprises greater than X% rock and cobble and was dredged from areas distant/remote from known sources of contamination".

5.4 Action Levels and their potential formulations are presented in the following sections. These examples are merely intended to represent possible types of Lower Action Level formats. They do not constitute either a definitive or a complete list of possibilities.

Lower Action Levels that are formulated as a fixed number

5.5 Lower Action Levels can be based on a set of numbers that are fixed or pre-defined. These fixed (pre-defined) limits should be developed so that they can take into account site-specific levels and/or natural background conditions.

5.6 For chemical characteristics, Lower Action Levels can be formulated as:

.1 "*The Lower Action Level is not exceeded if the mean concentrations in sediment of all the following are below the lower benchmarks: Cd X.X mg/kg, Hg X.X mg/kg, X.X ug/kg PAH, XX ug/kgPCB*;"

5.7 For biological response characteristics (e.g., toxicity), the Lower Action Levels could be formulated as:

.1 "*The Lower Action Level is not exceeded and disposal is not likely a concern if x% of a sensitive marine species used in an assay survive.*"

Lower Action Levels that depend on comparison with a reference site or value

5.8 Rather than a pre-defined set of numbers, Lower Action Levels may also be formulated as a comparison to a reference value.

5.9 These are formulated such that the Lower Action Level is not exceeded as long as each measured characteristic (chemical or biological metric) is no different than or below that of the designated reference site (or average ambient or background concentrations):

.1 "*The Lower Action Level is not exceeded and disposal is not likely a concern if chemical concentrations in the dredged material are not significantly different than concentrations in an appropriate reference sediment.*"

.2 "*The Lower Action Level is not exceeded and disposal is not likely a concern if the % survival of a sensitive marine species is:*

(a) less than 20% different than the reference, and
(b) not significantly different from the reference."

5B. UPPER ACTION LEVELS

5.10 "*The Upper Level should be set so as to avoid acute or chronic effects on human health or on sensitive marine organisms representative of the marine ecosystem.*" Upper Action Levels are intended to indicate the point above which materials will pose an unacceptable risk to the marine environment and human health. Materials that exceed Upper Action Levels cannot be disposed of at sea without the application of management techniques and processes.

5.11 It should be noted that the following section is not intended to recommend formats, but merely to serve as examples of the types of format that Upper Action Levels might take.

Upper Action Levels that are formulated as a fixed number

5.12 Fixed Number Upper Action Levels can be formulated as:

.1 "*The Upper Action Level is exceeded and disposal is not permitted if the sediment concentration exceeds any effects-based upper chemical benchmark on the National Action List e.g., Cd X.X mg/kg, Hg X.X mg/kg, X.X ug/kg PAH, XX ug/kg PCB*"; or

.2 "The *Upper Action Level is exceeded and disposal is not permitted if the percent survival in a 10-day amphipod toxicity test is less than 70%.*"

Upper Action Levels that depend on comparison with a reference site or condition

5.13 When using chemical characteristics, Upper Action Levels can be constructed such that the Upper Action Level is exceeded when a measured characteristic is above that of a known reference condition. The most commonly used reference condition refers to a site or sediment that has not been significantly impacted by past dredging activities or other sources of contaminants. However, when being applied to an Upper Action Level, a reference condition could be used that represents a limit beyond which conditions would be considered degraded and causally linked to adverse effects. Used in this manner, a chemical reference condition for an Upper Action Level could be derived as a specific percentile from a distribution of chemical survey data from coastal and near-shore sediments, in urban as well as other environments.

5.14 When using biological response characteristics, reference-based Upper Action Levels can be constructed as follows:

.1 "*The Upper Action Level is exceeded and disposal is not permitted if the percent survival in a 10-day amphipod toxicity test is statistically lower in the dredged material, compared to the reference sediment, and more than 20% different.*"

5C. Between the Upper and Lower Action Levels

5.15 In the case when a dredged material falls between the Upper and Lower Action Levels, additional information would be required before a decision permitting disposal could be made. This information would be produced through further assessment. Alternatively, a decision could be made to seek a disposal option other than sea disposal, for example, in circumstances where the costs associated with additional assessment are expected to be larger than the differential between sea disposal and the next, least costly option.

5.16 The nature of follow-on assessments that could be conducted in cases falling between Upper and Lower Action Levels will depend on the nature of the existing results. At this stage of the process, the purpose of additional assessment would be to address specific sources of uncertainty that prevent classifying the sediment as either suitable or unsuitable for sea disposal.

5.17 In some cases additional sampling may be required to accomplish further assessment. Additional sampling could be undertaken to increase spatial coverage (i.e. a larger number of samples per unit area), to increase the depth of coring to examine the vertical distribution of characteristics, to expand the list to chemicals being analysed, etc. This may show that some discrete areas within the dredging zone may be suitable for disposal at sea while others are not. Alternatively, an investigation of the source(s) of contaminants could also be undertaken. Additional bioassays with different endpoints could be used to better determine the effects associated with identified contaminants. Again, the specific nature of follow-on assessments will depend on the specific features of the site and the results of the initial assessment.

