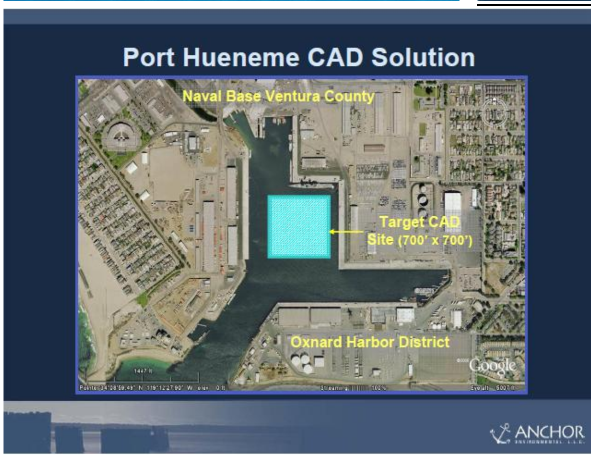
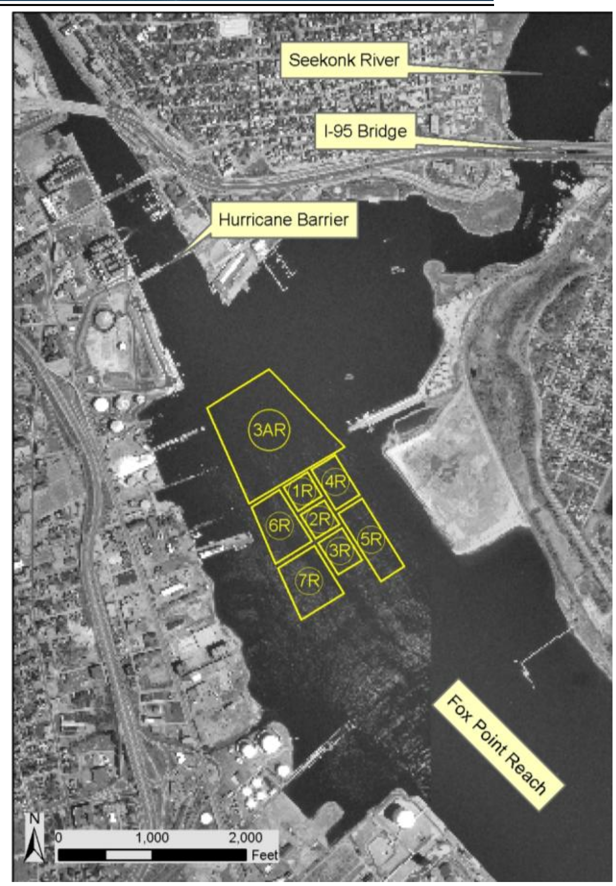
International Review of Practices and Policies for Disposal in Ocean and Coastal/Estuarine Waters of Contaminated Dredged Material

March 30, 2009





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On the cover:

Upper left:

Island CDF----IJsseloog in Lake Ketel in the Netherlands

Upper right:

Nearshore CDF----Slufter in the Netherlands

Lower left:

CAD cell----Port Hueneme in California, USA

Lower right:

CAD cells----Providence River, Rhode Island, USA

Below:

Nearshore CDF----Huelva Estuary, Spain

Preface

Environment Canada is considering implementation of the clause in the London Convention's 1996 Protocol (IMO 2003) that allows disposal at sea of contaminated dredged material provided that management techniques are used to prevent marine pollution. In order to fully consider any issues associated with this approach, Environment Canada commissioned this study to undertake a review of how other jurisdictions, especially those party to the London Convention/Protocol, currently manage and monitor the at sea disposal of contaminated dredged material, including the rationale behind management policies.

Environment Canada is particularly interested in the environmental, financial, and legal risks and liabilities and what procedures/practices are used to manage and minimize risks and liabilities to the government.

Results of an email questionnaire are included in this report that was sent to thirteen member countries of the London Convention. Those countries include:

Australia	Netherlands
Brazil	Norway
China	South Korea
Germany	Spain
Hong Kong, China	United Kingdom
Italy	USA
Japan	

In the context of this work for Environment Canada, disposal at sea includes: ocean waters and coastal waters (*i.e., estuaries up to the maximum extent of salinity at high tide, low flow conditions, includes the intertidal zone up to high water mark),* and therefore other country's experiences disposing of contaminated dredged material in estuarine waters (not just in the ocean) were valuable for this project.

The report was written by Mr. Craig Vogt, Craig Vogt Inc. The author acknowledges the contributions of those countries that formally responded to the questionnaire and also the numerous government and port representatives and consultants that participated in telephone conversations responding to the requests for information and data.

Acknowledgements

The author recognizes and thanks all of those that provided the information presented in this report, including those that spent time on the telephone enhancing the author's understanding of the available information.

Special thanks go to country representatives in the following LC/Protocol member countries:

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Keiko Ishihara	Japan

In the USA, the author did not seek out one country representative and instead contacted knowledgeable colleagues from federal and state governments, port authorities, and consultants. The author thanks the following for their efforts in providing information on USA practices and polices for disposal of contaminated dredged material into confined aquatic disposal facilities.

Tom Fredette	U.S. Army Corps of Engineers
John Tavolaro	U.S. Army Corps of Engineers
Joe Wilson	U.S. Army Corps of Engineers
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Deb Hadden	Port of Boston
Matt Masters	Port of New York/New Jersey
Mel Cote	U.S. EPA
Doug Pabst	U.S. EPA
Brian Ross	U.S. EPA
Dave Cowgil	U.S. EPA
Dan Goulet	State of Rhode Island
Rene Coenen	London Convention of 1972
Edward Kleverlaan	London Convention of 1972

Of course, the above list is not comprehensive and the author is certainly appreciative of others that assisted.

Finally, the author thanks and recognizes the assistance of Linda Porebski and Bill Martin, Environment Canada, for their guidance for the project.

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Executive Summary

Environment Canada is considering whether to issue permits for disposal of contaminated dredged material into ocean and coastal (i.e., estuarine waters), provided that specific "disposal management techniques" are used to prevent marine pollution. Recent modifications to the international treaty on disposal of wastes into ocean waters (i.e., London Convention 1972 and the 1996 Protocol) recognize that this is an acceptable approach for management of dredged material.

Environment Canada commissioned this study to undertake a review of practices and policies used by other jurisdictions, targeted primarily at those countries that are members of the London Convention/Protocol, to manage and monitor the disposal of contaminated dredged material into ocean and estuarine waters. Environment Canada is particularly interested in the environmental, financial, and legal risks and liabilities and what procedures are used to manage and minimize risks and liabilities to the government.

Requests for information on these issues were sent to a total of 13 countries and information from 10 of those countries is included in this report. Information on the internet was also an excellence source.

What are the Findings and Conclusions?

The simple message resulting from this international assessment of practices and policies:

- A wealth of international experience demonstrates that contaminated dredged material can be effectively disposed in ocean and estuarine waters by applying management techniques, which include four types of confined aquatic disposal facilities.

- Application of the practices and policies highlighted in this report will minimize environmental, financial, and legal risks and liabilities to the government permit issuing authority.

- Specific approaches used by several countries may be useful as models for Environment Canada in assigning liability for short and long term responsibility for confined aquatic disposal facilities.

- While isolation of contaminated dredged material via confined aquatic disposal facilities is effective, government programs should continue working to prevent further contamination of sediments.

What Management Techniques are used for Disposal of Contaminated Dredged Material in Estuarine Waters and Ocean Waters?

"Management techniques" include carefully designed and constructed confined aquatic disposal facilities. Four types of confined aquatic disposal facilities are in use:

1. Confined aquatic disposal (CAD) cells and capping

> The objective of confined aquatic disposal into CAD cells is to isolate the contaminated dredged material by disposal of the contaminated dredged material at a specific aquatic site and capping. The disposal can be in natural depressions in the seafloor, in borrow pits in the seafloor from mining operations (e.g., beach nourishment), or in specifically designed and constructed cells to contain the contaminated dredged material.

2. Level bottom capping

> Confined aquatic disposal can be accomplished via disposal of the contaminated dredged material on the seafloor, creating a mound, and capping it with clean material.

3. Nearshore confined disposal facilities

> A nearshore confined disposal facility (CDF) is a constructed in-water disposal site with containment structures or constructed dikes in the water, taking advantage of the shoreline as a dike. Numbers of nearshore CDFs have been constructed such that new land has been created for alternate uses, such as airports or port facilities.

4. Island confined disposal facilities

> Simply stated, an island CDF is a containment facility for dredged material in open water and is the same as a nearshore CDF except the island does not use the shoreline as a containment dike. Island CDFs can be created in such a manner to have multiple objectives, including habitat restoration and recreational opportunities.

A confined aquatic disposal facility including capping should be treated as an engineered project with carefully considered design, construction, and monitoring to ensure that the design is adequate. There are several factors which therefore must be carefully considered prior to approval of a confined aquatic disposal facility. These include potential water column impacts during disposal, efficacy of cap placement, and long term cap integrity for CAD cells and level bottom capping. For nearshore and island CDFs, important design factors include containment dikes, transport and disposal of material, site geometry and size, contaminant pathways, and dewatering and long term management.

What Countries are Using CAD cells, Nearshore CDFs, or Island CDFs?

A wealth of experience from around the world demonstrates successful use of confined aquatic disposal facilities for isolation of contaminated dredged material. *This is an important point*, addressing one portion of the concerns of Environment Canada regarding potential risks and liabilities.

The author believes that most industrialized countries have used nearshore CDFs for disposal of contaminated dredged material, although a number of these CDFs were created well before current definitions of what constitutes contaminated dredged material were in place. Less information is available on nearshore CDFs as an explicit management technique for disposal of contaminated dredged material; disposal of dredged material as fill material into nearshore CDFs to create new land has been a common practice for decades. A comprehensive survey would likely identify hundreds of projects that placed dredged material into nearshore CDFs to create new land.

From those countries surveyed for this report, countries that have used CAD cells for disposal of contaminated dredged material include: Netherlands, Hong Kong, Norway, United Kingdom, Australia, and USA. Germany, Japan, and Korea stated that they do not dispose of contaminated dredged material in ocean waters. There are a number of island CDFs in use today, including the Netherlands and the USA. A total of 34 confined aquatic disposal facilities were identified in the survey of countries.

What are the Advantages and Disadvantages of CAD Cells, Island CDFs, and Nearshore CDFs?

Confined aquatic disposal facilities represent an acceptable compromise when costs, regulatory acceptance, environmental risk, and public perception and acceptance are considered, and have a number of advantages over upland CDF disposal of contaminated dredged materials.

- Environmental and human health risk of confined aquatic disposal has been shown to be one of the lowest risk options, compared to upland disposal.

- The cost of island, nearshore, and upland CDFs can be 5-100 times higher than level bottom capping and CAD cells.

- Regulatory permitting agencies and natural resource agencies appear to find the case for use of confined aquatic disposal facilities compelling for isolation of the contaminants; however, nearshore and island CDFs consume bay or ocean bottom for disposal, resulting in less aquatic habitat on the bay or ocean floor. Regulatory agencies are not always all that keen to take bottom habitat out of service.

- When completed, island or nearshore CDFs may eventually be used for habitat or other uses such as recreational boating facilities.

- Experience to date has been that initial public concerns about disposal of contaminated dredged material in confined aquatic disposal facilities have been overcome through excellent analyses of the disposal alternatives and good communications. One of the concerns expressed by NGOs is that use of confined aquatic disposal facilities will result in insufficient attention placed upon preventing the contamination of sediments.

The advantages of confined aquatic disposal facilities as stated by the Port of Boston (USA):

> *"Cost effective. Environmentally sound. Confines impact of disposal to dredging footprint (the way we did it - not true for all projects). Acceptable (and strongly supported) by permitting agencies and NGOs."*

<u>What Practices/Policies are Governments using to Issue Permits for Disposal of Contaminated Dredged Material in Estuarine and Ocean Waters?</u>

Analysis of the information found on the internet and from the country responses shows striking similarities in practices and policies that are used in the overall approach to permit issuance and in the specific permit conditions. The general processes for ensuring that contaminated dredged material is disposed of properly minimizing environmental risk, and thereby government liability, include:

- <u>Preparation of environmental impact assessment</u>s-- Environmental impact assessments provide the basic foundation for predicting the potential harm to the bays, estuaries, or ocean water resources of proposed dredging and dredged material disposal projects. Key parts of an environmental impact assessment:
  - Baseline monitoring of the bay or estuary
  - Site selection
  - Engineering design of the confined aquatic disposal facility
  - Risk assessment

- <u>Establishment of an organization, setting procedures, and development of environmental management plans</u>--This area includes the government's initiation of the overall management structure to oversee the project, the development of management and operational criteria, the issuance of the permit itself including technical and public review, and the communication mechanisms with stakeholders

- Specific conditions in permits-- The specific conditions in permits are critical to minimizing the risks of environmental problems and government liabilities.

- Monitoring programs pre-, during-, post-dredging and disposal-- Requirements for monitoring programs are included in permits but are emphasized here, given their importance in the overall project to ensure that the environment is protected and that the integrity of the confined aquatic disposal facility is maintained.

A great deal of the report is dedicated to reporting the practices and policies used by various countries when issuing permits for disposal of contaminated dredged material disposal in confined aquatic disposal facilities. *This is the second important point.* There are important lessons in the level of attention and detail provided by those countries; the reader is encouraged to understand that risks and liabilities can be minimized through management actions by application of planning and operational considerations, similar to those followed by the reporting countries.

What are the Risks and Liabilities of Confined Aquatic Disposal?

The environmental risk is fairly straight-forward: contaminants could be distributed into the surrounding aquatic environments, including groundwater. The failure of the confined aquatic disposal facility could be the result of poor design or operation of the CAD cell or level bottom capping, the island CDF, or the nearshore CDF. Each of these facilities is designed based upon specific parameters, such as a containing structure/dikes, low energy environments, potential exposure pathways, or storm events.

The potential liabilities include simply: (1) negligent issuance of a permit that has inadequate conditions, and (2) responsibility to fix the problem with the confined aquatic disposal facility (e.g., repair a dike) (3) responsibility to clean-up the environmental problem resulting from the project (e.g., clean-up contaminants in the bay that leaked from the broken dike). The precise liability *depends* on a number of factors, including, but not necessarily limited to, existing legislation, regulations, permit conditions, and agreements between the permit issuing authority and dredging project sponsors.

Liabilities can be limited for the permit issuing authority through permit requirements and agreements with permittees. *This is the third important point.* Potential approaches for consideration by Environment Canada include the following as reported by the surveyed countries.

- The Netherlands stated that the federal government is responsible.

- The United Kingdom uses an informal approach with permittees to share liability.

- Hong Kong said that the government is the owner of the CAD cells and that their approach to limit risk and liability was to do a good upfront environmental impact assessment and apply management procedures and operational controls.

- The USA has several models depending upon the locality of the dredging project. In the USA, maintenance of federal channels into ports is the responsibility of the U.S. Army Corps of Engineers who is also the permit authority.

  1. For federal channels, the Corps authorizes (equivalent of a permit) itself to conduct the dredging and disposal (with review by other federal agencies and state agencies). In these cases, the Corps is carries the liability for the dredging and disposal.

  2. For dredging projects sponsored by port authorities, permits are issued to the port authority with boilerplate language which states that the U.S. government accepts no liability for the permitted action. In the case of the Newark Bay CAD cell, the permit required the Port of New York/New Jersey to procure an Owner Controlled Environmental Insurance Policy with a limit of $20,000,000 and a deductible of $100,000 relating to the construction, operation, management, and eventual closure of the Newark Bay CAD cell.

     For private parties (e.g., an oil and gas terminal) to use the Newark Bay CAD cell, they were/are required to sign an extensive agreement with the Port of New York/New Jersey which ensures that the full risk and liabilities of using the site for disposal of contaminated dredged material was carried by the users. The Port of New York/New Jersey allows private sponsors to use the CAD cell through a signed agreement. The agreement requires extensive insurance for private users of the site.

  3. In one case, the Corps of Engineers delegated responsibility for operation and maintenance of the CAD cells to the State of Rhode Island, which then issued permits for private users, charging fees depending upon the amount of contaminated dredged material disposed in the CAD cells.

<u>Are Fees Charged to Permit Applicants for Disposal of Contaminated Dredged Material?</u>

In short, all countries collect fees for the issuance of a dredging and disposal permit. Fees vary by country.

- Only one country (i.e., the Netherlands) stated that it collected fees for permit administration and for insurance objectives, to address future liability issues associated with maintenance of the confined aquatic disposal facilities or clean-up; however, the fees are only 1 to 2 Euros per cubic meter of dredged material disposed. It was noted that the amount of fees are low relative to the potential long term scenarios, are more symbolic than realistic, and go into the government treasury.

- Hong Kong collect fees but they do not serve any type of insurance purpose.

- The Corps of Engineers permit fee in the USA is $100. Thus, no funds are provided for insurance objectives for the federal government. In the case of the Providence River CAD cell, the State of Rhode Island is responsible for management and monitoring. The state charges fees for use of the site on a sliding scale from $12 to $25 per cubic yard of dredged material placed in the CAD cell. The state collected fees are used by the state program primarily for management and monitoring the Providence River CAD cell, and also for coastal resources management.

What are the Lessons Learned?

In terms of lessons learned, the following quotes are instructive:

Netherlands: Regarding liability, the representative of the Netherlands stated:

> *"If anything goes wrong. The government pays. The amount of money is about 1 to 2 euro per cubic meter. We have disposal sites for 20 to 30 years now. And never anything went wrong."*

USA: The representative of the State of Rhode Island who is manager of the CAD cells in Providence River responded to the inquiry on liability with a statement of confidence in well designed CAD cells that there is not much that can go wrong:

> *".....not much to break......not many moving parts."*

When asked for lessons learned and suggestions for Environment Canada to consider, the representative of the Port of Boston said:

> *"We thought it worked great and have used our initial project as a model for a maintenance dredging/disposal project that we completed last summer. Make sure you conduct borings in advance to fully understand subsurface conditions and CAD cell capacity (i.e. slope of side walls and depth to bedrock or other hard bottom will greatly affect cell capacity.)"*

Section 1
Introduction

Environment Canada is considering whether to issue permits for disposal of contaminated dredged material into ocean and coastal (i.e., estuarine waters), provided that specific "disposal management techniques" are used to prevent marine pollution. Recent modifications to the international treaty on disposal of wastes into ocean waters (i.e., London Convention 1972 and the 1996 Protocol) recognize that this is an acceptable approach for management of dredged material. Canada has been a member of the 1972 Convention since the 1970s and Canada ratified the 1996 Protocol in 2000. The 1996 Protocol came into force in 2006 (London Convention 1996 Protocol).

