Appendix 6.2
Field Trials of Geosynthetic Containers
ACE Report (to be endorsed by ACE)

拓展署
Territory Development Department
港島及離島拓展處
Hong Kong Island and Islands Development Office

Agreement No. CE 54/2001 (CE)

Wan Chai Development Phase II

Design & Construction

FIELD TRIALS OF GEOSYNTHETIC CONTAINERS ACE REPORT

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MAUNSELL CONSULTANTS ASIA LTD

Agreement No. CE 54/2001 (CE)

Wan Chai Development Phase II - Design & Construction

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LIST OF CONTENTS

1. INTRODUCTION

1.1 Background to Disposal of Dredged Sediments

1.1.1 The marine disposal of dredged sediments in Hong Kong is governed by the Dumping at Sea Ordinance, Cap. 466 (DASO). The Authority for the licensing and statutory control of marine disposal of dredged sediments is the Director of Environmental Protection (DEP). The Marine Fill Committee (MFC), of which the Director of Civil Engineering (DCE) is the Chairman, is responsible for establishing and managing suitable facilities for the disposal of dredged/excavated sediments and the allocation of disposal space at the different disposal sites.

1.1.2 Environmental, Transport and Works Bureau Technical Circular (Works) (ETWB TCW) No. 34/2002 sets out the management framework for dredged sediment disposal for all projects involving the marine disposal of dredged sediments. Based on their contaminant levels, sediments are classified as Category L (all contaminant levels not exceeding the Lower Chemical Exceedence Level (LCEL)), Category M or Category H (any one or more contaminant levels exceeding the Upper Chemical Exceedence Level (UCEL)). If Category H sediments are also found to have contaminants which exceed 10 times the LCEL, these sediments will need to undergo Tier III Biological Screening (Dilution Test). If the sediment passes the biological screening tests, the sediment will be allowed to be disposed of at the contaminated mud pits. If the sediment fails the screening tests, pre-treatment will be required prior to marine disposal of contaminated mud, or special arrangements will be required to ensure that there is no (or negligible) loss of contaminants to the marine environment during disposal.

1.2 The Wan Chai Development Phase II Proposals

1.2.1 Under the Wan Chai Development Phase II Comprehensive Feasibility Study (WDIICFS), it was thought that there may be some highly contaminated sediment (i.e. Category H) to be dredged in the Causeway Bay typhoon shelter that may fail the Tier III screening and which will therefore require pre-treatment or special disposal arrangements. The Environmental Impact Assessment (EIA) for the WDII project recommended special disposal arrangements for these dredged arisings.

1.2.2 The special disposal method proposed in the WDII EIA was to seal the dredged sediments in geosynthetic containers and, at the disposal site, to drop these containers into the designated contaminated mud pit where they would be covered by further mud disposal and later by the mud pit capping, thereby meeting requirements for fully confined mud disposal. It was further recommended in the WDII EIA to undertake field trials during the detailed design stage to establish the optimum handling method for this approach.

1.2.3 The approval condition for the WDII EIA report under the EIA Ordinance stated that the proposal for using geosynthetic containers for confined disposal of contaminated mud from the Causeway Bay Typhoon Shelter shall be subject to trial test. The applicant for the Environmental Permit for the WDII project shall report the results of the trial test to the DEP and the Advisory Council on the Environment (ACE).

1.2.4 In June 2002, Maunsell Consultants Asia Ltd were commissioned by Territory Development Department (TDD) to undertake the consultancy agreement for Wan Chai Development Phase II Design and Construction (WDIID&C). The field trials for the geosynthetic containers were undertaken under the Design Phase of the WDIID&C consultancy. This report outlines the arrangements for the field trials, including field testing procedures and monitoring programme, and the evaluation and recommendations of the field trials.

1.3 Report Purpose and Structure

1.3.1 This report is prepared in response to the conditions of approval of the WDII EIA, that the use of geosynthetic containers for confined disposal of contaminated mud shall be subject to trial test and the results of the trial test shall be reported to the DEP and ACE.

1.3.2 Accordingly, the report describes the preparations for the field trials and the field trial operations, and presents the results of the field trials of using geosynthetic containers.

1.3.3 Following this Introduction, Section 2 describes the rationale for using geosynthetic containers as proposed in the WDII EIA, and the disposal method to be tested in the field trials.

1.3.4 Section 3 outlines the preparatory works for the field trials, including the design and manufacture of the geosynthetic containers, the plant required for the trials and barge modification works, the field works procedures and monitoring programmes (including water quality monitoring) to be put in place for implementing and evaluating the field trials.

1.3.5 Section 4 describes the field trial operations.

1.3.6 Section 5 summarises the results of the filed trials.

1.3.7 Section 6 discussed the performance of the containers with respect to handling and disposal.

1.3.8 Section 7 confirms the feasibility of using this geosynthetic container system for special disposal of contaminated material and recommends the handling method and container design for use in the WDII project.

2. PROPOSED METHODOLOGY FOR CONTAINED DISPOSAL

2.1 Methods for Handling and Disposal of Category H^+ Sediments

2.1.1 During the course of the waste management assessments carried out under the WDII EIA, pre-treatment using techniques such as bioremediation, dechlorination, soil washing, solvent extraction and thermal desorption were examined. A number of drawbacks to the use of these pre-treatment techniques were, however, identified. These included the need for treatability studies to confirm the suitability of the pre-treatment process, requirements for dewatering, and the establishment of an off-site treatment facility. The time required for treatability studies and the establishment of an off-site treatment facility was found to have significant programme implications for the WDII project and, in view of the relatively small volume of contaminated sediments that were expected to require pre-treatment, the establishment of pre-treatment facilities was not considered to be a cost-effective measure.

2.1.2 Special disposal methods were examined instead, with the objective of keeping the loss of sediment to the surrounding marine environment to a negligible extent during the dumping operations. The major concern when bottom dumping category H^+ contaminated material is the loss of contaminants into the water body while the sediments drop through the water to the seabed. Once settled in the mud pit, records from the on-going contaminated mud pit monitoring programme indicate that there will not be any loss of contaminated material outside the mud pit. Several disposal options were considered to be potentially suitable, but the method selected as having the least likelihood of loss of contaminants to the marine environment was by containment of the sediments using geosynthetic material (geotextiles).

2.1.3 It should be noted that the choice of special disposal arrangements for the WDII project was made with respect to the particular circumstances of this project; it is not suggested that pre-treatment or other handling methods are not, in general, viable. Project-specific requirements and constraints should always be taken into account on a case-by-case basis.

2.2 Proposed Use of Geosynthetic Containers

2.2.1 The special disposal method as proposed in the WDII EIA involves essentially sealing the dredged sediments in geosynthetic containers and, at the disposal site, dropping these containers into the designated contaminated mud pit where they would be covered by further mud disposal and later by the mud pit capping, thereby meeting requirements for fully confined mud disposal. Simply put: the "bag it and drop it" ("BIDI") method.

2.2.2 The use of geosynthetic containers is not new. Geosynthetic containers have been successfully used for coastal engineering (eg for containment dykes for reclamation, slope toe erosion protection, river groynes, breakwater core construction, etc) in many parts of the world, such as the United States, Germany, the Netherlands, Singapore. From the successful engineering applications, the use of geosynthetic containers has been further developed for disposal of contaminated sediments. Examples of this application include contaminated soil disposal at Marina Del Rey in California and Yokohama Port in Japan.

2.2.3 Notwithstanding the successful use of geosynthetic containers in other parts of the world, in recognition of the fact that this method had not yet been used in Hong Kong, and in consideration of possible limitations that may be imposed by local operating constraints and locally available plant and equipment, field trials were proposed under the WDII EIA to test the handling method under local conditions. The implementation of these field trials was later imposed by ACE as a condition of approval of the WDII EIA.

2.3 Geosynthetic Container Disposal Method to be Tested

2.3.1 The disposal method that has been subjected to field trial tests uses a geosynthetic container fabricated as a 'box' or 'pillow' shaped unit made of a composite geotextile material that is designed to retain the enclosed sediments during the disposal process. It is partially prefabricated in the factory by sewing standard mill widths of geotextile together, including special seaming details at the ends of the container, to form an elongated 'box' with an open 'lid' (top cover). The geosynthetic container is placed in the hopper of a split hopper barge, filled with marine sediments and then closed in the field by insitu sewing. After towing the barge to the disposal site, the container is released by opening the split hopper and the container falls to the seabed. A diagrammatic illustration of this disposal method (the BIDI method) is given in **Figure 2.1**.

2.3.2 This disposal method is considered, on the basis of previous experience elsewhere, to be feasible and the technology readily available for the manufacture of geosynthetic containers to project-specific requirements.

2.3.3 The plant and equipment used for this disposal system includes, typically, a grab dredger, split hopper barges, supporting derrick barges and tugs, etc, all of which are commonly available in Hong Kong. The plant is similar to that which would be used in the WDII dredging contract, for the actual application of this disposal system.

2.3.4 An alternative containment system was also considered initially, involving the use of a tubular geotextile container with built-in reinforcement ribs, placed on a flat topped pontoon. This container would have potential benefits in that it would not require any on-site sewing or seaming and the outer skin material could be fabricated to a very high strength (not being constrained by having to be fitted into the barge hopper or having to pass through the narrow barge hopper opening). Disposal would be by flooding of ballast chambers so that the pontoon tilts to one side and the container rolls off into the water and drops to the seabed. However, the absence of a suitable pontoon locally meant that this system would not be able to satisfy the criterion of using locally available plant and equipment, and therefore this form of containment was not pursued in the field trials.

2.3.5 The field trials were undertaken as part of the WDII Site Investigation (SI) contract which was being carried out under the WDIID&C at the time. Issues of concern which were identified as requiring special attention in implementing the field trials include: the method of containment, the ability to handle various volumes of contained sediments (ie the size of the containers), the suitability of the locally available plant for the disposal method, and the ability of the container to withstand rupture and bursting stresses.

2.3.6 The purpose of the field trials was, firstly, to satisfy ACE as to the suitability of this special disposal method for the WDII project and, secondly, to establish the optimum container system design and handling method.

2.3.7 Acceptance criteria for the field trials, for determining the success of the trials, were taken to be essentially that there should be no significant loss of material from the container and that there should be no significant loss of suspended sediment resulting from impact of the container on the seabed outside the confines of the disposal area.

3. PREPARATION FOR THE FIELD TRIALS

3.1 Overview of the Field Trial Preparation

3.1.1 Implementation of the field trials required a number of preparatory activities, including the specification, design and manufacture of the geosynthetic containers, the procurement of plant for undertaking the works, modification of the hopper barge to suit the disposal system, obtaining dredged sediments for use in the trials, and agreement with the relevant authorities on the procedures for the field trials and monitoring programmes.

3.1.2 Extensive discussions were held with EPD and other concerned departments on arrangements for the field trials. Key issues and concerns that needed to be resolved included:

- source of dredged material to be used in the trials and the dredged material properties (whether contaminated or uncontaminated, similarity to the nature of the sediments which would be dredged in the WDII project, etc);
- the disposal site (whether at the South Cheung Chau disposal area or at East Sha Chau contaminated mud pits);
- flotation of the containers (whether subsequent to disposal they could be displaced from the mud pit or, through generation of biogas in the contained sediments, float and therefore become a hazard to shipping or end up on a beach);
- monitoring procedures and acceptance criteria (how to establish the success of the trials);
- issue of a DASO permit (approval for disposal under the Dumping at Sea Ordinance).

3.1.3 The following paragraphs outline the major preparatory works that were undertaken and some of the key issues that were addressed.

3.1.4 It should be noted that the field trials involved, to a certain extent, an iterative learning process. Problems that became apparent during the first trial disposals were resolved through modifying the handling method or the plant used, or by changing the container design and installation details, to suit the local conditions and material being handled. In particular, the hopper barge gate (bottom opening) was modified twice, once prior to commencement of the field works and again after the first trial, and the geosynthetic container material and fabrication specifications were upgraded when it became apparent that a more robust container would be required to suit the actual site conditions. These changes are included in the discussion below on the preparation for the field trials.

3.2 Design and Manufacture of the Geosynthetic Containers

3.2.1 The geosynthetic container system was designed to suit the local site conditions and the type of dredged marine sediments to be contained and disposed. The design included material specification, taking into account strength, sediment retention and permeability requirements. The design also considered the appropriate volume of containers and their associated handling characteristics, with due consideration given to the dredging methods, transport to the disposal site and disposal mechanisms. The structural integrity of the container is an issue requiring critical attention to appropriate fabric selection and fabrication details.

3.2.2 The containers were manufactured using two layers of polypropylene geotextile, comprising woven and non-woven fabric layers, which were used to provide both strength and retention of the dredged sediments. The use of this composite fabric and the container fabrication details (in particular the seam designs) were intended to:

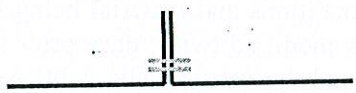
- retain the dredged material during the disposal operation and after placement on the seabed;
- resist the stresses imposed while handling the container and during filling operations, without seam or fabric rupture;
- resist puncture and tearing during release from the barge hopper;
- resist bursting on impact with the seabed.

3.2.3 The function of the non-woven inner lining is to prevent any loss of contained material. The geotextile used was Mirafi 160N. The outer lining provides the strength and rupture resistance. Initially, a woven polypropylene geotextile fabric with a tensile strength of 120kN/m (Geolon PP120S) was used. Later in the field trials, a stronger material was used for this layer, with a tensile strength of 200kN/m (Geolon PP200S). The data sheets for the technical properties of the woven and non-woven fabrics are attached in **Appendix E** for reference.

3.2.4 The geosynthetic containers were formed by joining together standard roll (mill) widths of fabric in the factory, with seamed joints having sufficient overlap to prevent any loss of contained material. Seam strength is critical to the structural performance for the container; seam strength is essentially a function of the type of seam stitching used and the strength of the parent material. The initial Geolon PP120S containers used a so-called 'prayer seam', which is commonly used overseas for the fabrication of geosynthetic containers. This type of joint gave a seam strength of around 45% to 50% of the parent fabric strength (ie 55 to 60kN/m seam strength), while the later Geolon PP200S containers used a modified flat seam with six lines of stitching, which provided a seam strength of around 70% of the parent fabric strength (ie 140kN/m seam strength).

3.2.5 A summary of the seam pattern, seam strength and fabric strength used in the field trials is given in Table 3.1.

Table 3.1 Summary of seam Pattern, Seam Strength and Fabric Strength

Type of seam	Prayer Seam	Flat Seam
Pattern (Typical Section)		
Strength of the seam as % of the fabric strength	45% to 50%	70%
Fabric Strength	120kN/m	200kN/m
Seam Strength	60kN/m	140kN/m

3.2.6 Two sizes of geosynthetic containers were used in the field trials, with notional volumes of $600m^3$ and $300m^3$. The dimensions of each size of container were designed to fit the internal dimensions of the hopper barge used for the disposal of the containers. **Figure 3.1** shows typical views of the containers and gives indicative container dimensions specified for the manufacture of the geosynthetic containers.

3.2.7 Air vents are provided at the top of the container (in the cover) to release any air pressure build-up inside the container during its descent to the seabed.

3.2.8 The containers were fabricated in a factory in the Netherlands and freighted out to Hong Kong. A total of five containers were used in the field trials. For ease of reference, these are labelled as A to E, with the following key properties:

- Container A had a notional volume of 600m^3 with a woven fabric tensile strength of 120kN/m
- Container B had a notional volume of 300m^3 with a woven fabric tensile strength of 120kN/m
- Containers C, D and E all had notional volumes of 300m^3 with woven fabric tensile strengths of 200kN/m.

3.2.9 Slip sheets were provided to cover the inside of the barge hopper. The slip sheets reduce friction between the container and the steel hopper and, by so doing, facilitate the smooth egress of the container. The slip sheets were made from a woven fabric with a tensile strength of 80kN/m.

3.3 Marine Plant

3.3.1 In conjunction with the design of the containers, appropriate dredging and marine plant was identified. The dredging and marine plant and equipment was procured through the WDII SI contract; major items of plant used for the field trials included:

- a grab dredger for dredging the marine sediments;
- two split bottom hopper barges with notional capacity of 1,000m^3 for the delivery and temporary storage of the dredged marine sediments;
- one modified split bottom hopper barge with notional capacity of 1,000m^3 for the deployment and disposal of the geosynthetic containers;
- one derrick lighter, equipped with a grab of capacity 2m^3, for filling the geosynthetic containers;
- tug boats for towing and manoeuvring;
- passenger launches for transfer of personnel to the barges.

3.3.2 The typical 1,000m^3 split bottom hopper barge (as shown in **Figure 3.2**) was considered suitable for the deployment and disposal of the geosynthetic containers in view of the size of the hopper (to cater for both the 600m^3 and 300m^3 containers), and its ready availability locally.

3.3.3 The hopper barge for the deployment and disposal of the containers needed to be modified to suit the two different sizes of containers and to facilitate the dropping of the geosynthetic containers through the hopper gate.

Barge Modification for 600m^3 Container

3.3.4 The barge modification work comprised the installation of longitudinal bulkheads along the full length of the two sides of the hopper such that the width of the hopper was reduced to around twice the maximum openable width of the hopper gate. This modification was considered necessary on the basis of previous experience where, on occasion, containers had 'hung' in the hopper instead of dropping out through the opened gate. Increasing the gate opening width in relation to the hopper width would minimise this occurrence. The installation of these longitudinal bulkheads also provided a gangway to serve as safe working and inspection platform along each side of the hopper, to facilitate the laying, filling and closing of the geosynthetic containers. The general layout for the barge modification work is given in **Figure 3.3**.

3.3.5 The resultant hopper dimensions provided an effective 600m^3 volume, for the larger container placement.

3.3.6 To ensure a smooth and protrusion free surface on the inside of the hopper, not only were all foreign attachments (concrete screed, etc) and rusty surfaces removed completely, new steel plates were also installed on the hopper surface.

Barge Modification for 300m^3 Container

3.3.7 For the installation of the 300m^3 geosynthetic containers, the split bottom hopper barge was further modified after the field trial operation for the 600m^3 container. Transverse bulkheads were installed to reduce the hopper volume and positioned such that the 300m^3 container was deployed in the central section of the hopper barge. The general layout of the barge modification work with the addition of the transverse bulkheads is shown in **Figures 3.4** and **3.5**.

3.3.8 The modification work for the split bottom hopper barge is further illustrated in **Figure 3.6**.

Barge Hopper Gate Modifications

3.3.9 It was also necessary to have the bottom opening of the hopper (the hopper gate) completely protrusion free and smooth. In its normal condition, the hopper gate has rows of steel angles (or 'teeth') along both sides of the gate; these are to help seal the hopper in its normal use. However, these steel teeth would present sharp protrusions when the hopper is opened and the container drops through the gate. As at first the barge owner was reluctant to remove these steel teeth from the hopper gate, rubber gaskets were installed along the hopper gate to provide a smooth edge over the existing angles. **Figure 3.7** illustrates the details of the rubber gaskets installed over the existing angles in the hopper gate.

3.3.10 However, after the first field trial, it was found that the installation of rubber gaskets was not sufficient to ensure a completely protrusion free and smooth hopper gate for the geosynthetic containers to pass through without damage. The hopper gate was, therefore, further modified as illustrated in **Figure 3.7**. The steel angle teeth (after agreement with the barge owner) were removed and new steel plates with rounded edges were welded to the hopper gate to provide a completely smooth surface.

3.3.11 The barge modification works were carried out at shipyards in Mainland China.

3.4 Source of Dredged Sediments for Use in the Trials

3.4.1 An exhaustive site search was undertaken for the source of marine sediments to be used for the field trials. A number of projects with dredging activities were identified, including:

- reclamation at Yam O under CED's Contract No. CV/2000/09 - Infrastructure for Penny's Bay Development, Contract 1;
- maintenance dredging at Approach to CT9 Area A1;
- maintenance dredging at Approach to CT4 and CT6;
- maintenance dredging at Approach to CT9 Area A2;
- maintenance dredging at Yau Ma Tei Typhoon Shelter;
- maintenance dredging at Wan Chai PCWA.

3.4.2 After considering the programme for the field trials and the nature of marine sediments to be used in the field trials, uncontaminated marine sediment for the field trials was agreed with EPD and CED to be obtained from CED's maintenance dredging project at Approach to CT9 Area A2 Phase 3. The agreed dredging area is shown in **Figure 3.8**.

3.5 Working and Disposal Sites for the Trials

3.5.1 The designated field trial works area, for the laying, filling and sealing of the geosynthetic containers on the modified hopper barge, was at the Western Anchorage Area, south of Tsing Yi.

3.5.2 Disposal of the geosynthetic containers under the field trial conditions, as well as of any excess dredged sediment not used in the trials, was designated at the East Sha Chau contaminated mud pits. Disposal was first proposed at the South Cheung Chau gazetted disposal area in view of the better visibility for underwater inspection of the containers. However, after considering the possible risk of the containers on the seabed being damaged by trawlers fishing in the nearby area at South Cheung Chau, and the requirement from EPD to ensure the field trials were carried out under similar conditions as the future disposal site (which will be at East Sha Chau), it was agreed that the field trial disposal of the geosynthetic containers should be at East Sha Chau. **Figure 3.9** shows the disposal location at East Sha Chau contaminated mud pit.

3.5.3 A number of issues needed to be resolved before EPD issued the required DASO permit for disposal of the containers. These included the risk of movement of the containers after dumping in the East Sha Chau contaminated mud pits due to wave action or tidal currents, and the risk of floatation of the containers due to possible biogas generation by the contained material. These risks were assessed and found to be negligible. The geosynthetic containers are not airtight and the incorporation of air vents would enable any excess air in the containers to escape in any event. At the disposal site, the containers would be placed within the mud pits and, subsequently, covered by on-going disposal and capping operations. There is, therefore, no reasonable possibility of movement of the containers out of the mud pit. Long term deterioration of the containers was also considered, but found not to be cause for concern as the containers will be capped by on-going disposal operations at East Sha Chau.

3.5.4 For easy reference, a copy of the DASO permits issued for the field trials is attached in **Appendix F.**

3.6 Performance Monitoring Programme

3.6.1 The dredging operation and the field works for the field trials was carried out by the WDII SI Contractor, with supervisory staff provided by Maunsell. Two specialists with overseas experience in the design and implementation of geosynthetic container systems also provided advice and assistance in the field trials.

3.6.2 For assessing the performance of the geosynthetic containers in the field trials, monitoring programmes including underwater visual inspection by divers, the addition of polystyrene spheres inside the geosynthetic containers and water quality monitoring were implemented.

Diver Inspections

3.6.3 Arrangements were made for underwater visual inspections of the geosynthetic containers, after each disposal operation, to be carried out by divers subject to the confirmation by the divers on the safety conditions of the surrounding environment and necessary visibility. The divers' primary objectives, having located the containers, were to report on the general condition and lie of the containers on the seabed, and to examine them for signs of rupture. Underwater photos of the geosynthetic containers on the seabed would be taken subject to visibility.

3.6.4 A further diving inspection was programmed to be undertaken two weeks after the last disposal operation to identify any short term movement of the containers. However, this inspection was

subject to safety and visibility conditions at the time and any on-going disposal operations that may have taken place at the disposal site in the intervening period.

3.6.5 In the event that safety conditions were not suitable for divers to operate at the disposal site, or that visibility was not good enough for visual inspection at the time of the trials, the monitoring for possible rupture or damage of the containers would rely on two other monitoring programmes, the polystyrene spheres test and the water quality monitoring.

Polystyrene Spheres Test and Patrol System

3.6.6 The objective of the polystyrene spheres test was to detect any rupture of the geosynthetic containers during disposal that may lead to significant leakage of sediments.

3.6.7 Polystyrene spheres were placed inside the geosynthetic containers along with the dredged material filling. Should there be any rupture or bursting of the container during the disposal process, some of the sediments together with the polystyrene spheres would leave the bag. The polystyrene spheres would float to the sea surface and act as a visual indicator of damage or rupture of the container.

3.6.8 An inspection patrol using launches was arranged to pick up any polystyrene spheres that might escape.

3.6.9 Details of the application of the polystyrene spheres test and the patrol system, as agreed with EPD and MD, are given in **Appendix A**.

Water Quality Monitoring

3.6.10 Water quality monitoring was carried out during the disposal process, for which the WDII SI Contractor provided the necessary boats and crew, as well as the monitoring equipment. Laboratory testing of water samples was carried out under the WDII SI Contract.

3.6.11 The objective of the water quality monitoring programme was to capture any possible plumes which might extend beyond the confines of the disposal zone arising from the contained disposal method. Monitoring stations were placed upstream and downstream of the disposal zone with the stations located at 200m and 600m from the container drop site location.

3.6.12 Sampling at the monitoring stations commenced two hours before disposal operations started in order to capture the background conditions of the water body. Sampling continued until any elevation of turbidity had returned to the background level or, in the event where no elevation was recorded, sampling continued until 2 hours after completion of disposal operations.

3.6.13 Details of the water quality monitoring programme are given in **Appendix B**.

4. FIELD TRIAL OPERATIONS

4.1 Geosynthetic Containers Tested

4.1.1 Five geosynthetic containers were tested in the field trials, one of size 600m^3 and four of size 300m^3, as summarised in Table 4.1. This section describes the field trial operations undertaken for the disposal of these five containers.

Table 4.1 Summary of the Field Trials and Containers

Geosynthetic Container	A	B	C	D	E
Date of Disposal	17/05/2003	20/06/2003	16/06/2003	26/07/2003	31/07/2003
Notional Volume (m^3)	600	300	300	300	300
Tensile Strength of Woven Fabric (kN/m)	120	120	200	200	200
Seam Strength (kN/m)	60	60	140	140	140

4.1.2 The preparatory procedures for the design and manufacture of the geosyntethic containers, and for the barge modification works, have been outlined in the preceding Section 3. The works undertaken on site, ie the laying, filling, closing and disposal of the containers, are described in the following paragraphs.

4.2 Dredging Operations for the Field Trials

4.2.1 Uncontaminated marine sediments were dredged over three separate days at the agreed maintenance dredging site at Approach to CT9 Area A2 Phase 3, for the five field trials.

4.2.2 The dredging work was carried out by conventional grab dredger and the dredged marine sediments were stored in two split bottom hopper barges with notional capacity of 1,000m^3. The storage barges were then moored up alongside the modified container disposal barge to facilitate transfer of the sediments from the storage barge to the container (as a separate operation).

4.2.3 Any surplus dredged sediments remaining in the storage hopper barges which was not used in the field trials was disposed of at the East Sha Chau contaminated mud pit.

4.2.4 **Figure 4.1** illustrates the dredging operation and the marine plant used.

4.3 Container Delivery, Storage and Handling

4.3.1 The geosynthetic containers were delivered to Hong Kong by either sea or air freight. After delivery to site, the containers were stored with proper covers in the derrick lighter moored next to the modified hopper barge.

4.3.2 The containers were unpacked and laid out in the derrick lighter, before being transferred (using the derrick winch) to the modified hoper barge for placing in the hopper and then filling. **Figure 4.2** illustrates the geosynthetic containers in the derrick lighter storage area, as delivered to site.

4.4 Laying of Containers in the Barge Hopper

4.4.1 Before laying the geosynthetic containers in the barge hopper, slip sheets were first laid on the sides and at the ends of the hopper. They were held in place by G-clamps on the hopper coaming. Excess lengths of the slip sheets were left folded at the bottom of the hopper; these extra lengths would drop through the bottom as the hopper was opened to provide a lining through the hopper gate. Extra lengths were also draped over the hopper coaming at the top to allow for gradual release during the container filling so as to relieve tension in the slip sheets.

4.4.2 The containers were unpacked and unrolled in the derrick lighter and then hoisted across and laid out along one side of the modified split hopper barge. They were then manually dropped into the side of the hopper and carefully pulled across the hopper using draw lines, until the container lined the sides and bottom of the hopper. The sides of the container were secured to the hopper coaming using the same G-clamps that were used to hold the slip sheets in place.

4.4.3 The containers were designed and laid such that a fold of material was left at the bottom of the hopper. This was to facilitate the drop through the hopper during disposal: as the hopper was first opened, the loose container material would fall through, fill with sediments and then aid the drop of the remaining container by 'pulling' it through the hopper gate. Same as the slip sheets, the top ends of the containers were draped over the hopper coaming leaving enough slack for release during the container filling to relieve tension in the containers.

4.4.4 **Figure 4.3** provides some illustrations of the laying of the geosynthetic containers in the barge hopper.

4.5 Filling of Containers with Dredged Sediments and Addition of Polystyrene Spheres

4.5.1 The geosynthetic containers were filled with marine sediments from the storage barge moored alongside. The sediments were transferred from the storage barge into the geosynthetic containers using a $2m^3$ clamshell grab rigged on the derrick lighter.

4.5.2 Care was needed during the filling process to avoid damage to the container. The sediments needed to be released from the grab from above the hopper coaming level to avoid possible damage due to the grab hitting the sides of the container; the release was carefully controlled to minimise impact loading on the container, especially when placing the first layers in the bottom of the container. Filling was carried out in even layers along the length of the container.

4.5.3 Together with the filling, polystyrene spheres were added in layers in accordance with the procedures mentioned in Section 3 and **Appendix A**. For each layer of polystyrene spheres added, the spheres were pushed into the marine sediments using long bamboo poles; this was in order to keep the spheres fixed in position when the next layer of filling was placed, otherwise the spheres would be displaced by the impact of the sediments dropped from the grab.

4.5.4 During the filling process, tension was induced in the fabric of the containers and slip sheets by the filling; this tension was relaxed by releasing the G-clamps and thus the fabrics on the four sides, progressively, as the container was filled.

4.5.5 The containers were not completely filled. A void was left at the top to allow for the sediment movement as the container was 'squeezed' out through the hopper gate, and to take up any resultant pressure build-up. The actual filled volumes of the containers, with allowance made for the voids, is summarised in Table 4.2.

Table 4.2 Summary of Filled Volume of Containers

Geosynthetic Container	A	B	C	D	E
Notional Volume (m^3)	600	300	300	300	300
Filled Volume (m^3)	550	210	225	210	210
Filled Percentage	92%	70%	75%	70%	70%

4.5.6 **Figure 4.4** provides illustrations of the filling process and the addition of polystyrene spheres to the containers.

4.6 Closing of the Containers

4.6.1 After filling the geosynthetic containers, the covers of the containers (ie the lid) were drawn across the upper surface of the sediments and sewn closed.

4.6.2 At the commencement of the trials, in-situ stitching was proposed using a hand-held sewing machine. However, when closing Container A (the first container), problems were encountered at the fabric joints (seams), which were too thick and caused the portable sewing machine to jam. Container A was therefore closed by a combination of sewing machine stitching and hand stitching over the seams. For the remaining Containers B, C, D and E, use of the portable sewing machine was abandoned and the in-situ closing of the containers was done solely by hand stitching.

4.6.3 The edges to be joined on site comprised the composite fabric layers (ie the woven and non-woven layers) of the container and two outer flaps of woven fabric which were pulled over the in-situ stitched seam. The hand stitching method involved rolling the edges to be joined together and tying them with seam stitching using 6mm nylon rope with a pitch of around 75mm (3 inches). Next, rope knots were used to fasten the two outer flaps together over the seamed joint; these knots were made at approximately 150mm (6 inches) separation. The first seam served the purpose of ensuring that soil does not escape from the container, while the second (rope-knotted) joint was designed to withstand stresses induced during the disposal.