6 CONCLUSIONS

6.1 An Action List is a set of chemicals of concern, biological responses of concern, or other characteristics that can be used for screening dredged material for its potential effects on human health and the marine environment. Action Levels establish thresholds that provide decision points that determine whether sediments can be disposed of at sea.

6.2 There are a number of approaches for selecting Action List characteristics and to derive levels for dredged material assessment. Jurisdictions will need to be clear on the level of protection they require and on their ability and capacity to administer a permit system using Action Levels to facilitate transparent and consistent decision-making.

6.3 There is no universal mechanism for the selection of Action Lists and the development of Action Levels.

6.4 The process begins with an identification of the chemical, biological, or physical characteristics that will make up the Action List. Next, benchmarks must be set for each characteristic on the Action List. Benchmarks are often developed using a reference-based approach (comparing to background or ambient conditions) or an effects-based approach (based on knowledge or direct observation of the effects of exposure). Finally, Action Levels are set by integrating the relevant characteristics and benchmarks to form a decision rule. This can be as simple as a pass/fail based on a single benchmark, or it can be more complex such as combining multiple lines of evidence in a weight-of-evidence approach.

6.5 An Upper Action Level can be created above which there would be concern due to increased potential for effects on human health and the marine environment, and if desired, a Lower Action Level can be created below which there would be little concern.

6.6 Appendix 1 goes into further detail providing options that can be used in setting benchmarks and provides some country examples.

6.7 Readers are encouraged to provide additional examples and it is expected that this document will evolve over time, as greater experience with the development and application of Action Levels is obtained.

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8 GLOSSARY

Action List is defined as a "*mechanism for screening candidate wastes and their constituents on the basis of their potential effects on human health and the marine environment*". The Action List can consist of chemicals of interest, biological responses of concern, or other characteristics that can provide insight into the potential for dredged material to cause adverse effects in the marine environment. An Action List can also be used as a trigger mechanism for further waste prevention considerations and could therefore have a role in controlling pollution at its source, in promoting cleaner technology, or in improving the efficiency of dredging to reduce the need for disposal.

Action Levels establish decision rules to identify dredged materials that may be disposed because the risk for adverse effects is low and acceptable, those that may not be disposed without management controls because the risks for adverse effects would be considered too high, or to identify cases where additional information may be required to make a sound judgement about the potential for the dredged material to cause adverse effects. If developed for the purposes of meeting the requirements of disposal at sea treaties, the Action Level will specify an Upper Level and may also specify a Lower Level. The Upper Level should be set so as to avoid acute or chronic effects on human health, or on sensitive marine organisms representative of the marine ecosystem. Below the Lower Level, there should be little concern for disposal at sea.

Ambient Conditions: The conditions observable in the vicinity of a site, e.g., a disposal site.

Background: the conditions observable in the vicinity of the site that are due to natural conditions, i.e. not due to anthropogenic activities.

Benchmark: is a point on the range of the metric (e.g., 4 mg/kg copper, 20% amphipod mortality) that is used to identify where environmental concern may be low or high for that characteristic. These can be referred to as the lower benchmark and upper benchmark.

Characteristic: is an attribute of the dredged material (e.g., copper, mercury, silt, petroleum compounds, pathogens) or a biological response to the dredged material (e.g., mortality, growth, bioaccumulation).

Metric: is a measurement that can be made on the characteristic (e.g., concentration, percent survival).

Reference site or sediment: is used as a basis for comparison to a disposal site or dredged material. The reference represents ambient conditions in the vicinity of the disposal site, absent any influence from past disposal activities. It is desirable that the reference should be substantially free of contaminants, but pristine conditions are generally not achievable.

APPENDIX 1: APPROACHES TO SETTING BENCHMARKS AND ACTION LEVELS

1A: REFERENCE-BASED APPROACH

Benchmarks for physical, chemical or biological characteristics can be set based on knowledge of background or ambient conditions in comparable areas that have not been impacted by dumping. This is a reference-based approach.

If reference-based benchmarks are to be used as Action Levels (simple approach), it is important that they be based upon some measure of potential risk. This way, resources can be applied to the highest risk sites.

Benchmarks derived from knowledge of background concentrations of substances may be termed "background-based" levels. These may be particularly relevant to the derivation of lower benchmarks for naturally occurring substances. If metals in the dredged material, for example, would not be expected to elevate metal concentrations in the receiving environmental media (e.g., sediment and water) above the range in natural background concentrations then there should be "*little environmental concern in relation to dumping*" of that dredged material.