After conducting a major assessment of progress and review of needed mid-course corrections among members of the London Convention, the treaty was modified and updated to address lessons learned since the treaty came into effect in the 1970s. One of the modified provisions included in the 1996 Protocol allows for the disposal of contaminated dredged material in ocean waters but only if management techniques are used to prevent marine pollution (London Convention: Specific Guidelines). The London Convention previously only allowed disposal at sea of "clean" dredged material (i.e., any contamination in the dredged material could not exceed specific action levels that protect against toxicity and other deleterious effects upon the ocean environment and human health).

Environment Canada commissioned this study to undertake a review of practices and policies used by other jurisdictions to manage and monitor the disposal of contaminated dredged material into ocean and estuarine waters. The study targeted those countries that are members of the London Convention/Protocol. Environment Canada is particularly interested in the environmental, financial, and legal risks and liabilities and what procedures are used to manage and minimize risks and liabilities to the government.

Requests for information on these issues were sent to a total of 13 countries and information from 10 of those countries is included in this report. Information on the internet was also an excellence source. The results of this study are part of a larger effort, the overall objective of which is to assist Environment Canada in if permits should be issued for disposal of contaminated dredged material in ocean/estuarine waters.

Project Approach and Methodology

The methodology to collect the information followed time-tested procedures.

- An internet search of targeted countries to find whatever information exists online on their disposal practices and policies for contaminated dredged material into ocean and estuarine waters.
- The information gained in the internet search assisted in developing an email sent to each of the targeted London Convention member countries requesting the types of information listed. See the questionnaire in Appendix 1.

- Follow-up emails and telephone meeting(s) were conducted to either encourage country representatives to respond to the email request from Environment Canada or to clarify what information had been provided.
- The information provided was then summarized into a draft report and provided to Environment Canada for review.
- After incorporating Environment Canada comments, the final report was transmitted to Environment Canada.

The countries for which information was requested included the following:

Australia	Netherlands
Brazil	Norway
China	South Korea
Germany	Spain
Hong Kong, China	United Kingdom
Italy	USA
Japan	

Information from 10 of these countries is included in the report. Information was not available from Brazil, China, or Italy.

In the context of this study, Environment Canada is evaluating disposal options in ocean waters and coastal waters (*i.e., coastal waters in this report are estuaries up to the maximum extent of salinity at high tide, low flow conditions, include the intertidal zone up to high water mark).* Environment Canada regulates ocean disposal of wastes in internal estuarine waters, as defined above, the same as ocean waters.

Almost 100% of the experience by reporting countries that use management techniques for disposal of contaminated dredged material in ocean and coastal waters has occurred within estuarine waters. Only one country to date, United Kingdom, reports disposal in ocean waters using management techniques. Therefore, as reported in the text of this report, the experience base by other countries in estuarine waters provides the bulk of available information.

Section 2
What "Management Techniques" are used for Disposal of Contaminated Dredged Material in Estuarine Waters and Ocean Waters?

The intention of the London Convention/Protocol provision for use of "management techniques" is to prevent marine pollution from disposal of contaminated dredged material in ocean waters. There are four management techniques in use today by London Convention/Protocol countries, all of which isolate the contaminants from the surrounding environment. These "management techniques" include carefully designed and constructed confined aquatic disposal facilities.

The four types of confined aquatic disposal facilities are discussed below and displayed in Figure 1. Other management techniques are theoretically possible, but were not identified in this work effort. Certainly, disposal at sea of contaminated dredged material in a high energy environment with the intent of "dilution is the solution" would not be appropriate. The four management techniques, collectively termed confined aquatic disposal facilities in this report, include:

1. Confined aquatic disposal cells with capping
2. Level bottom capping
3. Nearshore confined disposal facility
4. Island confined disposal facility

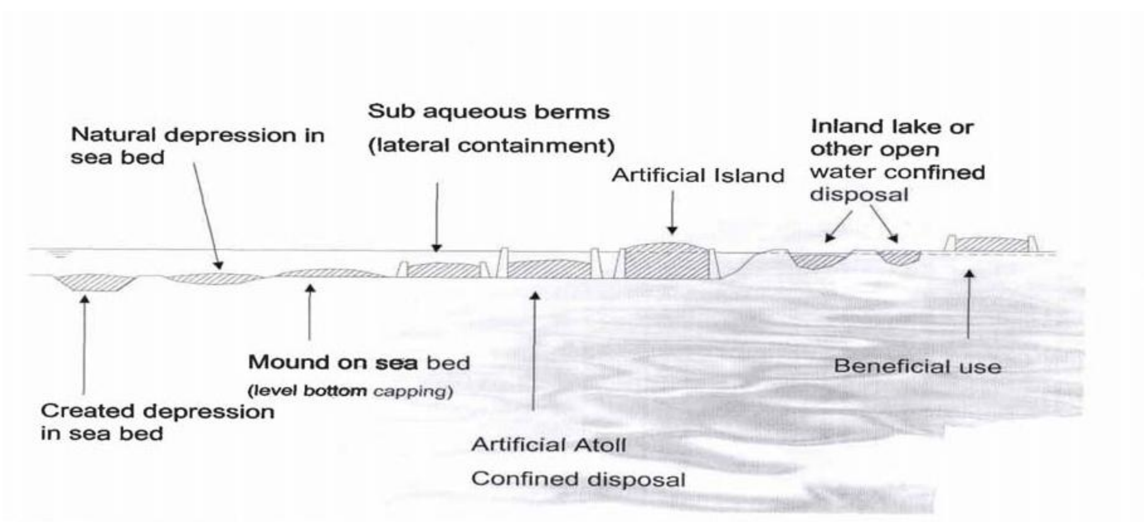


Figure 1 Confined Aquatic Disposal Facilities (Vivian 2007)

What are CAD Cells? What is Capping?

The objective of confined aquatic disposal into confined aquatic disposal (CAD) cells is to isolate the contaminated dredged material by disposal of the contaminated dredged material at a specific aquatic site and capping. The disposal can be in natural depressions in the seafloor, in borrow pits in the seafloor from mining operations (e.g., beach nourishment), or in specifically designed and constructed cells to contain the contaminated dredged material.

Capping is the controlled placement of clean material over the contaminated dredged material to effectively isolate it from the surrounding environment.

What is Level Bottom Capping?

Confined aquatic disposal can be accomplished via disposal of the contaminated dredged material on the seafloor, creating a mound, and capping it with clean material (termed level bottom capping). Similar to CAD cells, this option would only be appropriate in extremely low energy environments where currents or wave action would not erode the cap.

What are Nearshore Confined Disposal Facilities (nearshore CDF)?

A nearshore confined disposal facility (CDF) is a constructed in-water disposal site with containment structures or constructed dikes in the water, taking advantage of the shoreline as a dike. Numbers of nearshore CDFs have been constructed such that new land has been created for alternate uses, such as airports or port facilities.

What is an Island Confined Disposal Facility (island CDF)?

Simply stated, an island CDF is a containment facility for dredged material in open water and is the same as a nearshore CDF except the island does not use the shoreline as a containment dike. Island CDFs can be created in such a manner to have a number of objectives including habitat restoration and recreational opportunities.

Other management techniques are theoretically possible, but were not identified in this work effort. Certainly, disposal at sea of contaminated dredged material in a high energy environment with the intent of "dilution is the solution" would not be appropriate.

What are the Key Parameters to Understand the Management Techniques [Note: the material below is extracted directly from Palermo 2000; see also USACE CDF Features 2000]?

CAD Cells and Capping, and Level Bottom Capping

Capping is a contaminant control measure to isolate the contaminated dredged material to prevent impacts to the marine environment. Dredged material capping requires initial disposal of a contaminated material at an open water site. A capping operation should be treated as an engineered project with carefully considered design, construction, and monitoring to ensure that the design is adequate. There are several issues which therefore must be carefully considered within the context of a capping project design. These include:

- *Potential water column impacts during disposal*. The assessment should consider evaluation of potential release of contaminants to the water column, evaluation of potential water column toxicity, and evaluation of initial mixing.

- E*fficacy of cap placement.* The assessment should consider available capping materials, methods for dredging and disposal of contaminated material and placement of cap material, and compatibility of site conditions, material physical properties, and dredging and placement techniques.

- *Long-term cap integrity.* The assessment should consider the physical isolation of contaminants, potential bioturbation of the cap by benthic animals, consolidation of the sediments, long-term contaminant losses due to advection/ diffusion, and potential for physical disturbance or erosion of the cap by currents, waves, and other forces such as anchors and ship traffic.

Other considerations include:

- Evaluation of the feasibility of capping include site bathymetry, water depth, currents, wave climate, physical characteristics of contaminated and capping sediments, and placement equipment and techniques.

- Because long-term stability of the cap is of concern, capping is generally considered to be more technically feasible in low-energy environments.

- Precise placement of material is necessary for effective capping. Equipment and techniques applicable to disposal of contaminated material to be capped and clean material used for capping include conventional discharge from barges, hopper dredges, and pipelines; diffusers and tremie approaches for submerged discharge; and spreading techniques for cap placement.

Among the operational criteria that must be considered in evaluating potential capping sites are:

- The site volumetric capacity, nearby obstructions or structures, haul distances, bottom shear as a result of ship traffic (in addition to natural currents), location of available cap material, and potential use of bottom drag fishing equipment.

- The effects of shipping are especially important, since bottom stresses, because of anchoring, propeller wash, and direct hull contact at shallow sites, are typically of a greater magnitude than the combined effects of waves and other currents.

Nearshore and Island CDFs

There are several factors that must be fully considered for nearshore and island CDFs:

- *Retaining dikes.* The site conditions must allow for construction of structurally and geotechnically sound retaining dikes for long-term containment of dredged material solids and contaminants. The dike face will also be exposed to erosional forces due to currents and wave action, and some form of armor protection would normally be considered.

- *Transport and disposal of material.* Nearshore sites have waterfront access by definition. Material can be transported from dredging areas to a nearshore site by barge and directly offloaded to the site by mechanical rehandling or by hydraulic reslurry operations. Disposal by direct pipeline from hydraulic dredges is feasible if the site is located near dredging areas.

- *Site geometry and sizing* . The site must be volumetrically large enough to meet both short-term storage capacity requirements during filling operations and long-term requirements for the anticipated life of the site. Sufficient surface area and dike height with freeboard must be available for retention of fine-grained material that may be resuspended during filling or storm events.

- *Contaminant pathway controls.* Provisions for control of contaminant release through any of several pathways must be considered in the site design.

- *Dewatering and long-term management*. A nearshore site can be managed for dewatering of material above mean high high water (i.e., average highest tide). Dewatering of material in the saturated zone is limited by consolidation processes. If material is mechanically offloaded from the barge to the CDF, additional water is reduced compared to hydraulic offloading. An impermeable barrier to groundwater flow to divert groundwater flow from the shoreline into the CDF may be beneficial for some sites.

Section 3
What Countries are Using Confined Aquatic Disposal Facilities as a "Management Technique"?

Table 1 presents a summary those countries surveyed for this report that use confined aquatic disposal facilities. Brief descriptions by country are provided below.

The author believes that most industrialized countries have used nearshore CDFs for disposal of contaminated dredged material. Disposal of dredged material as fill material into nearshore CDFs to create new land has been a common practice for decades. Less information is available on nearshore CDFs as an explicit management technique for disposal of contaminated dredged material because it has been such a common and effective practice. The author notes that many of these CDFs were created well before current definitions of what constitutes contaminated dredged material were in place. A comprehensive survey would likely identify hundreds of projects that placed dredged material into nearshore CDFs to create new land.

From those countries surveyed for this report, countries that have used CAD cells for disposal of contaminated dredged material include: Netherlands, Hong Kong, Norway, United Kingdom, Australia, and USA. In addition, there are a number of island CDFs in use today, including the Netherlands and the USA. A total of 34 confined aquatic disposal facilities were identified in the survey of countries that explicitly received contaminated dredged material.

Netherlands

Of the anticipated 900 million cubic meters of dredged material to be dredged up to the year 2015, the Netherlands estimates that 200 million cubic meters will be contaminated and not acceptable for open water disposal. Approximately 800 million cubic yards will be for navigation objectives and 100 million for clean-up objectives (Laboyrie 2008).

The Dutch policy on handling of contaminated dredged material is:

- prevent future development of contaminated sediments;
- beneficial use of contaminated dredged material;
- use simple treatment techniques for contaminated dredged material for instance by using sand separation basins; and
- store the contaminated dredged material in large scale confined disposal facilities.

The Dutch have and continue to use a number of confined aquatic disposal facilities as listed below:

• Lake Ketelmeer (IJsseloog)	Island CDF
• Hollandsch Diep (see Figure 3)	Island CDF
• Pit Kaliwaal	CAD cell
• Slufter (See Figure 4)	Nearshore CDF

- Haringvliet — Level bottom capping
- Limburg — CAD cell in an old borrow pit.
- Averijhaven — Tidal waters
- Amsterdam: — CAD cell
- Rotterdam — Borrow pit
- Julianakanaal — CAD cells

Until recently, use of CDFs for storage of CDM was practically impossible because of environmental concerns about impacts upon the surrounding surface water. New insights into the leaching and release of contaminants during disposal indicate lower potential impacts than previously thought. Continuing research in the Netherlands on the handling of contaminated dredged material will focus upon:

- relevant effects and processes in a pit;
- measures to reduce the effects;
- optimal disposal methods; and
- acceptance criteria.

Acceptance criteria for emissions from CDFs for dredged material are in accordance with the ALARA principle (As Low As Reasonably Achievable). In certain cases to protect against contamination of the surrounding surface and ground water, the CDFs are lined with clay/clayey material rich in organic matter.

Figure 2 Island CDF at IJsseloog (Labyorie, Polite; Sednet 2008)

The Island CDF IJsseloog in Figure 2 was designed to hold 23 million cubic meters of dredged material. To reduce the flux of contaminants from the CDF with seepage, the surface area of the CDF was kept as small as possible: it consists of a 45 meter deep round pit with a 10 meter dike around it. This ensures consolidation of the contaminated dredged material to high densities and reduces the flux of contaminants even further.

A recent New Bulletin: *Hollandsch Diep dredging spoil disposal site provides region 20 years of storage capacity:*

Rotterdam, 2 October 2008 – Today was the official opening of the dredging spoil disposal site in the Hollandsch Diep, a section of river linked to the Rhine and the Meuse. The Dutch Department of Public Works can now store polluted dredging spoil from the lower reaches of the rivers at the site. Forecasts are that it will be twenty years before the site is full. At that point, it will contain an estimated 10 million m^3 *of polluted sediment. Once the site is full, it will be covered with clean soil and turned into a nature area.*
The Sassenplaat Consortium, of which Van Oord Nederland is a member, began working on the design for the dredging spoil disposal site in December 2005. The consortium partners spent the next two and a half years digging the site – which measures 1300 m in length and 500 m in width – next to Sassenplaat Island, a nature reserve. They also constructed dykes and grounds for facilities. At about 32 m depth, the site can store approximately 10.2 million m^3 *of spoil.*

Hollandsch Diep is shown in Figure 3. In addition to the site construction, the project also involved expanding the Sassenplaat nature reserve, replenishing the Hoogezandsche Gorzen mud flats and covering 590 hectares of polluted bed.
http://www.vanoord.com/webfront/base.asp?pageid=515

Figure 3 Hollandsch Diep Island CDF

To maintain adequate port facilities, 15 to 20 million m^3 of sediments are dredged per year. The relocation of this dredged material to the North Sea, the preferred disposal option, is regulated by a set of chemical criteria, the so-called Sea/Slufter limits. Dredged material exceeding these limits, mainly sediments from the eastern port areas (and partly from the Botlek area), has to be disposed of in a confined site, the Slufter. See Figure 4.

Figure 4 Slufter Nearshore CDF (Rotterdam Feb 2001)

Australia

Dredging in Australia generally does not have problems with contaminated dredged material, but there is one good example of the permitting and use of a CAD cell.

Beginning in 2008, a total of 22.9 million m^3 of material is being dredged from the existing shipping channels as part of the Port of Melbourne Channel Deepening Project (www.channelproject.com).

Contaminated materials dredged will be confined within an underwater clay containment area known as a ‘bund’ (i.e., CAD cell), at the Port of Melbourne Dredged Material Grounds disposal site (DMG), and capped with clean dredged sand. This will seal them off to prevent any adverse influence on water quality. Capping will not occur until sufficient settling of the sediment has occurred (about 140 days). A specialized pipeline fitted with a diffuser will lower the material directly to the seabed to reduce the potential for dispersion.

The contaminated dredged material is placed 15 meters under water, and, at this depth, wind and currents generally do not affect the sea floor and therefore the sediments are not moved by winds or tides.

The Port's approach to capping is similar to those in Boston Harbor, Providence, and Hong Kong. The site in Port Phillip Bay is within a pre-existing site that has been used for decades for disposal of dredged material.

Over two years of investigation into the marine assets of the Bay has resulted in the development of the Supplementary Environment Effects Statement. As part of that process, detailed studies into the existing conditions of the bays natural assets and assessment of potential impacts from project works were undertaken.

The outcome of these studies, plus a detailed risk assessment, played an integral part in the development of the project, including technology selection, work methods and the development of the Environmental Management Plan and monitoring program.
The Environmental Management Plan (see Appendix 6), prepared by the Port of Melbourne Corporation, sets out the environmental safeguards required to protect bay assets during dredging. It consists of a combination of regulatory controls, environmental controls, project delivery standards and environmental monitoring to do this.

Importantly, the Environmental Management Plan is subject to continual audit and review to ensure that its aim of minimizing environmental impacts is achieved.

A variety of monitoring programs will be implemented during the project and many will continue after the projects completion to monitor the recovery process and allow for the continued protection of the unique environmental assets of the bay. Environmental monitoring will be conducted through two main monitoring programs:

- Environmental Management Plan Monitoring Program: monitoring of environmental conditions such as turbidity and noise from dredging operations.
- Baywide monitoring program: monitoring of bay wide environmental conditions, such as water quality and seagrass.