4.6.4 The two ends of the container required special attention as, with a number of factory seams and in-situ seams all coming together at the same place, this was a difficult area to ensure robust closure. The hand stitching and rope knotting at the two ends of the container were further modified to ensure total containment of sediments. Hand stitching of a pitch of 25 to 50 mm (1 to 2 inches) and rope knots at 75mm (3 inches) spacing were adopted at the first metre at the two ends.

4.6.5 Details of the hand stitching, rope knotting and the modified closing at the two ends of the geosynthetic containers are illustrated in **Figure 4.5**.

4.7 Disposal of the Containers

4.7.1 Once the containers had been closed, and on pre-arranged days and times to allow CED to close the contaminated mud pits to other users during the time of the field trial disposals, the modified hopper barge was towed to the East Sha Chau contaminated mud disposal site (Pit IVc) for the disposal operations.

4.7.2 The water quality monitoring stations were set up two hours prior to the disposal time and baseline readings were taken at both upstream and downstream from the disposal location. The water quality monitoring was continued until two hours after the disposal of the containers.

4.7.3 Divers' inspections were arranged on the days of disposal. For Containers B and D, suitable weather, tidal phase and marine conditions meant that these inspections were carried out on the day as planned. However, for Containers A, C and E, the tidal and wind conditions on their disposal days were not suitable for divers' inspections; their inspections were carried out several days later when conditions were more suitable. The divers' inspection for the last container, Container E, was carried out together with the final divers' inspection, which was two weeks after the disposal of Container E.

4.7.4 Launches were on standby around the disposal site to look for and, if found, retrieve any polystyrene spheres which escaped and floated to the surface.

4.7.5 At the designated time of disposal, around the mid-ebb or mid-flood tide phase, the modified hopper barge was manoeuvred into position with the aid of global positioning system. The hopper (which was hydraulically operated) was opened and the containers slid out through the hopper bottom.

4.7.6 Photographs of the some of the disposal operations are provided in **Figure 4.6**. The results of the field trials are summarised in the following Section 5.

5. RESULTS OF THE FIELD TRIALS

5.1 Results of the Field Trial for Container A

5.1.1 Table 5.1 summarises the key results of the field trial operations for Container A.

Table 5.1 Results of the Field Trial for Container A

Geosynthetic Container	A	Date and Time of Disposal	17/05/03 12:35
Notional Volume	600 m^3	Weather	Occasional showers and windy
Filled Percentage	92%	Tide Phase	Ebb
Container Fabric	Geolon PP120S	Approximate water depth	28 m
Description of the Disposal	• Container A descended unevenly along the hopper length. A major portion of the drop was concentrated at a point around one-third from the fore end of the hopper. • Over half of the container passed through the hopper gate when the opening was only around 0.5m wide. The whole container had dropped by the time the hopper gate opening was only around 1m wide.		
Polystyrene Spheres Test	• Polystyrene balls were found soon after the container passed through the hopper gate, including inside the hopper. • A total of 520 nos. of polystyrene balls escaped from the container (around 40% of the total placed in the container).		
Divers' Inspection	• Container A was laying in a horizontal orientation partially embedded in the seabed with approximate dimensions of 30m long by 5m wide. • An approximately 10m longitudinal rupture was found in the geosynthetic fabric. • The container appeared to have twisted during its decent and many folds in the geosynthetic fabric were evident. • A piece of the geosynthetic fabric at the rupture location was retrieved by the divers.		
Water Quality Monitoring	• No apparent difference between the water quality monitoring data taken before and after the trials and at upstream and downstream of the disposal location. • The results of the water quality monitoring are attached in **Appendix C**.		
Additional Inspection	• The modified hopper barge for the disposal of Container A was inspected thoroughly on a slipway in Tsing Yi after the first field trial. • The rubber gaskets installed over the teeth at the hopper gate were found torn and dislodged.		
Remarks	• Container A was capped by on-going disposal activities at East Sha Chau after the divers' inspection.		

5.2 Assessment of Container A Performance

5.2.1 Based on observations at the field trial operation for Container A, rupture of the container was considered to have occurred on exit, due primarily to stresses as it passed through the hopper gate. The assessment was supported by inspection of the hopper gate on a slipway after the trial. The rupture was in the longitudinal direction (seams are in transverse direction), as inspected by the divers, and the sample of the ruptured material retrieved by the divers indicated significant stress-induced failure, rather than the container fabric tearing by being cut by a protuberance. A photograph of the ruptured edge of the fabric is provided in **Figure 5.1**, and the damaged hopper gate is shown in **Figure 5.2**.

5.2.2 The disposal for the first trial exhibited somewhat different characteristics to those expected on the basis of previous experience. Firstly, the rate at which the hopper opened was much slower than that of other overseas experience. On the basis of overseas experience, and as advised by specialists with overseas experience in attendance at the field trials, it would be preferable to have a hopper gate to open to its maximum width (of around 2800mm) in approximately 2 minutes, whereas the hopper barge in the field trial was able to open its hopper gate to its maximum width of 2600mm in around 4 minutes. Secondly, the container descended almost immediately, and very rapidly. Over half of the container had already passed through the hopper gate when the opening was only around half metre wide. The rapid exit was considered due in part to the contained sediment properties. Previous experience had involved the use of sandy material, which tended to 'bridge' across the opening and 'hang' in the hopper until the gate opening was wide enough (hence the reduction of hopper cross section to increase the relative opening width). The material used in this trial, however, was a very soft (with very high water content) clayey material, which clearly preferred a rapid exit by squeezing through a very narrow opening to hanging around. The slow rate of opening (which was a function of the available plant, and was not adjustable) exacerbated the problem.

5.2.3 With the container passing rapidly through a narrow opening, and (as evidenced by later inspection) the rubber gaskets not able to stand up to the resultant forces, the narrow opening with the (now exposed) sharp edges of the steel 'teeth' would have caused considerable stress to the geosynthetic fabric. The timing of the appearance of the polystyrene balls at the surface, and the fact that a number of balls surfaced inside the hopper, indicated that rupture must have taken place at the hopper exit. It was therefore concluded that the container was damaged as it passed through the hopper gate, and that the main reason for the failure was the container fabric being over-stressed as it passed through the narrow opening with exposed sharp edges.

Remedial Action

5.2.4 The rubber gaskets installed for the first trial (Container A) were found on inspection to be damaged and, in places, displaced after the disposal operation. With the assessment of container performance indicating the hopper gate with the steel 'teeth' as being one of the primary causes of failure of the container, the remedial action was to further modify the hopper gate. Details of the modification work have been explained in Section 3.3.

5.2.5 For all subsequent container trials (ie Containers B to E), the modified hopper barge with the steel 'teeth' removed and smooth steel plates welded over the hopper opening to provide a completely smooth surface, was used.

5.3 Results of the Field Trial for Container B

5.3.1 Table 5.2 summarises the key results of the field trial operations for Container B.

Table 5.2 Results of the Field Trial for Container B

Geosynthetic Container	**B**	Date and Time of Disposal	20/06/03 10:35
Notional Volume	300 m^3	Weather	Fine
Filled Percentage	70%	Tide Phase	Flood
Container Fabric	Geolon PP120S	Approximate water depth	32 m
Description of the Disposal	• Container B descended evenly through the hopper gate.		
Polystyrene Spheres Test	• Polystyrene balls were found after the container had dropped. The first polystyrene ball was found at around 60 seconds after the entire container had passed through the hopper gate. • A total of 40 nos. of polystyrene balls escaped from the container (around 6% of the total placed in the bag).		
Divers' Inspection	• Container B was laying horizontally partially embedded in the seabed with approximate visible dimensions of 15 m long by 5m wide. • A rupture was found in the form of a parted seam transverse across the width of the container. It was approximately half way down the length of the container. • A piece of the geosynthetic fabric at the rupture location was retrieved by the divers.		
Water Quality Monitoring	• No apparent difference between the water quality monitoring data taken before and after the trials and at upstream and downstream of the disposal location. • The results of the water quality monitoring are attached in **Appendix C**.		
Remarks	• Container B was capped by on-going disposal activities at East Sha Chau after the divers' inspection.		

5.4 Assessment of Container B Performance

5.4.1 Container B appeared to exit the hopper without any problem, however, polystyrene balls appeared on the surface some time after disposal, downstream of the drop position. The timing of the appearance of the balls indicated that some form of rupture had occurred at the seabed.

5.4.2 The divers located the container on the seabed and identified the rupture. Inspection of the sample of torn fabric that was retrieved by the divers showed that a seam failure had occurred, with the stitching torn. It was therefore concluded that Container B ruptured on impact with the seabed, due primarily to inadequate seam strength.

5.4.3 A photograph of the ruptured edge is provided in **Figure 5.3**.

Remedial Action

5.4.4 Seam strength needed to be increased. With the seam strength being partly a function of the base fabric strength, and with some concern remaining from the failure of Container A due to the stresses imposed on the container as it passes through the hopper gate (the modification of the gate notwithstanding), it was decided to use both a stronger fabric for the container and a stronger seam design.

5.4.5 New geosynthetic containers were therefore fabricated using a fabric with tensile strength of 200kN/m and with a flat seam design which gave a relative strength of around 70% of the fabric strength, as described in Section 3.2.

5.4.6 The new containers were confined to 300m^3 size, as this stronger material was much heavier and more difficult to handle than the lighter 120kN/m fabric, and it was considered that the manual handling of the large 600m^3 containers in placing them in the hopper and closing them would cause unnecessary problems.

5.5 Results of the Field Trial for Container C

5.5.1 Table 5.3 summarises the key results of the field trial operations for Container C.

Table 5.3 Results of the Field Trial for Container C

Geosynthetic Container	C	Date and Time of Disposal	16/06/03 14:40
Notional Volume	300 m^3	Weather	Fine
Filled Percentage	75%	Tide Phase	Ebb
Container Fabric	Geolon PP200S	Approximate water depth	32 m
Description of the Disposal	• Container C descended through the hopper gate normally. • At the final stage of the drop through the hopper gate, a pressure 'bubble' formed in the top of the container which was concentrated at the last portion of the container to pass through the gate, at the rear end of the hopper. (See **Figure 5.4**)		
Polystyrene Spheres Test	• Polystyrene balls were found soon after the container passed through the hopper gate. • A total of 6 nos. of polystyrene balls escaped from the container (around 1% of the total placed in the container). • The markings on the collected polystyrene balls indicated that the balls came out from the rear end of the container.		
Divers' Inspection	• Container C was laying horizontally partially embedded in the seabed with approximate visible dimensions of 16 m long by 5m wide. • The container was found intact with no evidence of damage or rupture.		
Water Quality Monitoring	• No apparent difference between the water quality monitoring data taken before and after the trials and at upstream and downstream of the disposal location. • The results of the water quality monitoring are attached in **Appendix C**.		
Remarks	• Container C was capped by on-going disposal activities at East Sha Chau after the divers' inspection.		

5.6 Assessment of Container C Performance

5.6.1 Container C dropped through the hopper evenly, however, at the final stage of the exit a pressure 'bubble' formed in the top of the last remaining portion of the container. The pressure bubble was concentrated at the rear end of the container, which was the last section to pass through the hopper gate. **Figure 5.4** illustrates the disposal of Container C with the 'bubble' highlighted.

5.6.2 A few (6 no.) polystyrene balls appeared on the surface at the rear of the barge soon after exit. The markings on the balls (the balls had been marked so as to identify where in the container they had been placed) indicated that all the balls which escaped were from the rear end of the container.

5.6.3 The concentrated pressure bubble at the rear of the container as it left the hopper and the fact that all the balls which escaped were from the rear end of the container led to the conclusion that some (minor) loss occurred through the rear end due to high pressure on exit. The very minor loss of balls further suggested that there must have been a very small gap which, under pressure, allowed some balls to escape. The fault was considered to lie with the hand stitching at the end. Due to the confluence of a number of seams (both factory and hand sewn) and material folds at the ends, these were difficult areas to close on site. It was assumed that a small gap may have been left in the ends, sufficient to enable a small number of the polystyrene balls to escape under pressure. This finding was supported by the divers' inspection, which found no signs of rupture or other damage to the container on the seabed.

5.6.4 On further inspection of the subsequent trials for Container D and E, with particular attention being paid to the closure at the two ends, it was demonstrated that a minor opening of the size of a fist could quite easily have been left at the ends where the cover and the adjacent fabric of the geosynthetic container are all joined together by hand stitching on site. An illustration of how such a minor (and unnoticed) gap could have been left in the end closure is shown in **Figure 5.5**.

5.6.5 Nevertheless, the results of the field trial operation for Container C demonstrated that the field trial was close to success with Container C being structurally sound and remaining intact on the seabed.

Remedial Action

5.6.6 Remedial actions for the subsequent field trials included the addition of closely packed hand stitches and rope knots at the two ends to ensure that any possible minor openings were closed.

5.6.7 To overcome the problem of the pressure bubble, the sides of the geosynthetic container were drawn up in the hopper when it was being placed, to provide a larger void at the top of container in order to better absorb any pressure build up. This resulted in less loose material at the bottom of the hopper, which in turn resulted in the container being held up in the hopper slightly longer when the hopper was opened, as there was less material to drop through the gate initially to pull the container through (refer to Section 4.4). However, this consequence was considered a benefit in itself, as it enabled the hopper to be opened wider before the container fell through.

5.7 Results of the Field Trial for Container D

5.7.1 Table 5.4 summarises the key results of the field trial operations for Container D.

Table 5.4 Results of the Field Trial for Container D

Geosynthetic Container	**D**	Date and Time of Disposal	26/07/03 11:40
Notional Volume	300 m^3	Weather	Fine
Filled Percentage	70%	Tide Phase	Ebb
Container Fabric	Geolon PP200S	Approximate water depth	27 m
Description of the Disposal	• Container D descended normally through the hopper gate.		
Polystyrene Spheres Test	• No polystyrene balls escaped from Container D.		
Divers' Inspection	• Container D was laying horizontally partially embedded in the seabed with approximate visible dimensions of 16 m long by 6 m wide. • The container was found intact with no evidence of damage or rupture. • The final divers' inspection carried out at around three weeks after the disposal of Container D found that there was no movement of Container D after the disposal inside the mud pit.		
Water Quality Monitoring	• No apparent difference between the water quality monitoring data taken before and after the trials and at upstream and downstream of the disposal location. • The results of the water quality monitoring are attached in **Appendix C**.		
Remarks	• Container D was capped by on-going disposal activities at East Sha Chau after the final divers' inspection.		

5.8 Assessment of Container D Performance

5.8.1 The disposal of Container D was successful. The container dropped through the hopper as expected, no polystyrene balls escaped the container and the container was inspected by the divers and found intact with no evidence of damage.

5.8.2 The design and disposal statement for the field trial operation for Container D was followed for Container E to further confirm the success of the geosynthetic container system.

5.9 Results of the Field Trial for Container E

5.9.1 Table 5.5 summarises the key results of the field trial operations for Container E.

Table 5.5 Results of the Field Trial for Container E

Geosynthetic Container	**E**	Date and Time of Disposal	31/07/03 15:05
Notional Volume	300 m^3	Weather	Fine
Filled Percentage	70%	Tide Phase	Ebb
Container Fabric	Geolon PP200S	Approximate water depth	24 m
Description of the Disposal	• Container E descended normally through the hopper gate.		
Polystyrene Spheres Test	• No polystyrene balls escaped from Container E.		
Divers' Inspection	• Container E was laying horizontally partially embedded in the seabed. • The container was found intact with no evidence of damage or rupture.		
Water Quality Monitoring	• No apparent difference between the water quality monitoring data taken before and after the trials and at upstream and downstream of the disposal location. • The results of the water quality monitoring are attached in **Appendix C**.		
Remarks	• Container E was capped by on-going disposal activities at East Sha Chau after the divers' inspection.		

5.10 Assessment of Container E Performance

5.10.1 The results demonstrate that the field trial for Container E was successful. The container dropped through the hopper as expected, no polystyrene balls escaped the container and the container was inspected by the divers and found intact with no evidence of damage. The successful design and disposal method for the geosynthetic container system were confirmed.

6. PERFORMANCE EVALUATION

6.1 Summary of Results of the Field Trials

6.1.1 Five geosynthetic containers were tested in the field trials. The results of their disposal operations are summarised as follows:

(i) Container A (600m^3 with 120kN/m outer woven fabric) failed due to rupture of the geotextile fabric on exit from the hopper barge. Around 40% of the polystyrene balls that were placed in the container escaped. The cause of failure was attributed primarily to stresses as the container passed through the hopper gate. Water quality monitoring detected some elevation of sediment levels immediately downstream, which would have been due to the loss of sediments from the container, but no significant loss of sediments beyond the confines of the disposal site.

(ii) Container B (300m^3 with 120kN/m outer woven fabric) failed due to rupture of the container on impact with the seabed. Around 6% of the polystyrene balls that were placed in the container escaped. The cause was seam failure due to inadequate seam strength. Water quality monitoring indicated that there was no significant loss of sediments beyond the confines of the disposal site.

(iii) Container C (300m^3 with 200kN/m outer woven fabric) did not fail structurally and was found intact on the seabed with no sign of damage. However, some 1% (6 no.) of the polystyrene balls that were placed in the container escaped. Their loss was attributed to a pressure 'bubble' that occurred at the rear of the container as it left the hopper and a small gap that had (presumably) been left in the container cover closure which enabled these few balls to be ejected form the container under pressure. Water quality monitoring indicated that there was no significant loss of sediments beyond the confines of the disposal site.

(iv) Container D (300m^3 with 200kN/m outer woven fabric) was adjudged a success. The container dropped through the hopper as expected and there was no loss of polystyrene balls or signs of damage to the container on the seabed. Water quality monitoring indicated that there was no significant loss of sediments beyond the confines of the disposal site.

(v) Container E (300m^3 with 200kN/m outer woven fabric) was also adjudged a success, with similar results as Container D.

6.2 Lessons Learnt

6.2.1 The first few trials highlighted a few of problems in the container design and deployment and with the hopper barge. These only became apparent in the trials under local conditions, particularly through the use of locally available plant and due to the properties of the sediments being used for disposal. However, once these initial deficiencies had been overcome or rectified, the later trials of the disposal of sediments using geosynthetic containers were successful.

6.2.2 In overcoming the initial problems, the following aspects with respect to the hopper barge preparation, the geosynthetic container design and the deployment of the container warrant consideration in the event of future use of this disposal system:

(i) In selecting the hopper barge to be used for disposal of the containers, given the choice, the barge with a faster rate of hopper opening should be chosen. This will help in enabling a wider hopper opening when the container drops through the hopper gate and thereby lessen the stresses of the geotextile fabric during the exit.

(ii) The barge hopper must be modified to ensure that the surfaces presented to the geosynthetic container are completely smooth and protuberance free. Particular attention needs to be paid to the hopper gate, where any steel angles and other sharp edges need to be removed; a smooth steel plate cover over the hopper gate has been found to perform satisfactorily.

(iii) Under local conditions (ie using locally available hopper barges and for disposal of soft muds), the strength of the container fabric and, particularly, the seam strength of the container, requires special attention. The use of an outer woven fabric with tensile strength of 120kN/m and a seam strength of around 60kN/m has been found not satisfactory. A stronger fabric (200kN/m) and associated seam strength (140kN/m) has been found to work well.

(iv) The deployment of the container in the hopper and its filling should allow for sufficient void volume at the top of the container, to accommodate the pressure build-up as the container is squeezed through the hopper gate during its drop from the hopper. Filling to 70% of the notional container volume is recommended.

(v) Closure of the container in situ (ie the hand stitching for sealing the container cover) requires special attention to detail and a high degree of supervision. The ends of the container are especially vulnerable to have small openings left in, due to the confluence of a number of seams and material folds at these critical areas. Experience has shown that even a very small (and barely noticeable) opening will result in some loss of filling from the container when it leaves the barge hopper. More closely packed stitching and knotting at the ends of the container is required, and close supervision is essential to ensure that openings are not left in place.

(vi) Provision of international and local expertise with experience in the design and on-site implementation of the geosynthetic container system will be an advantage to future operations and should be included in the contract requirements.

6.3 The Effective Container System

6.3.1 Five field trial operations were carried out to derive and confirm the effective disposal system. Initial trials that were not successful provided indications of inadequacies in the system and potential weak points. The barge, containers and/or deployment operations were modified in the subsequent trails in response to the findings of the initial trials to derive a system which is structurally sound and meets the requirements for contained disposal.

6.3.2 The Container A trial (600m^3, 120kN/m fabric strength), which ruptured on exit from the barge hopper, showed up the need for a smooth and protuberance free barge hopper, and raised concern about the need for a stronger fabric for the container when using locally available barges with their slower hopper opening rate for disposal of soft sediments.

6.3.3 The Container B trial (300m^3, 120kN/m fabric strength), carried out after further barge modification works in response to the first field trial results, but still using the 120kN/m strength fabric (albeit with a smaller container size), confirmed that, under local conditions at least, a stronger container fabric is required (in particular to provide a greater seam strength).

6.3.4 The Container C trial (300m^3, 200kN/m fabric strength) demonstrated the success of the barge modification works and the use of a stronger container fabric (with its associated greater seam strength). This container was structurally sound, although a small number of polystyrene balls did escape which indicated the presence of a small opening in the hand-stitched cover closing. The trial showed up the importance of attention to detail in sealing the container lid and the need for close supervision of this operation, especially where great importance is attached to the maximum containment of the sediments.

6.3.5 The trails for Containers D and E (both 300m^3, 200kN/m fabric strength) were successful in confirming the effectiveness of the container system, taking on board the lessons learnt from the earlier trials.

6.3.6 The use of a 300m^3 geosynthetic container, with an outer woven fabric tensile strength of 200kN/m and a seam strength of 140kN/m, has been demonstrated to be an effective method for contained disposal. Associated with the use of this container is the use of a specially modified hopper barge, with the inner lining of the hopper and the hopper gate plated over to provide a smooth and protuberance free surface. The use of slip sheets to line the hopper provides further protection from damage and facilitates the smooth egress of the container from the hopper.

6.3.7 This container system has been shown to be able to retain the dredged sediments without any loss due to rupture or damage of the container. Furthermore, water quality monitoring has indicated that there is no significant loss of sediments, due to re-suspension of the seabed sediments caused by impact of the container on the seabed, beyond the confines of the disposal site. This container system is therefore considered to meet ETWB TCW No. 34/2002 requirements for special disposal arrangements in ensuring that there is no (or negligible) loss of contaminants to the marine environment during disposal.

6.3.8 The disposal system utilises locally available plant and can accommodate local conditions and handling methods. The container itself is fabricated using readily and commonly available geotexiles. It is considered to present the optimal design and handling method, as determined within the time and budget allowances of the field trials.

6.4 Cost Considerations

6.4.1 For reference purposes, the following order of costs have been derived through the field trial operations. However, it must be stressed that these are purely indicative costs, arising from these field trials; they do not necessarily represent the actual costs that would be incurred under commercial contract conditions.

Fabrication and supply of 300m^3 geosynthetic container (with fabric strength 200kN/m)	HK$ 100,000
Modification of hopper barge (including reduction of hopper width, temporary bulkheads, hopper lining and hopper gate modification)	HK$ 600,000
Plant and labour costs for disposal of one container (four day cycle for container deployment, filling, closing and disposal)	HK$ 100,000

6.4.2 Clearly, using a $600m^3$ container would be more cost effective than the $300m^3$ container. However, the improved efficiency in terms of disposal production rate and unit costs must be offset against the (as yet) unproven feasibility of the larger container and the uncertain difficulties inherent in (manually) handling the bigger and much heavier $600m^3$ container. Disposal using the $300m^3$ container, on the other hand, has been proven (through these field trials) to be successful and the container easily handled.

7. RECOMMENDATIONS

7.1 The field trials have enabled the special disposal arrangements proposed under the WDII EIA, for highly contaminated dredged sediments (ie sediments that fail diluted biological screening tests), to be tested in order to demonstrate their feasibility. Disposal by sealing dredged sediments in geosynthetic containers and dropping these containers into the contaminated mud pits at East Sha Chau has been shown to be a successful and viable disposal method.

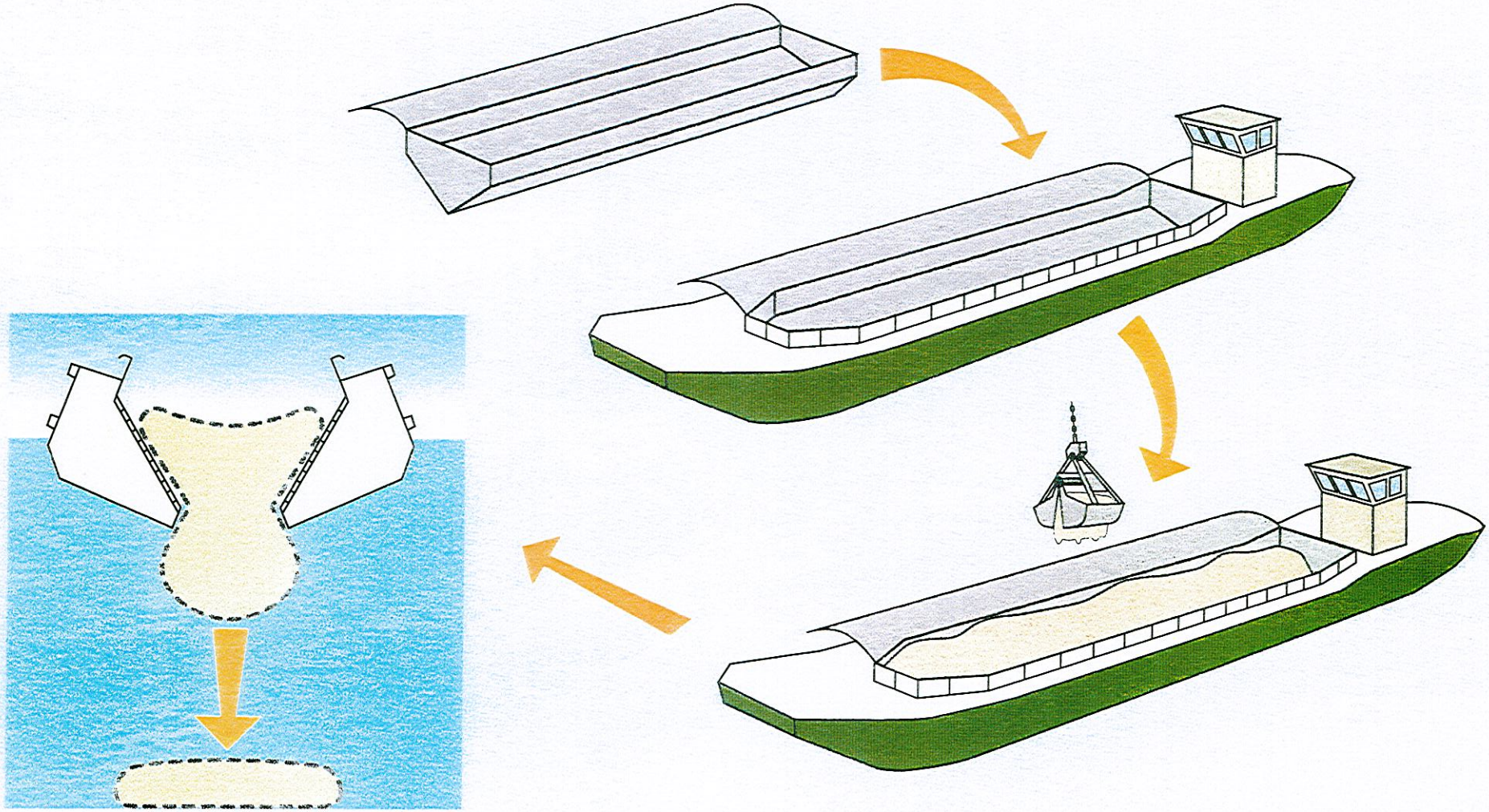
7.2 The container design and handling method have been refined through the field trials for the determination of the optimal design and handling method.

7.3 The use of a geosynthetic container system for special disposal arrangements is considered to an effective system which meets ETWB TCW No. 34/2002 requirements in ensuring negligible loss of contaminants to the marine environment during disposal.

7.4 The geosynthetic container system of notional size 300m^3 and using outer woven fabric tensile strength of 200kN/m, with fabricated seam strength of 140kN/m, as described in this report for the successful trials of Containers D and E, is recommended for use in the WDII project.