Some dredged material-associated substances that can produce adverse effects in the marine ecosystems also occur naturally within the environment. This can be the case for both organic (e.g., hydrocarbons) and inorganic substances of regulatory interest, but it is particularly relevant for metals. Metals exist naturally as components of minerals, as ions, and in complexes with other materials, including organic compounds. Lower benchmarks for metals can be based, for example, on the natural abundances of the subject metals in soil, crustal rock or sediment in the relevant region. The GIPME (2000) Guidelines describe the use of geochemical markers (e.g., Al, Li, Fe) to account for spatial variations in regional formations and geology.

The results of an analysis of sediment samples will depend in part on the methods used to collect, store, prepare and analyse those samples. It is important to bear this in mind when developing and applying Action Levels.

It should also be noted that if these approaches are used to set Lower Action Levels, they should trigger additional assessment when exceeded. In practice, there may be many cases in which almost all dredged material within an urbanised or industrialized region will exceed lower "background-based" benchmarks for naturally occurring substances, particularly if pre-industrial or natural background concentrations are used.

In addition, many substances, whose inputs arise solely from anthropogenic sources, have no natural background levels, including, for example, PCBs, TBT and many pesticides. The presence of compounds such as PCBs in trace quantities may be unrelated to local, or even regional activities, as these compounds can be transported through global circulation in the atmosphere and oceans. For such compounds, reference-based Benchmarks can be derived from ambient concentrations in sediment. Reference sites used as data sources for determining ambient concentrations should be remote from the influence of local waste streams and past dredged material disposal activities. GIPME (2000) and PIANC (2006) provide some guidance for selecting and using data from reference locations.

Lower benchmarks set using reference-based approaches, either alone or in combination with other approaches, are applied in many countries to make up Lower Action Levels, including Australia, Canada, Denmark, Finland, France, Germany, Hong Kong, China, Ireland, the

Netherlands, Spain, Sweden, the United Kingdom and the United States. The example below describes the use of reference-based benchmarks for this purpose in Ireland.

Country: Ireland

Overview of framework – Ireland applies a 3-phase weight-of-evidence approach to the assessment of the suitability of dredged material for disposal at sea; Phase I – screening based on a critical assessment of the available literature; Phase II – further assessment using sediment chemistry criteria; Phase III – further testing, including appropriate toxicity tests, should either lower or upper benchmarks be exceeded.

Derivation of the Action List – historic monitoring results for harbours in Ireland were used in order to prioritize those contaminants of greatest concern and to exclude from routine consideration those substances which had not been detected over the previous 10 years. The Action List can be reviewed and revised as necessary in light of new information.

Contribution of reference-based benchmarks – reference-based benchmarks are used for the derivation of lower action levels for a range of metals and organic contaminants (HCB, HCH and PCBs), in particular as part of Phase I and Phase II. Upper benchmarks are set using a chemical effects-based approach and bioassays if necessary.

Derivation of lower benchmarks – for metals and PAHs, reference-based benchmarks are set at the 95 percentile of background data, where data are available. In the case of arsenic, the ERL was used in the absence of relevant background data for Irish sediments. For several organic compounds, the 95 percentiles of ambient background levels were taken.

Definition of the Lower Action Level – if none of the lower benchmarks are exceeded then the Lower Action Level is not exceeded and the sediment quality is considered acceptable for dumping at sea (subject to dump-site and operational approval). If, however, one or more benchmarks are exceeded then, unless exceedance is marginal, further assessment of sediment quality would normally be required before any decision on acceptability for dumping or other management options can be made.

Definition of the Upper Action Level – if any of the upper benchmarks are exceeded then the Upper Action Level is considered to have been exceeded and further testing, including the use of bioassays, is used to inform the management decision.

Benchmarks

Characteristic	Units (dry weight[a])	Lower benchmark	Upper benchmark[b]
Arsenic	mg kg^{-1}	9[c]	70*
Cadmium	mg kg^{-1}	0.7	4.2
Chromium	mg kg^{-1}	120	370
Copper	mg kg^{-1}	40	110[d]
Lead	mg kg^{-1}	60	218
Mercury	mg kg^{-1}	0.2	0.7
Nickel	mg kg^{-1}	21	60
Zinc	mg kg^{-1}	160	410
Σ TBT & DBT	mg kg^{-1}	0.1	0.5
γ – HCH (Lindane)	μg kg^{-1}	0.3	1
HCB	μg kg^{-1}	0.3	1
PCB (individual congeners)	μg kg^{-1}	1	180
PCB (Σ ICES 7)	μg kg^{-1}	7	1260
PAH (Σ 16)	μg kg^{-1}	4000	
Total extractable hydrocarbons	g kg^{-1}	1.0	

[a] total sediment <2mm
[b] ERM (rounded up)
[c] ERL (rounded up) – No background Irish data available
[d] PEL as ERM considered high

Further information available from – www.marine.ie

Box 1: The use of reference-based approaches to set lower benchmarks in Ireland

1B: EFFECTS-BASED CHEMICAL ACTION LEVELS

Benchmarks for physical, chemical or biological characteristics can also be based on knowledge of effects that can be produced following exposure to dredged material. Such benchmarks, which may be termed "effects-based" benchmarks, can be based on information concerning the likelihood or magnitude for an effect.