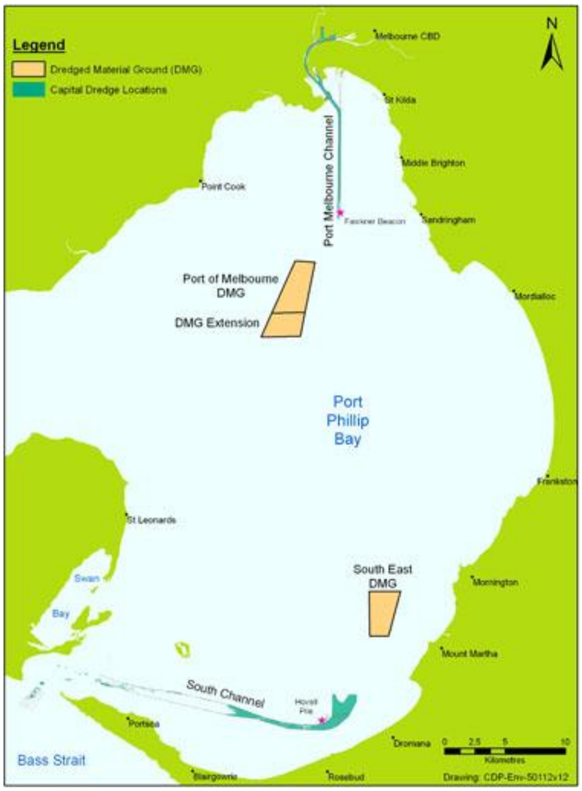


Figure 5 Port of Melbourne DMG Bund Site

Inspections and surveys of operational activities, physical conditions and post-construction environmental conditions will also be conducted, as well as monitoring of the implementation and effectiveness of the integrated management system.

An independent monitor has been appointed by the Minister of Environment and Climate Change to advise on the delivery of the project, and associated monitoring programs, in accordance with the Environmental Management Program. Data from more than 20 monitoring programs operating across Port Phillip Bay is routinely examined by the Office to detect any changes to its health.

Norway

Through a joint effort of the Municipality of Oslo, including the Oslo Harbour Authorities, Norwegian Road Administration and Pollution Control Authorities, a plan for remediation of Oslofjord has been implemented. After 15 years of assessments, laboratory and field studies, as well as political debate, the solution which was selected includes dredging the shallow parts of the harbor down to 15 meter water depth (700,000 cubic meters), capping the deeper parts of the harbor (1 million square meters), as well as construction of a deepwater confined disposal facility for the dredged material in Oslofjord. The dredging and disposal began in February 2006 (Oen, Seatac Conference).

The contaminated sediments are removed by dredging and deposited at the deepwater site Malmøykalven at 70 meters water depth (Figure 6).

In less shallow waters of the inner Oslofjord, the contaminated sediments will be covered by clean soil masses, in order to minimize the swirling up and spreading of contaminated sediments by the boat traffic.

The contaminated sediments in Oslo Harbour are not classified as special category waste, which has a much higher concentration of poisonous substances. The total mass volume in the Oslofjord project that will be dredged and deposited is about 600,000 m3. This volume corresponds to about two times the volume of Ullevaal Stadium (which has a capacity of about 25,000 spectators) filled up to the uppermost tribune. It is not practically possible to separate the different poisonous substances from such huge volumes of contaminated soil. A careful and controlled disposal of these sediments is therefore the most appropriate solution.

Figure 6 Malmøykalven, CAD cell at 70 m water depth (Jorgensen 2008)

The contaminated layer varies in thickness from 0.1 to 4.5 m consisting of among others cadmium (Cd), mercury (Hg) and PCB. Most of the mud consists of contaminated organic material. The removal of the contaminated sediments ($\approx$ 650,000 m^3) in the shallow parts of the harbor will be dredged and stored in a deep water confined aquatic disposal facility (CAD cell) in the inner parts of the Oslofjord. The deeper zones ($\approx$ 1,000,000 m^2) will be capped using clean clay recovered from the tunnel construction project. The sediments are being dredged using a specially designed closed grab in order to minimize resuspension. The material is then transported by a barge to the site of the CAD cell and pumped down to 70 meters using a submerged tremie tube. To supervise the operations at the site, an extensive control and monitoring program is being implemented. (http://www.sednet.org/download/conference2008/4%20Torild%20Jorgensen.pdf)

<u>Spain</u>

In Spain, contaminated dredged material is either disposed in an upland CDF or in nearshore CDFs. Legislation does not allow contaminated dredged material to be disposed in ocean waters, even with management techniques at this time. It is possible to consider the dumping of material with moderate degree of pollution (class II) under a special permit issued by the Spanish Merchant Marine Directorate of the Infraestructures Ministry. The applications for this special permit should include an assessment of the environmental impacts (Impact Hypothesis), studies to select the disposal site, and a monitoring program. The contaminated sediments usually are managed in specific CDF or in land. When the CDF is built within a harbour (as it is usual), the Port Authority issues the permit and has the control and monitoring (Jose Buceta email). Examples of nearshore CDFs in Spain are shown in Figures 7 and 8.

Figure 7 Nearshore CDFs in Spain

Figure 8 Nearshore CDF in Spain

United Kingdom

The United Kingdom reported on two projects that use confined aquatic disposal facilities, Port of Tyne and a small marina in Falmouth, England. The Port of Tyne project is the only dredged material disposal project identified by this study using a confined aquatic disposal site in ocean waters.

The Port of Tyne originally applied for the disposal of 500,000 tons of dredged material to sea from 9 sites within the estuary of the River Tyne (Figure 9). [Note: much of the information on the Port of Tyne project is directly extracted from Vivian 2007).] The applicants had undertaken contaminant analyses of the material and showed that up to 160,000 m^3 (~224,000 tons) of it was grossly contaminated with the anti-fouling agent tributyltin oxide (TBT) and heavy metals. Contaminants were above those levels that the UK would normally allow for disposal to sea. Management options for the material were proposed. Following consultation on the application and taking into account overriding socio-economic needs for the area, a trial capping project to deal with approximately 60,000 m^3 of the of the contaminated dredged material was agreed. All the capping options both inshore and offshore were discussed and level bottom capping offshore was determined to be a favored option. Offshore of the Tyne are two disposal sites North Tyne (TY070) and Souter Point (TY081). Rather than impact a new area and to minimize interference with other users and fisheries, it was decided that the existing disposal site at Souter Point should be used for the site of the project (Vivian, ANNEX Page 4, 2007).

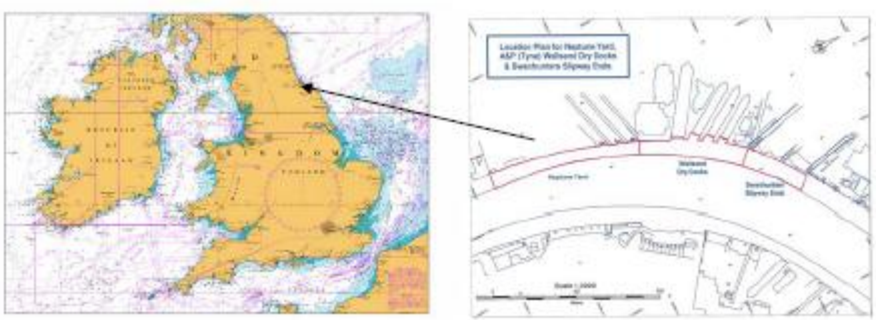


Figure 1 – Priority dredge areas in the River Tyne

Figure 9 Priority Dredge Area in the River Tyne

The aims of the trial were as follows:

- To accurately delineate areas, depths and volumes of contaminated dredged material to be removed from three priority docks in the Tyne Estuary (Wallsend Dry Docks, Neptune Quay and Swan Hunters − Slipway Ends).
- To determine the physical and chemical characteristics of the contaminated dredged material.
- To remove the contaminated dredged material from priority docks utilizing dredging techniques that retains the material in discrete solid blocks.

- To accurately place contaminated dredged material blocks in a delineated area of the Tyne Souter disposal grounds.
- To cover the contaminated dredged material with a pre-designed cap, based on methods used by the US Army Corp of Engineers USACE June 1998).
- To monitor the integrity of the cap, and to produce a UK guidance note on the procedure.

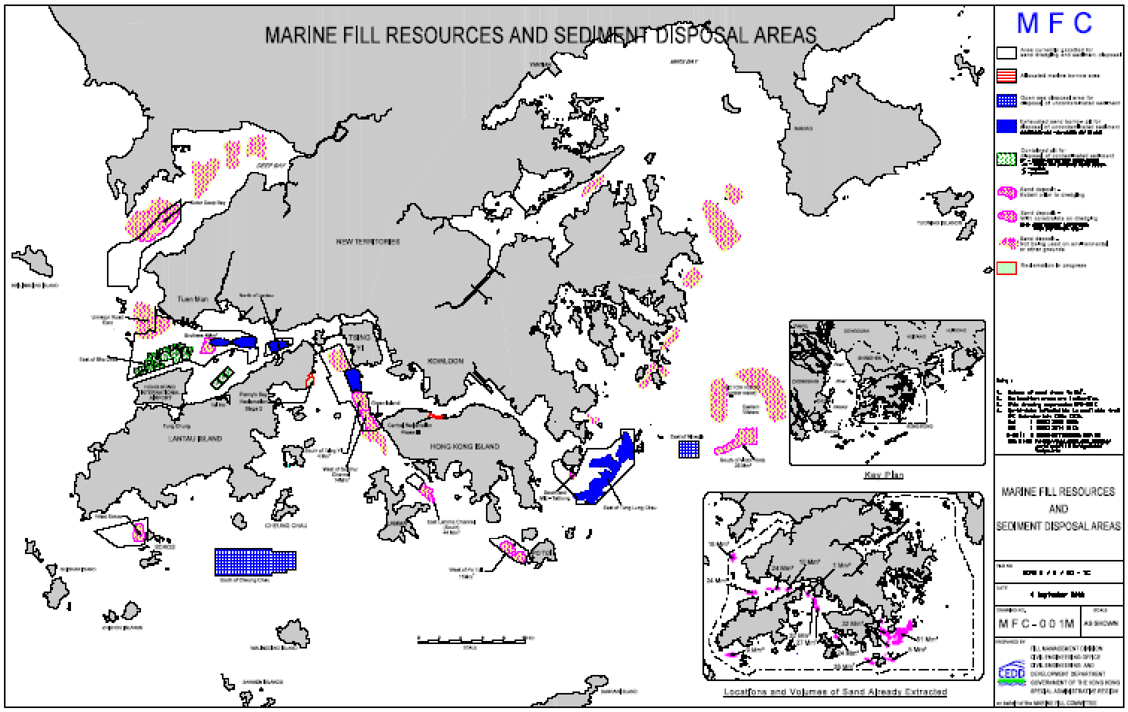
The overall objectives of the monitoring program were to assess and verify whether operations had met these requirements, to determine the level of success of the trial, and to provide information for the development of best practices.

In Falmouth, southwest England, a small marina received a licence to bury contaminated surface sediments by digging a trench, storing the contaminated surface layer and uncontaminated deep sediments separately on barges, replacing the contaminated surface sediment at the bottom of the trench and covering it with the uncontaminated deep sediments. A series of trenches were dug sequentially across the marina to deal with the contaminated area. Surplus clean material was to be disposed of at the usual disposal site.

Hong Kong, China

Use of CAD cells in Hong Kong began in the early 1990s for disposal of contaminated dredged material and continues today (see Figure 10). Much of the material presented below is extracted directly from Whiteside, P; Ng, K; Lee, W. "Management of Contaminated Mud in Hong Kong;" Terra et Aqua 65: 10-17. 1996.

Marine sediments in Hong Kong, polluted by industrial and domestic wastes, have to be dredged for reclamation foundations and navigational purposes. Using concentrations of seven metallic elements, the Environmental Protection Department categorizes the sediments as suitable for open sea disposal or as requiring contained marine disposal. Since late 1992, special pits dredged 15 meters below the seabed in a sheltered area of 5 meters water depth have been used for the disposal of the contaminated material (see Figure 11). The pits are filled to within 3 meters of the seabed and then capped in three stages: 1 meter of sand, 2 meters of clean mud, and finally, after the pit infill has consolidated, a further 1-2 meters of clean mud. The latter is soon recolonized by benthic fauna. Approximately 10 million m^3 of contaminated mud have already been disposed of in a series of small pits. The total cost of the facility amounts to about US$7/$m^3$. Although most dredging of the contaminated mud has been by grab, and most disposal by bottom dumping barges, an increasing use of trailer dredgers is expected. A 24-hour on-site management team directs and supervises the in-coming vessels, and there is a comprehensive program of environmental and ecological monitoring covering sediment, water, biota and ecotoxicology.



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GOVERNMENT OF THE HONG KONG
SPECIAL ADMINISTRATIVE REGION

on behalf of the MARINE FILL COMMITTEE

Figure 10 Hong Kong Dredging and Disposal Sites
(CAD Cells in Green)

An estimated 30 million m^3 of this contaminated mud will have required disposal between 1991 and the year 2000 as part of Hong Kong's program of port, airport and urban developments. The design of the cap was based upon the following: if the highest contaminated mud level was 9 meters below sea level, the possibility of remobilization of contaminated sediment was acceptably low, and if the pit cap was at least two meters thick the risk of complete erosion of a cap was negligible. In addition, seismic boomer surveys of the Holocene sediments in the area suggested that the maximum depth of natural scour of the seabed during the last several thousand years was about 1 meter, and so this thickness of mud cap should not erode even under extreme storm events not experienced for the 150 years during which records have been kept in Hong Kong. It was also important to preclude the possibility of burrowing organisms reaching the contaminated mud, which is commonly less than 0.5 meters thick.

The final cap design took account of the requirements discussed above and also practical considerations mostly related to construction. The cap comprises a nominal 1 meter thick layer of sand which sinks differentially into the surface of the contaminated mud to densify the surface layer and, importantly, provides a valuable marker horizon for later coring of the completed caps. The second and most important part of the capping, is the nominal 2 meters thick layer of clean (i.e. uncontaminated) mud. The third part of the capping takes place about 1 year later, after the pit infill has consolidated, and it involves placing a further layer of clean mud 1 to 2 meters thick to bring the upper surface of the cap up to the same level as the surrounding seabed. The resulting 3 to 4 meters thick layer of clean mud provides a barrier over the contaminated mud and isolates it from any future contact with the marine environment.

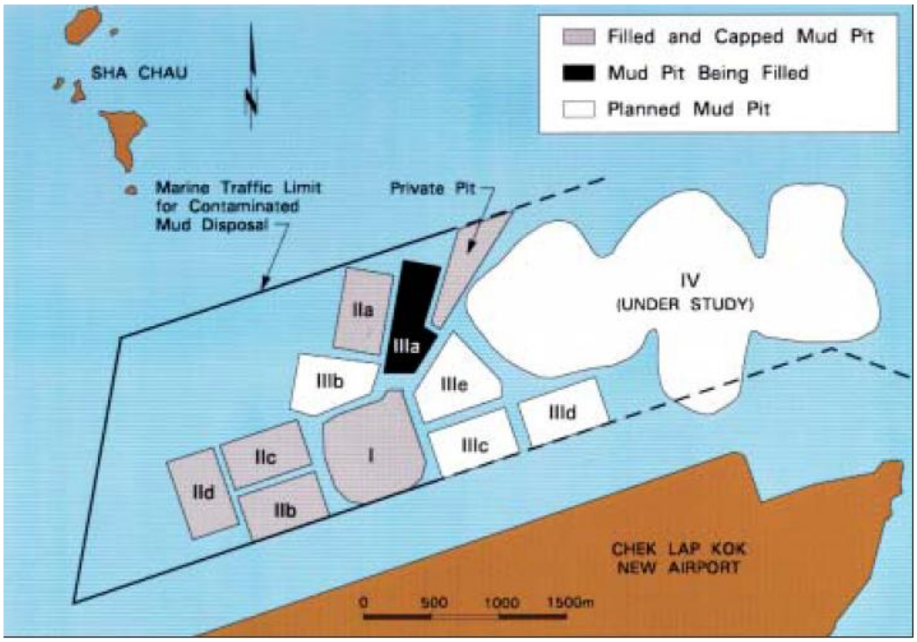

Figure 11 Hong Kong Pits East Sha Chau CAD Cells

Environmental monitoring of the East Sha Chau area commenced in October 1992 prior to the disposal of contaminated mud, and since then has evolved and developed into a very comprehensive program of physical, chemical and ecological monitoring. Apart from continued monitoring while pits are being filled and capped, the environmental monitoring of the site will continue until at least two years after the completion of the last disposal and capping operations at East Sha Chau. The environmental monitoring program now covers sediment and water quality, aquatic biota and ecotoxicology. The monitoring, which is carried out independently of the disposal operations, is in two parts –cumulative impact monitoring and pit-specific compliance monitoring.

Great Lakes: Canada and USA

Since the 1960s, the Corps of Engineers has constructed 40 confined disposal facilities around the Great Lakes. Of the total number of Great Lakes CDFs in the USA, 14 were constructed on land and 26 were built as nearshore CDFs. Those nearshore CDFs average 112 acres (45 ha) in size whereas the upland sites are considerably smaller, averaging 36 acres (14.5 ha). In Canada, 12 nearshore CDFs have been constructed.

About half of the material dredged from the Great Lakes each year is considered polluted or otherwise not suitable for open water disposal and placed in confined disposal facilities. This amount, averaging around 2.5 million cubic yards (1.92 million cubic meters) would fill 500,000 standard dump trucks and if parked end-to-end, the line of trucks would stretch from Windsor, Ontario, to Spokane, Washington. (Thorp, Steve 1996)

USA

Use of CAD cells, island CDFs, and nearshore CDFs in the USA is a commonly accepted approach to disposal of contaminated dredged material. Provided below is a list of sites and a brief description. The complete list for the USA in Table 1 is close to comprehensive for disposal of contaminated dredged material into CAD cells and island CDFs, but is not exhaustive. Nearshore CDFs are much more difficult to identify and track because they have been used for decades and likely received contaminated dredged material, but few records were kept and as mentioned before, criteria for what is "contaminated" have changed over the years.