7.5 An outline specification for the recommended geosynthetic container is provided for reference in **Appendix D**.

FIGURES



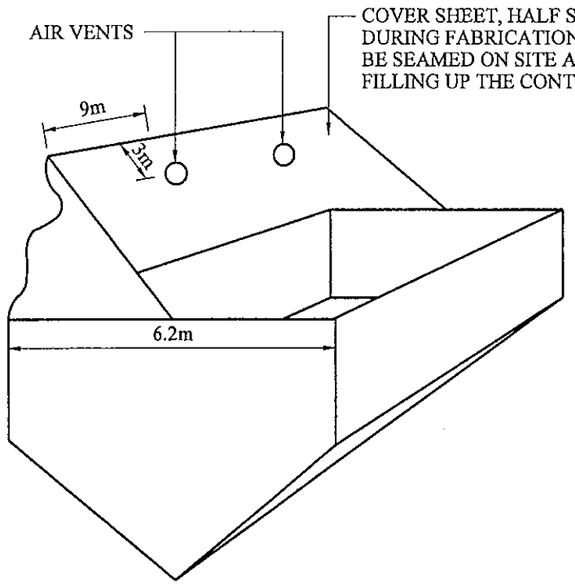
Maunsell

AGREEMENT NO. CE 54/2001 (CE)
WAN CHAI DEVELOPMENT PHASE II - DESIGN AND CONSTRUCTION

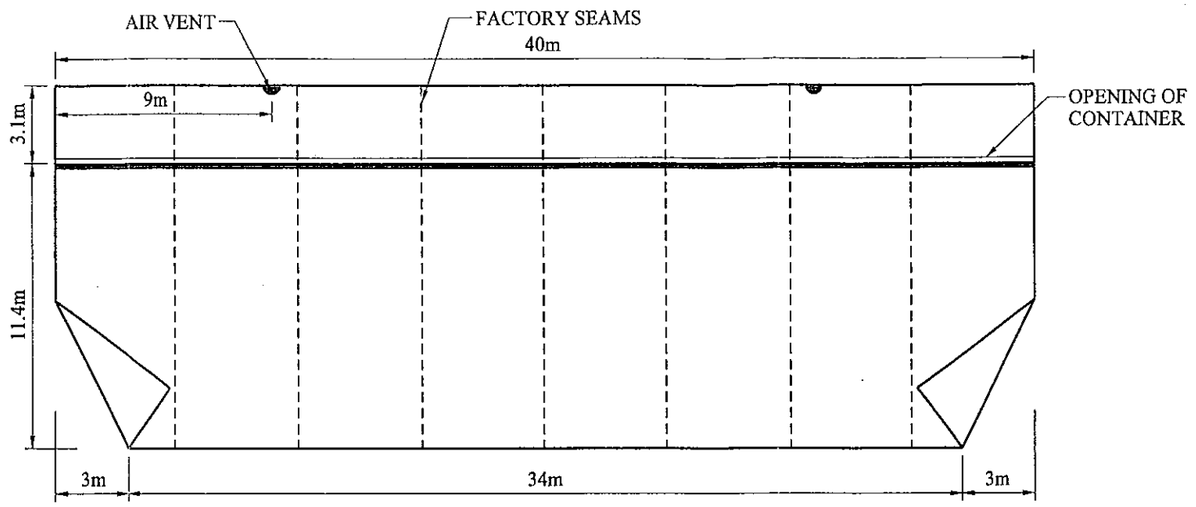
BIDI METHOD

Territory Development Department
Hong Kong Island & Islands

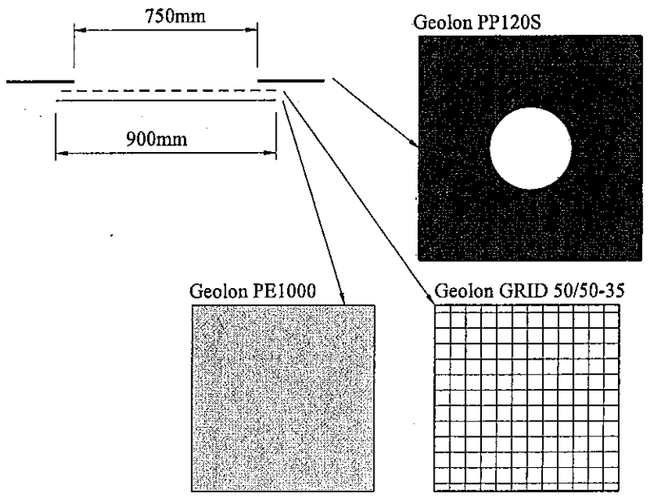
FIGURE 2.1



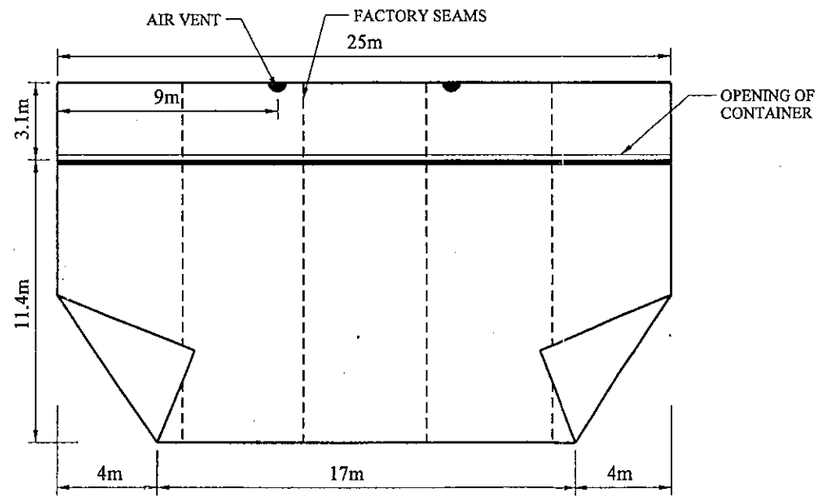
PERSPECTIVE VIEW
(CONTAINER PLACED INSIDE HOPPER)
N.T.S.



600m^3 GEOSYNTHETIC CONTAINER
SCALE 1 : 250



TYPICAL AIR VENT DETAILS
N.T.S.



300m^3 GEOSYNTHETIC CONTAINER
SCALE 1 : 250

NOTES:

1. DIMENSIONS SHOWN IN THIS DRAWING SHALL BE THOSE FOR THE FINISHED CONTAINER. SUFFICIENT ADDITIONAL MATERIAL SHALL BE PROVIDED FOR JOINT OVERLAPS AND INSITU SEALING OF THE COVER SHEET.
2. DIMENSIONS SHOWN IN THIS DRAWING ARE INDICATIVE

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GEOSYNTHETIC CONTAINER

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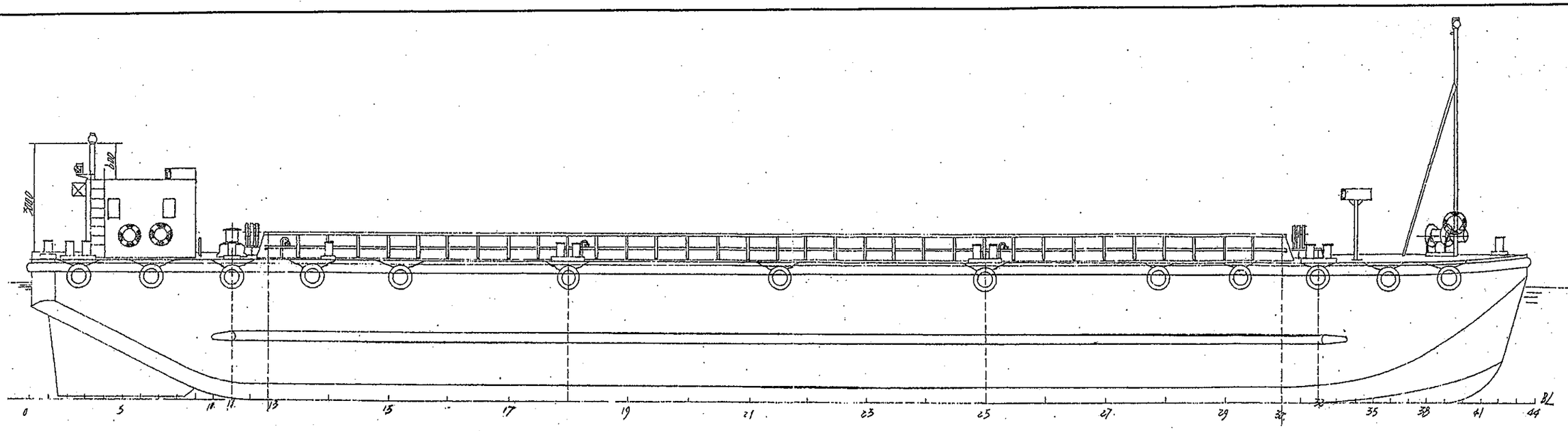
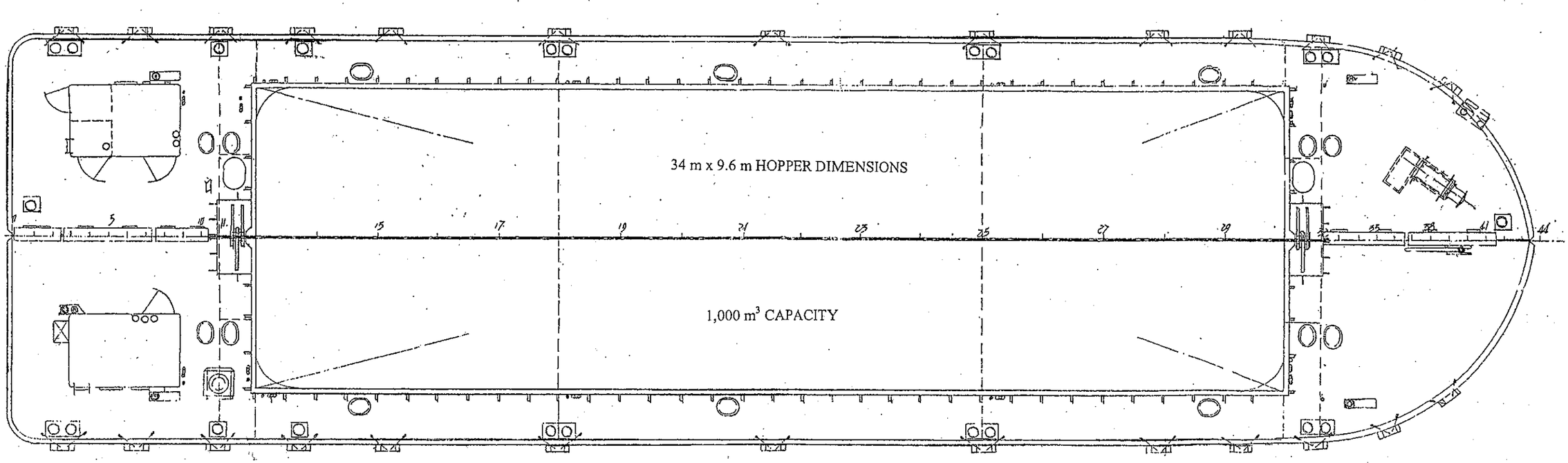
FIGURE 3.1

[C-D1] Q:/PROJECTS/93502/REPORT/FIELD TRIAL/FIG3-1.DGN SACLE: 1: 1000 A3 SEP 2003



ELEVATION
N.T.S.



PLAN
N.T.S.

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TYPICAL 1000m³ SPLIT BOTTOM HOPPER BARGE

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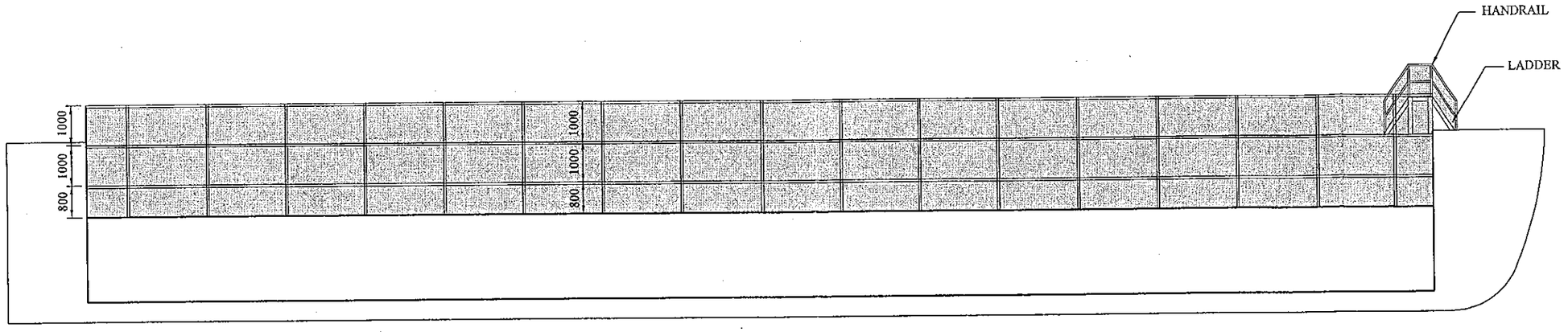
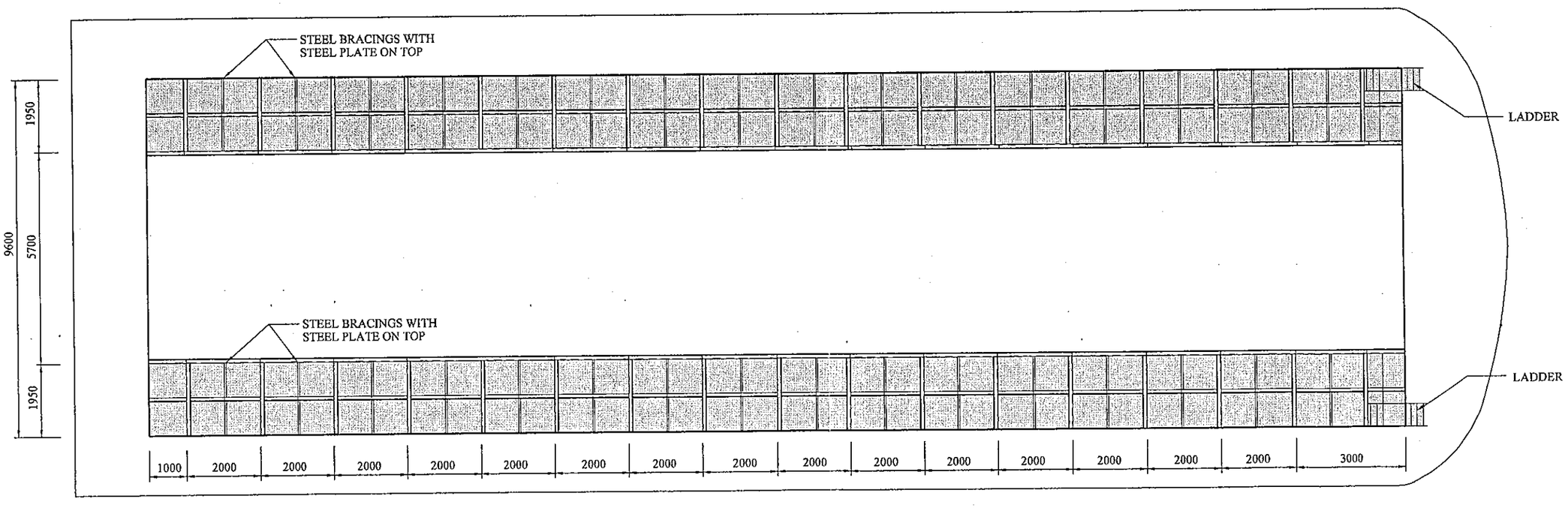
FIGURE 3.2



ELEVATION

SCALE 1 : 125



PLAN

SCALE 1 : 125

LEGEND:

MODIFICATION WORK

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BARGE MODIFICATION WORK FOR 300m^3 GEOSYNTHETIC CONTAINER

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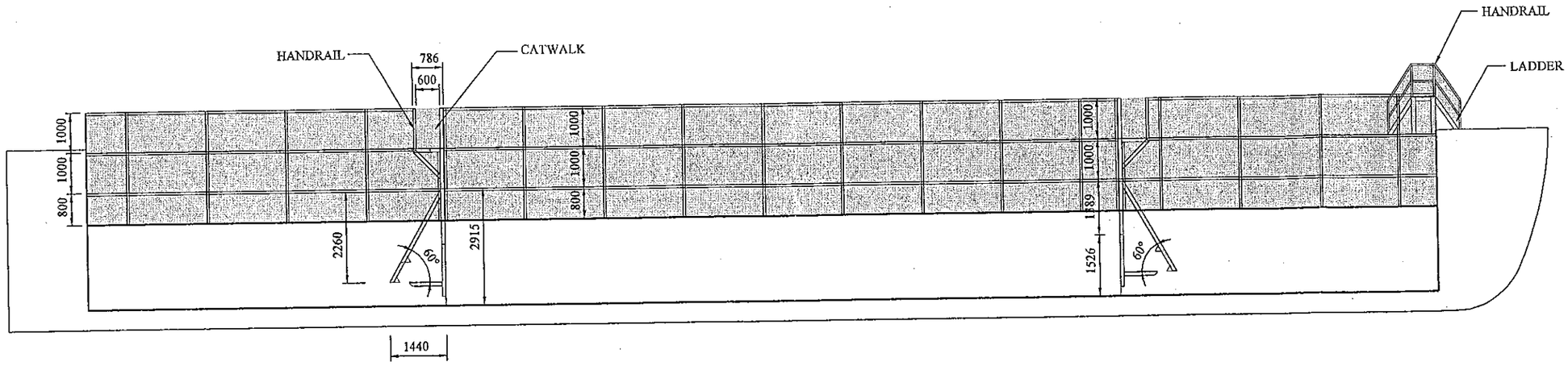
FIGURE 3.3

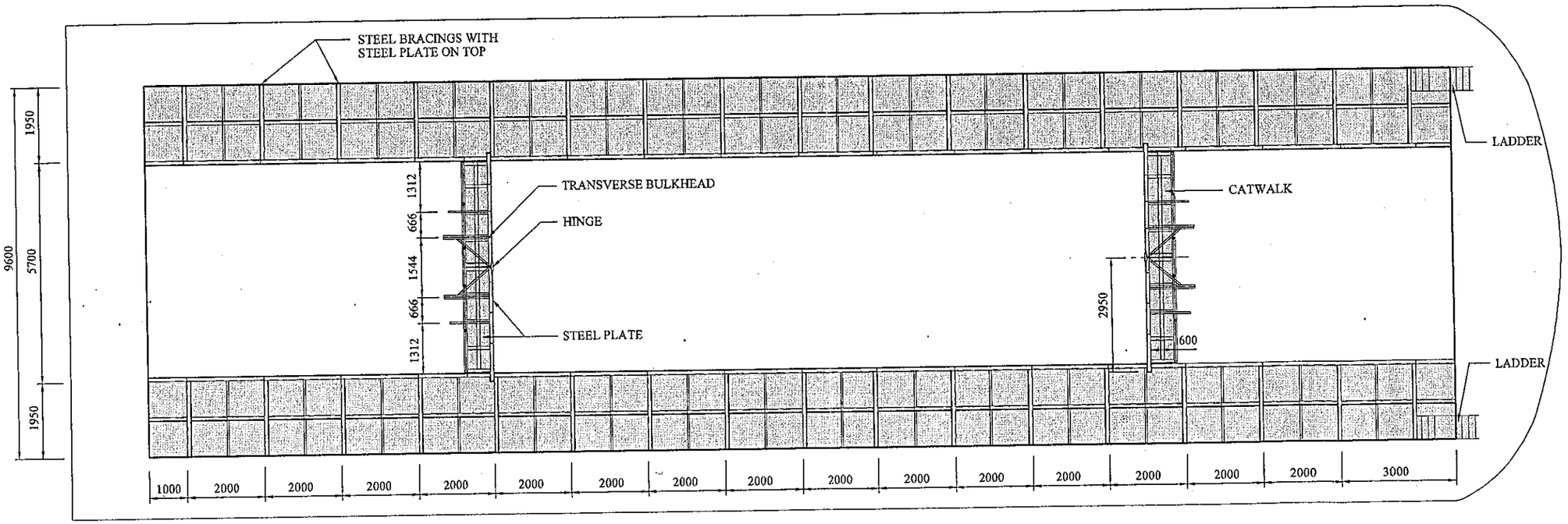
[C-D1] Q:/PROJECTS/93502/DRAWING/FIGURE/FIG 3-3.DGN

SEP 2003



ELEVATION

SCALE 1 : 125



PLAN

SCALE 1 : 125

LEGEND:

MODIFICATION WORK

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BARGE MODIFICATION WORK FOR 300m^3 GEOSYNTHETIC CONTAINER

SHEET 1 OF 2

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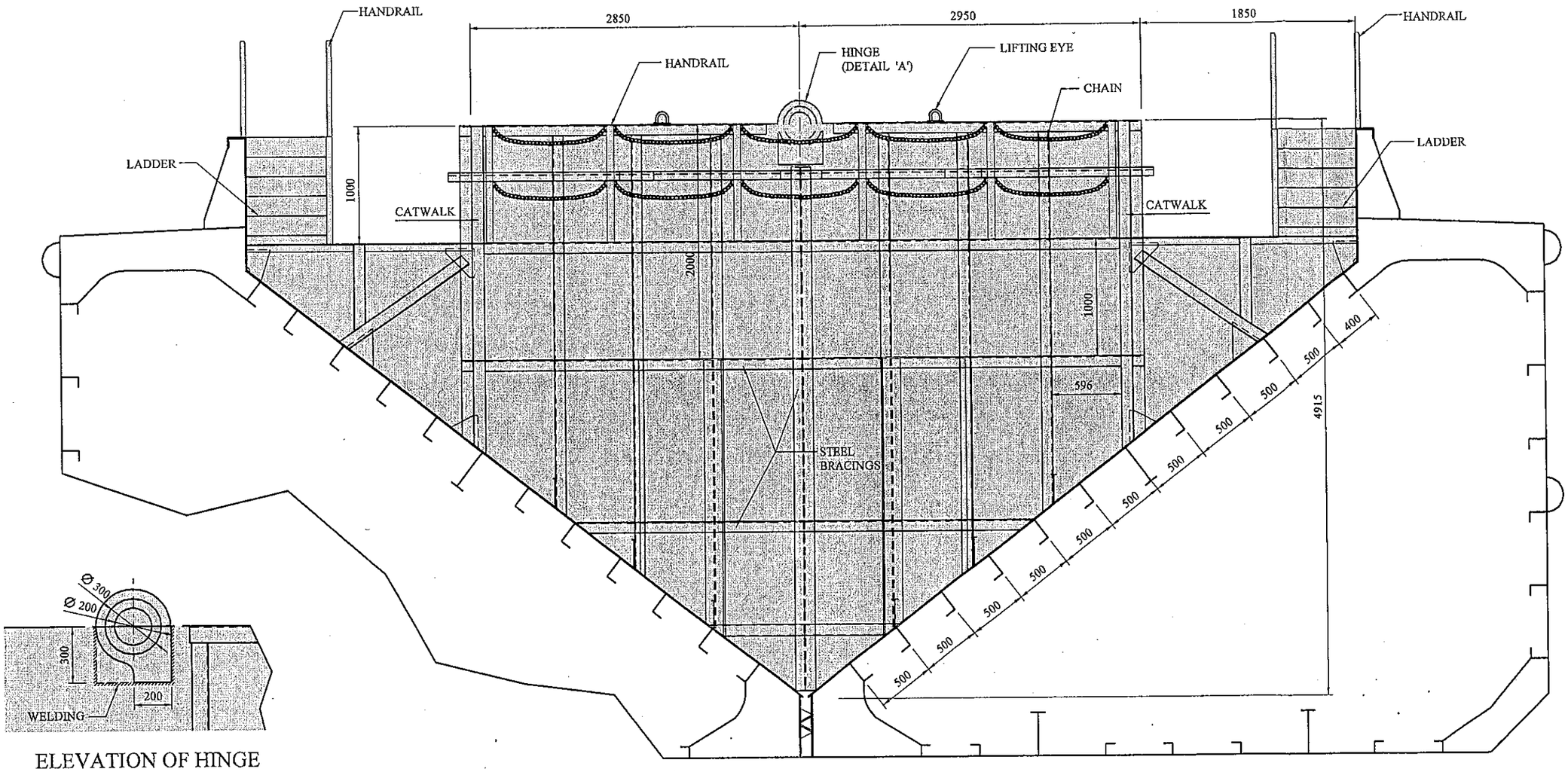
FIGURE 3.4

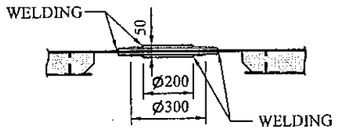
[C-D1] Q:/PROJECTS/93502/DRAWING/FIGURE/FIG 3-4.DGN

SEP 2003



TYPICAL SECTION FOR TRANSVERSE BULKHEAD
SCALE 1:40

ELEVATION OF HINGE



PLAN

DETAIL 'A' (HINGE)
SCALE 1:25

LEGEND:

MODIFICATION WORK

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BARGE MODIFICATION WORK FOR 300m³ GEOSYNTHETIC CONTAINER

SHEET 2 OF 2

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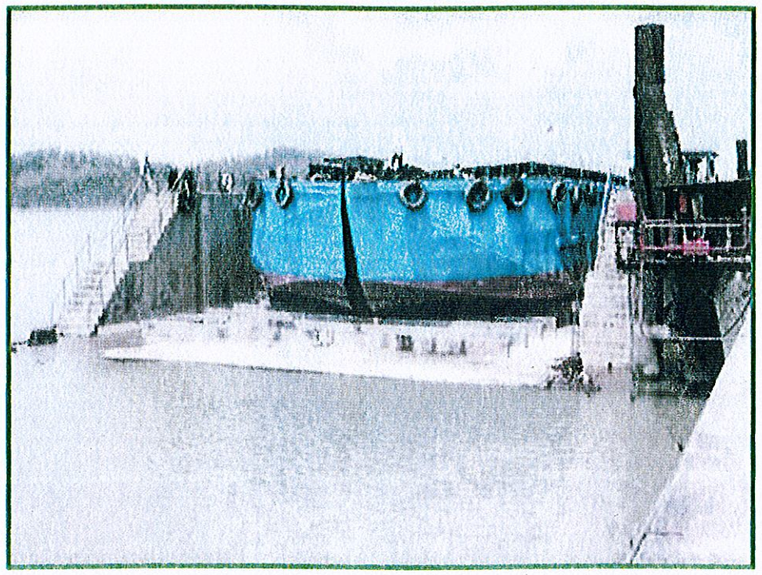
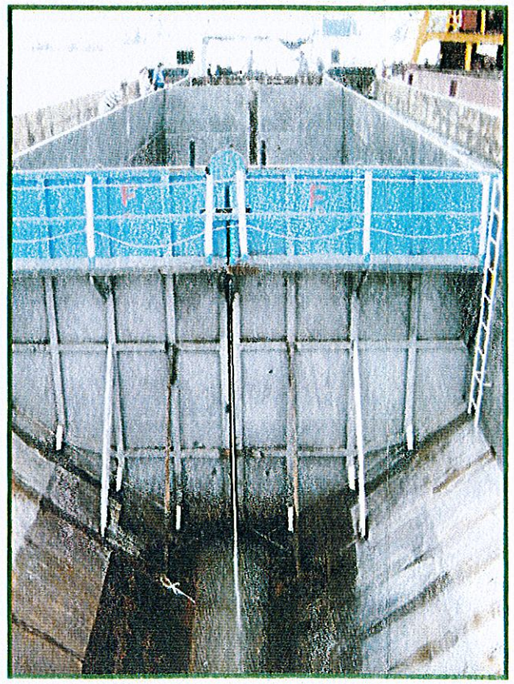
FIGURE 3.5

[C-D1] Q:/PROJECTS/93502/DRAWING/FIGURE/FIG 3-5.DGN

SEP 2003



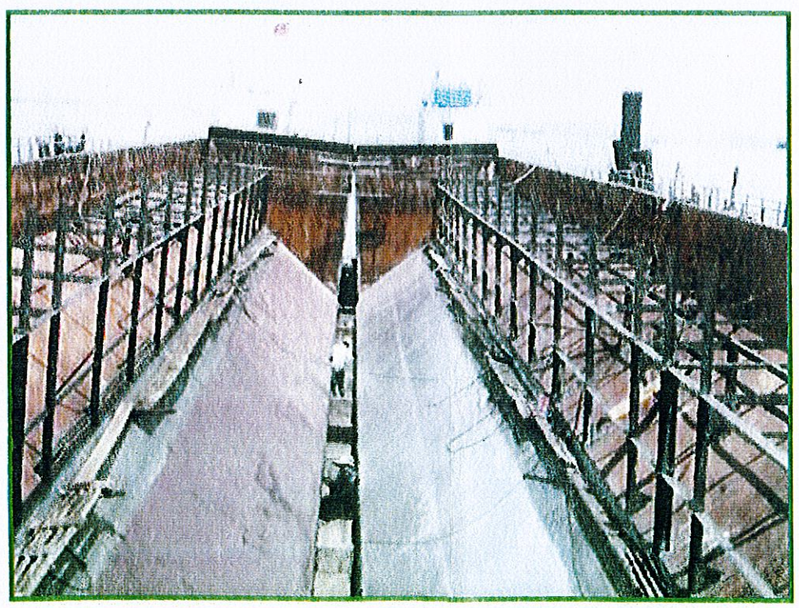
Barge modification work at a dry dock in China



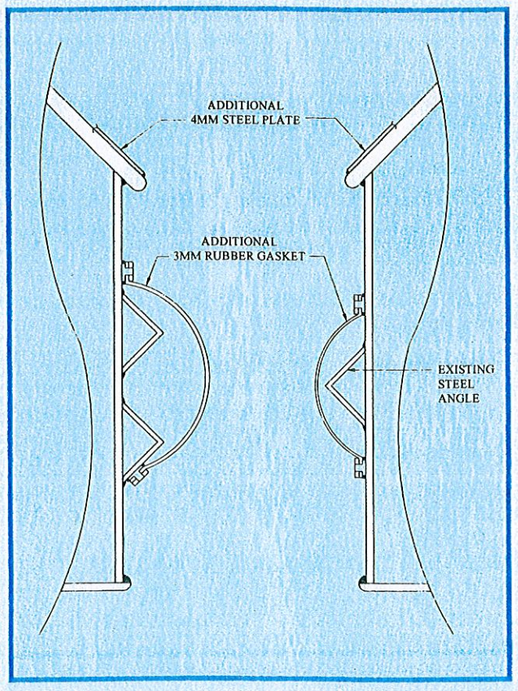
Transverse bulkheads installed on the split bottom hopper barge for the 300m^3 Geosynthetic Container

Openable transverse bulkhead for the disposal of 300m^3 Geosyntheic Containers

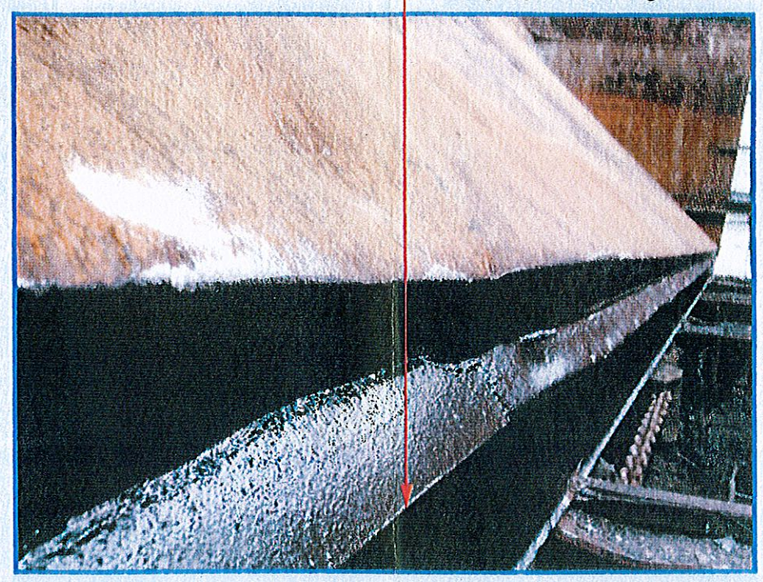
Split bottom hopper barge prior to installation of bulkheads



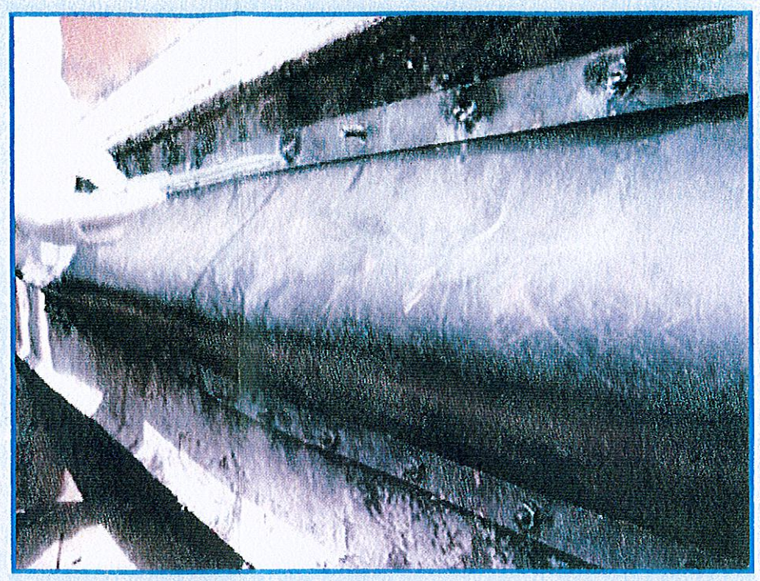
Installation of longitudinal bulkhead to the split bottom hopper barge