Several approaches suitable for establishing effects-based benchmarks have been proposed in the scientific literature, including those outlined below, though in practice some are more widely used than others. Overall, the different effects-based approaches may be subdivided into empirical, mechanistic and consensus approaches.

Empirical approaches to deriving Levels

1. Co-occurrence approach. A number of benchmarks have been developed empirically by comparing large databases of sediment chemistry and effects. They were not originally intended as clean-up or remediation targets, as discharge targets, as pass/fail criteria for dredged material disposal or for any other regulatory purpose (Buchman, 1999).

These levels, set by evaluating the impact of real contaminant mixtures in real sediments, indirectly account for issues of bioavailability and sediment geochemistry and they account for the synergistic and other effects of contaminant mixtures but report it for a single contaminant. They do so only in an average way, however, and cannot account for site-specific geochemical conditions, atypical bioavailability or the effects of unusual mixtures. Furthermore, these empirical approaches do not imply causality, but simply describe the co-occurrence of contaminants and observations of toxicity.

All the benchmarks described below are based upon compilations of many literature reports in which sediment chemistry and toxicity were reported, rather than one large, coordinated study. As such, values are generated from studies with potentially different sampling and analytical methods.

The Effects Range-Low (ERLs) and Effects Range-Median (ERMs) of Long *et al.*, (1995) and the marine Threshold Effects Levels (TELs) and Probable Effects Levels (PELs) of MacDonald *et al.*, (1996) are based upon similar data compilations, but are generated using different calculations. For example:

– **ERL values** (calculated as the lower 10^{th} percentile concentration of the available sediment toxicity data, using only data for those samples identified as toxic by original investigators) are at the low end of a range of levels at which effects were observed in the studies compiled, and therefore represent **the values at which toxicity may begin to be observed in sensitive species** – in contrast, **ERM values** (median concentrations of the compilation of toxic samples) represent **chemical concentration ranges usually associated with toxicity in marine and estuarine sediments**.

In a similar manner:

– **TEL values** (calculated as the geometric mean of the 15^{th} percentile concentrations of the toxic effects data set and the median of the no-effect data set), in a similar way to ERLs, represent **the concentrations below which adverse effects are expected to occur only rarely**.

– while **PEL values** (geometric means of the 50% of impacted, toxic samples and the 85% of the non-impacted samples) are **levels above which adverse effects are frequently expected** (Buchman, 1999).

ERLs and TELs have been used in some countries to set lower benchmarks, while recognising that error rates associated with their use are on the order of 10-20 per cent. Adjustments can be made for cases in which the background values are higher than the ERLs or TELs.

ERMs have been used to inform the setting of upper benchmarks (e.g., Denmark, Ireland and the United Kingdom), while recognizing that their use in isolation as upper benchmarks may not always be appropriate. The example below describes their use by the United Kingdom.

Country – United Kingdom

Overview of framework – Action Levels are used as part of a weight-of-evidence approach to assessing dredged material and its suitability for disposal at sea. This considers balancing multiple lines of evidence concerning ecological assessment as an aid to decision-making. New Benchmarks have recently been proposed.

Derivation of the Action List – Reference was made to the OSPAR compilation document on Action Levels to prioritise those contaminants of greatest concern in the United Kingdom.

Contribution of empirically derived effects-based chemical benchmarks – Effects-based data have been used in conjunction with benchmarks from other jurisdictions to inform the setting of the proposed new benchmarks.

Derivation of upper benchmarks – Existing benchmarks were derived from historical information, including existing data on contaminants from ports and harbours, combined with expert scientific judgement. Ecotoxicological data, based largely on data sets from the United States, in conjunction with benchmarks from other jurisdictions were used to guide the setting of the proposed new upper benchmarks for metals and PCBs and TBT. Proposed new lower benchmarks for PCBs were also set on the basis of ecotoxicological data, however, for metals these have been derived using nominal background concentrations. The United Kingdom is currently in the process of establishing upper benchmarks for PAHs.

Definition of the Lower Action Level – In general, dredged material containing concentrations below lower benchmarks are of no concern and are unlikely to influence the licensing decision. Dredged material with contaminant levels between lower and upper benchmarks require further consideration and testing before a decision can be made.

Definition of the Upper Action Level – Dredged material with one or more contaminant levels above upper benchmarks would generally be considered unsuitable for sea disposal.