Boston, Massachusetts, CAD Cells

The Boston Harbor Navigation Improvement Project, a joint project between the US Army Corps of Engineers and the Massachusetts Port Authority (Port of Boston, involved both maintenance and improvement dredging of Boston's Inner Harbor, its tributary channels, and berth areas. The overall project included dredging of approximately 2 million cubic yards of material from the Harbor with disposal of 800,000 cubic yards (1 million cubic meters) of contaminated dredged material into in-channel containment cells and disposal of clean sediments offshore at the Massachusetts Bay Disposal Site. Nine cells were constructed, located in the channel area of the Mystic and Chelsea Rivers (see Figure 12). The State Water Quality Certification required 3.3 feet (1 meter) layer of sand after completion of disposal as the cap.

As the project progressed, the Corps of Engineers learned from their initial experiences that the cap cannot be placed over the contaminated dredged material too soon. They found that consolidation was not sufficient to keep the cap from mixing with the contaminated dredged material until about 140 days after disposal. Of all the countries reporting on their confined aquatic disposal facilities, this issue of when to place the cap was the only problem identified by the survey. The problem was corrected in later disposal and capping operations by increasing the consolidation period before capping.

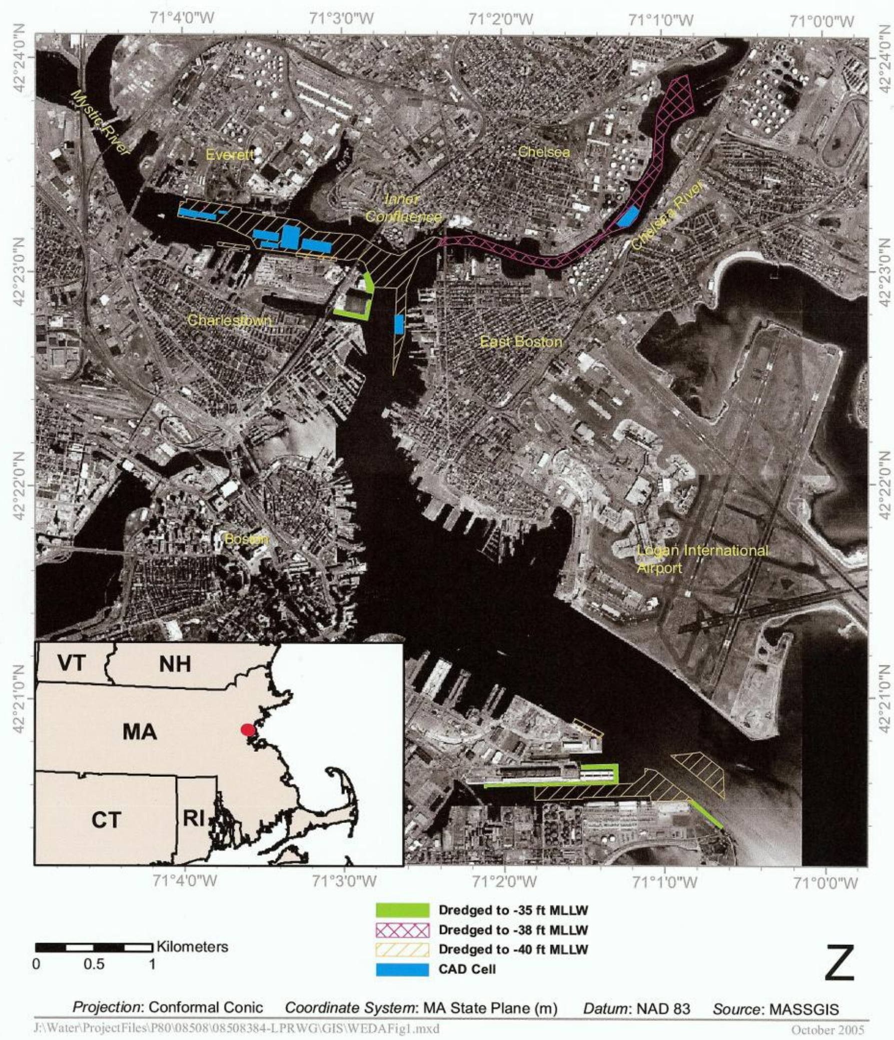

Figure 1. Boston Harbor Navigation Improvement Project dredged areas and CAD cells.

Figure 12 Boston Harbor Deepening In-Channel CAD Cells

<u>Providence, Rhode Island, CAD Cells</u>

A joint project between the Corps of Engineers, the state of Rhode Island Coastal Resources Management Council, and the Rhode Island permitting agency, Department of Environmental Management, dredging to maintain the federal channel of almost 4 million cubic yards was initiated in 2002. Approximately 1.1 million cubic yards was determined not to be suitable for open water disposal, and CAD cells were constructed in the Providence River channel to isolate the contaminated dredged material (see Figure 13).

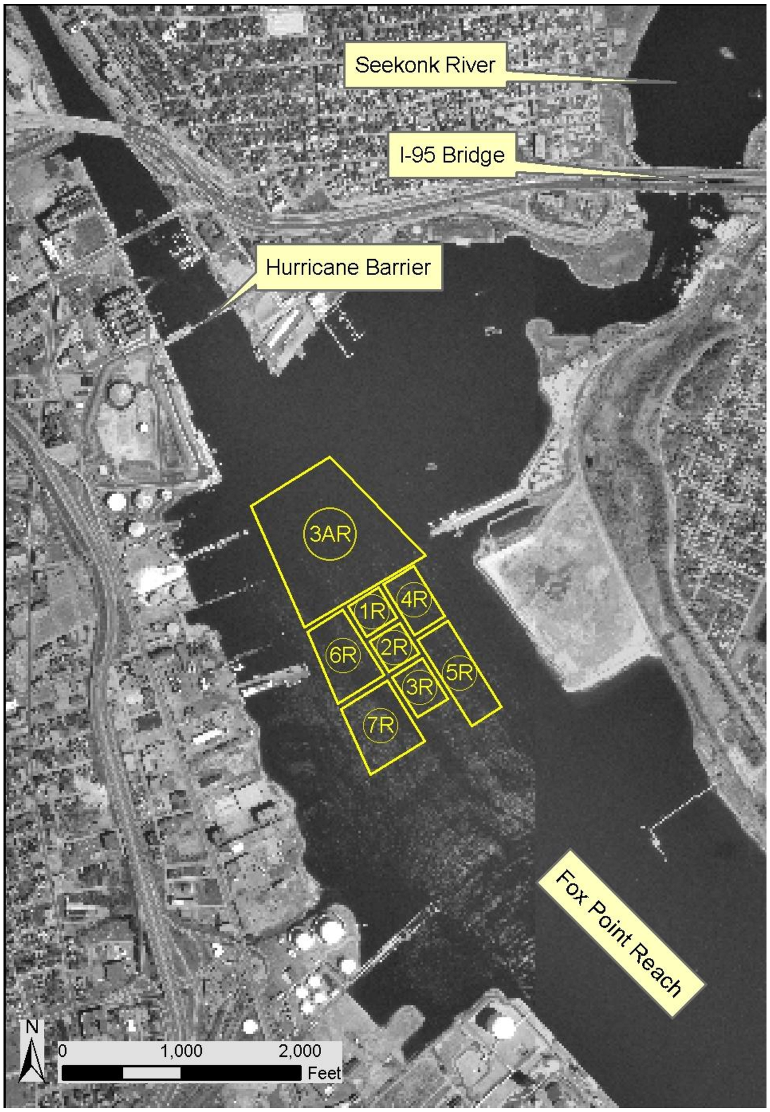

Figure 13 Providence River, Rhode Island, In-Channel CAD Cells

Newark, New Jersey, CAD Cell

The Port Authority of New York and New Jersey constructed a confined aquatic disposal facility in Newark Bay, New Jersey. The Newark Bay CAD cell was designed as a disposal site for dredged materials from channel maintenance and deepening that was unsuitable for ocean disposal. Contaminated dredged material to be placed in the CAD cell originate from the NY/NJ Harbor including Newark Bay, the Arthur Kill, and the Kill Van Kull (see Figure 14) (Kane Driscoll).

The CAD cell was designed with a surface area of 26 acres, a depth of -70 feet, a capacity of 2.0 million cubic yards, and expected to be full in seven years. Upon filling, the material was to consolidate for six months and then capped with 1 foot of clean sand.

Figure 14 Newark Bay Pit (CAD Cell)

Hart-Miller Island, Port of Baltimore, Maryland, Island CDF

Hart-Miller Island is located in Chesapeake Bay, approximately 6 ½ miles east of Baltimore, Maryland. It was originally two islands that were eroding into Chesapeake Bay, and has now been in use as a dredged material disposal CDF since 1984 restoring the two islands into one (see Figure 15). With a capacity to receive 70 million cubic yards of dredged material, the island is owned by the state of Maryland; the majority of it is controlled by the Maryland Port Administration and managed by the Maryland Environmental Services. Control of the island will eventually be transferred to the Maryland Department of Natural Services.

The initial dike was 18 feet in height and a cross dike divided it into two sections -- a south cell comprising 300 acres and a north cell of 800 acres. Eventually the dike around the south cell was raised to 28 feet and the north cell was raised to 44 feet in height.

Figure 15 Hart-Miller Island in Chesapeake Bay

The perimeter dike was completed by 1983 and the pumping of dredged material into the south cell was initiated in May of 1984. In 1990 the south cell was considered filled and restoration began, while pumping continued into the north cell. Current plans call for the 800-acre north cell to be added to the state park after it is filled in about five years. While the south cell was being filled, approximately 100 acres of the original islands were developed and operated by the Department of Natural Resources as Hart Miller Island State Park. The area includes tidal wetlands, sandy coastal forest and open beach. Stone breakwaters protect the beach itself. Currently there are hiking trails, a visitor's center, campsites, composting toilets, picnic facilities, an observation tower and the bathing beach. The park is managed out of North Point State Park in Baltimore County.

<u>Craney Island, Virginia, Port of Norfolk, Island CDF</u>

Craney Island has been used for dredged material disposal since the 1940's and originally was a large marsh (see Figure 16). During the 1950's the site was significantly expanded and full perimeter dikes were made. The site fronts on the Elizabeth River and directly onto the Hampton Roads. The site is the largest island CDF in the USA covering over 2,500 acres. The big issue now is that the Corps of Engineers needs to expand Craney Island and has proposed building a new cell which would go out into the Elizabeth River. To do that there would need to be significant dredging for the base of the dike which is very weak and may contain significant contaminants (Bill Muir, email).


Figure 16 Craney Island, Virginia, Island CDF

Craney Island is owned and operated by the Corps of Engineers. Craney Island is open to all for disposal of dredged material from local navigation projects. A fee is charged for disposal for each cubic yard of dredged material. There are several fees depending on whether the material is placed directly into Craney Island or dumped into a rehandling basin that is emptied by the Corps of Engineers. Each navigation project requires a permit from the Department of Environmental Quality of the State of Virginia and the Corps of Engineers. Testing requirements for each project may differ based on the reason to believe if the dredged material have been exposed to sources of contamination. In general the word "contaminated" is not used. There is a level of "contamination" that would warrant the material can not be placed in Craney Island, such as highly toxic wastes.

Each dredging contractor is responsible for the safe operation of the dredging project. They oversee operation of the weirs, water quality, and assure that the levees are stable. The Corps seeks to make the contractors responsible by having Corps of Engineers personnel oversee contractor operations. Both the Corps of Engineers and contractors conduct regular testing of water released to minimize Corps responsibility. In general, the Corps strives to follow approved protocols to minimize liability (Ron Vann, email).

<u>Ross Island, Port of Portland, Oregon, CAD Cells</u>

During the 1990s, the Port of Portland, Oregon, disposed of dredged material in five capped aquatic disposal (CAD) cells within Ross Island Lagoon, an active aggregate dredging facility in the Willamette River at Portland, Oregon (Figure 17). The cells contain between a few thousand and nearly one hundred thousand cubic yards of contaminated sediment.

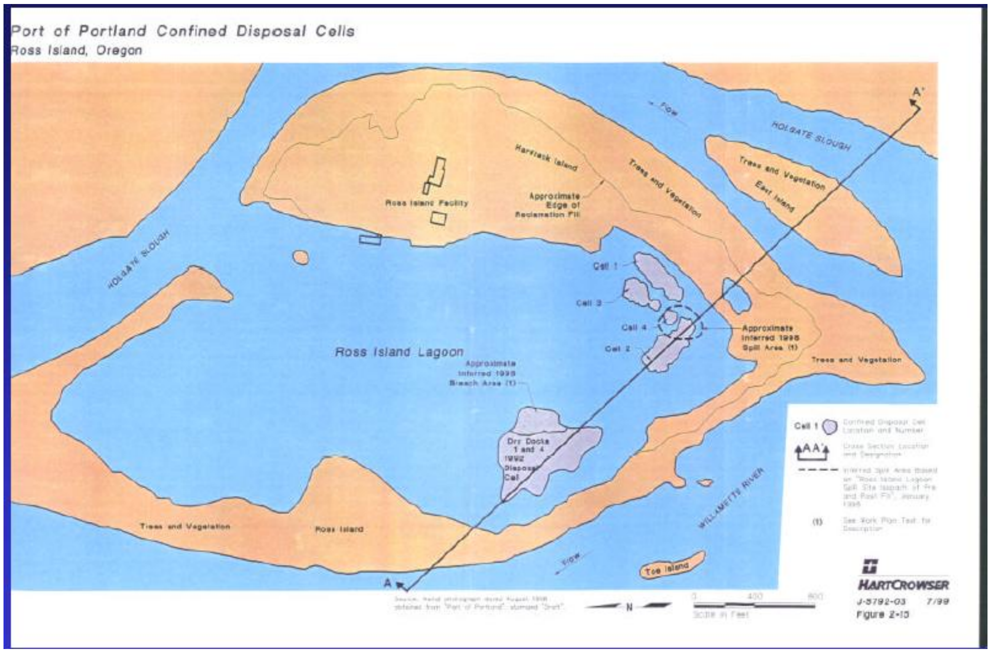

Figure 17 Ross Island CAD Cells Port of Portland, Oregon

<u>Energy Island Borrow Pit, Corps of Engineers, Port of Los Angeles, & the Los Angeles Contaminated Sediments Task Force, CAD Cell</u>

The project was a pilot project and involved the dredging of 100,000 cubic meters of contaminated Los Angeles River Estuary material and placing the material in the North Energy Island Borrow Pit, a historic borrow pit used to construct Island White. After the material was placed, 68,000 cubic meters of clean material was dredged from the South Energy Island Borrow Pit and placed as cap over the contaminated dredged material. The CAD cell was flat bottomed 52-66 feet deep. A three foot cap of sand was used in the pilot. The pilot disposal of contaminated dredged material used 9.9 acres of the 220 acre CAD cell (see Figure 18).

The multi-agency Los Angeles Basin Contaminated Sediments Task Force (CSTF) was established in 1998 to develop a long-term management plan by 2003, for dredging and disposal of contaminated sediments from coastal waters in Los Angeles County. The site has not had much use since the plan was produced, because the LA Contaminated Sediment Task Force, in its management plan, listed CAD as the option of last resort (Verduin III 2002).

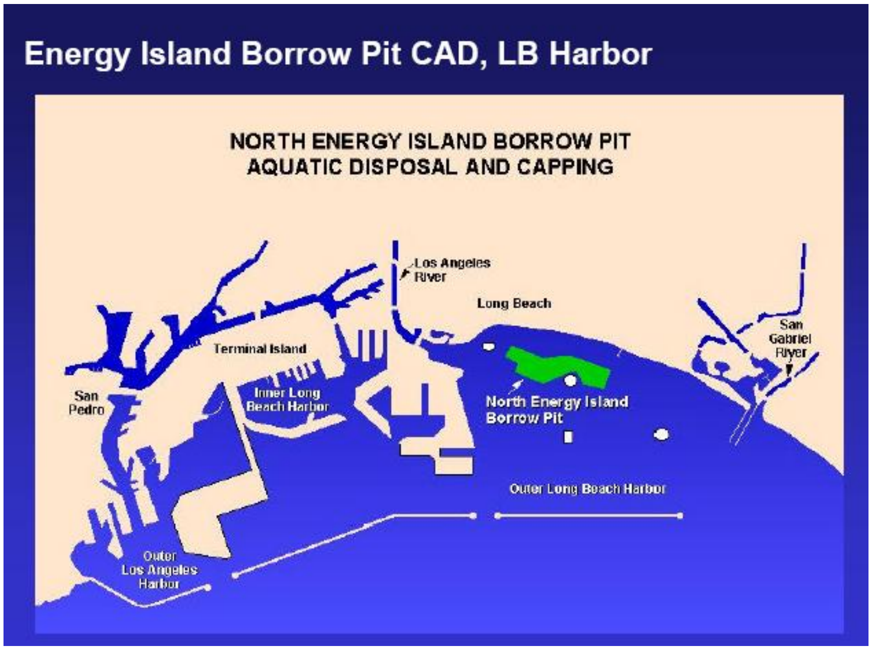

Figure 18 Pilot CAD Cell Port of Los Angeles, California

<u>Port of Los Angeles Pier 400 Shallow Water Habitat CAD Cell</u>

The Port of Los Angeles constructed the Permanent Shallow Water Habitat area inside the breakwater at Cabrillo Beach on the Port of LA side. The initial, and largest, phase of this area was the first time that a CAD site for contaminated dredged material was specifically designed into an aquatic mitigation area, and one specifically for endangered species habitat. In this case, a 300 acre area of ~40 foot depth was going to be shallowed to ~15 feet to provide compensatory mitigation - replacement shallow water foraging habitat for the endangered California least tern – for deepening other areas of the harbor. First, a subsea berm was built to ring in the area. Then, contaminated dredged material from the Marina Del Rey entrance channel (a separate Corps of Engineers project) was brought in and placed behind the berm made of geobags. The additional 500,000 cubic yards of contaminated dredged material from the LA deepening project was then bottom-dumped over and around the geobags, also behind the subsea berm. This aspect was carefully monitored using sediment-profile imaging which is a benthic sampling technique in which a specialized camera is used to obtain undisturbed, vertical cross-section photographs (profiles) of the upper 15 to 20 centimeters of the seafloor, and it was confirmed that only about 4% of the contaminated dredged material escaped the berm area and settled outside, nearby. After the contaminated dredged material was placed and monitored, another 4.5 million cubic yards of clean dredged material was placed over it all to bring the elevation up to target depth. Finally, 2 to 5 feet of clean sand capped the area, as a visually reflective backdrop for the tern to forage against (Brian Ross email).