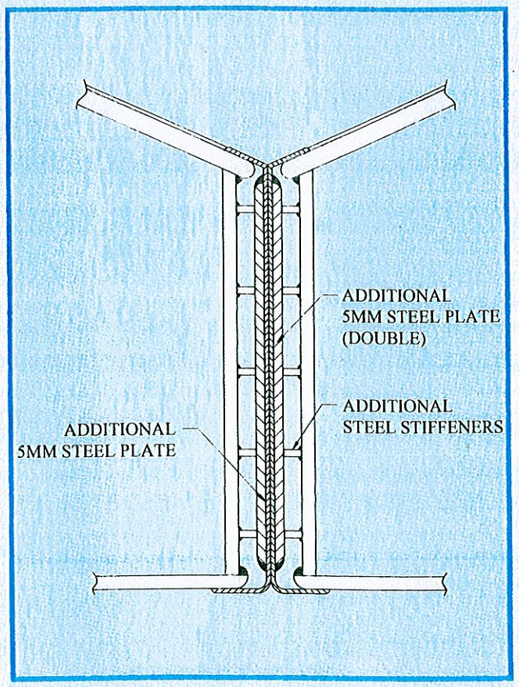
Typical details of additional rubber gasket at hopper gate



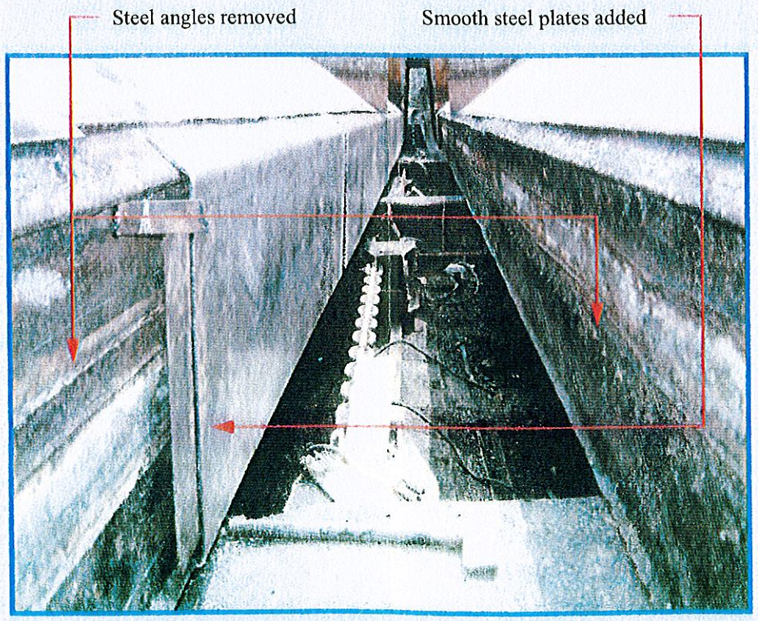
Existing steel angles at the hopper gate before modification work



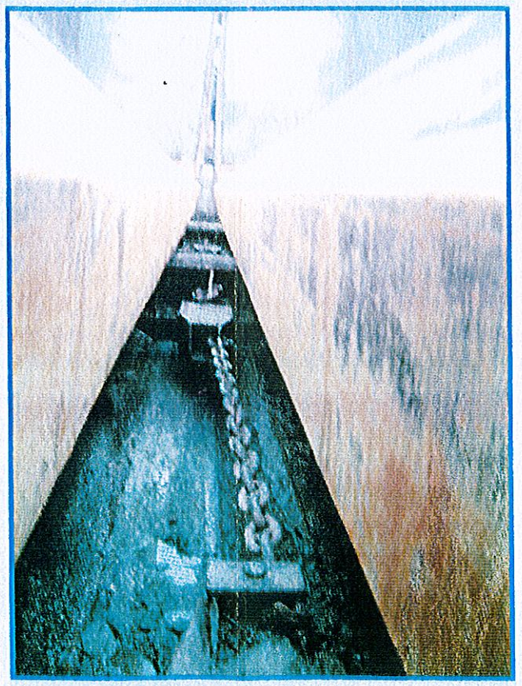
Rubber gaskets installed over the steel angles for the first field trial for Container A



Typical details of additional steel plates at hopper gate



Modified hopper gate with steel angles removed and additional smooth steel plates



Modified hopper gate for Containers B, C, D and E

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BARGE HOPPER GATE MODIFICATIONS

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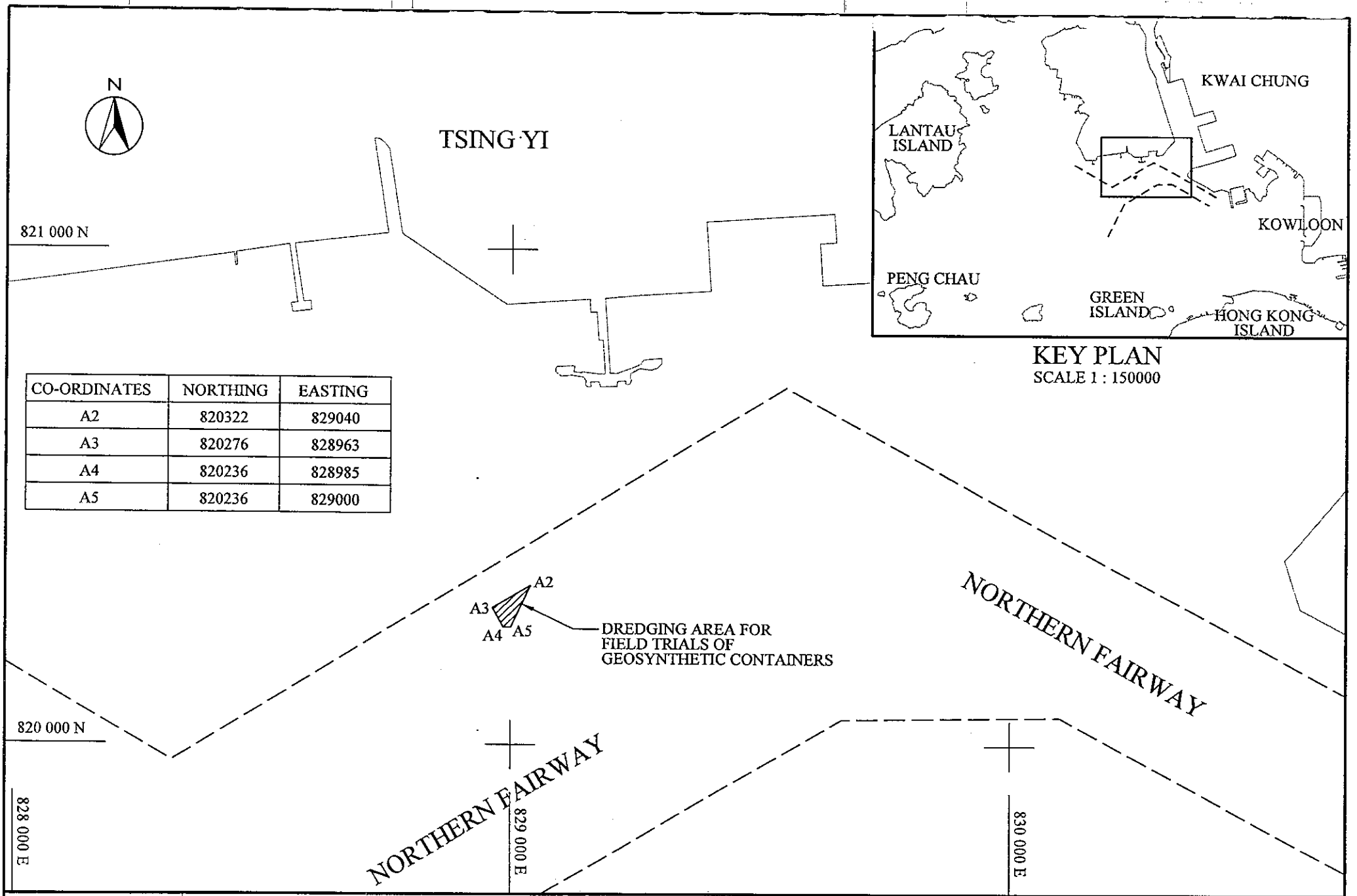
FIGURE 3.7



CO-ORDINATES	NORTHING	EASTING
A2	820322	829040
A3	820276	828963
A4	820236	828985
A5	820236	829000

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DREDGING AREA FOR FIELD TRIALS OF GEOSYNTHETIC CONTAINERS

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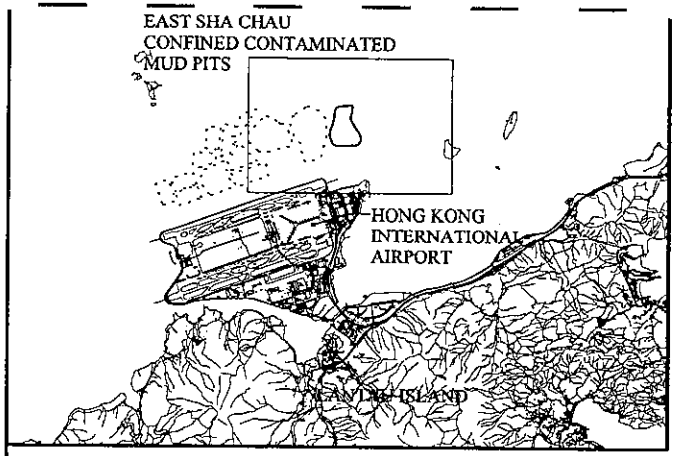
Hong Kong Island & Islands

FIGURE 3.8

[C-D1] Q:/PROJECTS/93502/REPORT/FIELD TRIAL/FIG3-8.DGN SACLE: 1: 10000 A4 SEP 2003



KEY PLAN
SCALE 1:200 000

N

FINAL LOCATION OF GEOSYNTHETIC CONTAINERS (CENTRE POINT)

CONTAINER	NORTHING	EASTING	BEARING
A	821781	811842	100°13'41"
B	821734	811801	114°11'10"
C	821637	811843	95°42'28"
D	821577	811846	111°34'35"
E	821466	811798	97°55'30"

LEGEND:

CONTAMINATED MUD PIT FOR THE FIELD TRIAL

NEARBY MUD PITS FOR REFERENCE ONLY

GEOSYNTHETIC CONTAINER

ABBREVIATION:

CMP CONTAMINATED MUD PIT

822 000 N

CMP IVa

CMP IVb

CMP IVc

A
B
C
D
E

EAST SHA CHAU
CONFINED CONTAMINATED
MUD PITS

CMP IIIc

810 000 E

HONG KONG INTERNATIONAL AIRPORT

812 000 E

814 000 E

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WAN CHAI DEVELOPMENT PHASE II - DESIGN AND CONSTRUCTION

LOCATION FOR DISPOSAL OF GEOSYNTHETIC CONTAINERS

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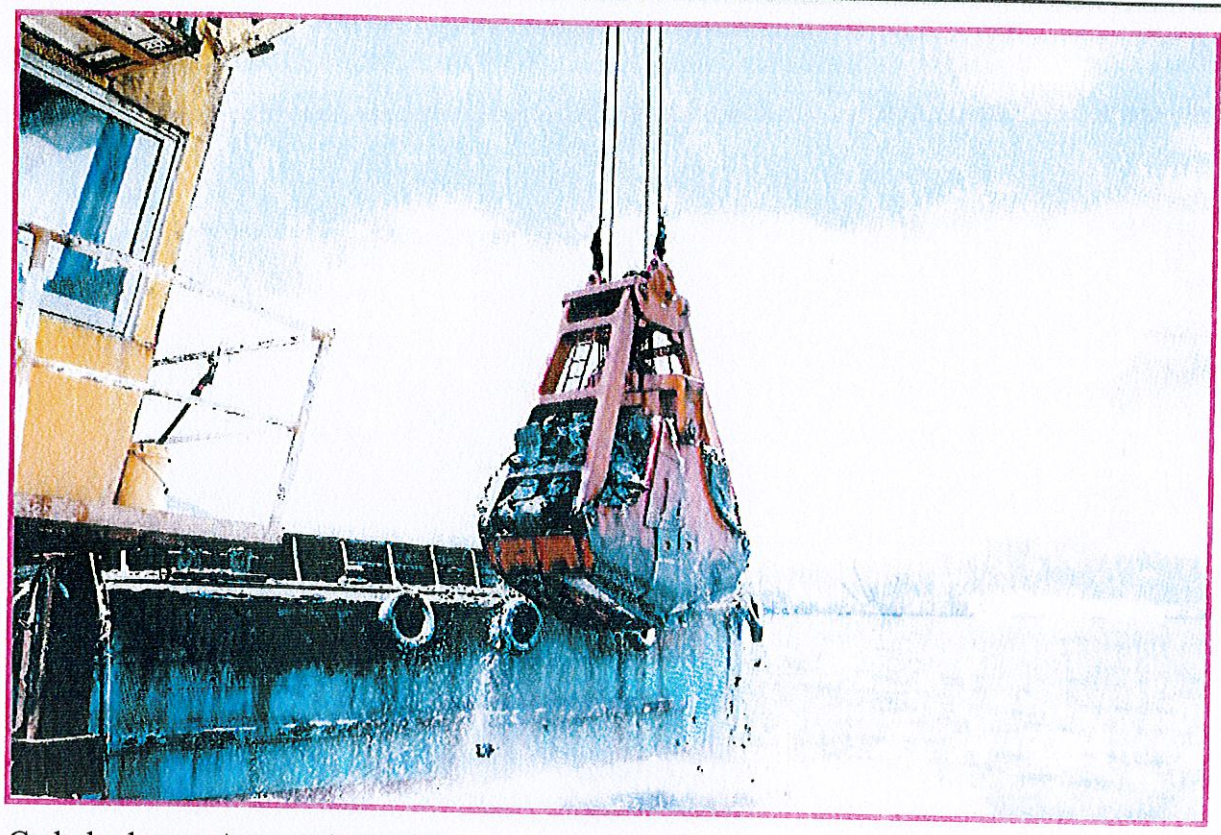
FIGURE 3.9

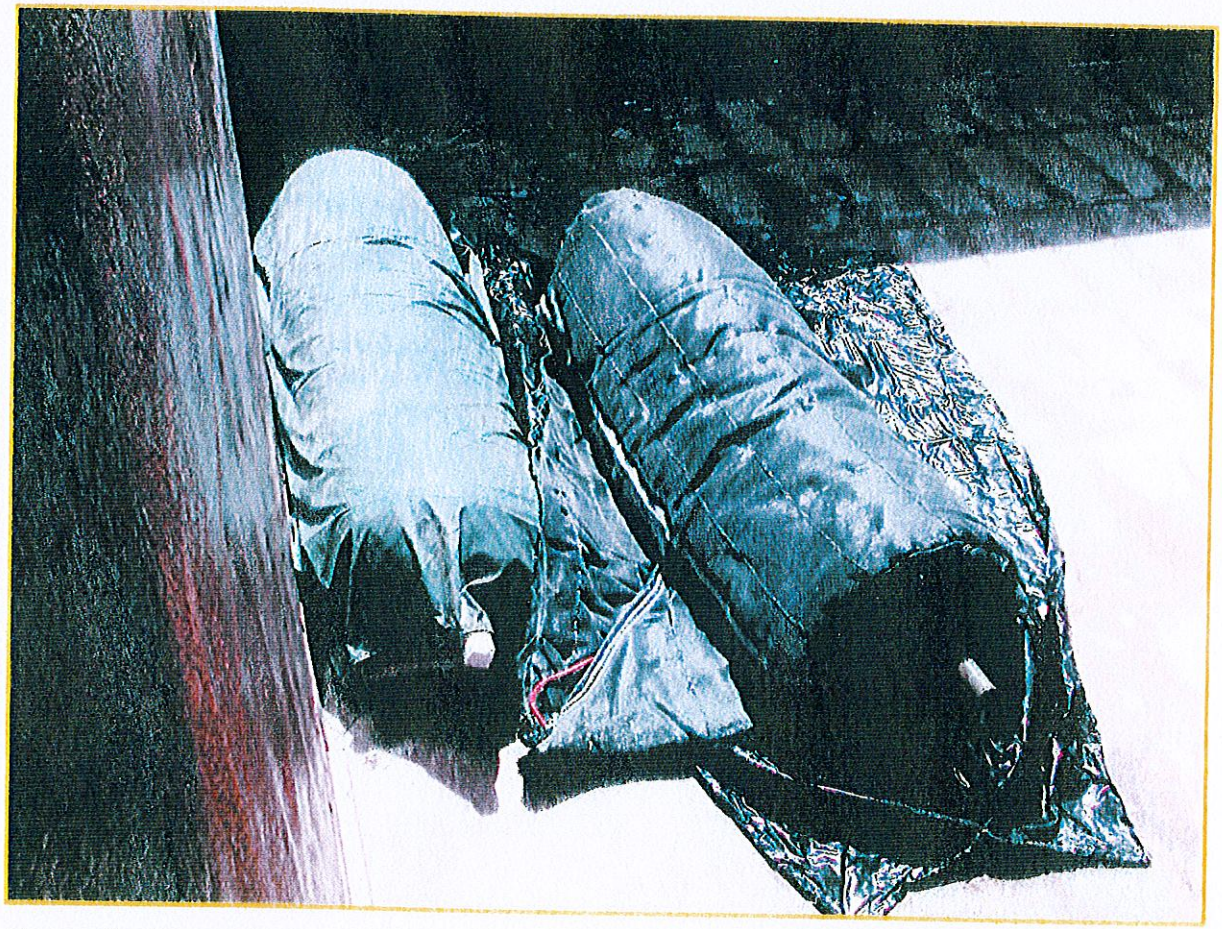
[C-D1] Q:/PROJECTS/93502/REPORT/FIELD TRIAL/FIG3-9.DGN SEPT. 2003 SCALE 1:20 000

Plot Plot by : STATES STIMES



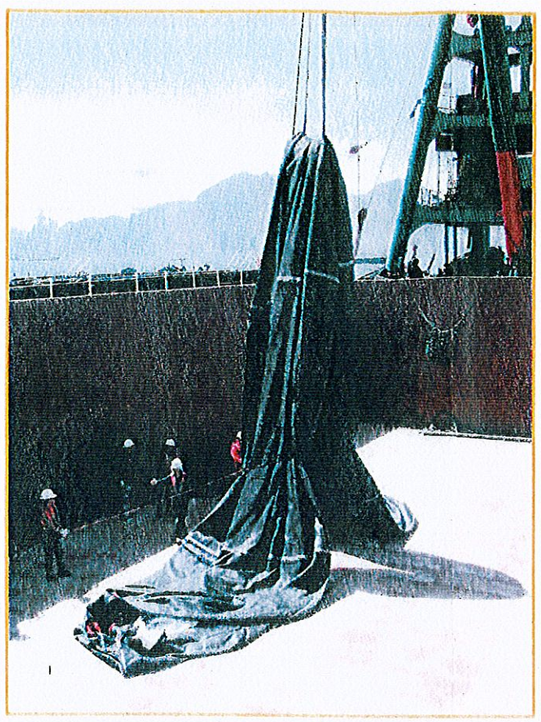
Grab dredger at Approach to CT9

Dredging by grab dredger and temporary storage of marine sediments in split bottom hopper barge

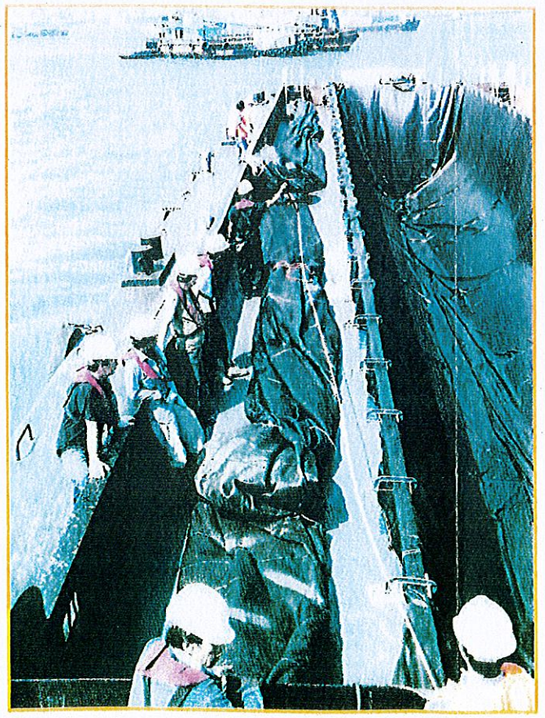


Geosynthetic containers as delivered :
Packed container (left) and unpacked container (right)

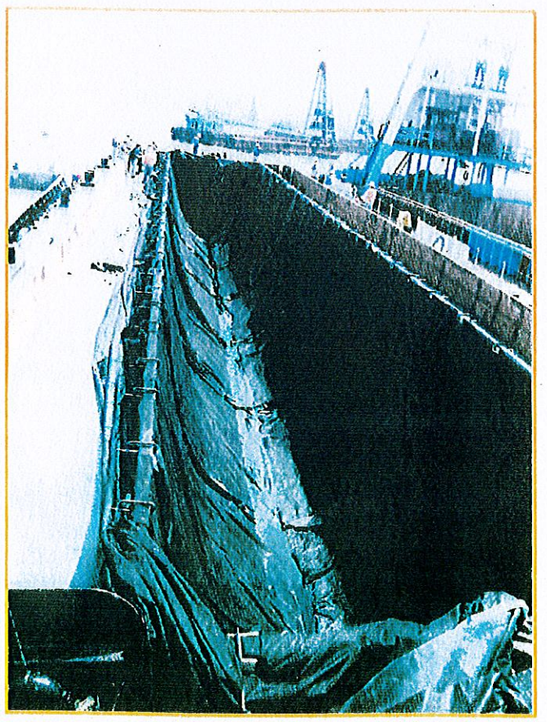
Unrolling the container in the derrick lighter



Transferring the container to the modified hopper barge



Slip sheets placed, container laid out besides the hopper and ready to be installed



Container installed (opened container lid along LHS)

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LAYING OF GEOSYNTHETIC CONTAINER IN THE HOPPER BARGE

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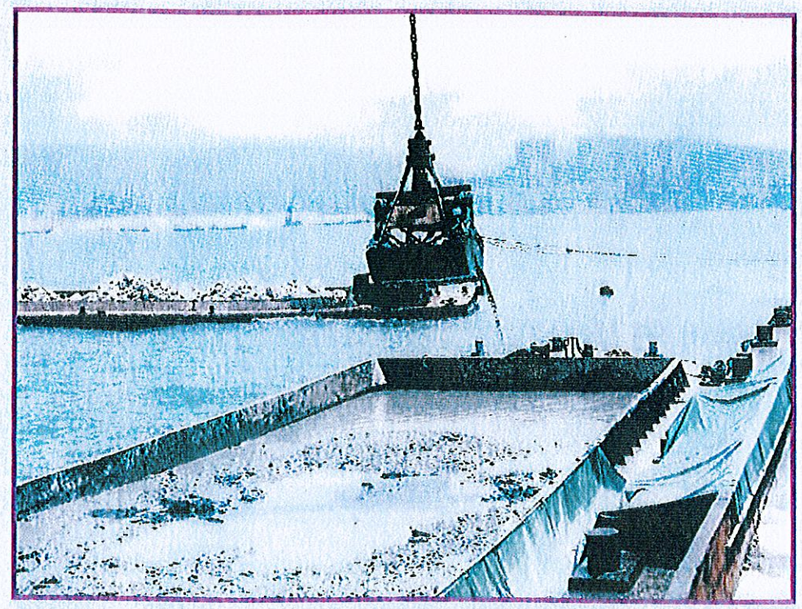
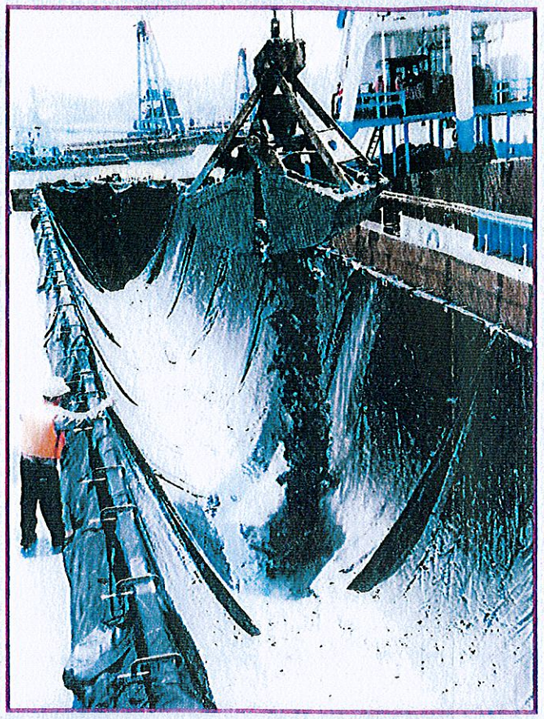
Hong Kong Island & Islands

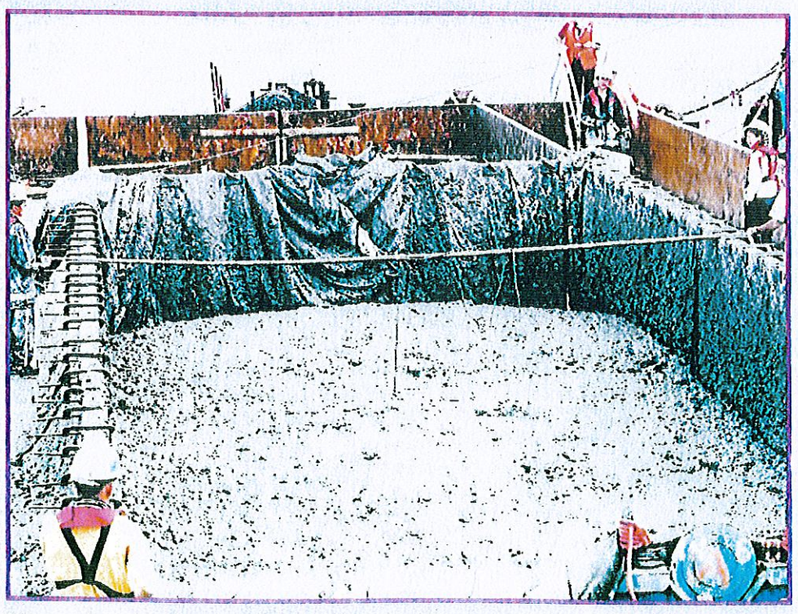
FIGURE 4.3



Storage hopper barge (left) berthed next to the modified hopper barge (right) for the filling of container



Filling of container with marine sediments by a grab hoisted by the derrick lighter

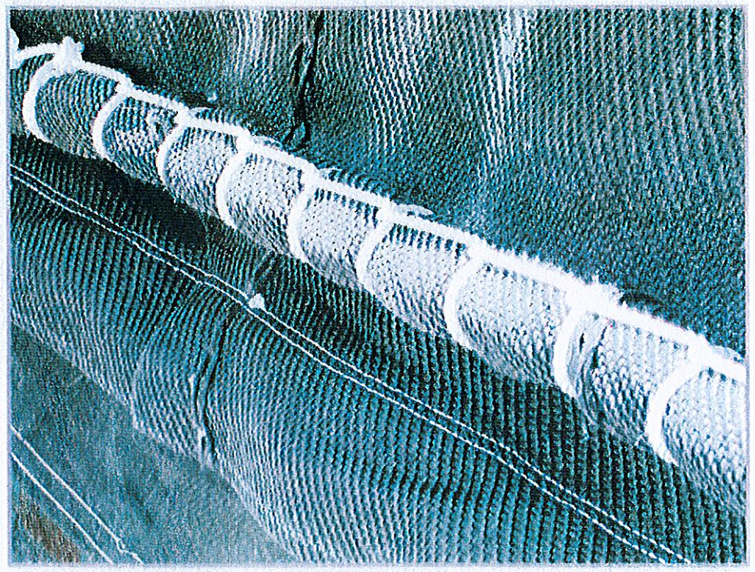


Measuring the depth of filled marine sediments

Addition of polystyrene spheres

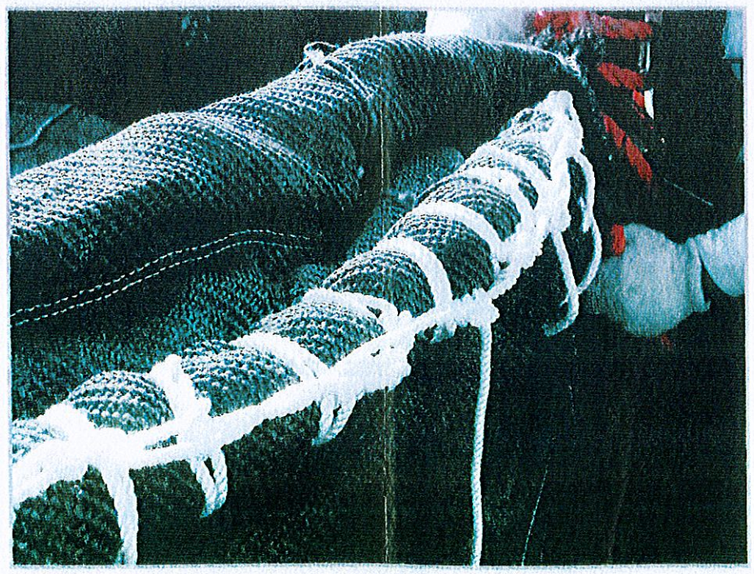
Sealing the container by sewing machine (Container A only)

Sealing the container by hand stitching

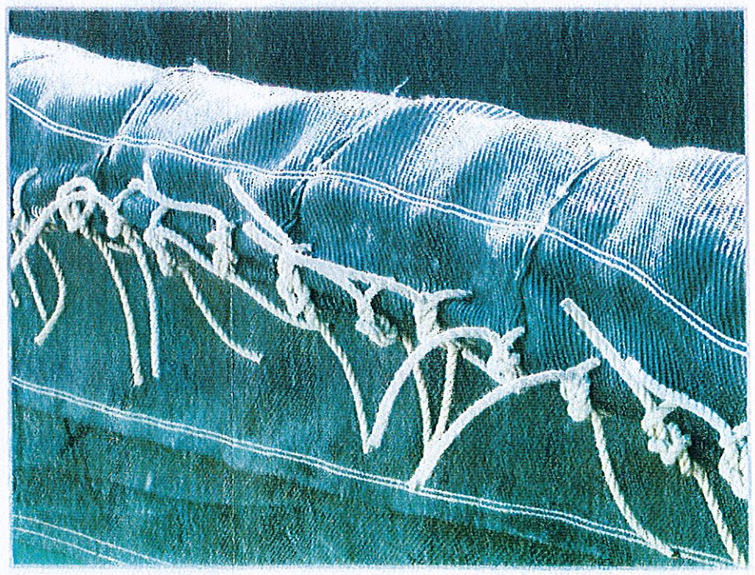


Detail 'A' – Typical hand stitches

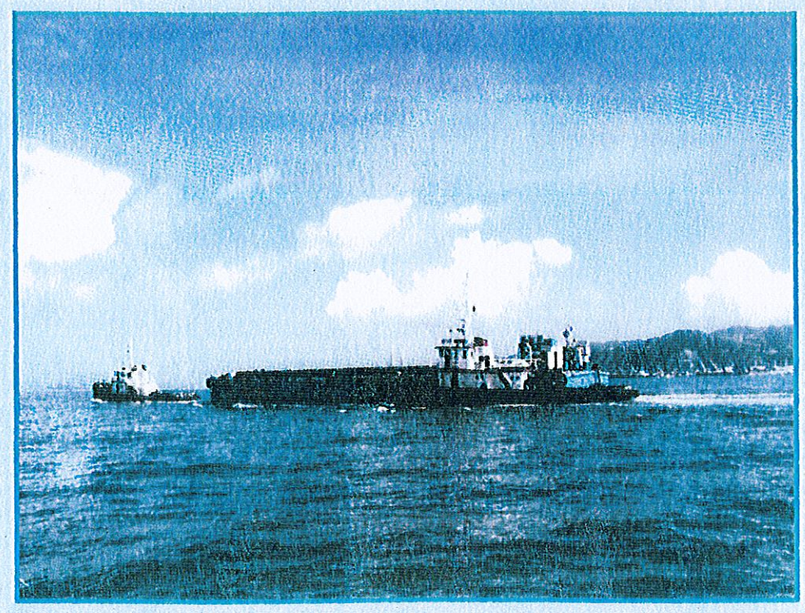
Two teams of worker sealing the container by hand stitching under the supervision of the site supervisors



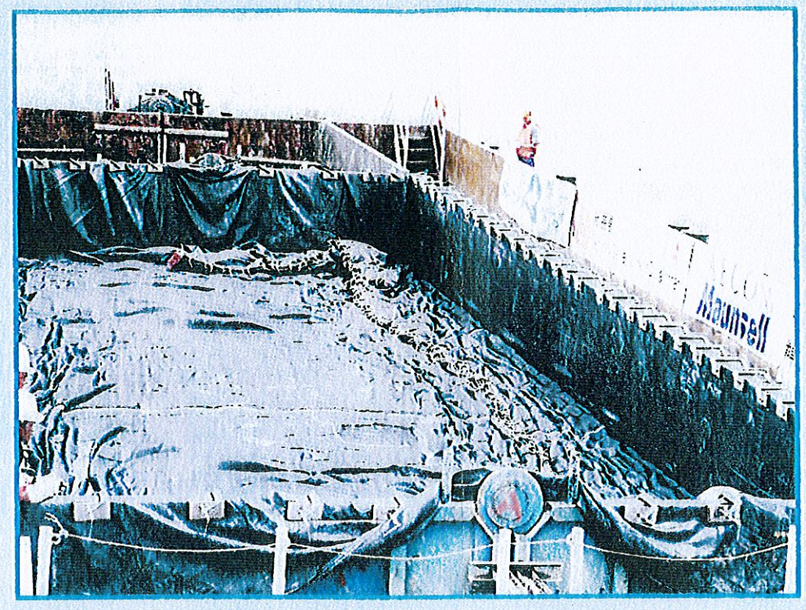
Detail 'B' – Hand stitches at the two ends of the container



Typical rope knots



Delivery to East Sha Chau Disposal Site



Sealed container ready for disposal

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DISPOSAL OF GEOSYNTHETIC CONTAINER

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Hong Kong Island & Islands

FIGURE 4.6

APPENDIX A

Field Trails of Geosynthetic Containers
Polystyrene Spheres Test

Introduction

The objective of the polystyrene spheres test is to detect any rupture of geosynthetic container during disposal that may lead to significant leakage of sediments.