Benchmarks

Characteristic	**Existing lower benchmark* mg.kg-1 (ppm)**	**Existing upper benchmark* mg.kg-1 (ppm)**	**Proposed lower benchmark mg.kg-1 (ppm) (dry weight)**	**Proposed upper benchmark mg.kg-1 (ppm) (dry weight)**
As	20	50-100	20	70
Cd	0.4	5	0.4	4
Cr	40	400	50	370
Cu	40	400	30	300
Hg	0.3	3	0.25	1.5
Ni	20	200	30	150
Pb	50	500	50	400
Zn	130	800	130	600
Tributyltin	0.1	1.0	0.1	0.5
PCBs	0.02	0.2	0.02	0.18
PAHs				
Acenaphthene			0.1	
Acenaphthylene			0.1	
Anthracene			0.1	
Fluorene			0.1	
Naphthalene			0.1	
Phenanthrene			0.1	
Benzo[a]anthracene			0.1	
Benzo[b]fluoranthene			0.1	
Benzo[k]fluoranthene			0.1	
Benzo[g]perylene			0.1	
Benzo[a]pyrene			0.1	
Benzo[g,h,i]perylene			0.1	
Dibenzo[a,h]anthracene			0.01	
Chrysene			0.1	
Fluoranthene			0.1	
Pyrene			0.1	
Indeno(1,2,3cd)pyrene			0.1	
Total hydrocarbons	100		100	

Further information available from – www.cefas.co.uk

*** The United Kingdom refers to upper and lower benchmarks as Action Level 1 and Action Level 2**

Box 2: The use of empirically derived effects-based chemical benchmarks in the UK

Apparent Effect Thresholds (AETs) relate chemical concentrations in sediments to synoptic biological indicators of injury (i.e. sediment bioassays or diminished benthic infaunal abundance). Individual AETs represent the concentrations observed in the highest *non-toxic* samples. As such, they represent the concentrations above which adverse biological impacts would *always* be expected by *that* biological indicator due to exposure to that contaminant alone (in the data set used). It should be noted that adverse impacts could also occur at levels below the AET. AET values were developed for use in Puget Sound (Washington DC, United States) and are not easily compared directly to other benchmarks based on single-chemical models and broader data sources.

2. **Triad Approach**. This involves the concurrent collection of sediment chemistry, benthic community, and sediment toxicity samples from field stations representing the range of regional sediment contamination (Long & Chapman 1985). The data from these samples are then evaluated using statistical approaches that establish levels at which biological effects (such as changes in the benthic community or some toxicity response) might be expected to occur for the various contaminants found in the sediments. Thus, benchmarks are *inferred* from the cumulative assessment of data.

3. **Spiking approach**. Spiking involves the deliberate introduction of a range of concentrations of a selected contaminant into uncontaminated sediment samples, to which test organisms can then be exposed in order to estimate concentrations that cause toxic effects. Such an approach, though more commonly used to establish water quality criteria, has been used by Canada, for example, as one component in the development of sediment quality guidelines used for assessment. A number of caveats apply, including that contaminant bioavailability may differ from a natural situation and that the mixing process may change equilibrium characteristics of the sediment. For example, available literature suggests that significant ageing (on the order of 6 months to a year for some substances) may be necessary to give realistic results and that the time to reach equilibrium can be different for each contaminant of interest. Data on spiked sediments are not widely available and those interested in using the approach would likely need to invest in research and field validation.

4. **Quotient Approach**. Recent work has focused on developing quotient methods for applying empirical benchmarks that are derived by summing the "toxic" contributions of a number of contaminants of concern (Wenning *et al*. 2002). Regression analysis that permits considering effects from several contaminants at once along a continuum of concentrations has also been developed (Field *et al*. 2002).

Mechanistically Derived Levels

Mechanistic approaches can be used in the development of benchmarks through the use of theoretical relationships based on knowledge of mechanics of action. **Equilibrium Partitioning (EqP)**, in which sediment benchmarks are established using water quality criteria as a starting point (Ankley *et al.* 1996, Chapman 1989, Swartz *et al.* 1990, Webster and Ridgway 1994), is an example. This approach involves calculating the sediment concentration that would be necessary to create a toxic water quality level when the sediment is assumed to be in equilibrium with the pore water contained within it.

This assumes that the distribution of contaminants among different compartments in the sediment matrix (i.e. solids and interstitial water) is predictable from physicochemical properties and that it is the interstitial water value that defines the contaminant risk.

In the EqP approach, benchmarks are calculated using water quality criteria, usually the final chronic values or equivalent criteria, in conjunction with sediment/water partition coefficients for the specific contaminants. The final chronic value is derived from the species mean chronic values that have been calculated using published toxicity data. The EqP approach provides a theoretical basis for identifying chronic effects thresholds for contaminants when they occur alone in sediments. However, this approach does not address the potential synergistic effects caused by contaminant mixtures and neglects a number of potential pathways in which organisms can be exposed to sediment contaminants. These values are probably of greatest value for the examination of the probability of toxicity of a single non-ionic organic, rather than for contaminant mixtures (Wenning *et al*., 2005).