Port Hueneme, California CAD Cell

The Harbor dredging plan will return the Port of Hueneme to minus 35 feet mean low low water providing commercial and military ships in the port the navigation depths they require. The Oxnard Harbor District (Port of Hueneme) is one of the three agencies participating in the maintenance dredging project, Oxnard Harbor District, the U.S. Navy and the Army Corps of Engineers. The plan is for the contaminated sediment to be deposited and capped more than 70 feet below the floor of the harbor in the CAD cell (Figure 19). In the meantime, clean dredge material from the CAD cell will be used to replenish Hueneme Beach. After excavation of the cell, contaminated sediments will be placed at the bottom then capped with a 10 foot layer of clean sand, keeping the contaminated sediment secure for a publicly stated port estimate of 8,000 years.

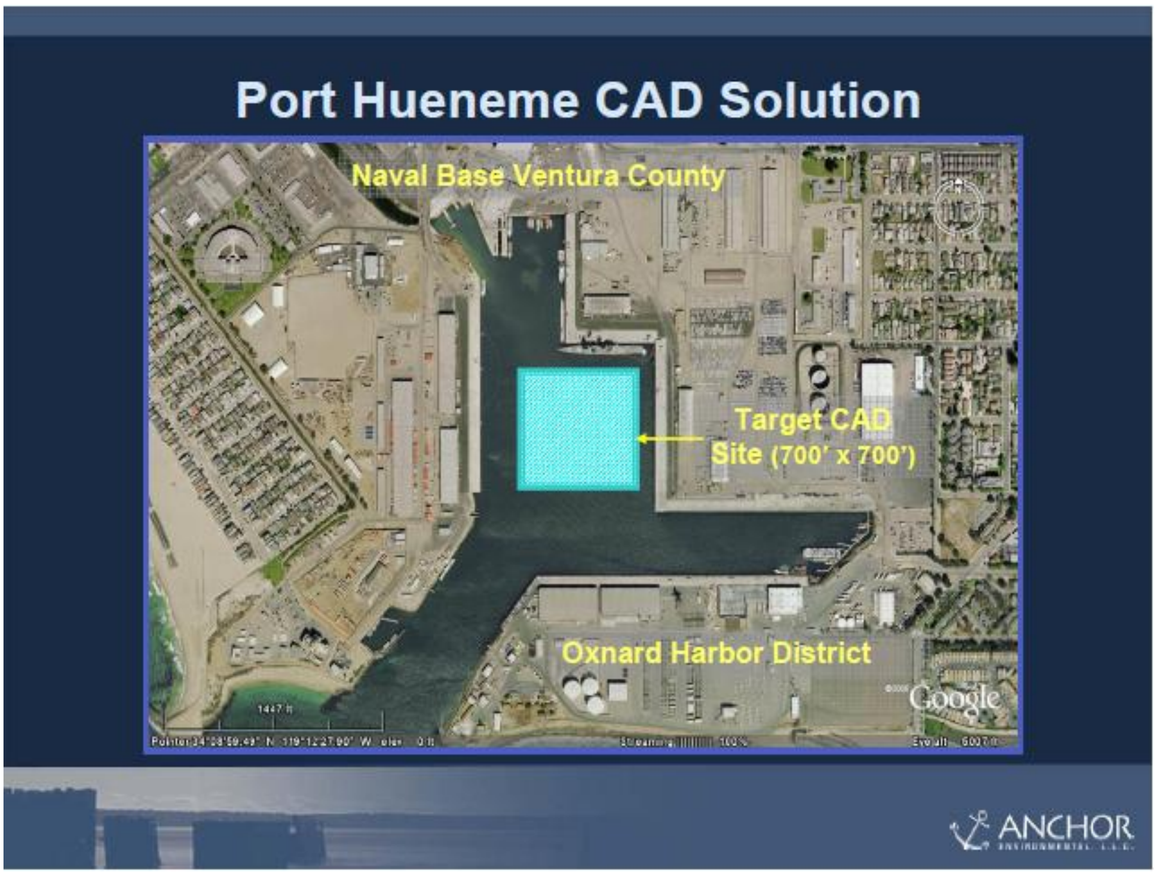

Figure 19 Port Hueneme, California CAD Cell (Capellino 2007)

In addition to the clean up benefits of this project, it will also result in vitally needed sand replenishment at Hueneme Beach. The replenishment of sand enhances ongoing shoreline protection operating by adding more than 500,000 cubic yards of clean sand to Hueneme Beach. See Figure 20 for the sequencing of the construction of the CAD cell and beach nourishment phases of the project.

Figure 20: Sequencing of the CAD Cell Construction at Port Hueneme, California

<u>Bremerton Naval Complex CAD Cell Bremerton, Washington</u>

Contaminated sediment was placed into a confined aquatic disposal pit 620 feet by 600 feet by 36 feet below the mudline. The project was permitted under a Corps of Engineers permit with a Biological Opinion from National Marine Fisheries Service for protection of threatened Puget Sound Chinook salmon, and a Record of Decision for Superfund remediation. The work was done with equipment that evolved from traditional clamshell dredging and bottom-dump barge disposal. The cost for dredging and disposal of 390,000 cubic yards in the Pit CAD and 310,000 cubic yards in open water was about 13 million U.S. dollars (Otten 2001).

Table 1
Use of Confined Aquatic Disposal Facilities for Contaminated Dredged Material for Surveyed Countries (does not include a comprehensive list of nearshore CDFs)

	Name/Location	Size of Project	Date	Comments	
1	Channel Deepening Project Port of Melbourne, Australia	22,900,000 cubic meters total project	2008-present	CDM placed in underwater bund and capped. 15 meters deep.	
2	East Sha Chau Hong Kong Airport	40,000,000+ cubic meters	Mid-1990s and continuing	Pits 15 meters below seabed	
3	Oslofjord, Norway	650,000 cubic meters (cm)	2006	CAD cell	
4	Great Lakes, Canada, various locations			12 nearshore and upland CDFs	
	The Netherlands				
5	Rotterdam Harbor Borrow Pit	16.3 acres			
6	Amsterdam, The Netherlands			Harbor Basin, multiple basins	
7	Ijmuiden (Averijhaven)			Tidal waters at entrance to North Sea	
8	Julianakanaal			Deep pits in the channel-CDM from River Maas	
9	IJsseloog Lake Ketel	23 million cubic meters		Island CDF	
10	Hollandsch Diep	10,200,000 cubic meters	2008	Island CDF	
11	Pit Kaliwaal				
12	Slufter			Nearshore CDF	
13	Limburg Borrow Pit				
14	Haringvliet			Level bottom capping	
	England				
15	Falmouth Marina Falmouth, England			Series of trenches flipping top sediments and bottom excavated sediments	
16	Port of Tyne England	60,000 cubic meters	2006	Level bottom capping	
	USA				
17	Duwamish Waterway Seattle, Washington	1.3 acres	1984	CAD cell	
18	One Tree Island Olympia,	0.5 acres	1987	Marina, CAD cell	

	Washington				
19	Nome, Alaska	1 acre, 35,000 cy	Not available		
20	Puget Sound Naval Shipyard Bremerton, Washington	10 acres, 390,000 cubic yards (CY) CDM	2000	CAD cell	
21	Port of Los Angeles Shallow Water Habitat Pier 400	94 acres,	1995	CAD cell	
22	Port of Los Angeles Shallow Water Habitat	10 acres, 66,000 cy CDM	1994	Marina del Rey CDM	
23	Energy Island Borrow Pit	10 acres, 100,000 cubic yards CDM	2001	CAD cell	
24	Port Hueneme	327,000 cubic yards CDM	2008-present	CAD cell	
25	Ross Island Lagoon Portland, Oregon	8.4 acres, 160,000 cubic yards	1992-1998	CAD cell	
26	Port of Boston CAD Cells	800,000 cubic yards	Mid 1990s to 2002	In channel cells	
27	Hyannis, Massachusetts	10,000 cubic yards	Early 1990s	CAD cell	
28	Bridgeport, Connecticut	1,500,000 cubic yards		CAD cell in process	
29	Norwalk, Connecticut	50,000-100,000 cubic yards	2005	CAD cell	
30	New Bedford, Connecticut			In channel cells; superfund site	
31	Providence River, Rhode Island	1,100,000 cubic yards	2002	In channel cells, Rhode Island manages cells	
32	Newark Bay Pit CAD cell	2,000,000 cubic yards	1997-present	1/3 of pit capacity still left	
33	Hart-Miller Island Port of Baltimore	70,000,000 cubic yards	1984-present	Much of capacity used with clean dredged material	
34	Craney Island Port of Norfolk		Early 1940s	Island CDF	
35	Great Lakes Various Locations	26 nearshore CDFs			

Section 4
Advantages and Disadvantages of Confined Aquatic Disposal Facilities

Numerous successes have been demonstrated around the globe for disposal of contaminated dredged material into CAD cells, level bottom capping, and into nearshore and island CDFs. These alternatives and especially CAD cells seem to be the preference when dredging project sponsors must address disposal of contaminated sediments. These alternatives represent an acceptable compromise when costs, regulatory acceptance, environmental risk, and public perception and acceptance are considered, and have a number of advantages over upland CDF disposal of contaminated dredged materials [Note: much of the material below has been extracted directly from Fredette 2000, 2006].

Environmental Risk

Environmental and human health risk of confined aquatic disposal alternatives has been shown to be one of the lowest risk options. Compared to upland disposal, there are fewer contaminant transfer and exposure pathways; CAD cells result in a reduced surface area for contaminant release and less potential for direct contact with human and biological resources. The potential for diffusion out of the CAD cell, or nearshore or island CDFs needs to be evaluated but the potential has been shown to be quite low.

Cost

The cost of CAD cells can be similar to level bottom capping of contaminated dredged material if the cells used are natural depressions in the seafloor or borrow pits. If CAD cells need to be constructed, those costs are 2-3 times higher. Other alternatives can be 5-100 times higher depending upon many factors, including construction costs of dikes, land costs, and other engineering aspects.

Regulatory Acceptance

Regulatory permitting agencies and natural resource agencies appear to find the case for use of CAD cells compelling for isolation of the contaminants, and the fact that CAD cells are often near the dredging location and thus may already be in contaminated areas. Thus, building a CAD cell does not impair additional water resources. In addition, use of a CAD cell results in fewer impacts of transportation, e.g., shorter haul distances using barges and no trucking of dredged material to upland sites.

The building of island CDFs and nearshore CDFs has the above advantages as well, but these alternatives use bay or ocean bottom for disposal, resulting in less aquatic habitat on the bay or ocean floor. The island or nearshore CDFs may eventually be used for habitat or other uses such as recreational boating facilities, but regulatory agencies are not always all that keen to take bottom habitat out of service. Mitigation of impacts by constructing wetlands or some other habitat is sometimes considered in order to build the nearshore or island CDF.

Public Perception Affects the Reality of the Dredged Material Disposal Alternatives

The court of public opinion is often one of the most important factors considered in the development of alternatives for dredged material disposal. Communication is critical of the project plans and potential impacts. Sometimes, public perceptions and the associated political pressure overrule good science and technical analyses.

In the case of CAD cells, experience to date has been that initial public concerns about disposal of contaminated dredged material in CAD cells have been overcome through excellent analyses of the alternatives and good communications. Dr. Tom Fredette (2000) postulates, "people are more comfortable with the concept of boxes, bowls, and containers, and CAD cells generally fall into that category for the general public. CAD cells provide a feature with clearly defined limits, which can result in a certain degree of psychological comfort."

Of course, there are exceptions, and the two places that CAD cells did not work in the public arena were in the Port of New York/New Jersey and the Port of Los Angeles.

- Dredged material management and disposal has been a huge issue for the Port of New York/New Jersey for over 20 years. Dredging essentially stopped in the mid-1990s, until the White House brokered a deal with between the Port, the Corps of Engineers, and the environmental interest groups.

  The Newark Bay pit was constructed in 1997 as a CAD cell for disposal of contaminated dredged material. Public concerns remained about disposal of contaminants into an aquatic site. Because the NGOs and thereby the politicians got into it, the state of New Jersey worked with the Port and determined that one of the basic principles for use of the pit was that it was to be the alternative of last resort (and economics was not to be a factor). Thus, the pit, while still available for use, has only used about 2/3 of its capacity, and will close over the next few years; it provides a stopgap disposal alternative for projects that have no other place to go.

- The Energy Island Borrow Pit was used by the Port of Los Angeles as a CAD cell for disposal of contaminated dredged material, but was designed just for 60,000 cubic yards as a pilot project. The pilot was successful, but the LA Contaminated Sediments Task Force, a federal-state-local partnership, prepared the Operation and Maintenance Plan and included a requirement that it was to be used as an alternative of last resort. As a result, it has not been used again.
- The local environmental interest group in Melbourne raised issues about use of the CAD cell; their main issue related to the disposal of contaminated dredged material, then leaving it exposed to the Bay ecology for 140 days while it

consolidated before it would be capped. The project was approved, but it is a good example that it is not all smooth sailing.

Isolation techniques that include design and constructing a CAD cell in the bottom of the bay or ocean floor, inserting contaminated material, and covering with clean material can be viewed either in a positive light or negative depending upon numbers of influences; one line of thinking is that all contaminated dredged material is bad, it should not be in the water potentially impacting coastal waters, it is just putting off the problem by putting in an aquatic setting, and, by doing so, no one will focus on the preventing the contamination of sediments. Another line of thinking is one more based upon pragmatism: dredging needs to happen, and what are the alternatives within economic reality that meet environmental protection goals.

Whether using confined aquatic disposal facilities or not, prevention of contamination should be a fundamental part of any government permit program such that, in the long term, fewer incidences of contaminated dredged materials will need to be addressed.

Other Factors

Several other factors provide distinct advantages for CAD cells:

- CAD cells can usually be constructed by using readily available construction equipment such as mechanical dredging equipment (e.g., clamshell bucket dredges).

- Transport distances from the site of dredging to the CAD cell are usually relatively short and efficient given that large loads can be carried by barge, compared to upland disposal sometimes requiring long haul distances by truck and sometimes by train if the disposal site is not near the shoreline.

- Loss of bay or ocean bottom for habitat is temporary until the cells are filled and capped, which then can be recolonized.

- The top surface of a capped CAD cell will usually be lower than the surrounding sediments, given the consolidation process, and if water currents from storms or ship propellers causes disturbance of the sediments, the CAD cell will likely act as a sediment repository. Fredette states that it is "difficult to envision a plausible scenario in which substantial erosion from a CAD cell is likely."

Nearshore CDFs and island CDFs also have advantages over upland CDFs, but they also have to overcome some challenges:

- As mentioned before, the loss of bay bottom habitat is an issue.
- Not in my backyard or in my bay can be a serious issue.
- For nearshore CDFs, the costs of using the shoreline as a dike or to attain landside access to the nearshore site are not simple issues.

- The costs of constructing an island or nearshore CDFs have to be weighed against the alternatives. Construction of the containment facility can be challenging given the marine environment and the potential for erosion from waves.
- Island CDFs and nearshore CDFs offer the opportunity for beneficial use of CDM, as recreation facilities or wetlands habitats can be included as part of the design. These possibilities can help address the "not in my backyard or bay" issue.

As reported in the responses to the questionnaires by Hong Kong, the Port of Boston, and the Port of Hueneme, the advantages and drawbacks to using CAD cells are summarized below:

<u>Hong Kong, China</u>

Advantages:
The CAD facility is both environmentally acceptable and cost effective –

(1) Environmentally acceptable

- Hong Kong's experience with the CAD facility is substantial and more than 16 years of environmental monitoring results have confirmed that there are no significant impacts on water quality, sediment or marine life at East Sha Chau, nor any adverse effects on public health and the marine ecology; and
- The environmental monitoring and other related assessment have demonstrated the success of the CAD disposal method in isolating contaminated sediment from the marine environment by capping of the CAD facility with uncontaminated material.

(2) Cost effective

- Relatively lower cost and lower risk than other in-situ and ex-situ treatment methods; and
- Relatively faster in disposal of the contaminated material.

Drawbacks:

(1) The selection of a suitable disposal site is required. The site should be environmentally acceptable, should have minimal hazards or risks to human health and safety, and sufficient distance to the sensitive receivers and important amenities. In general, the CAD facility has to be placed within an environment where the water is shallow, the current speeds are low, and where wave activity is not severe;

(2) On-site management is required as the accuracy of disposal relies on site specific disposal techniques; and

(3) Environmental monitoring program is required to confirm that there are no significant impacts on water and sediment quality, public health, and marine ecology.

Port of Boston, Massachusetts, USA

"Cost effective. Environmentally sound. Confines impact of disposal to dredging footprint (the way we did it - not true for all projects). Acceptable (and strongly supported) by permitting agencies and NGOs."

Port of Hueneme, California

Port of Hueneme Harbor Commission President Jess Herrera said, "The District's and Navy's plan to encapsulate the sediment made the most sense both financially and environmentally." To dispose of this material at an on shore facility would have resulted in hundreds of daily truck trips along with their accompanying air quality and congestion impacts. The excavation of the CAD in the center of the harbor will result in hundreds of thousands of cubic meters of clean beach suitable dredge material ready for Hueneme Beach placement.

Section 5
What Practices/Policies are Governments using to Issue Permits for Disposal of Contaminated Dredged Material in Estuarine and Ocean Waters?

Analysis of the information found on the internet and from the country responses shows similar types of practices and policies were used in the overall approach to permit issuance and in the specific permit conditions. Within that generality, there are a number of specific conditions and requirements unique to different federal governments and even different within local government authorities, such as states that either issue permits or comment on federal government permits.

Objectives of Processes and Procedures

After determining that disposal in a confined aquatic disposal facility is the selected alternative for contaminated dredged material disposal (following similar procedures to the London Convention Dredged Material Assessment Guidelines (London Convention)), the management objectives of dredging and disposal operations are to minimize environmental risk; see the text box below [Note: these are directly from the United Kingdom's information paper presented to the Scientific Group of the London Convention in 2007; while for a level bottom capping project, the objectives are applicable to CAD cells, nearshore CDFs, and island CDFs.].