Polystyrene spheres, which are readily available, are placed inside the containers along with the dredged material. If there is any rupture or bursting of the container during disposal, some of the sediments together with the polystyrene spheres will leave the container. The polystyrene spheres will float to the sea surface and act as a visual indicator of damage or rupture of the container.

In order to distinguish the polystyrene spheres from different containers, the polystyrene spheres are painted in different distinct reflective colours, with each bag containing spheres of a particular colour.

The main advantage of this testing method is that it provides direct evidence of rupture or damage of the container which would cause leakage of sediments. It is also simple to apply and inexpensive.

Equipment

Polystyrene Spheres

Size:	Around 100mm in diameter
Quantity:	Around 1200 spheres for $600m^3$ container
	Around 600 spheres for $300m^3$ container.

Inspection and working boats

Two boats for observation and collection of polystyrene spheres during the field trials and one boat for daily patrol between trial events until two weeks after the last field trial.

The inspection boats have two crew equipped with binoculars or spotting scopes to visually sweep the sea surface to search for the presence of spheres. Spotlights are provided for inspection at night. Nets are provided for scooping up floating spheres from the sea.

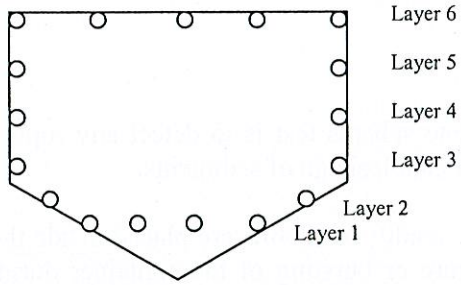
Application Method

Polystyrene spheres are added around the inside periphery of the container in layers. For the $600m^3$ container (approximately 34m long), around 1200 spheres are added to the container. For the $300m^3$ container (approximately 17m long), around 600 spheres are added to the container.

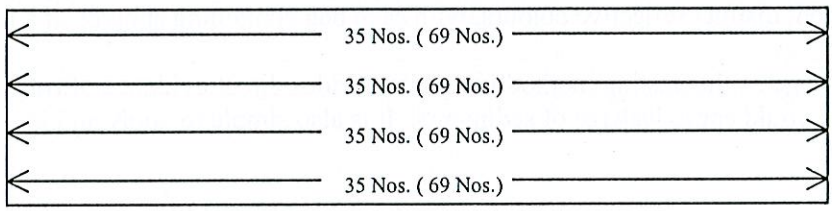
An initial layer of sediments of around 1m thick is first placed inside the container to fill up the bottom part. Then polystyrene spheres are added on top of the sediments at about 4 balls per half metre interval longitudinally. This is the first layer (Layer 1) of polystyrene spheres.

The subsequent filling of the containers is divided into five layers and five layers of polystyrene spheres are added (ie Layer 2 to Layer 6). For Layer 2 to Layer 5, spheres are placed at the sides of the container at half metre intervals longitudinally by sliding the spheres down along the hopper edge for each layer. For Layer 6, polystyrene spheres are added on top of the sediments at about 5 balls per half metre interval longitudinally.

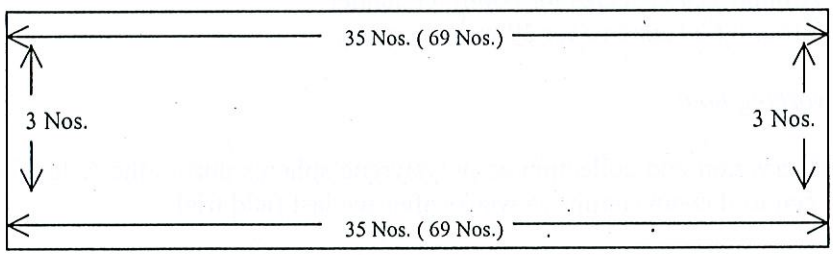
The approximate distribution of polystyrene spheres is illustrated as follows: -



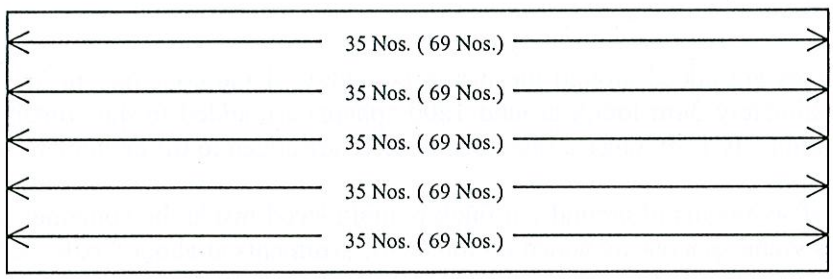
Distribution of Polystyrene Spheres
at Typical Section



Distribution of Polystyrene Spheres at Layer 1
(Bracket indicates numbers for the 600 m^3 container)



Distribution of Polystyrene Spheres at Layer 2 to 5
(Bracket indicates numbers for the 600 m^3 container)



Distribution of Polystyrene Spheres at Layer 6
(Bracket indicates numbers for the 600 m^3 container)

Inspection Duration

If there is any damage or rupture of the container during disposal, it will either occur as it passes through the hopper gate or as it impacts on the seabed. Once the container lands on the seabed, it will be stable and the probability of rupture of the container thereafter is negligible. However, in view of the concerns from relevant departments on the possible leakage between the trial events, an inspection/patrol system is arranged both during and in between trial events. The inspection/patrol system includes:

i) During the field trials (within one hour after the disposal of container):
   - Two boats will circle around the disposal site; the routing of the patrol will depend on the visibility and site conditions.

ii) In between trial events until two weeks after the last field trial:
   - One inspection boat will stay at the disposal site for 24-hour around the clock inspection with at least one hour patrol around the site in circles each day.

In case of detection of any floating polystyrene spheres, the inspection boat will collect the escaped spheres immediately; additional boats can be arranged whenever necessary.

APPENDIX B

Field Trials of Geosynthetic Containers
Water Quality Monitoring Programme

Introduction

The objective of the water quality monitoring programme is to capture any possible plumes which might extend beyond the confines of the disposal zone arising from the proposed contained disposal method. Seven monitoring stations are proposed: two to the upstream of the disposal zone and five to the downstream of the disposal zone with all stations located around 200 to 600m from the container drop site location (Figures B.1 and B.2).

Sampling at all seven monitoring stations shall commence two hours before disposal operations start in order to capture the background conditions of the water body. Sampling shall continue until elevation of turbidity has returned to background level or, in the event where no elevation is recorded, sampling shall continue until 2 hours after completion of disposal operations.

Parameters to be measured *in situ* are:

- dissolved oxygen (DO) (% saturation);
- dissolved oxygen (DO) (in mg L^{-1});
- temperature (^{o}C);
- turbidity (NTU);
- salinity (mg L^{-1}); and
- water depth (m).

Parameters to be measured in the laboratory are:

- suspended solids (mg L^{-1}).

In addition to the water quality parameters, other relevant data shall also be measured and recorded, including monitoring station location, time, weather conditions, sea conditions (where appropriate), tidal stage (where appropriate), special phenomena and work activities at the drop zone.

A full list of water quality monitoring parameters to be monitored at each location is given in Table 1. The *in situ* parameters will be stored digitally in a logger.

Table 1 Summary of Water Quality Monitoring Programme

Parameter	Monitoring Stations	Frequency
Dissolved oxygen Temperature Turbidity Suspended solids Salinity	M1, M2, M3, M4, M5, M6, M7	Every 30 minutes (commence 2 hours before disposal operations start until 2 hours after the containers are dumped if turbidity levels have returned to the background levels or if no elevation of turbidity is recorded). If monitoring should need to be continued after this time, then sampling rate reduced to hourly intervals.

Monitoring Equipment

For water quality monitoring, the following equipment shall be supplied under the WDII SI contract:

Dissolved Oxygen and Temperature Measuring Equipment

The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and shall be operable from a DC power source. It shall be capable of measuring:

- dissolved oxygen levels in the range of 0 - 20 mg L^{-1} and 0 - 200% saturation; and
- a temperature of 0 - 45 degrees Celsius.

It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 25 m in length. Sufficient stocks of spare electrodes and cables shall be available for replacement where necessary. (For example, YSI model 59 meter, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or an approved similar instrument).

Turbidity Measurement Equipment

Turbidity within the water shall be measured *in situ* by the nephelometric method. The instrument shall be a portable, weatherproof turbidity-measuring unit complete with cable, sensor and comprehensive operation manuals. The equipment shall be operated from a DC power source, it shall have a photoelectric sensor capable of measuring turbidity between 0 - 1000 NTU and shall be complete with a cable with at least 25 m in length (Hach 2100P or an approved similar instrument).

Water Depth Gauge

A portable, battery-operated echo sounder (Seafarer 700 or a similar approved instrument) shall be used for the determination of water depth at each designated monitoring station. This unit shall either be hand-held or affixed to the bottom of the workboat if the same vessel is to be used throughout the monitoring programme.

Salinity Measurement Instrument

A portable salinometer, capable of measuring salinity in the range of 0 - 40 mg L^{-1}, shall be provided for measuring salinity of the water at each monitoring location.

Water Sampling Equipment

A water sampler, consisting of a transparent PVC or glass cylinder of not less than two litres, which can be effectively sealed with cups at both ends, shall be used (Kahlsico Water Sampler 13SWB203 or an approved similar instrument). The water sampler shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth.

Water samples for SS measurements shall be collected in high-density polythene bottles, packed in ice (cooled to 4 ^{o}C without being frozen), and delivered to a HOKLAS laboratory as soon as possible after collection.

Positioning Device

A differential Global Positioning System (GPS) shall be used during monitoring to ensure the monitoring vessel is at the correct location before taking measurements.

Testing Protocols

All *in situ* monitoring instruments shall be checked, calibrated and certified by a laboratory accredited under HOKLAS or any other international accreditation scheme before use. Responses of sensors and electrodes shall be checked with certified standard solutions before each use. Wet bulb calibration for a DO meter shall be carried out before commencement of the trial. The turbidity meter shall be calibrated to establish the relationship between turbidity readings (NTU) and levels of suspended solids (mg/l^{-1}) where possible.

For the on-site calibration of field equipment, the ***BS 1427: 1993, Guide to Field and On-Site Test Methods for the Analysis of Waters*** shall be observed. Sufficient stocks of spare parts shall be maintained for replacements when necessary. Backup monitoring equipment shall also be made available so that monitoring can proceed uninterrupted even when equipment is under maintenance, calibration etc.

Laboratory Analysis

All laboratory work shall be carried out in a HOKLAS accredited laboratory. Water samples of about 1,000 ml shall be collected at the monitoring and control stations for carrying out the laboratory determinations. The determination work shall start within 24 hours after collection of the water samples. The analyses shall follow the standard methods according to Table 2 and as described in ***APHA Standard Methods for the Examination of Water and Wastewater, 19th Edition***, unless otherwise specified.

Table 2 Analytical Methods to be Applied to Marine Water Quality Samples

Determinant	Standard Method
Suspended solids	APHA 2540D

The QA/QC details shall be in accordance with requirements of HOKLAS or another internationally accredited scheme. The QA/QC results shall be reported. EPD may request the laboratory to carry out analysis of known standards provided by EPD for quality assurance. Additional duplicate samples may be required by EPD for inter-laboratory calibration. Remaining samples after analysis shall be kept by the laboratory for 3 months in case repeat analysis is required. If in-house or non-standard methods are proposed, details of the method verification should, if required, be submitted to the EPD. In any circumstances, the sample testing shall be subject to comprehensive quality assurance and quality control programmes. The laboratory shall be prepared to demonstrate the quality control programmes to EPD or their representative if and when required.

Monitoring Locations

Seven monitoring stations with two (M1 and M2) located to the upstream of the disposal zone and five (M3, M4, M5, M6 and M7) to the downstream of the disposal zone will be located at around 200 to 600m from the drop site location in order to detect any suspended sediment leaving the confines of the disposal site (see Figures B.1 and B.2).

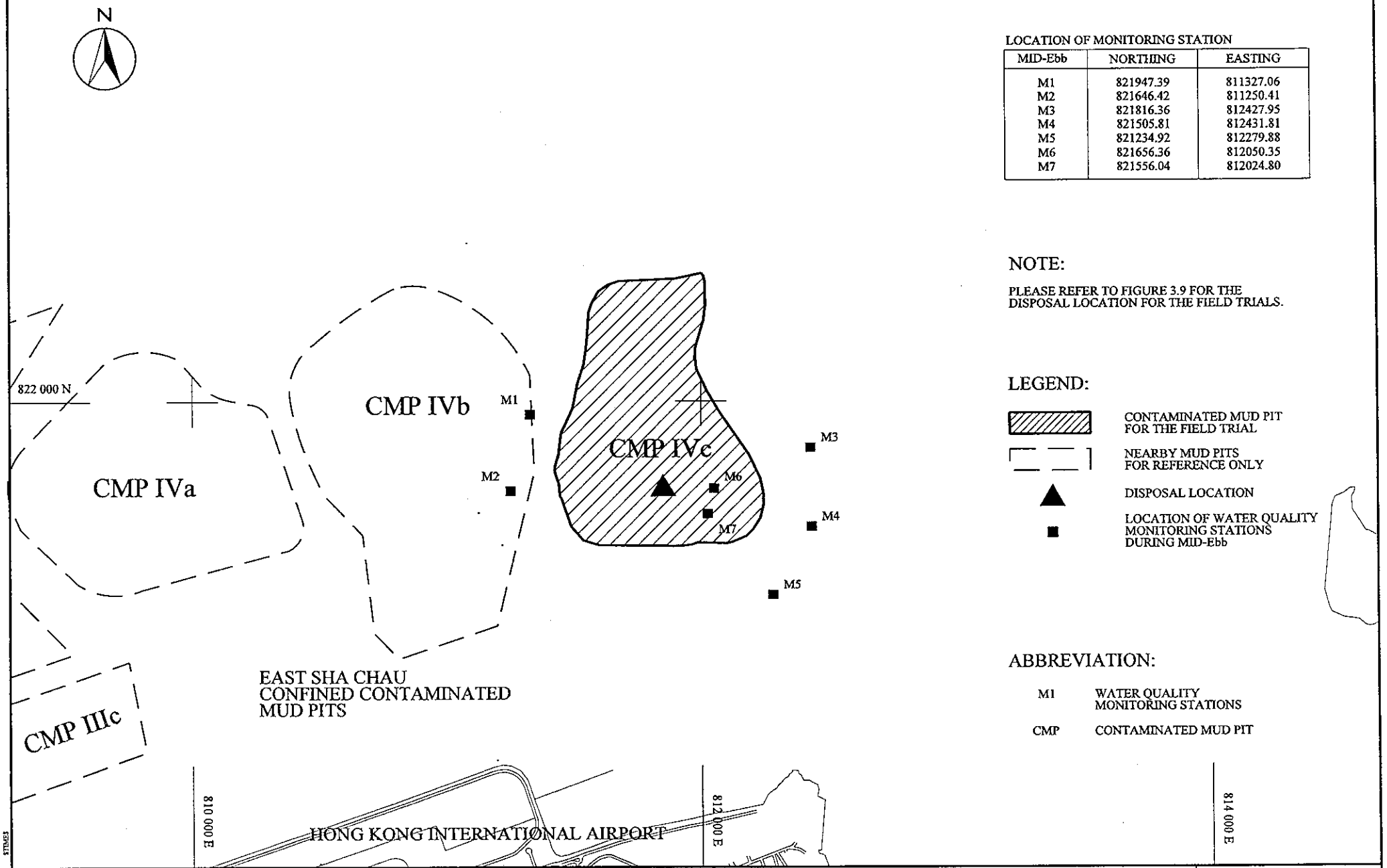
All measurements shall be carried out at three water depths, namely, 1m below water surface, mid-water depth, and 1m above seabed. If the water depth is less than 6m, the mid-depth measurement shall be omitted. If the depth is less than 3m, only the mid-depth measurement need be taken.

Monitoring at each station shall be undertaken at 30 minute intervals. Two consecutive measurements of DO concentration ($mg\ l^{-1}$), DO saturation (%) and turbidity (NTU) will be taken *in situ* according to the stated sampling method. The monitoring probes shall be retrieved out of water after the first

measurement and then redeployed for the second measurement. Where the difference in value between the first and second measurement of DO or turbidity parameters is more than 25% of the value of the first reading, the reading shall be discarded and further readings shall be taken. Water samples for SS (mg l^{-1}) measurements shall be collected at the same depths.

In addition to the above *in situ* measurements, temperature and salinity shall be determined at all monitoring stations at the same depths, as specified above.

Note that in addition to the water quality parameters, monitoring location/position, time, water depth, weather conditions, sea conditions, tidal stage and any special phenomena and work underway in the area shall be recorded.



LOCATION OF MONITORING STATION

MID-Ebb	NORTHING	EASTING
M1	821947.39	811327.06
M2	821646.42	811250.41
M3	821816.36	812427.95
M4	821505.81	812431.81
M5	821234.92	812279.88
M6	821656.36	812050.35
M7	821556.04	812024.80

NOTE:

PLEASE REFER TO FIGURE 3.9 FOR THE DISPOSAL LOCATION FOR THE FIELD TRIALS.

LEGEND:

- CONTAMINATED MUD PIT FOR THE FIELD TRIAL
- NEARBY MUD PITS FOR REFERENCE ONLY
- DISPOSAL LOCATION
- LOCATION OF WATER QUALITY MONITORING STATIONS DURING MID-Ebb

ABBREVIATION:

M1	WATER QUALITY MONITORING STATIONS
CMP	CONTAMINATED MUD PIT

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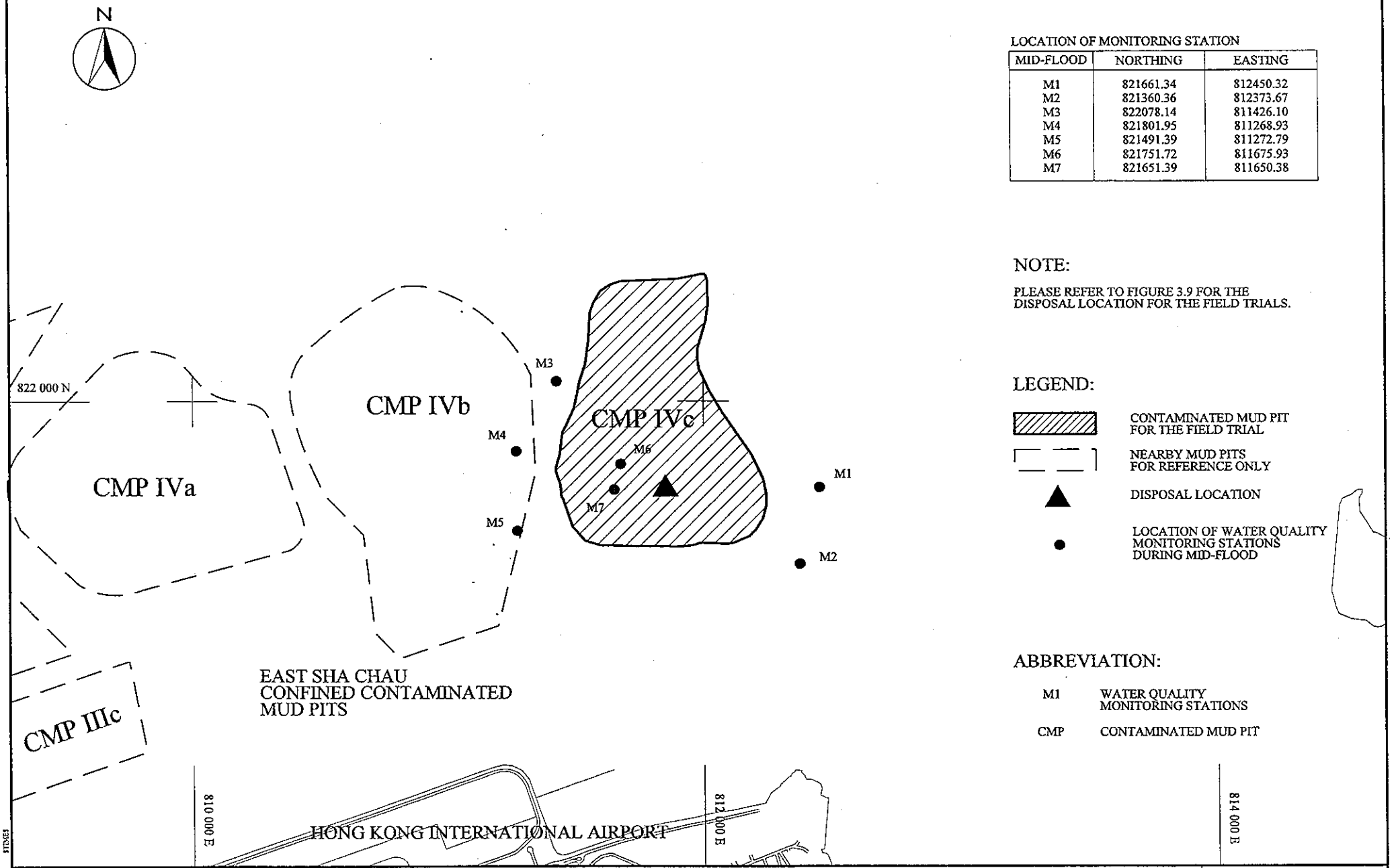
LOCATION FOR WATER QUALITY MONITORING STATION DURING MID-Ebb

Territory Development Department
Hong Kong Island & Islands

FIGURE B.1

Plot File by : $DATE$ $TIME$

[C-D1] Q:/PROJECTS/93502/REPORT/FIELD TRIAL/FIGB-1.DGN SEPT. 2003 SCALE 1:20 000



LOCATION OF MONITORING STATION

MID-FLOOD	NORTHING	EASTING
M1	821661.34	812450.32
M2	821360.36	812373.67
M3	822078.14	811426.10
M4	821801.95	811268.93
M5	821491.39	811272.79
M6	821751.72	811675.93
M7	821651.39	811650.38

NOTE:

PLEASE REFER TO FIGURE 3.9 FOR THE DISPOSAL LOCATION FOR THE FIELD TRIALS.

LEGEND:

- CONTAMINATED MUD PIT FOR THE FIELD TRIAL
- NEARBY MUD PITS FOR REFERENCE ONLY
- DISPOSAL LOCATION
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LOCATION FOR WATER QUALITY MONITORING STATION DURING MID-FLOOD

Territory Development Department
Hong Kong Island & Islands

FIGURE B.2

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APPENDIX C

Field Trials of Geosynthetic Containers
Water Quality Assessment

Summary of Monitoring Events

There were five monitoring events carried out for the five trials as shown in Table C.1. Their respective trial details have been presented in the Tables 5.1 to 5.5 of the Main Report.

Table C.1 Summary of Monitoring Events

Date	Water Quality Monitoring Period
Container A Trial 17 May 03	1030 – 1430
Container C Trial 16 June 03	1230 – 1630
Container B Trial 20 June 03	0830 – 1230
Container D Trial 26 July 03	0930 – 1330
Container E Trial 31 July 2003	1300 – 1700

Result Analysis

The disposal of geosynthetic container may cause potential water quality impact in the following ways:

- When a geosynthetic container hits the pit bottom, it may disturb the bottom sediment causing an increase in turbidity or suspended solid levels.
- When a geosynthetic container is damaged or ruptures during the release process, it may release its content (dredged sediment) into the water column.

Dissolved oxygen, turbidity and suspended solids were the key parameters for evaluating the water quality impact associated with the dumping of geocontainers. Depth-averaged values were used for calculation and analysis of turbidity and suspended solids. For dissolved oxygen, a depth-averaged value was calculated for the surface and mid-bottom data but not for the bottom data.

Results were analysed by comparing with the two controls:

i) the background average of all stations for the entire period before the dumping event
ii) the upstream control stations M1 and M2 average

Time-series plots of monitoring results are given in Figures C.1 to C.10.

Trial for Container A on 17 May 03

(Figures C.1 and C.2)

Results:

- Background average of all stations before dumping was around 15 NTU for turbidity and 21 mg/L for suspended solids.
- After dumping, upstream control stations M1 + M2 showed increasing trends in turbidity and suspended solids levels compared to pre-dumping ambient conditions. M7 showed increased turbidity and suspended solids levels up to approximately 1.5 hours after the dump event. M5 also showed elevated turbidity levels up to 2 hours after the dump event.

- Dissolved oxygen levels were all above 4mg/L. Bottom DO levels at M6 and M7, though still more than 4 mg/L, were below the pre-dumping baseline as well as the post-dumping DO levels at the upstream control stations (M1+M2).

Interpretation:

- Short-term elevation of turbidity and suspended solids was observed at station M7 200m downstream of the dump location. Elevated turbidity levels were also observed at M5 600 m away, showing a potential plume movement in the southeast direction during ebb tide. The turbidity and suspended solids levels returned to below the upstream control (M1+M2) and the pre-dumping background average after 1.5 to 2 hours.
- No effect on surface DO was observed. Bottom DO showed decreased levels at M6 and M7 200 m downstream, but levels were still above 4 mg/L. Low bottom DO conditions were not observed at the 600-m stations indicating that such conditions were confined to within the disposal pit.

Trial for Container C on 16 June 03
(Figures C.3 and C.4)

Results:

- Background average of all stations before dumping was around 30 NTU for turbidity and 39 mg/L for suspended solids.
- As a general trend, turbidity and suspended solids levels at both control and downstream stations decreased after the dump event when compared with the pre-dumping background levels for the area, except suspended solids levels at M7. Elevated levels of suspended solids at M7 were detected 1.5 to 2 hours after the dump event.
- After dumping, there was only a slightly increase in turbidity (5 NTU) at station M6 (200m away). At one hour after dumping, the levels at M6 followed M7 and control stations(M1+M2) dropped down to below the background average(before dumping). Turbidity at M6 and M7 was slightly higher than the control stations(M1+M2) throughout the post-dumping monitoring period.
- For other stations(M3, M4 and M5) 600 away, the turbidity and suspended solids levels were similar to the control stations(M1+M2) and were less than the background average(before dumping) almost all the time.
- All stations had dissolved oxygen content well above 3 mg/L and similar to the control levels.

Interpretation:

- No significant change was found in water quality in terms of turbidity, suspended solids and dissolved oxygen as compared to the control stations and the background levels, except suspended solids levels at M7 that was detected 1.5 to 2 hr after the dump event. Such sudden increase was not reflected in the turbidity measurements. It was likely that the high suspended solids levels at M7 were unrelated to the dump event, since these were detected 1.5 hr after the dump event had occurred.

Trial for Container B on 20 June 03
(Figures C.5 and C.6)

Results:

- Background average of all stations before dumping was around 10 NTU for turbidity and 12 mg/L for suspended solids.
- After dumping, all stations (M3, M4, M5, M6, M7) showed low (<15 NTU) turbidity levels that were similar to the background average (before dumping).
- Station M7 (200m away) showed elevated suspended solids levels 1.5 to 2 hours after dumping.
- For other stations M6 (200m away), M3, M4 and M5, the suspended solids levels were found similar to the control station (M1 and M2) and the background average (before dumping).
- Dissolved oxygen levels were found similar to the pre-dumping background and above 3 mg/L.

Interpretation:
- High levels of suspended solids were recorded at M7 1.5 hours after the dump event, which were unlikely to be caused by the dump trial. Such sudden increase was not reflected by the turbidity measurements.