The example below describes the application of EqPs in Belgium.

Country: Belgium

Overview of framework – The assessment of dredged material is based upon quantitative action levels that must be manageable, scientifically founded and realistic in practice. Chemical analyses are followed by bioassays, if necessary, to aid in the decision-making process.

Derivation of the Action List – Selected to fulfil mandate under OSPAR

Contribution of mechanistically derived benchmarks – Equilibrium Partitioning was used, among other methods, to set Action Levels.

Derivation of benchmarks – Equilibrium partition coefficients were derived from a combination of sediment analysis and data available from published literature and used to determine 'safe concentrations' as benchmarks. These values were subsequently adjusted for local conditions and, if deemed necessary, also for bioaccumulation and biomagnification potential.

Definition of the Lower Action Level – if all analyses yield values below lower benchmarks, then the material may be dumped at sea. If any lower benchmark is exceeded, additional sampling and analysis are required. If these results confirm the original, then bioassays are required to aid the final decision.

Definition of the Upper Action Level – if the analyses yield values exceeding any three of the upper benchmarks, the Upper Action Level is exceeded and dumping at sea is not permitted.

Benchmarks

Characteristic (dry weight for whole sediment)	Lower benchmark	Upper benchmark
Hg	0,3 ppm	1.5 ppm
Cd	2,5 ppm	7 ppm
Pb	70 ppm	350 ppm
Zn	160 ppm	500 ppm
Ni	70 ppm	280ppm
As	20 ppm	100 ppm
Cr	60 ppm	220ppm
Cu	20 ppm	100 ppm
TBT	3 ppb	7 ppb
Mineral oil	14 mg/g_{OC}	36 mg/g_{OC}
PAKs	70 µg/g_{OC}	180 µg/g_{OC}
PCBs	2 µg/g_{OC}	2 µg/g_{OC}

Further information available from – www.mumm.ac.be

Note: Belgium refers to upper and lower benchmarks as Action Level 1 and Action Level 2.

Box 3: Use of mechanistically derived effect-based chemical benchmarks in Belgium

In undisturbed anoxic sediments, the chemistry of many trace metals is dominated by reactions with sulfide. Di Toro *et al.* (1991) developed an EqP-type approach to trace metals in anoxic sediments, known as the acid volatile sulfide (AVS) model. According to this model, the iron in sedimentary iron monosulfide, FeS(s) (defined as AVS), can be exchanged with a divalent trace metal to form a solid sulfide less soluble than FeS(s), thus releasing equivalent amounts of iron into pore waters. As long as the trace metal concentration in sediments is less than the concentration of AVS, free-metal ion activity in the porewater is maintained at very low levels and the sediment is not toxic. When the metal concentration added becomes greater than that of AVS, free-metal ion activity increases sharply in pore waters and the sediment can become toxic. The measurements needed to apply this model are the AVS concentration and the sum of the molar concentrations of divalent trace metals forming less soluble sulfides than iron, referred to as simultaneously extracted metals (SEM).

While this approach may be useful for predicting metal availability in static, reduced sediments, it has a number of problems that limit its usefulness. For example, while the bulk of undisturbed sediments may be anoxic, disturbance of sediments by shipping activity, storms, the activities of benthic organisms (bioturbation) and, in particular, by dredging and disposal, markedly affect redox conditions. It has also been observed that metals often flux out of sediments at higher rates than would be predicted by porewater gradients, possibly due to bioirrigation and other sources (*e.g.*, Apitz and Chadwick, 2003).

Consensus SQGs

Consensus levels, currently under review by west coast regions in the United States and Canada, are the mean value of the benchmarks derived from a variety of methods (Swartz 1999, MacDonald, 1999). Since benchmarks are often given for low, intermediate and high effects levels, consensus levels have been proposed for Threshold, Median and Extreme Effects Concentrations (TEC, MEC, EEC), or for Threshold and Probable Effects Concentrations (TEC, PEC). The consensus benchmarks for mixtures of PAHs (Swartz 1999) and PCBs (MacDonald *et al.* 2000) were used in the successful formulation of SQGQ1 by Fairey *et al.* (2001). The motivation behind the consensus method is not simply to make a list of available benchmarks for a particular chemical and then to calculate the average. The premise behind the consensus approach is that if different methods for deriving benchmarks result in quantitatively similar concentrations, then the validity of the common result is greatly enhanced. Only then is the calculation of a consensus guideline justified. Even if consensus of different benchmarks is not evident for a particular chemical, the method is expected to serve the function of identifying potential errors with one or more benchmarks. In the calculation of consensus-based benchmarks for total PAHs, Swartz (1999) reported that many of the benchmarks derived with a similar narrative intent, but derived using different empirical and theoretical approaches, resulted in very similar concentrations and that this similarity probably was not coincidental.