To achieve the objectives stated above, governments that have issued permits for contaminated dredged material disposal into confined aquatic disposal facilities have striking similarities in their approach and procedures. The general processes for ensuring that contaminated dredged material is disposed of properly, minimizing environmental risk, include these four categories:

1. Environmental impact assessments: pre-permit issuance

2. Organization, procedures, and development of environmental management plans

3. Specific conditions in permits

4. Monitoring programs pre-, during-, post-dredging and disposal

1. Environmental Impact Assessments

Environmental impact assessments provide the basic foundation for predicting the potential harm to the bays, estuaries, or ocean water resources of dredging and dredged material disposal projects. Key parts of environmental impact assessments include (not comprehensive list):

- Baseline monitoring survey of the bay, estuary, or ocean waters identifying environmental resources as well as conducting bathymetric surveys

- Site selection: identification of candidate confined aquatic disposal facility (e.g., low energy environment/currents, isolation objectives-minimal exposure pathways)
- Engineering design of the confined aquatic disposal facility (e.g., storm events, CAD cell side slopes, island CDF and nearshore CDF containment dikes)
- Risk assessment of the disposal of the contaminated dredged material

The representative from Hong Kong stated that conducting an environmental impact assessment is their basic approach to minimizing risks to the government. Hong Kong also uses detailed operational controls to ensure permit conditions are met.

2. Organization, Procedures, and Development of Environmental Management Plans

This area includes the government's initiation of the overall management structure, the development of management and operational criteria, the issuance of the permit itself including technical and public review, and the communication mechanisms with stakeholders. Successful projects have included most of the following elements:

- Office in charge of the overall project, including day to day operations control.
- Office in charge of environmental monitoring
- Office set up for oversight, review, and audit of the project to ensure the project meets permit conditions
- Outreach to stakeholders; meetings, newsletters, user friendly and comprehensive websites that include up-to-date information and data on the project
- Publicly released government environmental policy
- Transparent permit process
    - Each country's permit process differs but they all have some mechanisms of checks and balances with other agencies/offices within the government that have other statutorily required missions.
    - These other departments within the federal government are concerned about economics, water quality, fisheries, or endangered species, or it could include provincial or state or local governments with interest in the project, some with a role provided by statute.
- Public review processes. Some of these are set forth in permit regulations, but successful projects go beyond the minimum to involve stakeholders from the initiation of planning to completion of the project.
- Environmental management plans. These are the project operation detailed specifications which provide the full range of environmental management and controls, including such areas as dredging and disposal plans, confined aquatic disposal facility management plans, monitoring programs, and stakeholder involvement.

Specific Conditions in Permits

The specific conditions in permits are critical to minimizing the risks of environmental problems resulting from projects that are disposing of contaminated dredged material in confined aquatic disposal facilities. Provided below is a list of some of the specific conditions in permits.

- Confined aquatic disposal facility location and design

- Criteria for environmental quality:
  - Project will not cause exceedances of water quality standards
  - Project will not impact fisheries
  - The cap will be recolonized by marine organisms to pre-dredging status.

- Operational management plans—an example for permit conditions for CAD cell management includes the following (see Providence River Cell Management Plan Appendix 6)
  - CAD cell filling sequence (allows for the greatest time for consolidation of the maintenance material.)
  - Control of dumping operations
    - Filling dumping patterns (i.e., dump in the middle of the grid first to insure no spillage outside the cell)
    - Check scows for leaks
    - Check the vessel navigation systems that it works with correct accuracy
    - Conduct a dry run of dumping with government representatives on board
    - Silent inspector--Vessel electronic tracking and dumping system (differential GPS) to track its location over time
    - On board third party inspector during dumping operations/reporting
    - Random checks by government officials
  - Suitability of cap material
    - Clean material, usually sand, but sometimes layered.
    - Depth of cap-----varies, but good example is 1 meter
  - When to cap--consolidation of materials in the cell: times will be specified depending upon the materials (e.g., 140-150 days)
  - Environmental windows----specific times for when dredging, disposal, and capping can occur during the year
  - No debris placed into the cells
  - Surveys and Reports---bathymetric surveys are needed to determine the status:
    - Fill level of the cells and distribution of dumped material in the cell
    - The stability of cells that are capped
    - No material, contaminated dredged material or cap, can be outside of the cells

- Types of dredging and dumping equipment—depends upon the physical characteristics of the contaminated dredged material. The objective is to minimize water content in the contaminated dredged material so that when placed into the cell, it is more like a solid than a liquid. Many projects have used mechanical dredging, enclosed environmental buckets for the contaminated dredged material and split bottom hopper dredges for cap (sand) placement.

- Fisheries protection: fisheries observer, sonar detection systems, blasting requirements
- Monitoring requirements—see below
- Insurance requirements: environmental liability, maritime liability, and general liability
- Communications and reporting
- Contingency plans and reporting
- Enforcement and compliance provisions----notice of penalties for non-compliance with the permit

Monitoring Programs: Pre-, During-, and Post-Dredging and Disposal

Requirements for monitoring programs are included in permits but are emphasized here in a separate section, given their importance in the overall project to ensure that the environment is protected and that the integrity of the CADF is maintained. Three examples are provided below:

Hong Kong's intensive environmental monitoring program for the CAD cells at East Sha Chau involves various field sampling and laboratory testing works to collect data and measurements for verifying the following:

(a) the operation of the facility will not result in any exceedance of the statutory Water Quality Objectives of the Water Control Zone where the facility is situated;
(b) the operation of the facility will not increase sediment contaminant concentrations over time at individual monitoring stations or a trend of increasing concentrations with proximity to the active pit;
(c) the operation of the facility will not increase sediment toxicity over time at individual monitoring stations or a trend of increasing toxicity with proximity to the pit;
(d) the operation of the facility will not affect the abundance of the fisheries resources and will not increase the tissue or whole body contaminant concentration over time in selected target species; and
(e) recolonization is occurring at the capped pits such that the affected seabed will return to its pre-dredged state for marine organisms.

The United Kingdom monitoring program for the Port of Tyne level bottom capping operation included the eight different monitoring segments to ensure each stage of the dredging and disposal project was characterized, as shown in the text box below (Vivian

2007) [The reader is directed to the full paper for a complete listing of the detailed elements of the monitoring program.].

<u>Port of Tyne Level Bottom Capping Project Monitoring</u>

Pre-disposal monitoring

- This was to determine the baseline characteristics of the trial site prior to disposal and capping operations.

Monitoring during disposal

- To determine the dispersion and loss of sediment to the water column during deposition of contaminated dredged material.
- To determine the loss of TBT/DBT to the water column during deposition of contaminated dredged material.

Monitoring of contaminated dredged material post disposal prior to placement of cap.

- To define the extent and thickness of the contaminated dredged material deposit to guide cap placement and to monitor any fragmentation or slumping of contaminated dredged material.

Monitoring post disposal – Short Term (2 weeks).

- To define the extent and thickness of the cap immediately following disposal.
- To confirm return to pre-existing SPM & TBT/DBT concentrations.

Monitoring post disposal – Medium term (2-3 months).

- To demonstrate the integrity of the cap and provide evidence to the public and non-scientists.
- To assess any immediate impacts on sediment quality and benthos associated with the trial.

Tier One Long-term post disposal --Monitoring (Annual).

- To ensure the integrity and thickness of the cap is maintained.
- To determine the cap effectiveness in isolating the CDM from the environment.
- To provide information for risk-based assessment and associated management actions.
- To provide information that can be used in the development of best practice extendable to the UK.

Tier Two post disposal --Monitoring.

- • Tier two monitoring will be undertaken if any of the management trigger values (table 2 Management actions linked to post disposal) are exceeded.

Management Actions linked to post disposal (Tier one and two monitoring).

<u>In the USA,</u> detailed and comprehensive monitoring programs are required similar to the Port of Tyne capping project. No attempt will be made here to summarize the specific requirements for monitoring for pre-dredging conditions, during dredging and disposal, and post dredging evaluating the integrity of the cap and the potential for any short and long term effects on the water and benthic qualities.

In the USA, states provide the Water Quality Certification that the project will not exceed water quality standards after review of the environmental impact assessment, the confined aquatic disposal facility design, and modeling efforts. Without the Water Quality Certification, no project can go forward. Water Quality Certifications are provided to the permittee conditioned upon the permittee carrying out, among other requirements, detailed monitoring programs for pre-, during-, and post dredging and dredged material disposal. Good examples of state required monitoring are included in the (1) Record of Decision for the Providence Harbor Maintenance Dredging Project Environment Impact Statement which includes the Water Quality Certification, Appendix 6, #13, pages 4-9; (2) the Water Quality Certification for Boston Harbor Deepening, pages 37-41 see Appendix 6, #9; the Newark Bay Pit Operation & Maintenance Plan, Appendix 6, #14; and the Newark Bay Permit and Monitoring Plan, Appendix 6, #15.

<u>Case Studies: Practices and Policies</u>

Australia

Detailed studies into the existing conditions of the bays natural assets and assessment of potential impacts from project works were undertaken for the Port of Melbourne's Channel Deepening Project. The outcome of these studies, plus a detailed risk assessment, played an integral part in the development of the project, including technology selection, work methods, and the development of the Environmental Management Plan and monitoring program.

The Environmental Management Plan, prepared by the Port of Melbourne Corporation, sets out the environmental safeguards required to protect bay assets during dredging. It consists of a combination of regulatory controls, environmental controls, project delivery standards, and environmental monitoring. Importantly, the Environmental Management Plan is subject to continual audit and review to ensure that its aim of minimizing environmental impacts is achieved. A series of Method Statements, one for implementation of the Environmental Management Plan, are comprehensive specifications for the dredging and disposal project.

The state of Victoria and the Commonwealth Government set conditions that the Port of Melbourne must adhere to. These include arrangements set out in the Environmental Management Plan which includes 58 "Project Delivery Standards," which are rules about where, when and how the Project must be conducted. See Table 2 for the list of the standards at the end of this chapter.

The Office of Environmental Monitor was established by the state of Victoria in December 2007 as a requirement for the Project. The Office's objectives are to:

- Be accessible to all stakeholders and the community;
- Scrutinize, report and advise on the Project's environmental performance in an independent and transparent way; and
- Communicate all available information on the Project's environmental performance in a meaningful and timely way to stakeholders and the community.

The Office of the Environmental Monitor brings an added layer of scrutiny to the Port Phillip Bay Channel Deepening Project by providing an around-the-clock independent and transparent view of the environmental performance of the dredging project to the regulators and the Victorian community.

- Led by the Environmental Monitor, Mick Bourke, the Office uses a wide range of information and data to assess the whether or not the Project has followed the rules set out in the Environmental Management Plan.
- Data from more than 20 monitoring programs operating across Port Phillip Bay is routinely examined by the Office to detect any changes to the Bay's health.
- The results from these programs are made available to the community on the website, which aims to be a one-stop-shop for all data, information, reports and advice on the Project.

An excellent user friendly website for the project was put in place, which includes the project description, the Environmental Management Plan, the Method Statements, results of audits, monitoring results, and meeting announcements and results.

Netherlands

The present policy on contaminated dredged material in the Netherlands comprises the following:

- Attain good quantification of the amount and quality of the sediments to be removed;
- Develop a few large scale confined disposal facilities for the storage of most of the contaminated dredged material;
- Use simple treatment techniques on some very heavily contaminated area's or use separation techniques on material with a high sand content;
- Improve public opinion on the projects on contaminated dredged material.

Impacts upon ground water are a major concern in the Netherlands. Emissions from confined disposal facilities for dredged material are restricted in accordance with the ALARA principle (As Low As Reasonably Achievable). In the Netherlands, a Directive for Confined Disposal Facilities for Contaminated Dredged Material with the aim of Protection of the Groundwater is in Preparation. To determine whether the use of isolation measures (e.g., island CDF) should be considered, a tiered approach is suggested:

<u>Phase 1.</u> Assessment of the quality of the expelled pore water against target values for the groundwater. For contaminants that do exceed the target values, Phase 2 must be carried out.

<u>Phase 2.</u> Assessment of the fluxes of the facility against permissible fluxes. It is not necessary to take isolation measures if no permissible fluxes are exceeded. If the permissible fluxes for one or more contaminants are exceeded, Phase 3 must be carried out for these substances.

<u>Phase 3.</u> Assessment against dispersion criterion (permissible area of influence) If after a certain long period (e.g., after 10,000 years), the volume of the area that is affected by the emission of contaminants from a facility is still smaller than the volume of the facility, the use of isolation measures

is often less urgent. If after this period the affected area will take a greater volume than a volume equal to that of the disposal facility, it is necessary to attempt to take measures that are adequate to meet the criteria.

If, based on the tiered assessment, it is considered necessary to use isolation measures (specifically to meet the requisite dispersion criterion), one or more (combinations) of the measures/provisions given below can be selected. In the light of current experience and knowledge these fall within the ALARA-principle.

1. Water level control: prevention of infiltration/advective transport by means of the reduction of the hydraulic head between the upper and lower levels of the disposal facility.

2. Lining of the base of the facility with clay/clayey material that is rich in organic matter.

3. Covering the bottom and slopes by a sand/sandy layer that is rich in organic matter (for example, a layer that is 0.5 m thick).

4. The use of an effective geohydrological isolation system to limit the extent of the affected area.

The above mentioned measures can be used separately or in combination. Depending on the conditions prevailing at the chosen location, a specific choice of an isolation system, supported by a research model, can provide optimal protection of the environs against emissions from the facility.

Hong Kong

Hong Kong has successfully used CAD cells since the mid-1990s, and to do so, they set up an organizational structure that has addressed the need for dredging and the need for use of CAD cells for contaminated dredged material, operational controls for on-site CAD cell management, extensive monitoring programs, and programs to outreach to fishermen and the public.

One of the keys to this success is the Marine Fill Committee. The Marine Fill Committee, which is responsible for the provision and management of disposal capacity for dredged/excavated sediment, determines the most appropriate marine disposal site on the basis of the chemical and biological test results. The full terms of reference of the Marine Fill Committee are:

- To report to the Secretary for the Environment, Transport and Works on the management and use of marine fill reserves and management and operation of disposal facilities for dredged/excavated sediment
- To liaise with the Public Fill Committee and co-ordinate with all Government, quasi-Government and major private sector project proponents to identify:

    - the demand for marine fill materials
    - the marine disposal requirement
- To formulate policies and strategies for the supply of marine fill, the minimization of disposal of dredged/excavated sediment, and the provision of marine disposal facilities
- To identify marine fill resources to meet demand
- To liaise with the Public Fill Committee and make decisions on the conservation, allocation and utilization program of marine fill resources with due regard for development priorities, environmental acceptability and the overall effectiveness
- To identify marine disposal capacity to meet demand
- To establish and manage facilities for marine disposal of dredged/excavated sediment

The East Sha Chau disposal facility is owned by the Hong Kong Special Administrative Region Government. The Civil Engineering and Development Department of the Hong Kong Special Administrative Region Government exercises on-site management of the disposal operation and has adopted the current "drift disposal" method for regulating the disposal operations within the East Sha Chau disposal facility.

- Under this method, the site staff will check the water current speed and direction upon arrival of a dumping barge and determine from the computer modeling the best disposal location at the upstream boundary of the disposal facility such that the disposed sediments under the action of the water current direction will settle within the pit boundary.
- This will prevent uncontrolled contamination of the adjacent waters due to the drifting of the disposed sediments before they settle into the mud pits.
- The Civil Engineering and Development Department also regulates the marine activity at the site to ensure its impacts are not significant.
- The Civil Engineering and Development Department also implements an Environmental Monitoring and Audit program so as to safeguard that impacts arising from the East Sha Chau disposal facility are kept within the established guidelines and the assumptions in its environmental impact assessment.

CAD Cells and Level Bottom Capping: Technical Experience from 2 Case Studies---- Conclusions, Operating Guidance, and Lessons Learned

As one might expect as part of the examination of the practices and polices used to reduce risk, a number of reports from completed projects stated lessons learned and provided technical and operational recommendations for future projects. While not necessarily within the intended scope of this study, the author believes that Environment Canada may find them useful if permits are issued are disposal of contaminated dredged material into confined aquatic disposal facilities. See Appendix 4.

Table 2
Project Delivery Standards----Construction Management
Channel Deepening Project----Environmental Management Plan (Annexure 4)
Port of Melbourne, Australia
(Annexure 4 Project Delivery Standards
CDD_IMS_PL_004 Environmental Management PlanP_3 Rev 6
www.ChannelProject.com)

Project delivery standards are established in Annexure 4 of the Environmental Management Plan to ensure conformance with all environmental limits and controls and construction plans. The list below merely provides the title of the standards. The actual standards include detailed requirements.

1. Hours of operation
2. Airborne noise
3. Airborne noise monitoring
4. Waste management
5. Energy and greenhouse gases
6. Equipment maintenance
7. Fuels, oils, chemicals, and hazardous goods
8. Emergency response preparedness
9. Safety
10. Marine pests
11. Vessel anchoring
12. Vessel bunkering
13. Cetaceans – vessel maneuvering
14. Cetacean sighting and log
15. Services protection and removal
16. Marine-based berthworks and river protection works
17. Heritage (marine-based) – identification of potential relics
18. Maritime heritage – berthworks and river protection
19. Maritime heritage – dredging
20. Stormwater and groundwater management
21. Contaminated material
22. Aboriginal heritage
23. Sands and adjacent cost and beaches monitoring
24. Dredging and plume
25. Management of pipeline between TSHD and spreader or diffuser pontoon during transfer of sediments
26. Third party infrastructure
27. Dredging of unconsolidated contaminated sediment
28. Dredging of contaminated clays
29. Monitoring removal of contaminated sediments – TSHD
30. Monitoring removal of contaminated sediments – backhoe and grab dredges
31. Dredging schedule

32. Consideration of environmental limits
33. Consideration of seasonal sensitivities
34. Dredged material disposal
35. Port of Melbourne DMB – bund
36. Port of Melbourne DMG – containment of contaminated material
37. Port of Melbourne DMG – capping
38. Port of Melbourne DMG – maintenance and inspection
39. SE DMG
40. Draghead design
41. Dredging in the entrance
42. Clean up in the entrance
43. Northwest side of the Nepean Bank
44. Fish modeling
45. Pre-construction plateau inspection
46. Construction plateau inspection
47. Post-construction plateau inspection
48. Pre and post-construction bathymetric survey
49. Post-construction deep reef habitat – impact & recovery assessment
50. Post-construction tide monitoring report
51. Minimize use of hydrohammer
52. Hours of operation
53. Start procedure
54. Hydohammer – noise assessment
55. Hydrohammer – cetaceans
56. Hydrohammer – no-dive zone
57. Marine-based pile driving – noise assessment
58. Marine-based pile driving - cetaceans

Section 6
What are the Environmental, Financial, and Legal Risks and Liabilities?