Trial for Container D on 26 July 03
(Figures C.7 and C.8)

Results:
- Background average of all stations before dumping was around 9 NTU for turbidity and 39 mg/L for suspended solids.
- Turbidity and suspended solids levels for stations M6 and M7 200m away from the dump location were observed to be lower than the control stations (M1+M2) and remained at levels ±5 NTU of the background average before dumping. Suspended solids levels were also (20mg/L) below the background average before dumping and lower than the control stations (M1+M2).
- For stations M3, M4 and M5 (600m away), the turbidity and suspended solids levels were found similar to the control station (M1+M2) and followed similar trend of being lower than the background average (before dumping).
- All stations had dissolved oxygen content well above 4 mg/L and similar to the control levels.

Interpretation:
- No significant change was found in water quality in terms of turbidity, suspended solids and dissolved oxygen as compared to the control stations and the background levels.
- There was no significant impact to water quality from this trial for Container D, which was successfully disposed.

Trial for Container E on 31 July 03
(Figures C.9 and C.10)

Results:
- Background average of all stations before dumping was around 23 NTU for turbidity and 42 mg/L for suspended solids.
- Station M7 (200m away) showed a slight increase in turbidity level to a peak of around 33 NTU at about 1.5 hours after the dump. At about 2 hours after dump the turbidity level returned to about 24 NTU, which was similar to the background average before dumping. The control stations (M1+M2) dropped to about 9 NTU and the difference was small (only 15 NTU). Slightly elevated suspended solids level was observed half an hour after dumping and the level dropped down to below the background average before dumping and similar to the control stations (M1+M2) at 1 hour after dumping.
- For station M6 (200m away), the turbidity levels were all below the background average (before dumping) and followed similar decreasing trend with the control stations (M1+M2).
- For stations M3, M4 and M5 (600m away), the turbidity and suspended solids levels were found similar to the control station (M1+M2) and followed similar decreasing trend of being lower than the background average (before dumping).
- Dissolved oxygen levels were similar among the control and the impact stations.

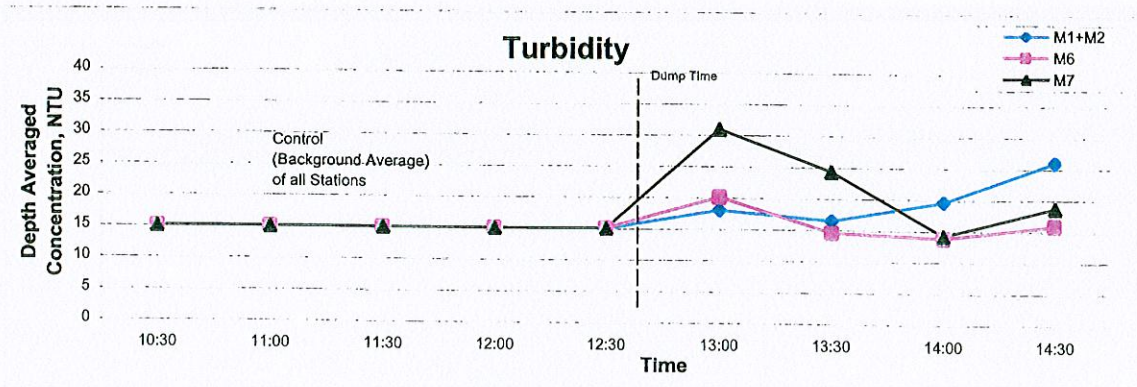
Interpretation:
- Turbidity and suspended solids levels increased slightly at M7 compared to the control stations M1+M2 and the pre-dumping background average. Turbidity returned to pre-dumping background in 2 hours and suspended solids in less than one hour. Such increase was confined to the disposal pit and no elevation of suspended solids or turbidity level was detected at the 600-m stations outside the pit.
- There was no significant impact to water quality from this trial for Container E which was successfully disposed.

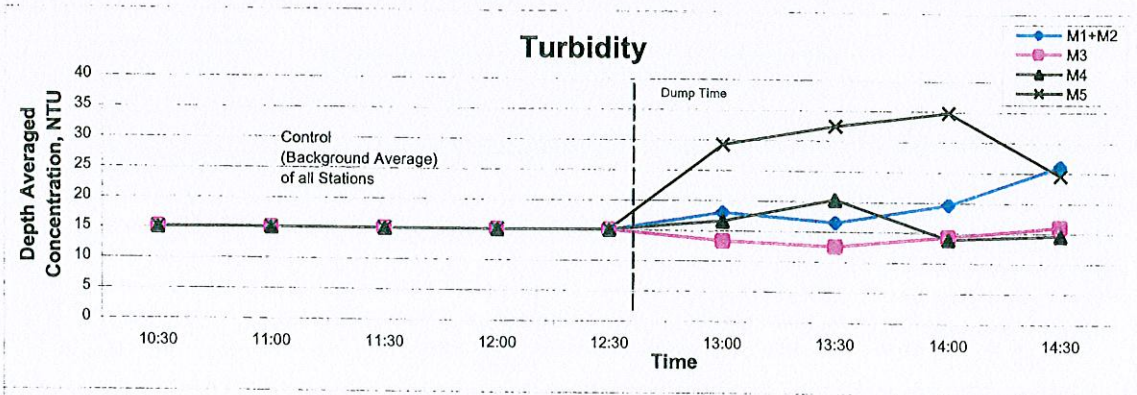
Summary and Conclusion

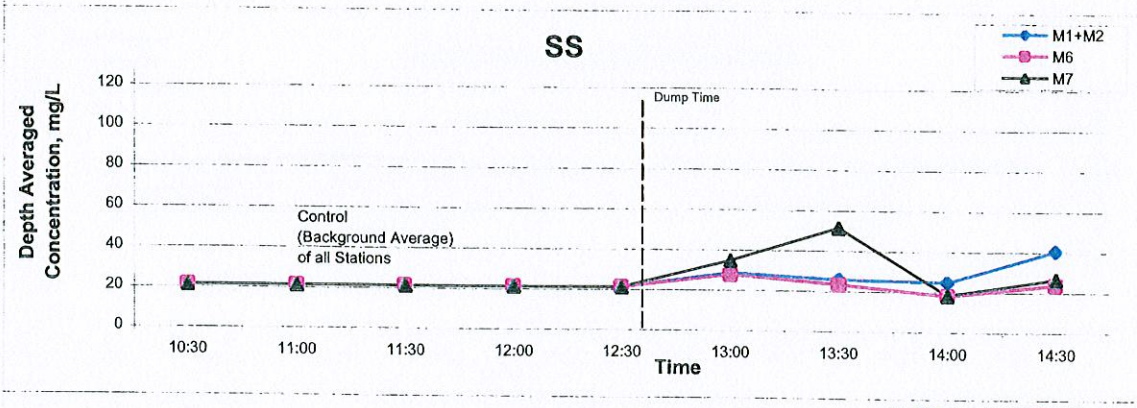
The water quality monitoring aimed to assess the impact by setting monitoring stations around the disposal position. The results were compared with the background control before dumping and the upstream control after dumping.

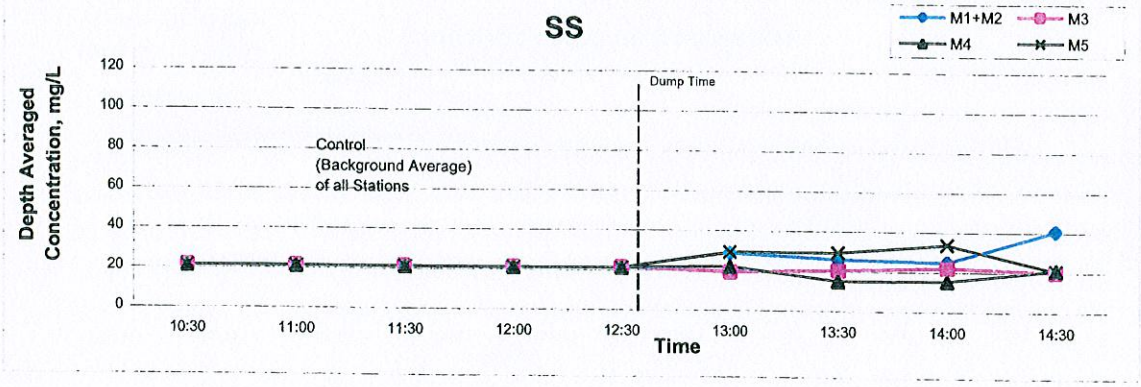
Two successful trials were recorded for Containers D and E. The water quality monitoring results for these two trials revealed that there was no significant change in water quality in terms of turbidity, suspended solids and dissolved oxygen as compared to the control stations and the background levels. Slight elevations of turbidity and suspended solids levels were detected at M7 within the pit after the dumping of Container E, but no such elevation was detected at the stations outside the pit. Hence, no water quality deterioration was observed from the two successful trials for Containers D and E.

For trials which were not successful (Containers A and B) and which had minor escape of polystyrene balls (Container C), short term impacts on the water quality in terms of turbidity and suspended solids were observed at the monitoring stations within the dump pit and 200m away from the disposal point (less than one and a half hour). There was no significant difference in water quality for monitoring stations outside the dump pit and 600m away except for one failed trial (Container A).

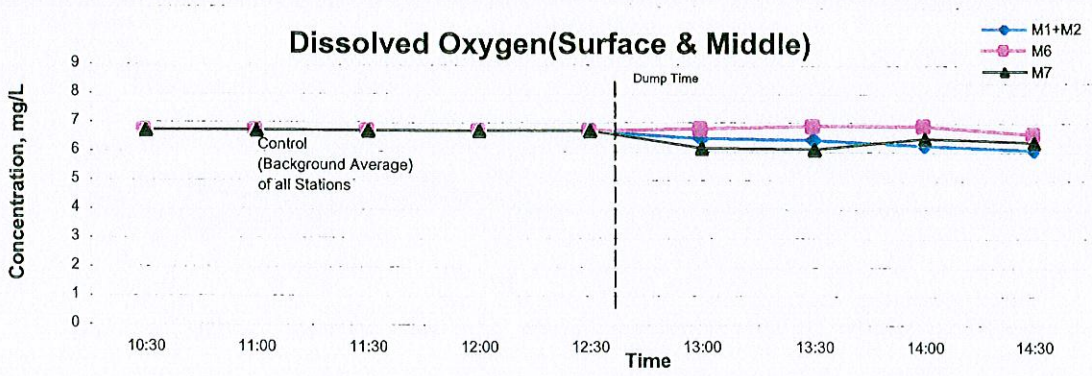


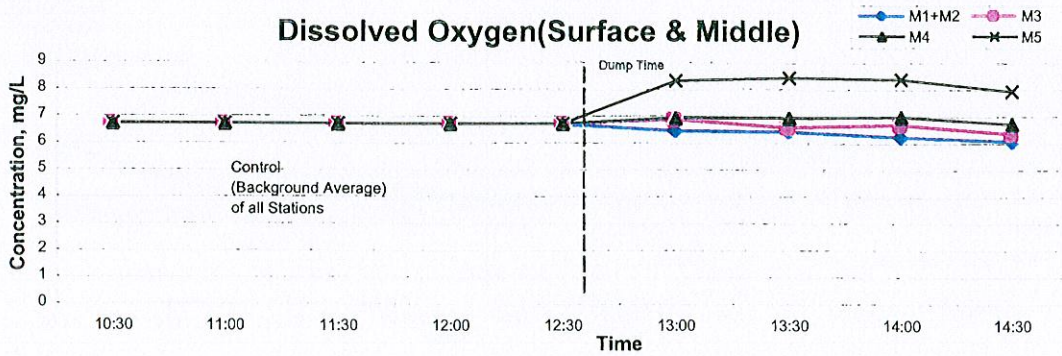


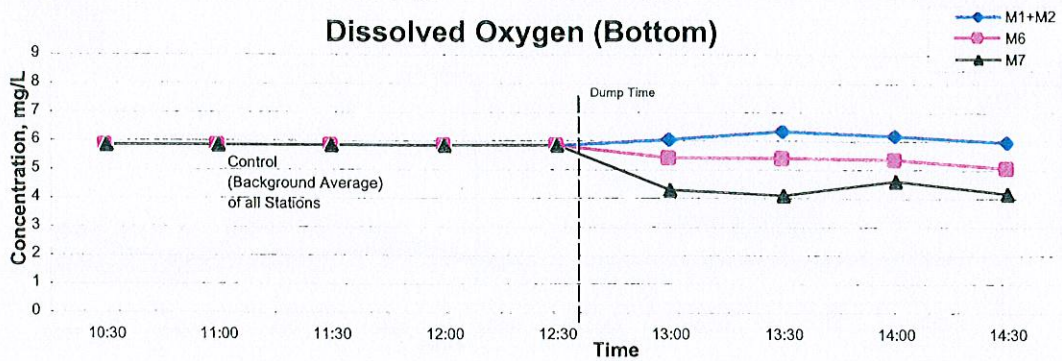


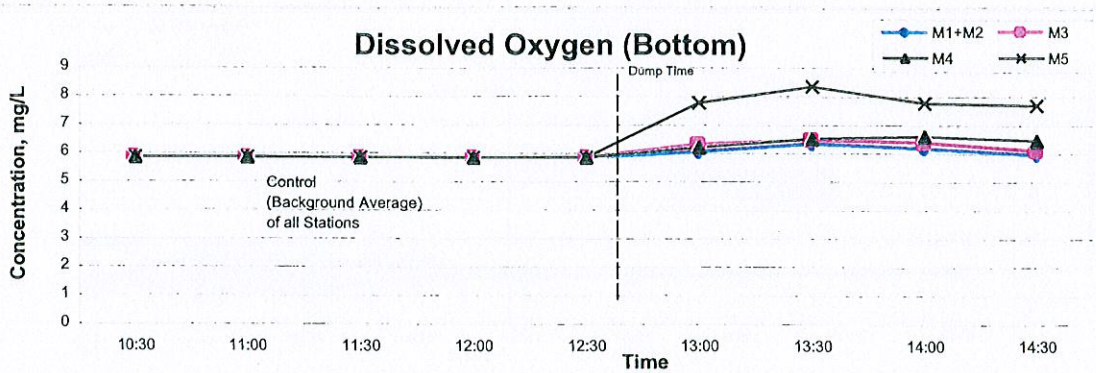


Title: WD II Geocontainer Field Trial Water Quality Monitoring Results on 17 May 2003	Project No.	A04602-010		Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD
	Date.	2003	Figure No. C.1	









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WD II Geocontainer Field Trial Water Quality Monitoring Results on 17 May 2003		Date.	2003	Figure No. C.2

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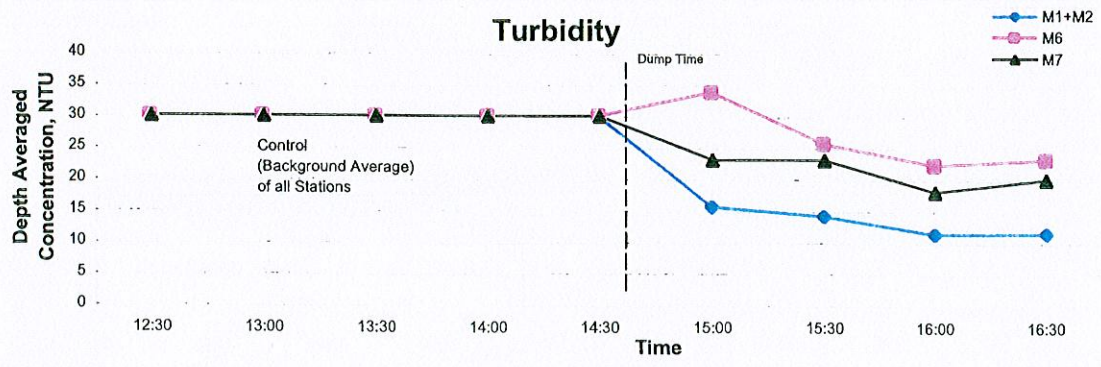

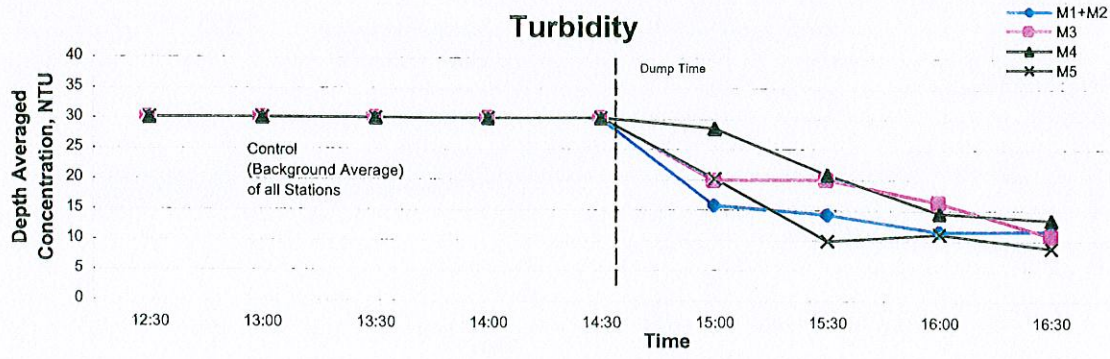

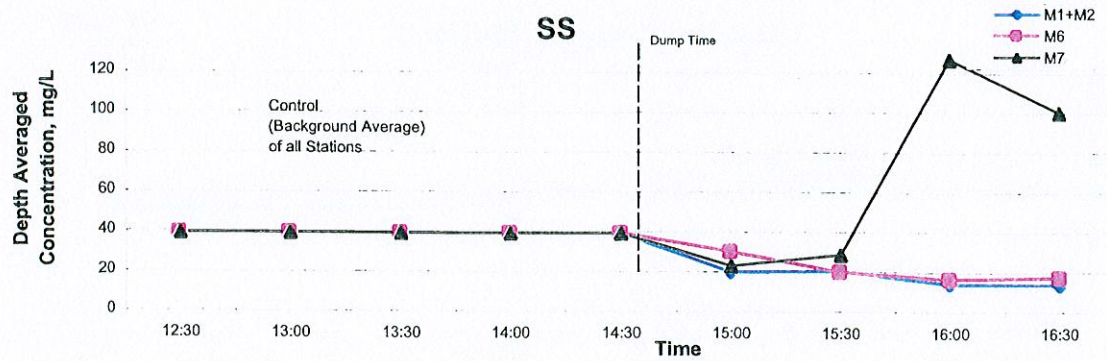

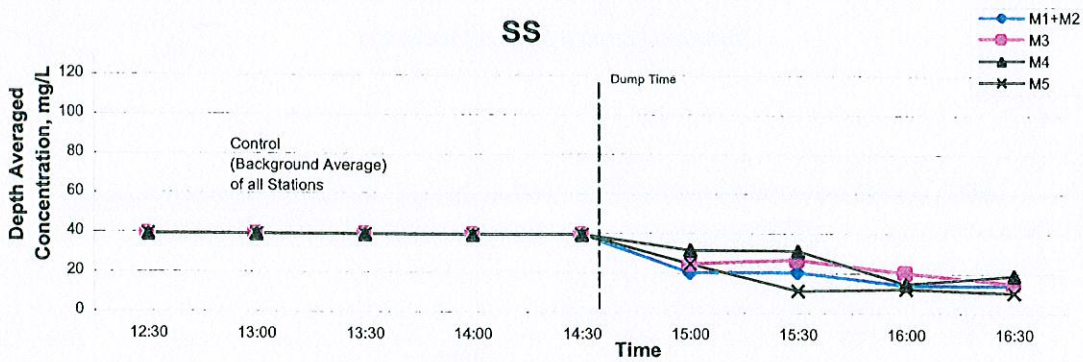

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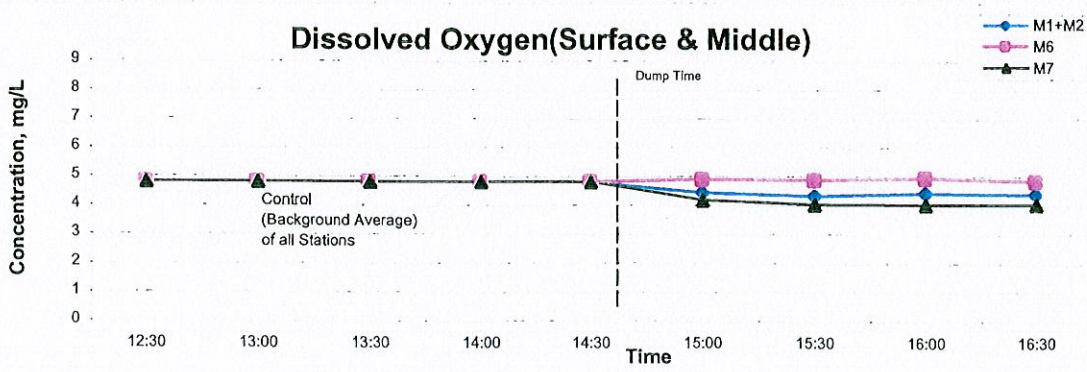

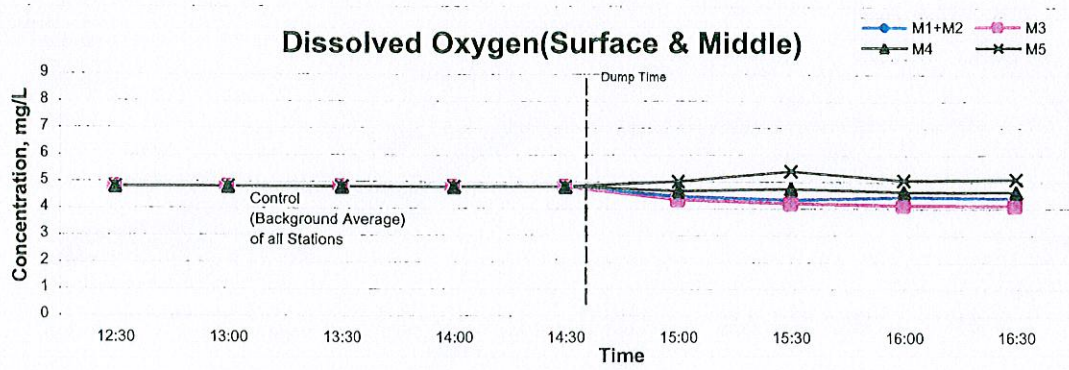

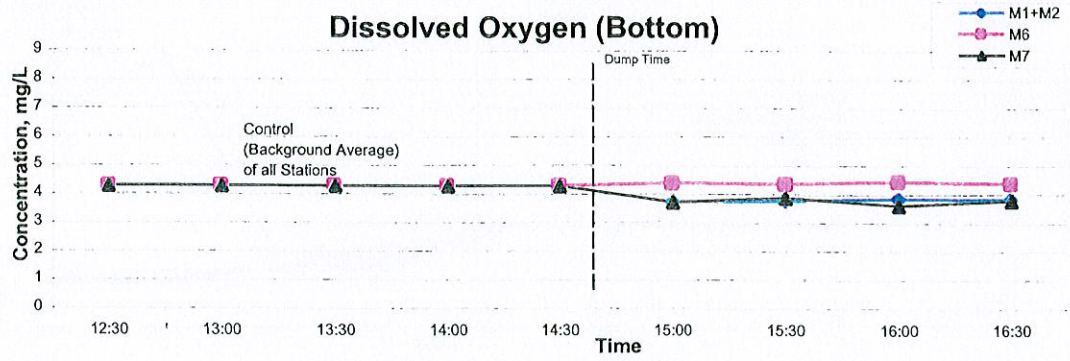

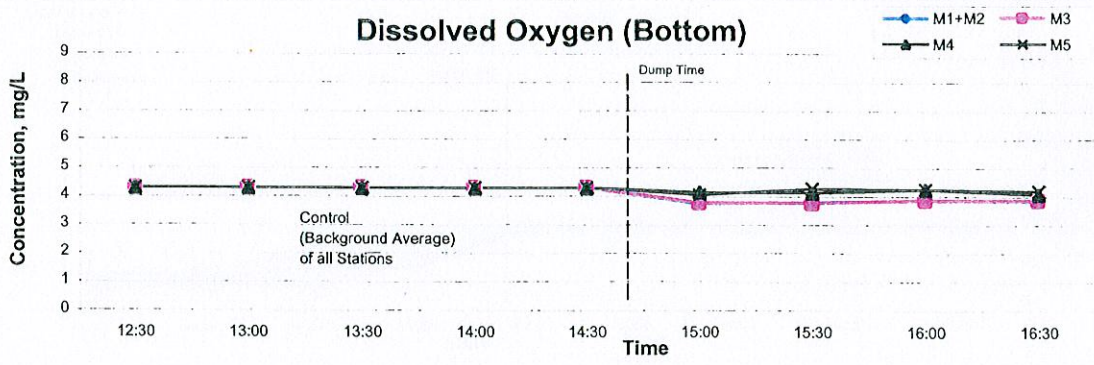

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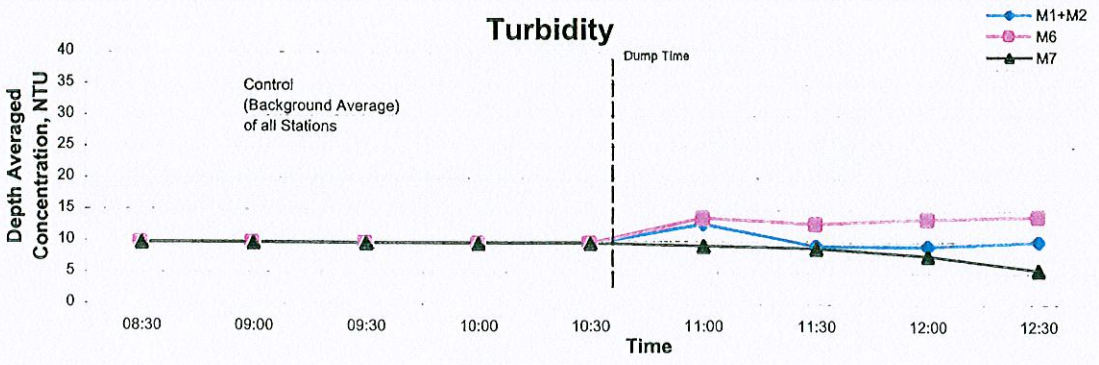
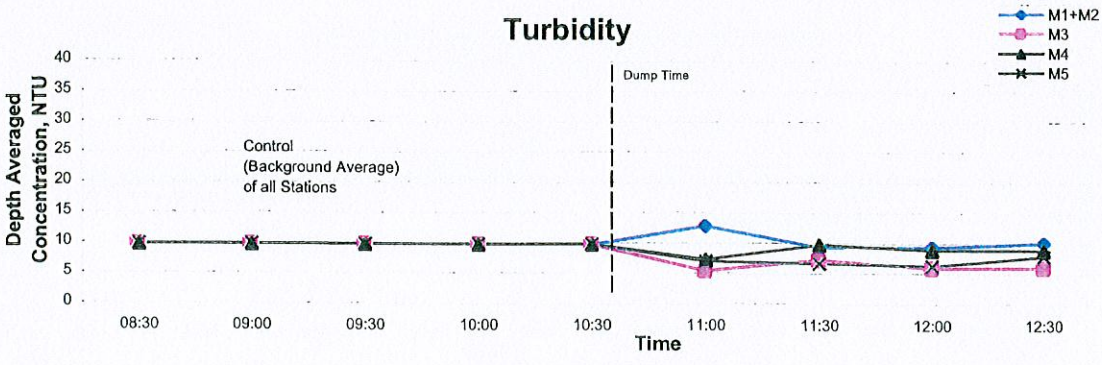
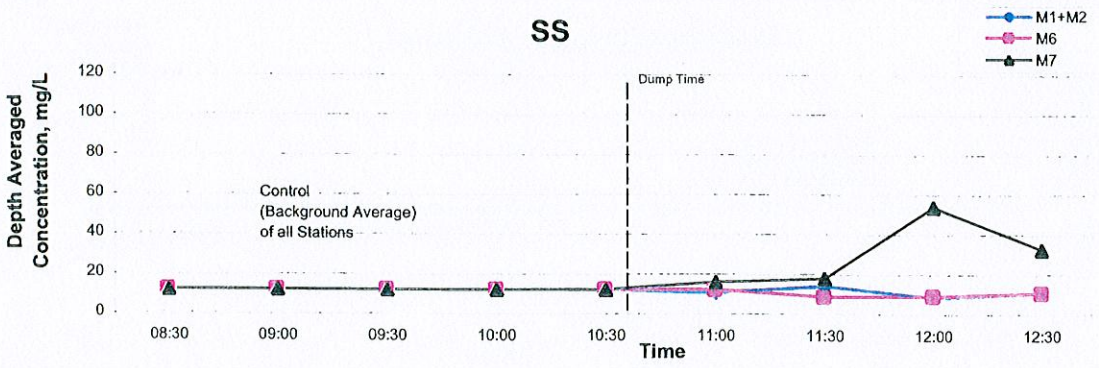
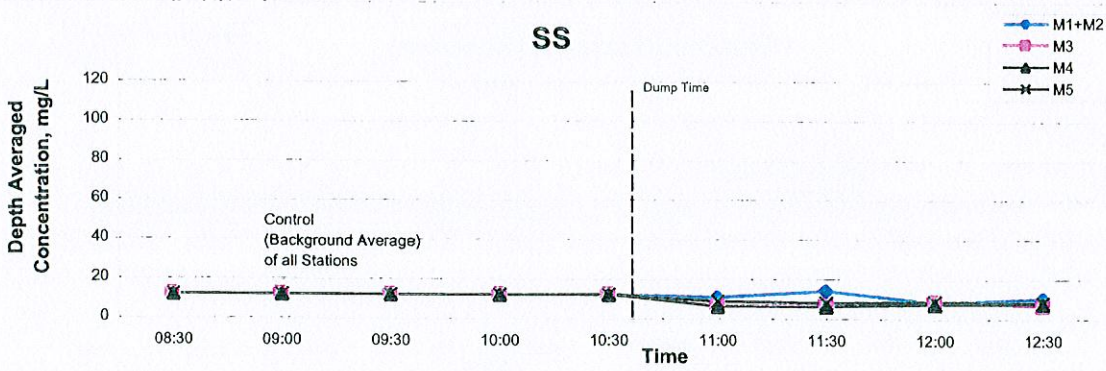
WD II Geocontainer Field Trial Water Quality Monitoring Results on 16 June 2003		Date.	2003	Figure No. C.4	