1C: BIOLOGICAL EFFECTS-BASED ACTION LEVELS

Plants and animals will come in contact with dredged material-associated substances through one of three primary exposure pathways: 1) through contact with bedded sediment particles; 2) through contact with water; and 3) through contact with contaminants through bioaccumulation and trophic transfer within a food chain.

Risk, i.e. the likelihood for adverse effects, is a function of the rates that organisms are exposed to contaminants and the relationship between rates of exposure and adverse biological effects. Biological tests may provide either measures of effect or exposure, or in some cases both. Laboratory and field-based methods are available for generating information about the potential for **effects** and **exposure**:

.1 Tests that provide measures of **effect** provide insight into risk by providing information about the toxicity of a substance and adverse responses in organisms exposed to the material. Laboratory-based toxicity tests are commonly used in dredged material evaluations. Methods for measuring effects in the field are also appropriate for some case-specific applications. Such field methods include measurements of benthic community structure or observation and measurement of effects on individual organisms (e.g., cancer in resident fish).

2. Other biological tests provide information about **exposure** conditions including measures of the bioavailability of the contaminants present in dredged material, or the concentration or dose received by the receptor. Bioaccumulation tests that

measure the movement of contaminants into the tissues of the test organism are the most commonly applied biological tests for collecting information about exposure. For an effects-based Action Level, such a measure of exposure might be compared to limits to ensure the protection of humans exposed through consuming fish or shellfish, or similar limits to ensure protection of wildlife.

This Appendix describes three approaches for establishing Biological Effects-Based Action Levels. These approaches are: Solid-phase toxicity tests, Water-column Toxicity Tests, and Bioaccumulation Tests.

Solid-Phase Toxicity Tests (Bioassays in whole sediments)

1 Effects-based Action Levels for dredged material can be based upon direct measures of toxicity using solid phase toxicity tests. These tests involve exposing test organisms to bedded sediments for a defined period and measuring the responses of those organisms (e.g., rates of survival, growth, reproduction) at the conclusion of the test. To ensure that test results will be protective with respect to the exposure conditions expected at a management site, the species used in such tests should be selected based on their close behavioural association with the sediment and their sensitivity to contaminants. Organisms that live in and/or ingest sediments (e.g., infaunal invertebrates) are expected to have high exposure to sediment-associated contaminants due to their intimate contact with sediment particles and pore water. Tests using infaunal amphipods, polychaetes, bivalve molluscs, urchins, and other taxa have been developed and commonly applied to assess dredged material (PIANC 2006).

2 Recognized differences among candidate test species, in terms of their behaviour within sediments, have resulted in a broad consensus on the need for testing using multiple species. Some taxa actively burrow through sediments while others live within semi-permanent burrows or even tubes they construct with mucus and sediment particles. Some species actively ingest sediment particles while others rely more on removing particles from suspensions in the overlying water. Species with these different behavioural characteristics will experience different exposures to contaminants adsorbed to sediment particles or dissolved within pore waters. Selecting a battery of tests that represents this diversity of behaviour will provide for more confidence that the assessment will be protective of exposure conditions at the management site. Efforts should also be made to ensure that the species used in such tests are sensitive to contaminants, i.e. they respond to the presence of contaminants. Taxa differ in their sensitivity to contaminants with respect to one another and among contaminants. Even though limited understanding of this variation in sensitivity currently prevents tailoring assessments for specific mixtures of contaminants or benthic communities at disposal sites, it must be acknowledged that using multiple tests with different species is a precautionary approach for assessing sediments (Cairns 1986).

Water-column Toxicity Tests

3 Substances may be released from a dredged material into the water column during or after disposal through diffusion, leaching, or other mechanisms. Effects-based Action Levels to assess the potential for effects being caused through these means of exposure can be developed using water-column toxicity tests. These tests generally make use of planktonic species including algae, copepods, and other arthropods (e.g., cladocerans), as well as larval molluscs, echinoderms, and fish. Such tests, described in detail in USEPA/USACE (1991), are commonly conducted using a dilution series of sediment-water mixtures (e.g. elutriates) in evaluations of dredged material. Tests are conducted by exposing test organisms to water extracts of dredged

material that are intended to represent the range of substance concentrations organisms would be exposed to in the field.

Bioaccumulation Tests

4 Addressing questions concerning the potential for contaminants in dredged materials to move into the food chain and produce effects in organisms, above and beyond the borders of a disposal site, begins with assessing bioaccumulation potential. Bioaccumulation, in this case, refers to the movement of contaminants from the dredged material into the tissues of exposed organisms. It is important to recognize that bioaccumulation tests provide a measurement of exposure rather than effect. Bioaccumulation of a compound will not always result in an adverse effect on the organism accumulating the compound. In the case of essential elements (e.g., zinc and copper), a certain amount of accumulation is required to support normal physiological function. In general, adverse effects from any contaminant will only be manifest after the concentration exceeds a specific tolerance level or toxicological threshold. For this reason careful attention must be given to interpreting bioaccumulation data.