The primary concerns being addressed in this report are the potential risks and liabilities to Environment Canada if it is determined that permits are to be issued for confined aquatic disposal of contaminated dredged material.

What are the Environmental Risks?

The environmental risk is fairly straight-forward: contaminants could be distributed into the surrounding aquatic environments, including groundwater. The potential environmental impact is dependent upon such factors as the quantity of contaminants released, their potential toxicities, currents and pathways of exposure, and the existing water and sediment quality (i.e., pristine high quality or already contaminated to some degree).

The failure of the confined aquatic disposal facility could be the result of poor design of the CAD cell or level bottom capping, the island CDF, or the nearshore CDF. Each of these facilities is designed based upon specific parameters, such as containing structure/dikes, low energy environments, potential exposure pathways, or storm events.

Operational factors can also contribute to release of contaminants outside of the CADF. In capping operations, contaminated dredged material can be released if the contaminated dredged material in the CAD cell or in level bottom capping sites has not consolidated sufficiently and clean material is dumped and mixes with the contaminated dredged material; this can create a plume of CDM into the water column and contamination of benthic resources a distance away. For island CDFs or nearshore CDFs, contaminants can be released into the surrounding water in the overflow from the consolidation of the dredged material process. Poor operations can cause insufficient settling and short-circuiting of discharge water from the CDFs.

What are the Potential Liabilities?

The answer to this question is not so easy. The answer: *it depends* on a number of factors, including, but not necessarily limited to, existing legislation, regulations, permit conditions, and agreements between Environment Canada and dredging project sponsors (i.e., permittees). The responses from other countries on liability were quite mixed, and ranged from “haven’t thought about it,” “yes, we would have to go fix it if it broke,” to the government has no liability.

In many cases, the disposal of contaminated dredged material in a confined aquatic disposal facility would only be part of a dredging project and that some portion of the dredged material could be determined acceptable for open water disposal in the normal permitting regime. Any liabilities for permit issuance for dredging and for the open water disposal portion of the project would remain the same, but new concerns are raised by permitting disposal of contaminated dredged material in a confined aquatic disposal facility. These concerns relate mostly to the potential failure of the facility and release of contaminants into the aquatic environment. Potential liabilities:

- Negligent issuance of permit with inadequate conditions.

- The need to fix the environmental problem. This could mean two areas of action: (1) responsibility for fixing the cause of the environmental issue, likely to be the failure of a dike, capping too soon or with inappropriate material, or location of the CADF; and (2) remediation of the contaminated area, which could be more dredging for clean-up and disposal of contaminated dredged material or result in mitigation actions.

  The fixing of a dike failure or operational problems causing dispersion of contaminants are issues that are fairly clear in what needs to be done. However, the same cannot be said for remediation of a contaminated estuary. Getting the last contaminant that escaped from the confined aquatic disposal facility is technically infeasible and approaching that goal would be inordinately expensive. Determining the extent of clean-up could be years in evaluation (e.g., assessments via monitoring programs of the extent of dispersion from one particular site and risk assessments of potential human health and environmental impacts). Without cool heads, including stakeholders, at the table to agree upon the corrective action, this could certainly be a candidate for litigation.

Financial liability goes in parallel with the above discussion of responsibilities and associated liabilities for fixing problems created by the disposal actions or in the failure of some design aspects. Paying for fixing a confined aquatic disposal facility and for remediation brings with it many questions on how much money is needed, sources of funding, and administering the funds. As noted later, most countries collect a small fee for administering the dredging and disposal permit, but no one collects sufficient funds to cover potential CADF failure and remediation actions.

<u>Country Experiences with Liability Issues</u>

<u>Netherlands</u>

The country representative from the Netherlands stated simply, "Yes we are liable. We had long discussions about it, but in the end we are always responsible."

To address the potential issues related to the integrity of the confined aquatic disposal facility and the risk of dispersion of contaminants into the surrounding water and benthic resources and water resources (including groundwater), an amount of the fees is earmarked as insurance. The country representative stated:

"*In the calculations of the amount of money to set aside, this was, due to the long term effects, even in worst case scenarios, always neglectable [negligible]. So, the amount in the fees is more symbolic than realistic.*"

Hong Kong

In response to the question on government liabilities, the representative from Hong Kong stated, "We do not have much experience to share with you in minimizing government liabilities." However, they have taken numbers of actions to minimize their risks.

The East Sha Chau disposal facility is a CAD cell site, is owned by the Hong Kong Special Administrative Region Government, and it exercises on-site management of the disposal operation. The intentions are to prevent uncontrolled contamination of the adjacent waters due to the drifting of the disposed sediments before they settle into the mud pits. In addition, the government also implements an Environmental Monitoring and Audit Program so as to safeguard that any impacts arising from the East Sha Chau disposal facility are kept within the established guidelines and the assumptions in its Environmental Impact Assessment.

The representative of Hong Kong felt that conducting an EIA study of the disposal facility may be a possible way to minimize the government liabilities to a certain extent. Under the EIA study, the potential environmental impacts associated with the construction and operation of the disposal facility will be assessed and mitigation measures to minimize environmental impacts will be recommended. The disposal facility will not be allowed for construction and operation unless it has been concluded by the EIA study that the proposed works will not cause long-term environmental impacts.

Australia

Liability can arise in both the short term, during the disposal process, and in the longer term, after the disposal is completed. This latter category may also include the question of any remedial work that has to be done after site closure.

Industry generally seeks to reduce risks in the case of liabilities as there are strong economic drivers to do so. Thus, industry pursues activities in a responsible way which will reduce the risks of incurring any future liabilities, bearing in mind that any person suffering damage or nuisance as a result of debris or disturbance is free to pursue both the operator and the regulator through the courts under common law.

Any such actions would be considered on case-by-case basis.

In such a situation, a court would consider whether the regulator had behaved appropriately and whether the operator had complied. In general, if it was shown that such damage resulted from negligence or fraud on the part of the operator or the regulator, then the person suffering the damage would likely have a good chance of obtaining redress.

However, if defendants showed that all activities were undertaken responsibly and in good faith, based on the best knowledge at the time of disposal, then courts would be unlikely to rule that liability rested with the operator or the regulator. As a general statement, the law requires reasonableness, not perfection, and it would be difficult to win a case if everything had been done properly. Nevertheless, this remains hypothetical and definitive answers cannot be given.

In this context, if a regulator was found by a court to have approved a sub-standard environmental management plan, then it could be argued that the operator was also at fault for submitting such a plan.

UK

For the two projects that have/will dispose of contaminated dredged material in ocean or estuarine waters (i.e., Port of Tyne, Falmouth Marina), the permitting system was the normal one but with a very extended and detailed discussion of the details of the license. For the two projects, particular attention was placed upon the capping manual from the US Army Corps of Engineers (USACE June 1998). Liability has not been thoroughly considered as yet and it appears that the Government might ultimately be responsible. The license does not deal with liability.

As licenses currently are only for a maximum of 5 years, any monitoring, adding to the cap material, or other needed action beyond that period has to rely on informal agreement with the relevant licensees. Regarding integrity, the license for the Port of Tyne project, which is level bottom capping of CDM, includes the following stipulation:

> *9.15 The Licence Holder shall ensure that the cap integrity is maintained. If monitoring of the cap integrity shows this to be under threat then consultation with the Licensing Authority is to be sought immediately to agree a course of action.*

Within the five years, the Port of Tyne is responsible for the cap. Outside the license period, the government would need to reach an informal agreement with the Port to monitor the capping site and top up the cap when necessary.

USA

Boston Harbor CAD Cells Corps of Engineers and the Port of Boston

In the USA, the Corps of Engineers has responsibility to maintain federally designated shipping channels, of which there are 25,000 miles of federal channels. The Corps either does the dredging with its own equipment or contracts with dredging companies to accomplish the needed dredging. For non-federal channel dredging, private interests are required to get a permit from the Corps for dredging under the 1899 Rivers and Harbors

Act and under the Clean Water Act for disposal of dredged material in estuaries or fresh waters (i.e., inside the base line) or under the Marine Protection, Research, and Sanctuaries Act for disposal in ocean waters. For federal channels, the Corps provides themselves with a specific authorization and must meet the same regulatory controls as private dredging projects. For federal channels leading into specific ports, the ports are required to share in the costs of dredging and disposal, as that port is the immediate beneficiary of the dredging. States also have specific roles in approving Corps dredging projects and permits under the Clean Water Act and the Coastal Zone Management Act.

- Under the Clean Water Act, states must provide certification that the dredging project will not cause state water quality standards to be exceeded. To ensure that projects do not cause water quality problems, the state Water Quality Certification for the project frequently includes a very long list of requirements for such things as project controls, design, environmental windows, and monitoring.

- Under the Coastal Zone Management Act, states must determine that dredging projects are consistent with state objectives for environmental quality.

The above background is provided to assist in understanding the roles of the Corps of Engineers and the Port of Boston (i.e., Massport) in the disposal of contaminated dredged material into the CAD cells in the Boston Inner Harbor underneath the federal navigation channel.

The dredging and disposal into CAD cells of contaminated dredged material in Boston Harbor was a federal project dredging federal channels and co-sponsored with the Port of Boston. As such, the Corps of Engineers did not issue a permit, but conducted the work via their own authorities. The Corps designed, constructed, filled, and capped the CAD cells and bears all long-term monitoring responsibility. When issues of ownership have arisen, the Corps has consistently claimed ownership. The Corps is continuing its monitoring programs to ensure the integrity of the caps and that contaminants remain isolated.

The primary risk/liability that the Port of Boston was concerned with was the potential that material disposed of into the cells would later be required to be relocated and/or would be attributed to some sort of environmental or natural resources damage and the Port of Boston could be pursued as a potentially responsible party. Port representatives discussed this at length with the permitting agencies, but in the end the most the Port received in assurances was a letter from the Massachusetts State Department of Environmental Protection indicating that this was unlikely. The Port of Boston determined not to go any further thinking that environmental insurance would be an option, but unless risks can be better defined, it would likely be cost-prohibitive.

Newark Bay CAD Cell New York District Corps of Engineers Permittee: Port of New York/New Jersey

The Corps of Engineers issued a permit to the Port of NY/NJ for disposal of contaminated dredged material into the Newark Bay confined disposal facility (NBCDF). Regarding liabilities, the Corps of Engineers (and thereby the U.S. government) does not assume any liabilities as a result of issuing permits. Limits of authority and liabilities are contained in the boilerplate general conditions of Corps of Engineers permits. See the text box below for an example of boilerplate liability provisions in a dredging and disposal permit issued by the New England District of the Corps of Engineers to the U.S. Navy). The same boilerplate language was used in the Newark Bay permit. Authorized agents of the applicants sign their permits, and by doing so, they legally accept these limitations.

The Newark Bay CAD cell was designed to be a multi-user site meaning that the Corps of Engineers could use it for disposal of contaminated dredged material as well as the Port and private parties such as dredging of various private terminal berths in the port area. The construction, management and monitoring responsibilities and costs were all borne by the New York/New Jersey Port Authority as permittee. The Port Authority procured an Owner Controlled Environmental Insurance Policy with a limit of $20,000,000 and a deductible of $100,000 as it relates to the construction, operation, management, and eventual closure of the Newark Bay CAD cell.

For private parties to use the CAD cell, they were/are required to sign an extensive agreement with the Port of NY/NJ which was to ensure that the full risk and liabilities of using the site for disposal of contaminated dredged material was carried by the users. The full agreement ("Agreement for Disposal of Dredged Material in the Newark Bay Confined Disposal Facility") is reproduced in Appendix 5. Excerpts are provided below:

> *….agrees that the Port Authority has made no representations regarding the physical characteristics of the NBCDF other than its location and has assumed no liability to User, its contractors, subcontractors, employees, and agents and third parties in connection with the physical characteristics of the NBCDF.*
>
> *The User assumes the following distinct and several risks, whether they arise from acts or omissions (whether negligent or not) of the User, of the Port Authority, or of third person, or from any other cause, and whether such risks are within or beyond the control of the User, excepting only those risks which arise from sole negligence of the Port Authority.*
>
> *(a) The risk of claims, fines or penalties, just or unjust, made by third persons including agents, servants and employees of the user and the Port Authority or assessed by courts or governmental agencies or entities against the User or the Port Authority on account of injuries (including wrongful death), loss, damage or liability of any kind whatsoever arising or alleged to arise out of or in connection with the performance of the Work (whether or not actually caused by or resulting from the performance of the Work) or out of or in connection with the User's operations whether at or away from the NBCDF, including claims against the Port Authority including but not limited to, among other matters, claims as "arranger" or as "generator" of the dredged materials including but not limited to liability which may arise under contractual, common or statutory law, rules or regulations, orders or directives, Federal, State and local laws including, but not limited to, the Clean Air Act, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), Solid Waste Disposal Act (SWDA), Marine*

Protection, Research and Sanctuaries Act (MPRSA) Toxic Substances Control Act (TSCA), or Federal Water Pollution Control Act (FWPCA), including claims against the User or the Port Authority for the payment of workers' compensation, whether such claims, fines or penalties are made or assessed and whether such injuries, damage, loss and liability are sustained at any time both before and after the completion of the Work. As used above, "law" means any current or future law, rule, order, ordinance, directive, permit, regulation, judgment, decision or decree of any Federal, State or local executive, legislative, judicial, regulatory or administrative agency, board or authority;

(b) The risk of loss or damage to any property of the User, and of claim made against the User or the Port Authority for loss or damage to any property of subcontractors, materialmen, workmen and others performing the Work, occurring at any time prior to completion of removal of such property from the operations and sites or the vicinity thereof.

The User shall indemnify the Port Authority against all claims described in subparagraphs (a) and (b) above and for all expense incurred by it in the defense, settlement or satisfaction thereof, including expenses of attorneys.

Insurance is also required in the agreement and a small excerpt is provided below indicating that users of the CAD cell are fully insured.

The User shall take out and maintain at its own expense Commercial General Liability Insurance....covering the obligations assumed under this Agreement in a limit of not less than $5,000,000.

The user will procure and maintain in force an occurrence-based Contractors Pollution Legal (CPL) Environmental Liability policy, with an insurance company and policy form acceptable to the Port Authority. "Covered Operations", as defined in the policy, will include dredging and associated activities at the specified job site, and all transportation of materials to the NBCDF.

***Minimum** Limits of Environmental Liability Required:*

Size of Project	*Limit of Liability*	*Completed Operations Period*
Project costs Less than $1,000,000	*$1,000,000 per occurrence/ $1,000,000 aggregate*	*Two Year after completion project*
Project costs $1,000,000 to $3,000,000	*$3,000,000 per occurrence/ $3,000,000 aggregate*	*Three years after completion project*
Project costs Greater than $3,000,000	*$5,000,000 per occurrence/ $5,000,000 aggregate*	*Five Years after completion of project*

Thames River CAD Cell (Connecticut) New England District Corps of Engineers
U.S. Navy Permittee

As shown in the text box below, the boilerplate liability language is intended to relieve the Corps of Engineers from liability from any future liabilities, although the specifics of the permit are not that clear as to what responsibilities are provided to the permittee. The only longer term responsibilities are noted: (1) remove any material outside the cell and cap, which could be interpreted to include contaminated dredged material that had escaped from the cell, and (2) remove, relocate, or alter the CAD cell if problems are found to navigation interests through the area.

DEPARTMENT OF THE ARMY PERMIT

Permittee U.S. Department of the Navy

Permit No. NAE-2004-3047

Issuing Office New England District

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

15. The permittee shall perform a final sweep survey after the CAD cell is capped so that the final elevation of the top of the CAD cell can be recorded. The survey shall be performed at the CAD cell site and shall include an area 1000' north and south and from the top of slope to top of slope east and west of the Federal Navigation Channel. The permittee shall remove any material outside of the CAD cell as directed by the Corps.

25. The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

One other key in the consideration of liabilities is the simple but powerful provisions in all Corps issued permits: enforcement and compliance. The standard language:

> *Failure to adhere to this requirement will be considered a violation of this permit and cause for invoking its enforcement provisions, which carry substantial penalties.*

Section 7
Are Fees Charged to Permit Applicants for Disposal of Contaminated Dredged Material?

Researching whether other governments collect fees for disposal of contaminated dredged material in confined aquatic disposal facilities has two objectives----assess whether funds are collected:

1. to cover the normal expense of permit issuance including administrative costs in issuance of the permit (e.g., costs of conducting public hearings, or person-hours spent reviewing an EIS), assessment and monitoring costs, and, potentially, costs of ensuring compliance with permit conditions; and

2. to cover the potential failure of the confined aquatic disposal facility, including (a) costs of fixing the cause of the failure, such as a break in a dike in an island CDF or nearshore CDF, and (b) costs of remediating the dispersion of contaminated sediments into the estuary or ocean waters. If funds are collected for the objective of remediation, the question is then: how are these funds administered (e.g., environmental clean-up fund, a trust)?

Which Countries Charge Fees?

In short, all of them, for which information was available, but each is different as noted below. The responses from the country representatives were not comprehensive about fees.

Netherlands

The Netherlands collects fees to cover both objectives, permit issuance and what was called "insurance" purposes, to cover long term effects of worst case scenarios. The amount of fees collected is 1 to 2 Euros per cubic meter, and it was noted that the amount of fees are more symbolic than realistic. The fees are collected from the sponsors of the dredging projects, including ports, provinces, or private organizations.

Hong Kong

Hong Kong requires an applicant to pay a prescribed fee as stipulated in their regulations that govern dumping wastes at sea (Dumping at Sea (Fees) Ordinance, Chapter 466). The specific fees were not available. The specific regulatory language states:

14. For private projects allocated with marine disposal space, there will be a charge per cubic meter as measured in situ at the dredging site and as certified by the AP/RSE/RGE. Dumping at Sea Ordinance (DASO), Chapter 466

Australia

Fees are applied for permit applications under the Sea Dumping Act, in keeping with the polluter pays principle under the London Protocol. Additional fees are not charged for disposal of contaminated dredged material into a confined aquatic disposal facility.