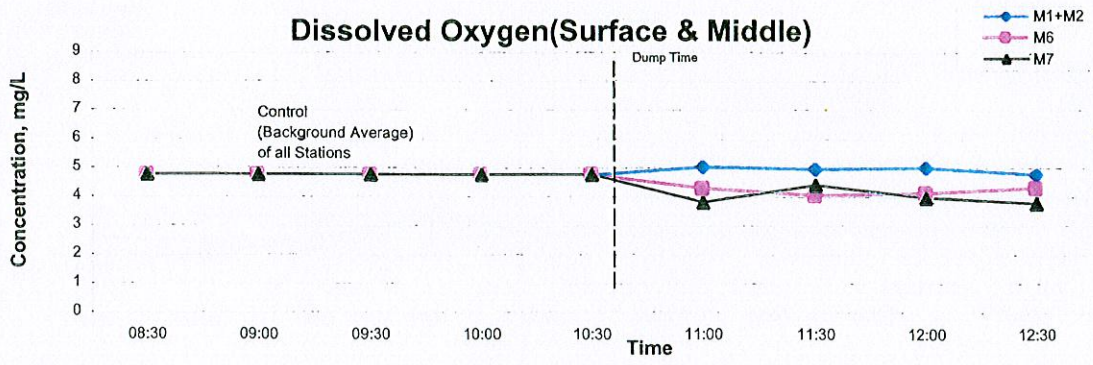


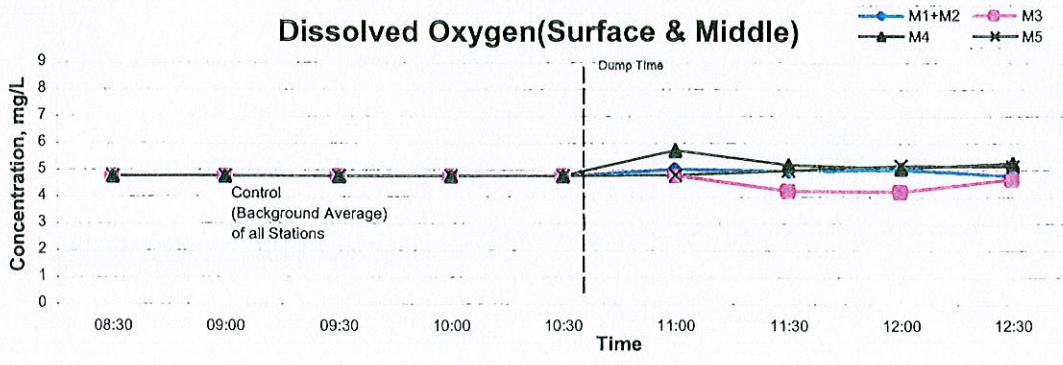


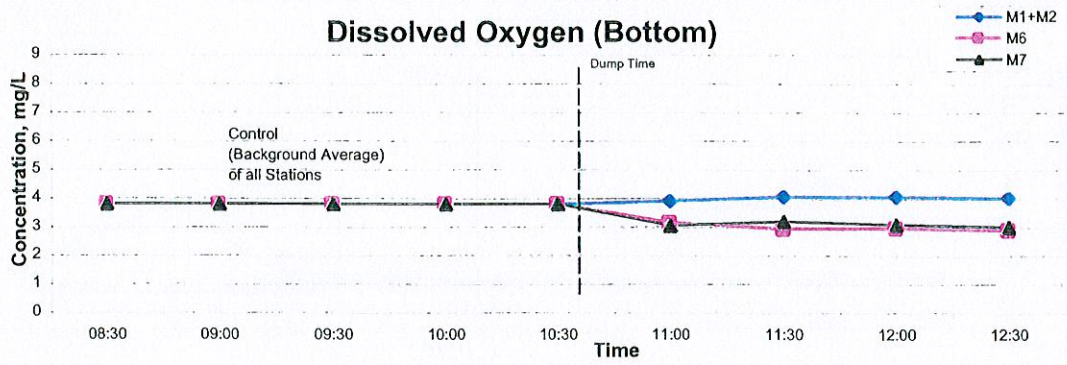


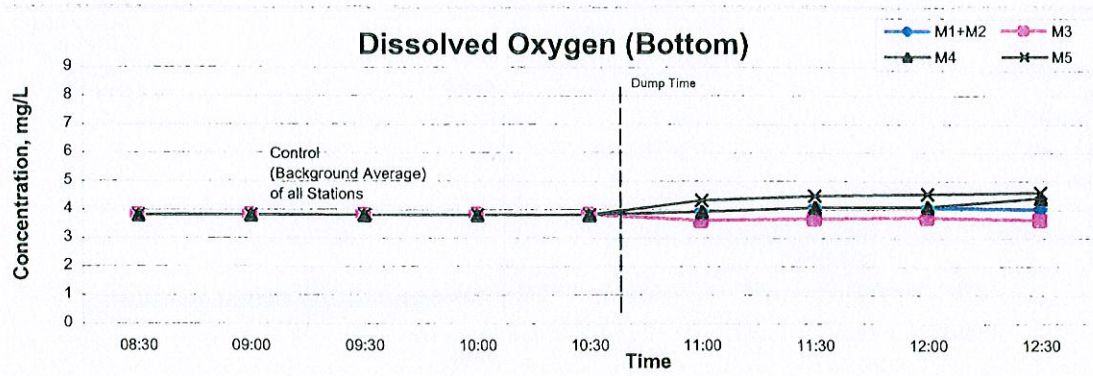


Title		Project No.	A04602-010		Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD
WD II Geocontainer Field Trial Water Quality Monitoring Results on 20 June 2003		Date.	2003	Figure No. C.5	

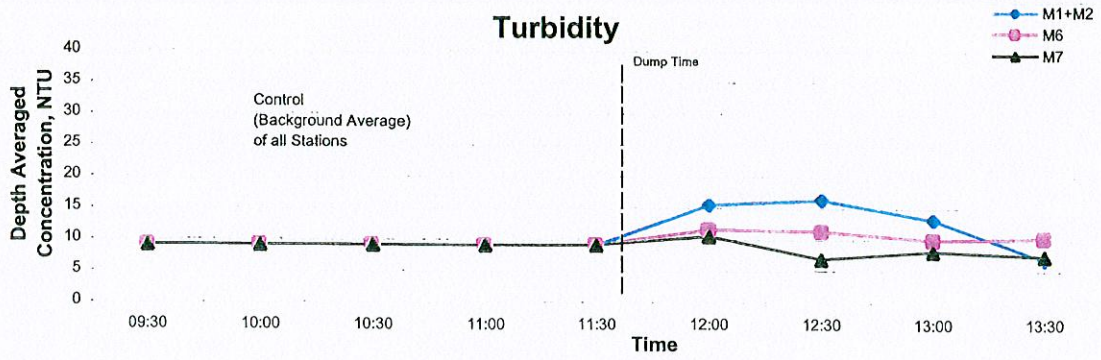


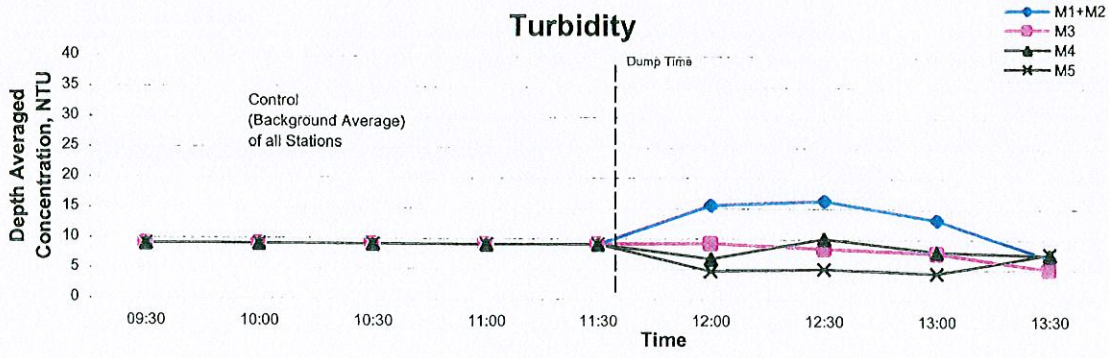


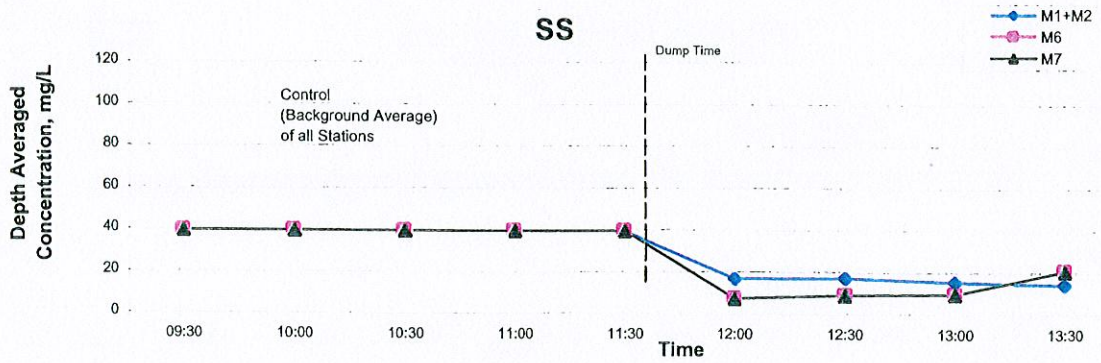


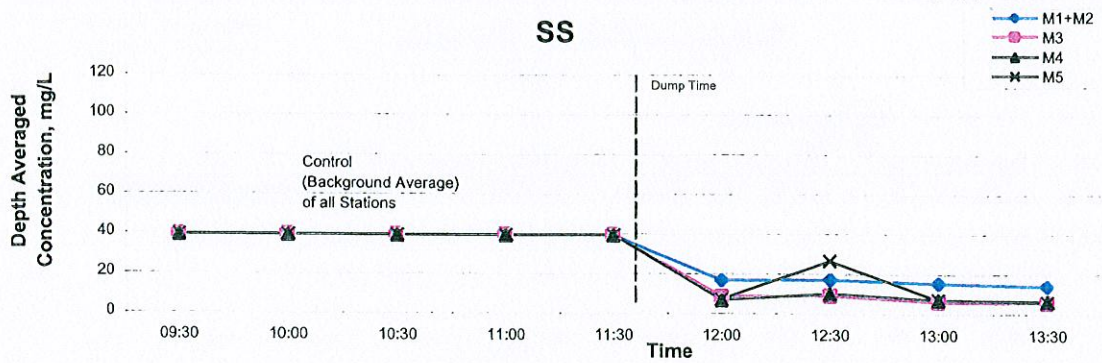


Title	WD II Geocontainer Field Trial Water Quality Monitoring Results on 20 June 2003	Project No.	A04602-010		Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD
		Date.	2003	Figure No. C.6	

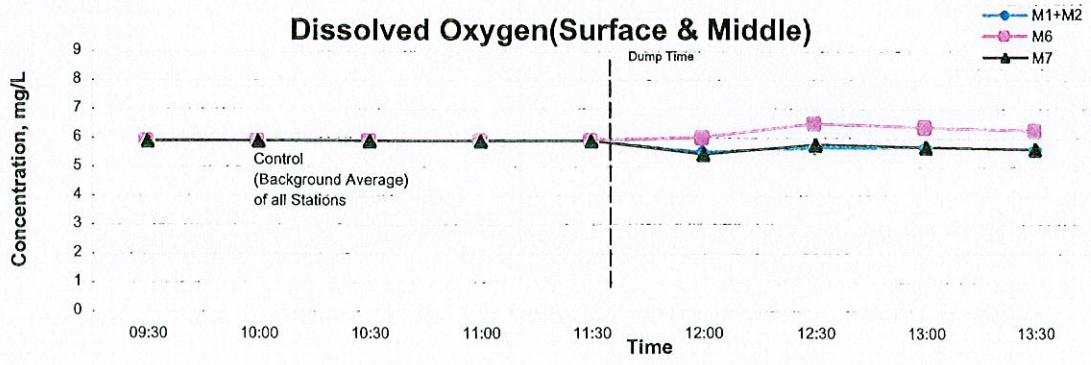


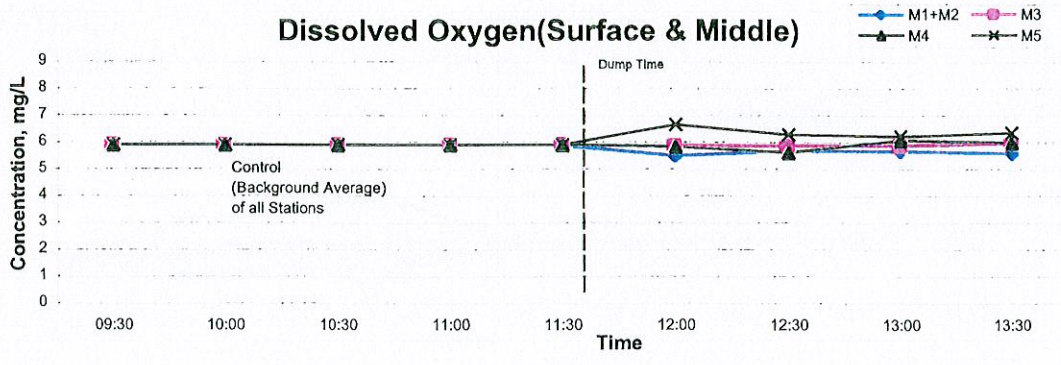


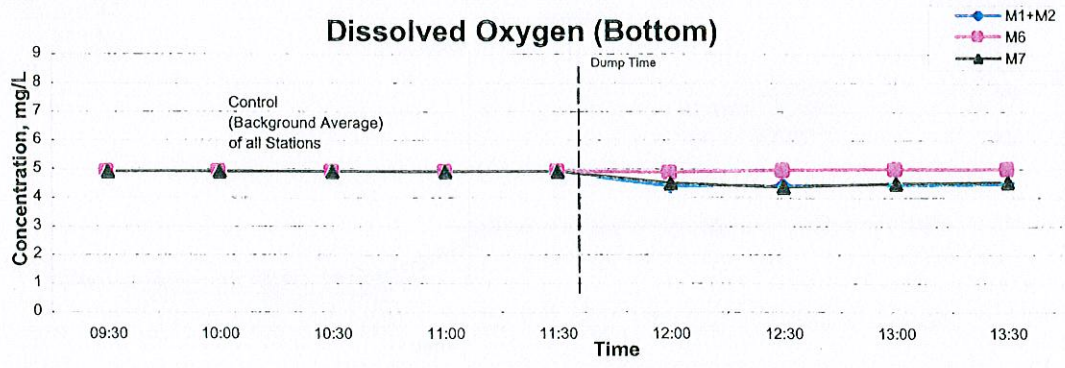


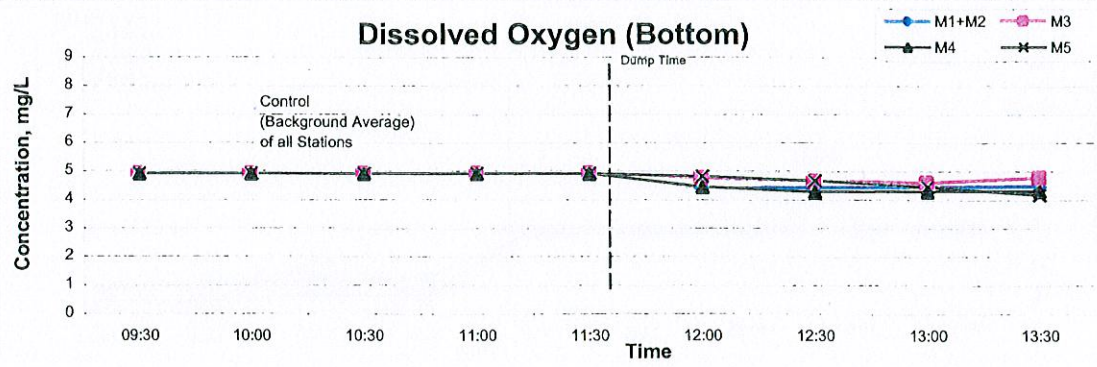


Title: WD II Geocontainer Field Trial Water Quality Monitoring Results on 26 July 2003	Project No.	A04602-010		Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD
	Date.	2003	Figure No. C.7	









Title		Project No.	A04602-010		
WD II Geocontainer Field Trial Water Quality Monitoring Results on 26 July 2003		Date.	2003	Figure No.	C.8

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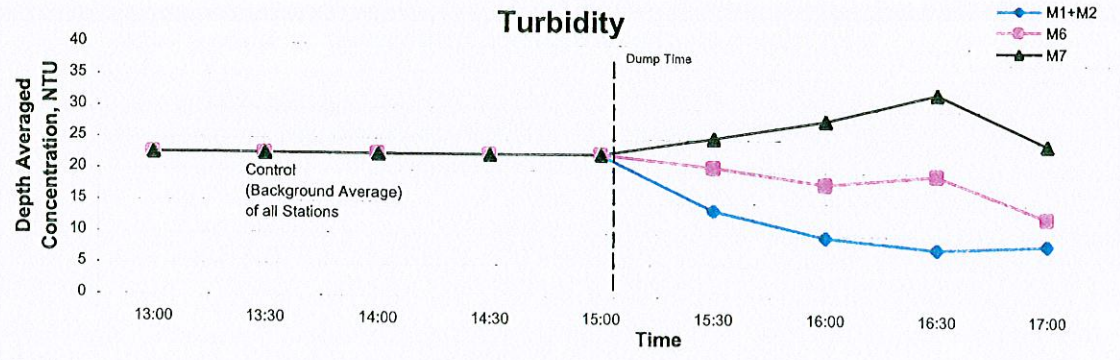
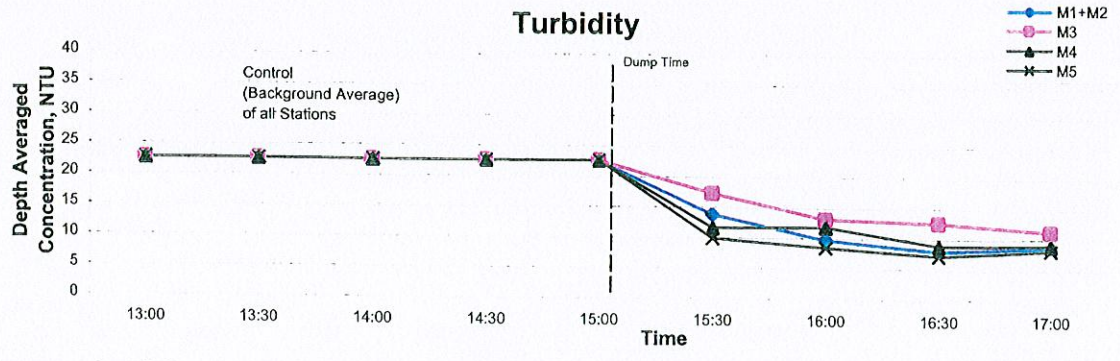
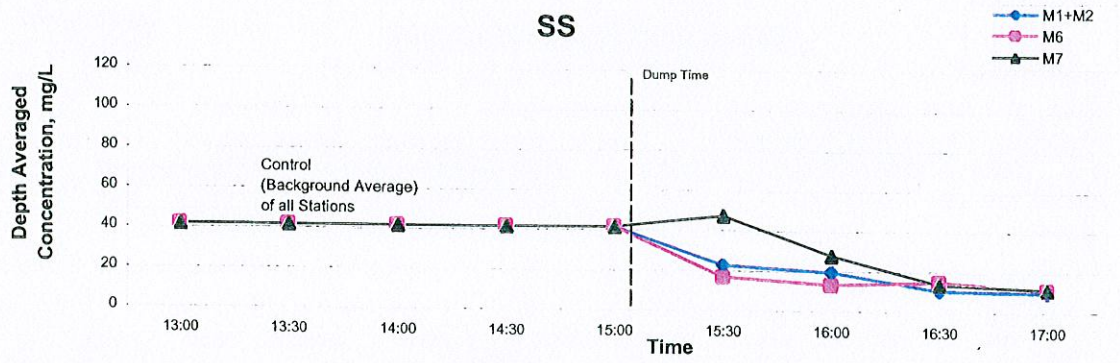
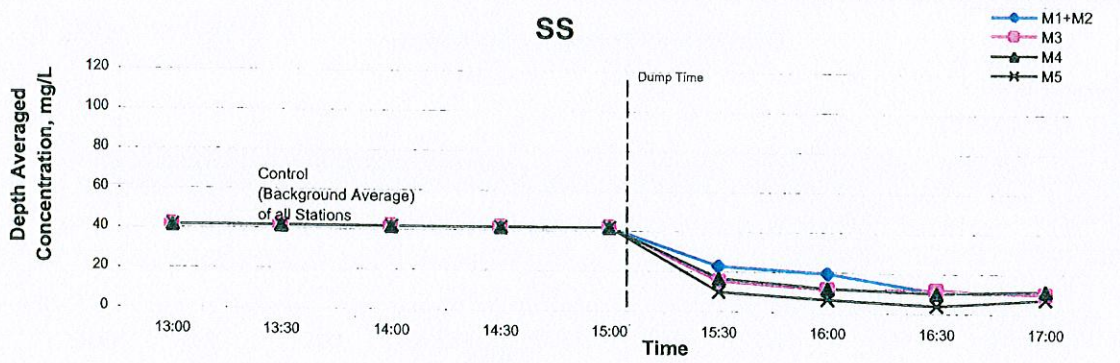
MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

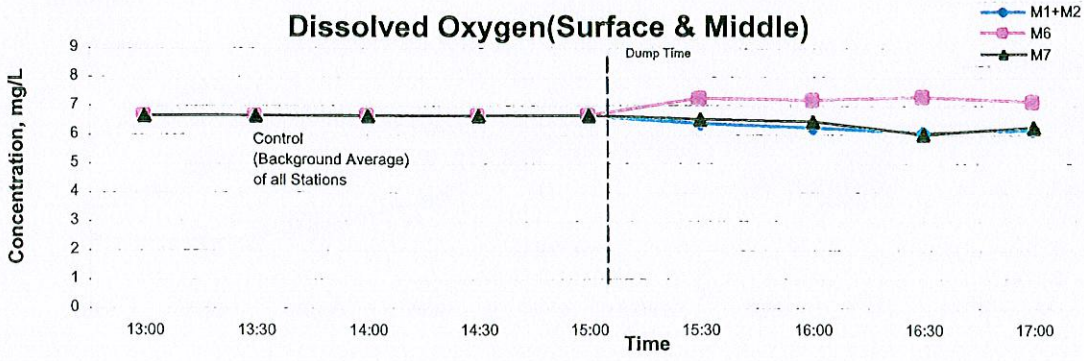


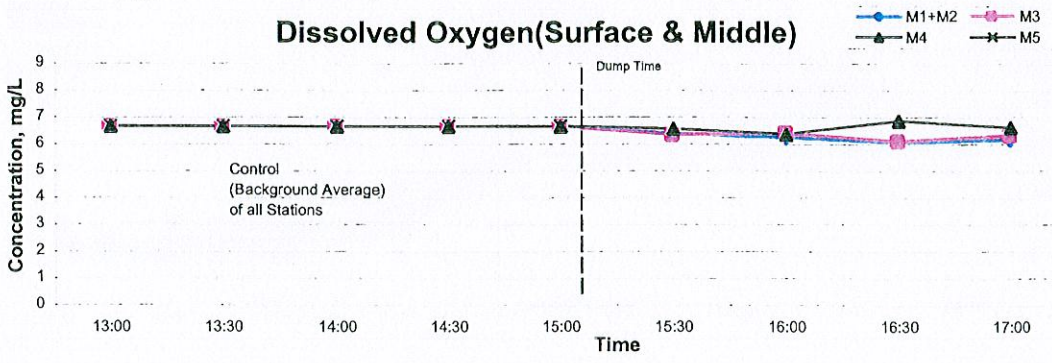


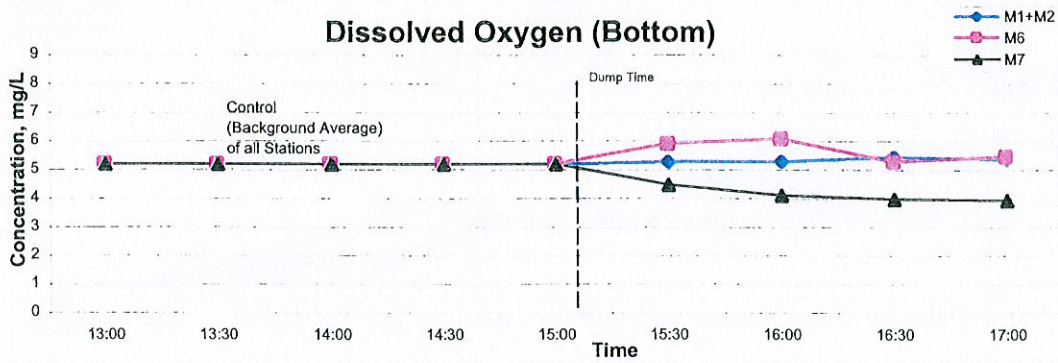


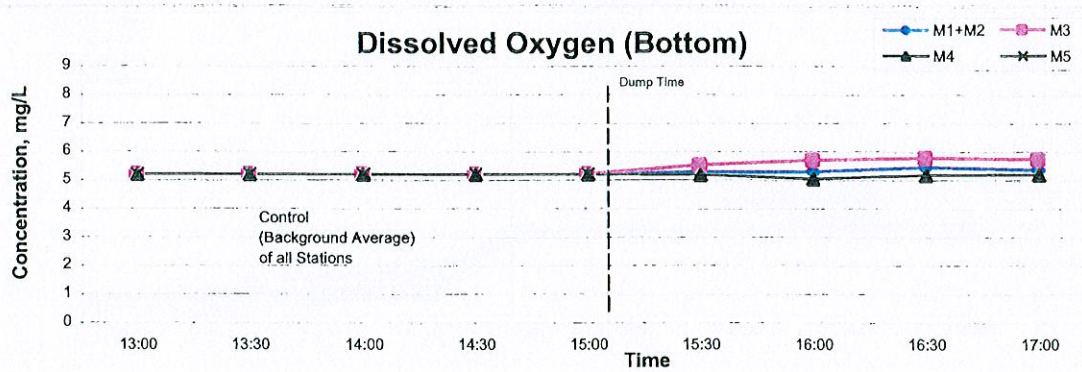


Title		Project No.	A04602-010		Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD
WD II Geocontainer Field Trial Water Quality Monitoring Results on 31 July 2003		Date.	2003	Figure No. C.9	









Title		Project No.	A04602-010	
WD II Geocontainer Field Trial Water Quality Monitoring Results on 31 July 2003		Date.	2003	Figure No. C.10

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APPENDIX D

Field Trials of Geosynthetic Containers
Outline Specifications for Geosynthetic Containers

Introduction

The geosynthetic container shall be a "box" or "pillow" shaped unit made of a soil-tight geotextile. It shall be partially prefabricated by sewing mill widths of the appropriate length together and also at the ends to form an elongated "box". The "box" shall then be closed in the field, after filling, by sewing specially designed seams. Air vents will be provided (two numbers for each container) and details are given in Attachment A.

The geosynthetic container will be placed in a split hopper barge and mechanically filled using a grab dredger. After towing the barge to the disposal site, the container will be released by opening the split hopper.

Fabric

The geosynthetic container shall be manufactured using two layers of polypropylene geotextile fabric comprising a non-woven fabric and a woven fabric. The composite fabric and the container shall be designed to:

(a) retain the dredged materials, including the contaminants, during the disposal operation and after placement on the seabed;
(b) resist the pressures of filling and the active loads without seam or fabric rupture;
(c) resist erosive forces during filling operations;
(d) survive construction abuse during filling and disposal;
(e) resist puncture and tearing, including during release from the barge hopper;
(f) resist bursting on impact with the seabed.

In meeting the above criteria, the non-woven inner liner shall, as a minimum requirement, have a minimum weight of 200 g/m^2; its primary function shall be to prevent any loss of the contained material. The outer liner shall be a woven polypropylene geotextile fabric such as Geolon PP200S or products with equivalent specifications and performance. The outer liner shall, as a minimum, comply with the following criteria:

(a) the minimum weight shall be 500 g/m^2;
(b) the apparent opening size (O90) shall be 0.2 mm; (O90) is taken as the particle size at which 90% by weight of particles are retained on the geotextile upon dry sieving using balontini (spherical glass beads);
(c) the wide width tensile strength in both warp and weft direction shall be at least 200 kN/m.

Seams and Overlaps

Each piece of fabric shall be joined together by seamed joints with sufficient overlaps to prevent any loss of contained material and a minimum strength of 70% of the fabric in the warp and weft (i.e. 140kN/m). Overlap flat seams shall be used for fabrication of container.

After filling up, the container will be closed insitu on site. The edges to be joined on site comprised the composite fabric layers (ie the woven and non-woven layers) of the container and two outer flaps of woven fabric which were pulled over the in-situ stitched seam. The hand stitching method involved rolling the edges to be joined together and tying them with seam stitching using 6mm nylon rope with a pitch of around 75mm (3 inches). Next, rope knots were used to fasten the two outer flaps

together over the seamed joint; these knots were made at approximately 150mm (6 inches) separation. The first seam served the purpose of ensuring that soil does not escape from the container, while the second (rope-knotted) joint was designed to withstand stresses induced during the disposal.

The two ends of the container required special attention as, with a number of factory seams and in-situ seams all coming together at the same place, this was a difficult area to ensure robust closure. The hand stitching and rope knotting at the two ends of the container were further modified to ensure total containment of sediments. Hand stitching of a pitch of 25 to 50 mm (1 to 2 inches) and rope knots at 75mm (3 inches) spacing were adopted at the first metre at the two ends.

Sizes of Geosynthetic Containers

Geosynthetic containers of nominal volume 300 m^3 shall be fabricated. The dimensions of each size of container shall be designed to fit the internal dimensions and size of opening of the hopper barge to be used for the disposal of the containers. Indicative container dimensions are given in Attachment A.