5 Laboratory bioaccumulation tests are generally conducted by exposing the test organisms to the test material (e.g., dredged material) under controlled conditions and recovering the animals at the end of the exposure to measure the concentration of contaminants of concern in the tissues of the test organisms. Test organisms used in bioaccumulation tests are generally selected on the basis of their relative tolerance to contaminants (i.e. they survive the exposure) and their body size, such that there is sufficient tissue recovered at the end of the exposure for chemical analysis.

6 Because of the expense and time involved in conducting bioaccumulation tests, alternative approaches have been developed for assessing bioaccumulation potential. One of these approaches is called Thermodynamic Bioaccumulation Potential (TBP). This approach makes use of the principle of equilibrium partitioning of non-polar organic chemicals as a means of estimating the amount of chemical that will partition to the lipid phase within the organism from the organic carbon phase of the sediment at equilibrium (Clarke and McFarland, 2000).

7 Interpreting the consequences of bioaccumulation test data commonly involves the use of mathematical models and risk calculations in order to apply the data to a particular target of protection within the food web (e.g., a fish-eating bird or particular human population). These and other aspects of using biological tests to evaluate dredged material are discussed at length in PIANC (2006).

Country: Canada

Overview of framework – The Canadian framework adopts both chemical and biological Action Levels to determine sediment is suitable for ocean disposal. The framework employs, in tier 1, a chemical Lower Action Level (LAL) that can adjusted for background concentration and exposure and, in tier 2, a biological Upper Action Level (UAL) that conside lethal and sub-lethal toxicity and bioaccumulation. This approach focuses resources on materials that pose greater risk, or a associated with greater uncertainty.

Derivation of the Action List – the Action List comprises different characteristics for consideration at lower and upper action levels. Characteristics considered for Lower action levels are chemical contaminants, selected on the basis of the London Convention Black List and supplemented on a case-by-case basis by site-specific characteristics of the area, while those considered for upper action levels are biological endpoints.

Contribution of biological-effects based benchmarks – biological effects testing is used to set the Upper Action Level based on toxicity, persistence and bioaccumulation.

Derivation of upper benchmarks – upper benchmarks are set using a battery of standard bioassays, including metrics of survival, growth, bioaccumulation and metabolic response. In contrast, lower benchmarks were set using a combination of reference-based and effects-based chemical approaches.

Definition of Lower Action Levels – if all analyses yield values below lower benchmarks, then the material may be dumped at sea. If, however, any regulated lower benchmark is exceeded, the Lower Action Levels is exceeded and further assessment is required.

Definition of Upper Action Levels – the Upper Action Level is exceeded if the lethal bioassay is failed or if any two biological tests are failed. Open water disposal is then not permitted without the use of management techniques or processes.

Benchmarks

Characteristic	Units (dry weight[a])	Lower benchmark	Upper benchmark
Arsenic	mg kg^{-1}	7.2	
Cadmium	mg kg^{-1}	0.6*	
Chromium	mg kg^{-1}	52.3	
Copper	mg kg^{-1}	18.7	
Lead	mg kg^{-1}	30.2	
Mercury	mg kg^{-1}	0.75*	
Nickel	mg kg^{-1}	Na	
Zinc	mg kg^{-1}	124	
PCB Total	µg kg^{-1}	100*	
Total PAH (Σ 16)	µg kg^{-1}	2500*	
Amphipod survival			A decrease in survival of at least 20% is observed between the test sediment and a clean sediment used as a reference
Photoluminescent bacterial metabolic effect			Five minute IC50 is less than 1000 mg/kg.
Echinoid reproduction and development			A decrease in fertilization of at least 25% is observed between the test sediment and control water.
Bivalve bioaccumulation			Significant difference from reference/ control

[a] Levels are regulated and represent minimum action list at lower level

Further information available at – www.ec.gc.ca/seadisposal **Note: Canada refers to upper and lower benchmarks as upper and lower Action Levels**

Box 4: The use of biological effects benchmarks in Canada

1D: OTHER APPROACHES

Among the examples from jurisdictions, it was noted that some benchmarks and Action Levels were set based on an approach other than those described. Frequently, there will be insufficient data, time or funding to enable the setting of benchmarks on purely scientific grounds. In order to proceed with a functional decision-making system in a reasonable time it is often necessary to take interim measures. Many jurisdictions may have limited information and simply decide to apply safety factors to benchmarks derived for other purposes, or set one benchmark as a multiple of another benchmark using a policy basis, or in an arbitrary fashion to help overcome a lack of data, or allow consistent decisions to be taken.