United Kingdom (England and Wales)

Fees are charged to license applicants according to the size of the project, as noted below. The objective of collection of the fees is for three elements:

- **A**n administration fee for case-handling and decision-making - the cost of time devoted by staff to processing applications and administering each license, including associated overheads;

- An enforcement fee that takes into account the time spent by regional staff in enforcing license conditions as well as in providing local fisheries advice; and

- A scientific support fee covering the cost of scientific and environmental assessment, chemical analyses of samples, inspection activities, compliance and monitoring of disposal sites. This support is provided by the Centre for Environment Fisheries and Aquaculture Science.

Source: http://www.mceu.gov.uk/MCEU_LOCAL/FEPA/FEPA-Charges-Consultation.htmh

While the authorizing language for the current fee structure (see text box below) would appear to include provisions for increasing fees for disposal of contaminated dredged material in a confined aquatic disposal facility, current licensing fees have not been established to take into account this new method for disposal, or any potential for remediation of CADF failures.

UK Treasury guidelines generally require that fees are fixed so as to fully recoup costs and charges. The charges are set, following Ministerial agreement, with this objective in mind.

Costs and Responsibilities: License charges are reviewed annually to bring them into line with the forecast cost of running the licensing system during the fees year (see the text box below for England and Wales fees for dredging projects). Rates are set such that they recover the cost of administering, monitoring and enforcing licenses. Such re-assessment pays special regard to the need to reduce the burden for industry as far as possible, commensurate with the need adequately to safeguard the marine environment and to comply with the statutory and international obligations required by the OSPAR Convention.

Section 8(7) to (9) of the Food and Environment Protection Act 1985 (FEPA) provides that:

"(7) A licencing authority may require an applicant for a licence, on making his application, to pay a reasonable fee in respect of the administrative expenses of processing his application.

(8) A licensing authority may also require an applicant for a licence to pay a further reasonable fee towards the expense

(a) of carrying out any examinations and tests which in the opinion of the authority are necessary or expedient to enable the authority to decide

(i) whether to issue a licence to the applicant; and

(ii) the provisions which any licence issued to him ought to include;

(b) of checking the manner in which operations for which a licence is needed have been or are being conducted; and

(c) of monitoring the effect of such operations.

(9) Fees under this section shall be determined on principles settled by the Ministers with the consent of the Treasury and after consultation with organisations appearing to the Ministers to represent persons who are likely to apply for licences".

England and Wales Fees for Dredging Projects

Examples of the sliding scale for fees charged for a license are shown below:

Tonnage (wet weight, i.e., as dredged): 100,000 - 499,999
Charge for Capital Dredging: £14,500
Charge for Maintenance Dredging: £12,000

Tonnage (wet weight, i.e., as dredged): 1,000,000 +
Charge for Capital Dredging: £31,000
Charge for Maintenance Dredging: £25,000

The fee structure includes lower rates for extension of dredging projects into a second or third year.

Source: http://www.mfa.gov.uk/environment/works/fees-disposal.htm

In response to the question regarding whether funds are set aside in some standing fund (e.g., a trust) for use in case environmental problems occur or for short and long term use in maintenance, monitoring, and possible remediation, the representative from the UK replied, "No. Current (section 10 of FEPA) and probably future legislation provides powers to carry out remediation and recover the cost of that operation from anyone convicted of an offence in relation to the operation."

USA

In the USA, the U.S. Army Corps of Engineers is the permit issuing agency and collects a nominal fee of $100 for processing the permit, which has been the same fee for as long as long term staff can recall. States can also charge a fee, and an example is provided below.

For the Providence River CAD site, the state charges fees for use of the site on a sliding scale as shown in the text box below. The site is a multi-user site and the State of Rhode Island is responsible for management and monitoring of the site.

Providence Rhode Island State fees

$12/cubic yard of dredged material for marinas

$15/cubic yard for commercial users, such as oil and gas terminals, or cement storage terminals

$25/cubic yard for residential or recreational users. These fees are going up next year to $50/cubic yard. The basis for the higher costs for private residential owners is that there is no public interest for use of a federal-state facility.

The Rhode Island collected fees are used by the state program that manages and monitors the Providence River CAD cell.

- Some of the fees go into the Rhode Island general fund to pay back for the initial costs of construction of the CAD cells.

- The remainder of the funds is used for coastal resources management. The agency that is responsible is the Coastal Resource Management Council within the State government. The primary purpose of these funds is to provide CAD cell management which has included such things as the purchase and operation of a research and monitoring vessel. The Coastal Resource Management Council uses the vessel to be a watchdog on the site as local projects dispose of their contaminated dredged material into the CAD cell. Monitoring of the potential impacts is also conducted along with a number of broader monitoring programs of Narragansett Bay. The funds are also available to provide the non-federal match for various coastal restoration projects, for which federal funding is sometimes available with the stipulation that federal funds be matched with non-federal funds.

The Port of New York/New Jersey charges a tipping fee for use of the Newark Bay Cad cell of $29 per cubic yard. The fee is intended to cover the cost of port authority overhead and administrative costs of building the pit, and management and monitoring of dumping operations. The cost of upland disposal in the vicinity is $70-90 per cubic yard, not counting the cost of dredging which is about $7-8 per cubic yard (Masters, Port of New York/New Jersey personal communication)

Another example is the Port of Boston (or Massport) which charged a fee to private terminal operators who coordinated with Massport, the non-federal sponsor, so that their berth dredging could be completed using the Corps of Engineers contractor with disposal of unsuitable material into the CAD cells. The fee was structured based on the amount of dredged material from the private berths that was disposed in the cells.

Section 8
Findings/Conclusions/Lessons Learned/Challenges

The findings, conclusions, lessons learned, and challenges that have resulted from the assessment of country practices and policies in issuing permits for disposal of contaminated dredged material in ocean or estuarine waters are provided in this section.

In general, extensive experience with successful disposal of contaminated dredged material into confined aquatic disposal facilities exists in a number of countries, including Hong Kong, Netherlands, United Kingdom (i.e., England), Norway, Spain, Canada-Great Lakes, and the USA.

The author believes that most industrialized countries have used nearshore CDFs for disposal of contaminated dredged material. Disposal of dredged material as fill material into nearshore CDFs to create new land has been a common practice for decades. Less information is available on nearshore CDFs as an explicit management technique for disposal of contaminated dredged material because it has been such a common and effective practice. The author notes that many of these CDFs were created well before current definitions of what constitutes contaminated dredged material were in place. A comprehensive survey would likely identify hundreds of projects that placed dredged material into nearshore CDFs to create new land.

From those countries surveyed for this report, countries that have used CAD cells for disposal of contaminated dredged material include: Netherlands, Hong Kong, Norway, United Kingdom, Australia, and USA. In addition, there are a number of island CDFs in use today, including the Netherlands and the USA. A total of 34 confined aquatic disposal facilities were identified in the survey of countries that explicitly received contaminated dredged material.

The primary focus of this study was to determine what practices and policies are being used to minimize risks and to manage liabilities. The responses to the questionnaires, exchanges of emails, and information found on the internet were very instructive. Overall, it can be said:

- Confined aquatic disposal facilities are being successfully used for disposal of contaminated dredged material in ocean and estuarine waters.

- Countries are using similar procedures and policies to issue effective permits which minimize the risks of environmental impacts to marine resources.

- The approaches to liability issues by the governments that issue permits for placing contaminated dredged material in confined aquatic disposal facilities vary dramatically. Responses ranged from “have not addressed liability issues yet” to “we have no liability.”

- There are lessons to be learned from each of the countries on management of liabilities that can be used by Environment Canada.
  - In general, the approach to managing liabilities is to ensure that procedures and policies are put in place to minimize environmental risk.
  - Permits issued in the USA include specific provisions that transfer the risk to the dredging project sponsor, usually the Port Authorities. In some cases, the Port Authority then transfers that risk to private dredging projects that use the confined aquatic disposal facility, through detailed written agreements, including insurance requirements.

The general approach for ensuring that contaminated dredged material is disposed of properly, minimizing environmental risk, includes:

- Preparation of <u>environmental impact assessments</u>. The EIAs include such key areas as alternatives analyses, disposal site selection, design of the confined aquatic disposal facility, modeling of potential impacts, and the potential impact analysis including a risk assessment. All of these activities are pre-permit issuance and development of the EIA provides real opportunities for involvement of stakeholders.

- <u>Organization, procedures, and development of environmental management plans</u>. This area includes the government's initiation of the overall management structure to oversee the dredging and disposal project, the development of management and operational criteria, the issuance of the permit itself including technical and public review, and the communication mechanisms with stakeholders.

- <u>Specific conditions in permits</u>. These include such key items as:
  - Confined aquatic disposal facility location and construction design (e.g., depth and size of CAD cell, side slopes of CAD cell, placement of berms or dikes for island or nearshore CDFs)
  - Criteria for environmental quality such that the project will not cause exceedances of water quality criteria or standards
  - Confined aquatic disposal facility management plans
    - Cell filling sequence
    - Control of dumping operations
    - Cap material specifications, thickness, and capping procedures
    - Environmental windows
    - Surveys and reports
  - Types of dredging and dumping equipment
  - Monitoring programs
  - Communications and reporting
  - Insurance requirements, if needed

- <u>Monitoring requirements.</u> Monitoring programs are usually included in the permit but are emphasized here separately, given their importance in the overall project to ensure that the marine environment is protected and that the integrity of the cap is maintained. Requirements should be included in permits for pre-, during-, and post-project to understand the baseline conditions of the marine resources from which to measure potential impacts. Detailed monitoring program elements are included in the references.

The potential liabilities include simply: (1) negligent issuance of a permit that has inadequate conditions, and (2) the need to fix an environmental problem (and the cause) resulting from the project. The precise liability *depends* on a number of factors, including, but not necessarily limited to, existing legislation, regulations, permit conditions, and agreements between the permit issuing authority and dredging project sponsors.

Financial liability goes in parallel with the responsibilities and associated liabilities for fixing problems created by the disposal actions or in the failure of some design aspects of the confined aquatic disposal facilities. Most countries collect a small fee for administering the dredging and disposal permit, but no one collects funds to cover potential confined aquatic disposal facility failure and remediation actions.

- The Netherlands stated that they are responsible, but they do collect fees from project sponsors for insurance purposes. However, the fees are low relative to the potential long term scenarios are more symbolic than realistic.

- Hong Kong said that the government is the owner of the CAD cells and that their approach was to do a good upfront environmental impact assessment, and apply management procedures and operational controls. Fees were collected but no information was available regarding their amounts; the representative from Hong Kong did not indicate that fees served any type of insurance purpose.

- The USA has several models depending upon the locality of the dredging project. In the USA, maintenance of federal channels into ports is responsibility of the Corps of Engineers who is also the permit authority.

    1. For federal channels, the Corps authorizes (equivalent of a permit) itself to conduct the dredging and disposal with review by other federal agencies and state agencies. In these cases, the Corps carries the liability for the dredging and disposal.

    2. For dredging projects sponsored by port authorities, the Corps of Engineers issues permits to the port authority with boilerplate language which states that the U.S. government accepts no liability for the permitted action. In the case of the Port Authority of New York/New Jersey, the Port Authority was required to procure an Owner Controlled Environmental Insurance Policy with a limit of $20,000,000 and a deductible of $100,000 as it relates to the construction, operation, management, and closure of the Newark Bay CAD cell. For private

parties (e.g., an oil and gas terminal at a port) to use the Newark Bay CAD cell, they were/are required to sign an extensive agreement with the Port of New York/New Jersey which was to ensure that the full risk and liabilities of using the site for disposal of contaminated dredged material was carried by the users. The agreement requires extensive insurance for private users of the site.

3. In one case, the Corps of Engineers delegated responsibility for operation and maintenance of the CAD cells to the State, which then issued permits for private users, charging fees depending upon the amount of contaminated dredged material placed in the CAD cells.

Lessons Learned and Challenges

Netherlands: The fees received as noted by the Netherlands representative were symbolic of the need for potential clean-up of a failed confined aquatic disposal facility and were noted as insufficient to cover the costs of clean-up. However, further, he noted:

> *"If anything goes wrong. The government pays. The amount of money (i.e., fees) is about 1 to 2 euro per cubic meter. We have disposal sites for 20 to 30 years now. And never anything went wrong."*

Hong Kong: It is a challenge for the authority to catch the illegal dumping activities red-handed. As a result, the Real Time Tracking & Monitoring of Vessel (RTTMV) System has been developed to allow both the authority and the permit holders to carry out round-the-clock monitoring of the movement and dumping activities of the dumping vessels listed in the Disposal at Sea Ordinance permits. All dumping vessels have to install the Front End Monitoring Unit, a key component of the RTTMV, and get prior approval from the authority before engaging in the dumping activities as permitted under the Disposal at Sea Ordinance.

USA: The representative of the State of Rhode Island who is manager of the CAD cells in Providence River responded to the inquiry on liability with a statement of confidence in well designed and operated CAD cells, that there is not much that can go wrong:

> *".....not much to break......not many moving parts."*

When asked for lessons learned and suggestions for Environment Canada to consider, the representative of the Port of Boston said:

> *"We thought it worked great and have used our initial project as a model for a maintenance dredging/disposal project that we completed last summer. Make sure you conduct borings in advance to fully understand subsurface conditions and CAD cell capacity (i.e. slope of side walls and depth to bedrock or other hard bottom will greatly affect cell capacity.)"*

Australia: All elements of the CAD proposal, including details of the disposal method (e.g., barges verses dynamically positioned vessels), should be tested against the world's best practice. It is important that assertions regarding CAD proposals are thoroughly tested through the EIA process.

The long term nature of CAD cells, including monitoring and contingency requirements, places an additional burden on proponents and regulators.

The advantages to the proponent of the CAD approach may divert attention from onshore disposal, reuse, and remediation options. In the USA, two projects built a CAD cell and then limited its use by saying the CAD cell was the alternative of last resort.

Open and transparent communication is critical to moving a project from planning to operations. The status, issues, and current results of any monitoring programs or information on the status of the permit should be made available to the community on a user-friendly and comprehensive website, which aims to be a one-stop-shop for all data, information, reports and advice on the Project.

Bunding (i.e., CAD cells) in Port Melbourne is not without controversy:

At Ricketts Point today (September 29, 2007), Sue Pennicuik, Greens MLC for the Southern Metropolitan Region, released a report on the SEES Inquiry into Channel Deepening, which was held from 18 June to 31 July.

She pointed to one of the designated dredge material dumping grounds just off shore, where the Port of Melbourne Corporation plans to dump dredge material, some of it highly contaminated.

'The Port proposes to contain the dredged material underwater, by capping it with clean sand. But the SEES states that contaminated material may remain uncapped within the bund for any time between 140 days and five years! During this time, toxic materials may diffuse into the Bay, damaging the environment, impacting on marine life, washing up on Bay beaches and posing risks to human health,' Ms Pennicuik said.

'I and many others are concerned that the method of underwater containment chosen by the Port to store contaminated dredge material, will fail, causing toxins to leak into our Bay. The SEES states that the bund has a design life of only 30 years. Many toxins last for much longer than that,' she said.

UK: The normal permit is for a relatively short period, 5 years, and the issue is who is monitoring and has responsibility over the long term for maintenance of the integrity of the cap. The UK approach is to attempt to work out something informally with the permittee.

Section 9
Recommendations for Environment Canada

The following are recommendations for Environment Canada to consider based upon the findings of this study:

- Permits should be issued for contaminated dredged material disposal into confined aquatic disposal facilities, if requested, provided that: (1) proper analyses have been conducted, and (2) appropriate safeguards are in place to protect the marine environment.

  These consist of, but not limited to: preparation of an environmental impact assessment that includes an alternatives analysis, site location, design of the confined aquatic disposal facility, a risk assessment, and an analysis of how the project would meet Environment Canada's regulations for dredged material disposal.

- Prior to issuance of the permit, Environment Canada should:
  - Establish an overall organizational structure to oversee the project,
  - Establish management and operational criteria and prepare an environmental management plan
  - Conduct technical and public review
  - Establish communication mechanisms and communicate with stakeholders.

- The permit should include very specific details regarding the dredging and disposal of contaminated dredged material, including, but not limited to, the design and operation of the confined aquatic disposal facility. These include such key items as:
  - Confined aquatic disposal facility location and construction design (e.g., depth and size of CAD cell, side slopes of CAD cell, placement of berms or dikes for island or nearshore CDFs)
  - Criteria for environmental quality such that the project will not cause exceedances of water quality criteria or standards
  - Confined aquatic disposal facility management plans
    - Cell filling sequence
    - Control of dumping operations
    - Cap material specifications, thickness, and capping procedures
    - Environmental windows
    - Surveys and reports
  - Types of dredging and dumping equipment

- The permit should include the requirements of the environmental management plan, which would consist of the specific details listed above as well as:
    - Monitoring programs

    - Communications with Environment Canada, provincial governments, and the public
    - Reporting requirements
    - Insurance requirements, if needed

- The permit should require the permittee to accept all liability for the dredging and disposal project including the construction and operation of the confined aquatic disposal facility.

- Fees should be assessed to the permittee to cover the costs of permit administration and management and monitoring of the project.

- The permittee should be required to be covered by insurance or its equivalent (e.g., bond) for the costs of repair of any problems with the confined aquatic disposal facility. The author is not recommending insurance for coverage of the cost of clean-up of a bay or estuary if a confined aquatic disposal facility were to fail and widely disperse contaminants. Given the stellar record of confined disposal facilities around the world, it would seem an unnecessary cost to add to dredging projects, provided that the design and operational criteria included in the permits are well grounded.

Author's note:

The author believes that confined aquatic disposal facilities have been demonstrated to be effective in isolating contaminated dredged material. Thus, use of these isolation techniques is warranted. However, in order to minimize risks to the marine environment, and thereby liabilities, the practices and policies highlighted in this report should be followed. The author emphasizes detailed attention to the engineering and operational factors, such as design of CAD cells or capping procedures, and the need for government staff to actively manage and oversee the overall dredging and disposal project.

Section 10
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