Slip Sheets

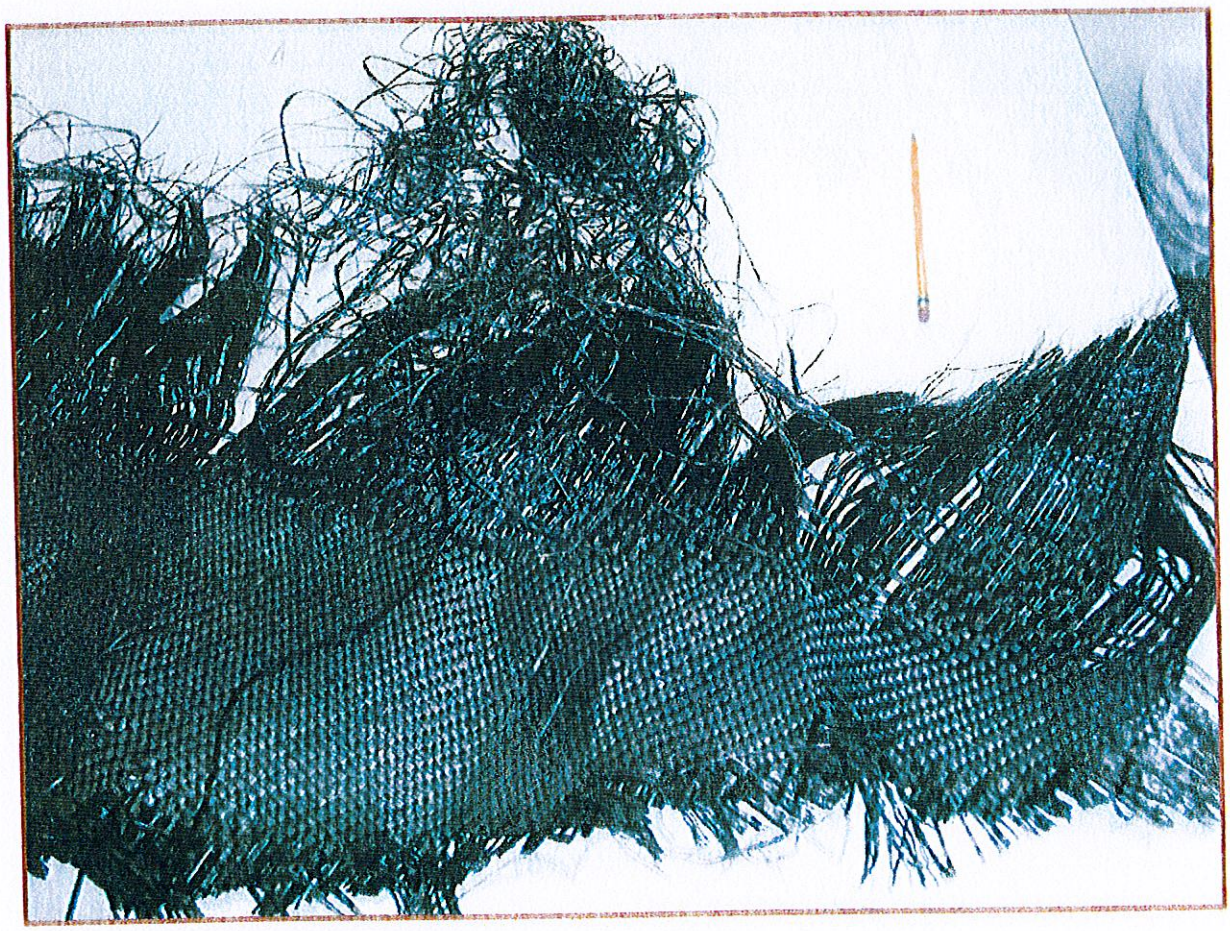
In order to facilitate the disposal of the geosynthetic containers from the hopper barge, smoothly and without damage, slip sheets shall be provided to cover the inside of hopper. The slip sheets shall be made of woven fabric, such as Geolon PP80 or products with equivalent specifications and performance. The slip sheets shall comply with the following minimum criteria:

(a) the tensile strength in both warp and weft direction shall be at least 80 kN/m,
(b) the minimum weight shall be 360 g/m^2.

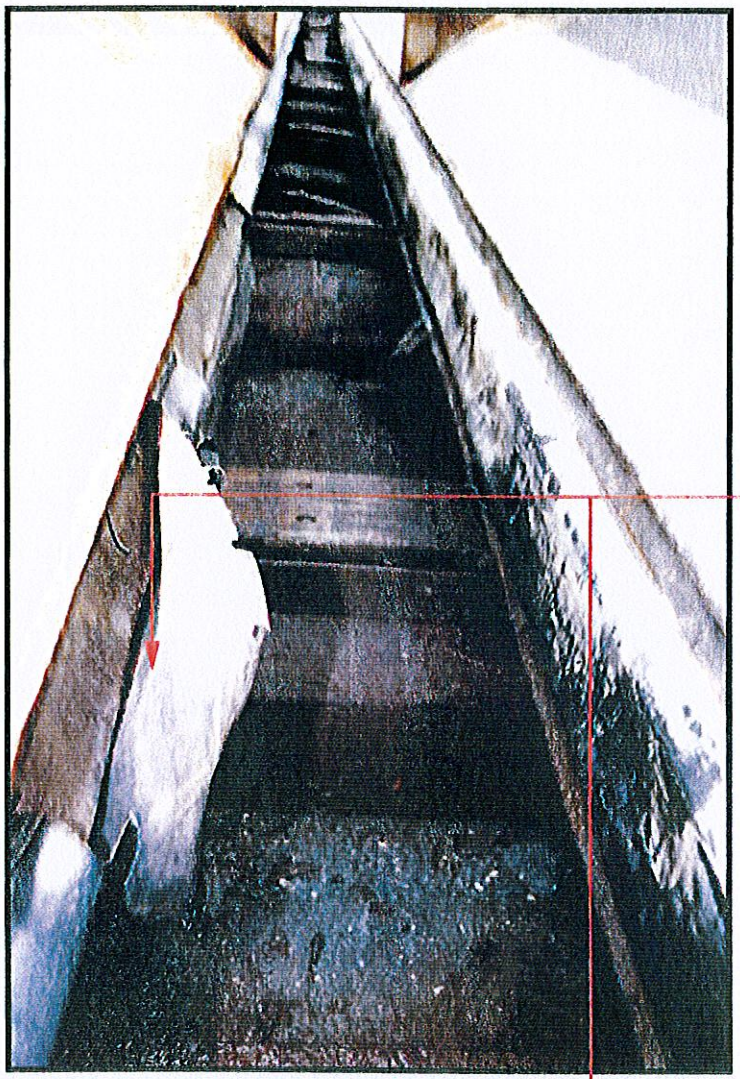
Handling, storage and delivery

Prior to unrolling, the geotextile fabric and the fabricated geosynthetic containers shall be stored in light-proof containers and out of direct sunlight. Once unrolled, no geotextile fabric or the fabricated geosynthetic containers shall be exposed to sunlight for longer than 1 week.

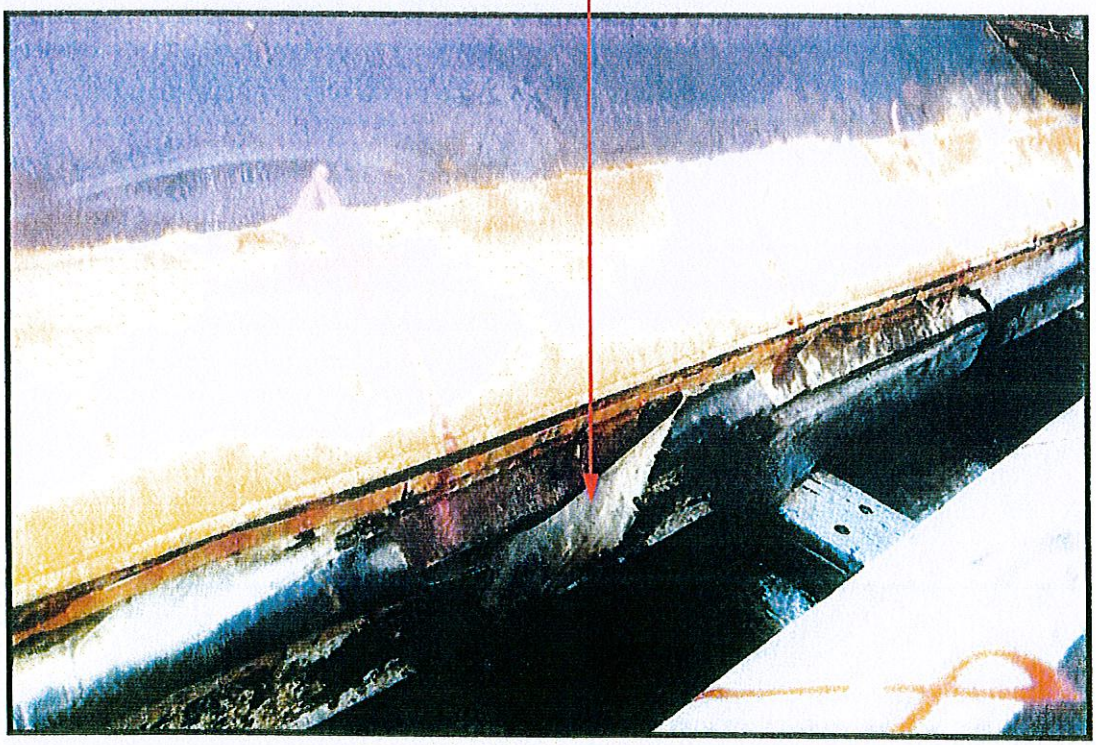
During delivery of geosynthetic containers, care must be taken to ensure that the geotextile fabric and the containers are not damaged.



Maunsell	AGREEMENT NO. CE 54/2001 (CE) WAN CHAI DEVELOPMENT PHASE II - DESIGN AND CONSTRUCTION SAMPLE OF RUPTURED EDGE OF CONTAINER A	Territory Development Department Hong Kong Island & Islands FIGURE 5.1



Torn and damaged rubber gaskets



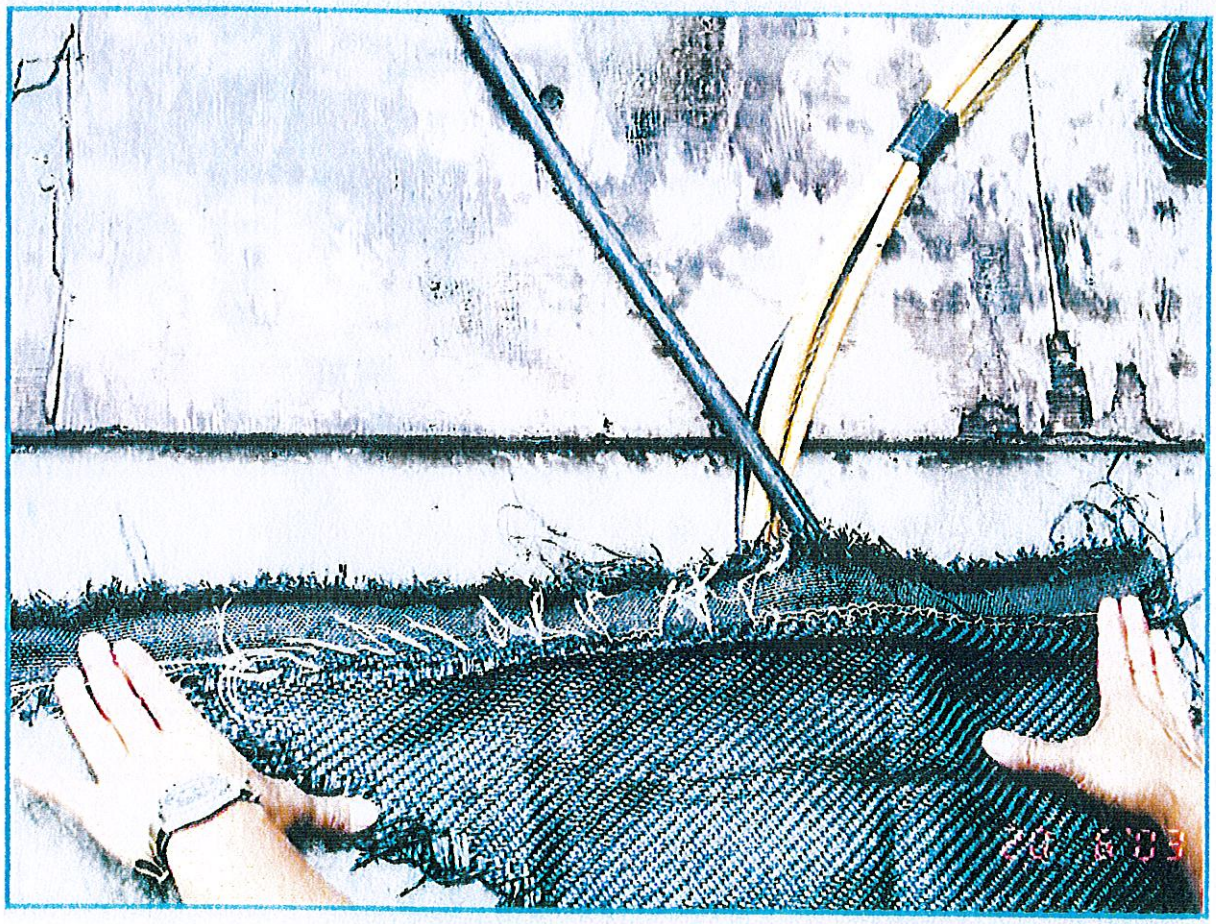
Maunsell

AGREEMENT NO. CE 54/2001 (CE)
WAN CHAI DEVELOPMENT PHASE II - DESIGN AND CONSTRUCTION

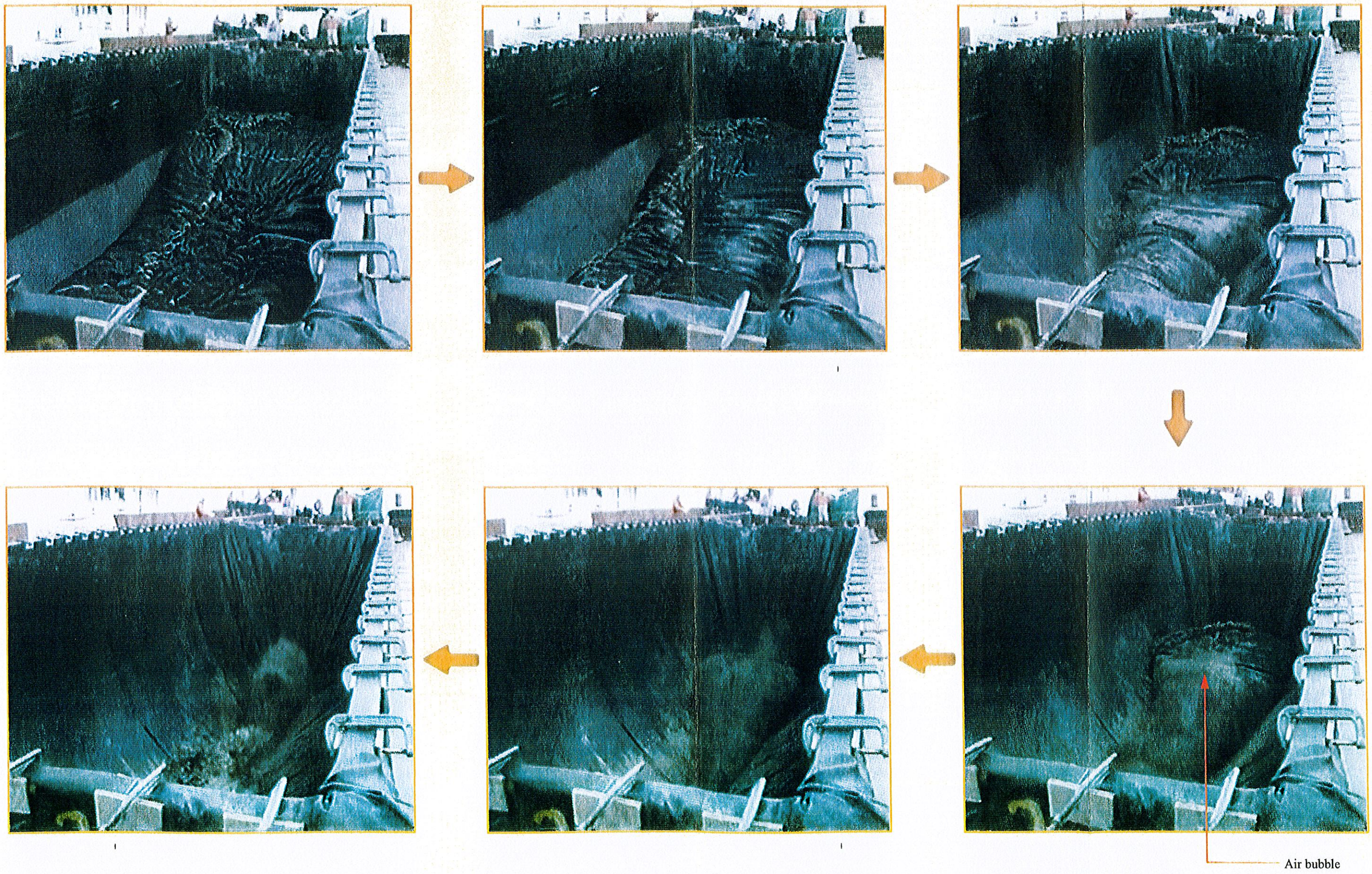
HOPPER GATE AFTER THE FIRST FIELD TRIAL

Territory Development Department
Hong Kong Island & Islands

FIGURE 5.2



Maunsell	AGREEMENT NO. CE 54/2001 (CE) WAN CHAI DEVELOPMENT PHASE II - DESIGN AND CONSTRUCTION SAMPLE OF RUPTURED EDGE OF CONTAINER B	Territory Development Department Hong Kong Island & Islands FIGURE 5.3



Maunsell

AGREEMENT NO. CE 54/2001 (CE)
WAN CHAI DEVELOPMENT PHASE II - DESIGN AND CONSTRUCTION

DISPOSAL OF CONTAINER C

Territory Development Department
Hong Kong Island & Islands

FIGURE 5.4

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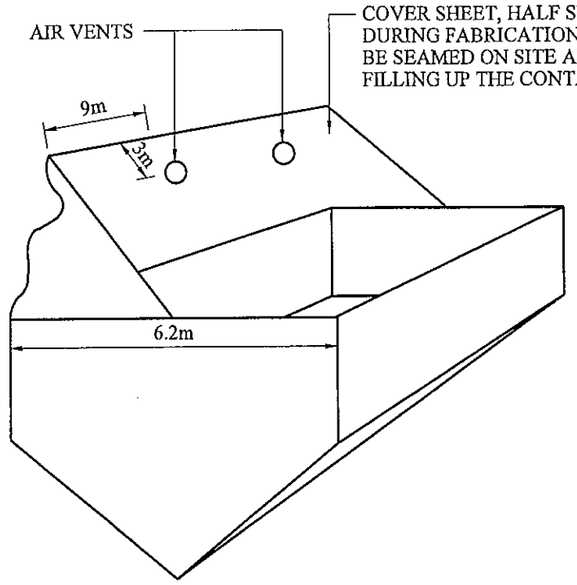
AGREEMENT NO. CE 54/2001 (CE)
WAN CHAI DEVELOPMENT PHASE II - DESIGN AND CONSTRUCTION

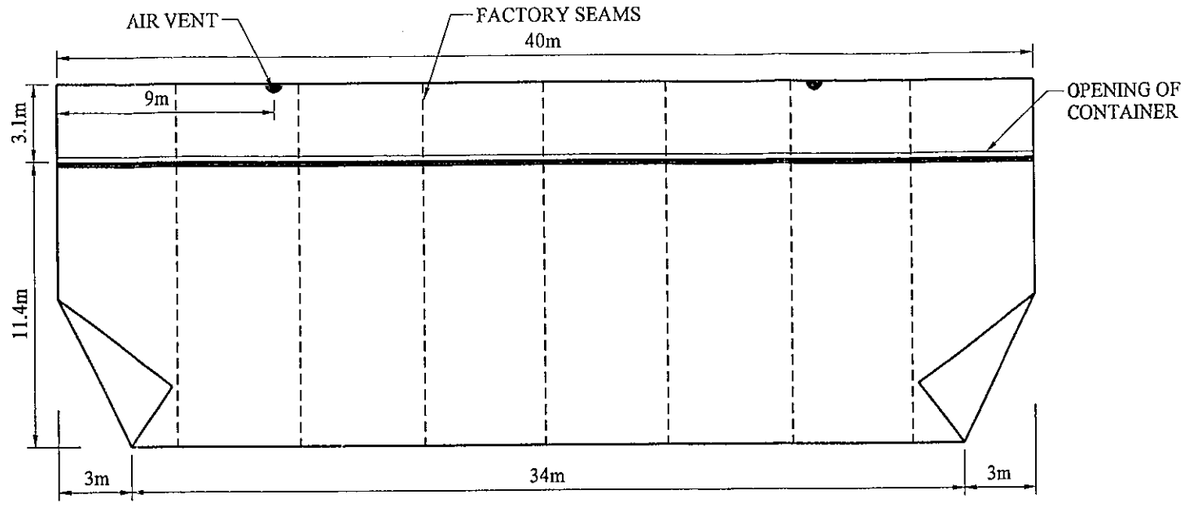
POSSIBLE MINOR GAP AT END CLOSURE OF GEOSYNTHETIC CONTAINER

Territory Development Department
Hong Kong Island & Islands

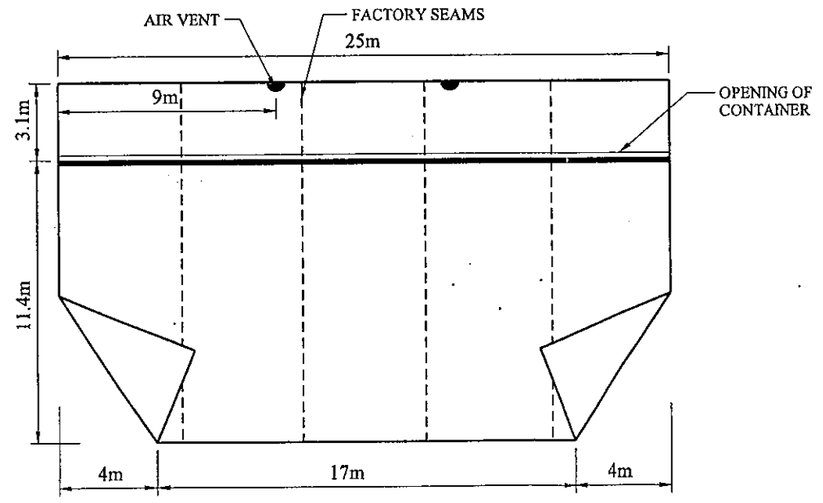
FIGURE 5.5



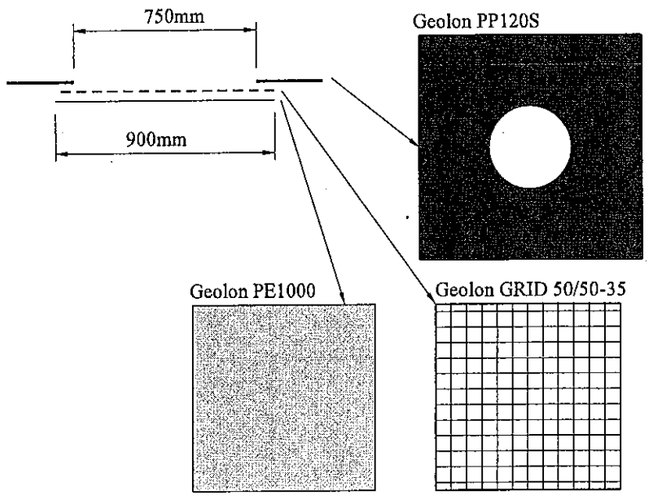
PERSPECTIVE VIEW
(CONTAINER PLACED INSIDE HOPPER)
N.T.S.



600m^3 GEOSYNTHETIC CONTAINER
SCALE 1 : 250



300m^3 GEOSYNTHETIC CONTAINER
SCALE 1 : 250



TYPICAL AIR VENT DETAILS
N.T.S.

NOTES:

1. DIMENSIONS SHOWN IN THIS DRAWING SHALL BE THOSE FOR THE FINISHED CONTAINER. SUFFICIENT ADDITIONAL MATERIAL SHALL BE PROVIDED FOR JOINT OVERLAPS AND INSITU SEALING OF THE COVER SHEET.
2. DIMENSIONS SHOWN IN THIS DRAWING ARE INDICATIVE

Maunsell

AGREEMENT NO. CE 54/2001 (CE)
WAN CHAI DEVELOPMENT PHASE II - DESIGN AND CONSTRUCTION

GEOSYNTHETIC CONTAINER

Territory Development Department
Hong Kong Island & Islands

ATTACHMENT A

[C-D1] Q:/PROJECTS/93502/REPORT/FIELD TRIAL/ATTACHA.DGN SACLE: 1: 1000 A3 SEP 2003

APPENDIX E

product

Geolon Woven Polypropylene Geotextiles

for stabilisation and marine applications

Property	Units	PP200	P200S	PP300	PP400	PP500	PP600	PP800
Mechanical properties								
Wide width tensile strength								
EN ISO 10319 : 1993, AS 3706.2 : 2000								
Mean peak strength - warp	kN/m	200	200	300	400	500	600	800
Mean peak strength - weft	kN/m	40	200	40	50	50	50	50
Extension at peak strength - warp	%	11	14	15	15	10	15	15
Extension at peak strength - weft	%	8	13	11	11	9	11	11
CBR puncture								
EN ISO 12236 : 1996, AS 3706.4 : 2000								
Mean peak strength	kN	11	20	11	11	11	11	12
Drop cone								
EN 918 : 1996, AS 3706.5 : 2000								
D_{500}	mm	8	6	6	6	6	5	5
Hydraulic properties								
Pore size								
Dry sieving NEN 5168, AS 3706.7:1990								
AOS – O_{90} ,EOS – O_{95}	mm	0.35	0.5	0.25	0.15	0.3	0.3	0.3
Wet sieving EN ISO 12956 : 1998								
AOS – O_{90}	mm	0.2	0.2	0.2	0.15	0.2	0.2	0.2
Water permeability								
NEN 5167, AS 3706.9 : 1990								
Q_{100}	L/m².sec	25	25	15	20	25	25	25
Permittivity	/s	0.4	0.5	0.3	0.4	0.3	0.3	0.6
Physical properties								
Mass per unit area								
EN 965 : 1995, AS 3706.1 : 1990	g/m²	570	940	750	900	1200	1400	1900
Thickness								
EN 964 : 1995, AS 3706.1 : 1990	mm	2	3.3	2.5	2.5	3.2	3.5	4
Roll width	m	5.2	5.05	5.05	5.05	5.05	5.05	5.05
Roll length	m	200	200	200	200	100	100	100
Roll weight	kg	620	970	780	940	650	720	970

Ten Cate Nicolon

ISO 9001 KEMA CERT. NR. 56002

Data sheet MIRAFI

product

Geolon Woven Polypropylene Geotextiles

for separation applications

Property	Units	PP15	PP25	PP40	PP60	PP80	PP100S	PP120	PP120S
Mechanical properties									
Wide width tensile strenghth									
ISO 10319 : 1993, AS 3706.2 : 2000									
Mean peak strength - warp	kN/m	15	25	40	60	80	100	120	120
Mean peak strength - weft	kN/m	15	25	40	60	80	100	40	120
Extension at peak strength - warp	%	20	15	14	9	11	12	12	14
Extension at peak strength - weft	%	11	13	7	7	11	8	7	7
CBR puncture									
ISO 12236 : 1996, AS 3706.4 : 2000									
Mean peak strength	kN	2.5	3	3.5	7	10	12	8	14
Drop cone									
EN 918 : 1996, AS 3706.5 : 2000									
D_{500}	mm	16	11	8	6	6	6	6	6
H_{50}	mm	2,500	4,500	7,300	11,000	11,000	11,000	11,000	11,000
G rating									
QMRD		>2,500	>4,000	>5,500	>8,500	>10,000	>11,000	>9,000	>12,000
Hydraulic properties									
Pore size									
EN ISO 12956									
AOS – O_{90}	mm	0.15	0.15	0.2	0.2	0.2	0.15	0.4	0.2
AS 3706.7 : 1990									
EOS – O_{95}	mm	0.2	0.2	0.3	0.3	0.2	0.2	0.5	0.2
Water permeability									
BS 6906.3 : 1989, AS 3706.9 : 1990									
Q_{100}	L/m².sec	16	10	25	23	30	15	30	15
Permittivity	/s	0.1	0.15	0.4	0.4	0.4	0.3	0.6	0.4
Physical properties									
Mass per unit area									
EN 965 : 1995, AS 3706.1 : 1990	g/m²	100	110	180	260	360	420	360	500
Thickness									
EN 964 : 1995, AS 3706.1 : 1990	mm	0.5	0.5	0.8	1.0	1.1	1.4	1.3	2.7
Roll width	m	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Roll leangth	m	200	200	200	200	200	200	200	200
Roll weight	kg	110	125	200	280	385	480	390	530

Ten Cate Nicolon

ISO 9001 KEMA CERT. NR.55002 DUTCH COUNCIL FOR ACCREDITATION

product Mirafi Nonwoven P Series Geotextiles

Property	Units	130P	140PC	140P	150P	160P	170P	180P	190P	1100P	1120P	1140P	1160P
Mechanical properties													
Wide width tensile strength													
EN ISO 10319, ASTM D4595:1986													
Mean peak strength	kN/m	7.0	8.0	8.0	9.0	11.0	13.0	14.5	16.0	17.5	20.5	24.0	26.0
Extension at peak strength	%	45	45	45	45	50	50	50	50	60	60	60	60
CBR puncture resistance													
EN ISO 12236: 1996, ASTM D6241:1998													
Mean peak strength	N	1,100	1,200	1,400	1,550	1,850	2,100	2,400	2,600	3,000	3,500	4,000	4,500
Extension at peak strength	%	50	45	50	50	50	50	50	50	50	50	50	50
Grab tensile resistance													
ASTM D4632:1991													
Mean peak strength	N	450	500	550	650	700	850	1,000	1,100	1,250	1,450	1,650	1,850
Extension at peak strength	%	70	70	70	70	70	70	70	70	70	70	70	70
Trapezoidal tear resistance													
ASTM D4533:1991													
Mean peak strength	N	150	175	190	200	250	300	350	380	420	460	500	550
Drop cone													
EN 918:1996													
D_{500}	mm	35	32	30	28	25	23	22	20	16	13	10	8
Hydraulic properties													
Pore size													
Dry sieving – ASTM D4751:1995													
AOS – $O_{90,d}$	mm	0.15	0.10	0.12	0.11	0.10	0.09	0.08	0.07	<0.06	<0.06	<0.06	<0.06
Wet sieving – EN ISO 12956:1999													
AOS – $O_{90,w}$	mm	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.08	0.07	0.07	0.06	0.06
Water permeability													
Velocity index	m/s	0.09	0.09	0.09	0.08	0.06	0.05	0.04	0.04	0.04	0.03	0.03	0.03
EN ISO 11058:1999													
Permittivity	/s	2.0	1.9	1.8	1.5	1.4	1.3	1.2	1.1	1.0	0.8	0.7	0.6
ASTM D4491: 1996													
Flow rate Q_{100}	L/m^2.s	170	130	150	150	140	130	120	110	100	90	80	70
BS 6906:3:1989													
Physical properties													
Mass per unit area													
EN 965:1995, ASTM D5261:1992	g/m^2	130	140	150	175	200	250	280	300	350	400	450	500
Thickness													
EN 964:1995, ASTM D5199:1991	mm	0.9	0.9	1.0	1.2	1.3	1.4	1.5	1.7	1.9	2.1	2.3	2.5
Roll width	m	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Roll length	m	200	200	200	200	200	200	100	100	100	100	100	50
Roll weight	kg	105	115	120	140	160	200	115	120	140	160	180	100

UKAS QUALITY MANAGEMENT BS EN ISO 9002 : 1994

APPENDIX F

本署檔號
OUR REF: (6) in EP/MD/04-030
來函檔號
YOUR REF: H02 0328 05-3.1.2.8/L410/YY/JY/il
電 話
TEL. NO.: 2835 1189
圖文傳真
FAX NO.: 2305 0453
電子郵件
E-MAIL:
網 址
HOMEPAGE: http://www.epd.gov.hk/

Environmental Protection Department
Headquarters
28th Floor, Southorn Centre,
130 Hennessy Road,
Wan Chai, Hong Kong.

環境保護署總部
香港灣仔
軒尼詩道
一百三十號
修頓中心廿八樓

10 July 2003

Terraform-FGS Limited
Unit 6, 10/F, Worldwide Industrial Centre,
43-47 Shan Mei Street,
Fo Tan, Shatin, N.T., Hong Kong.
(Attn.: Mr. Ho Yuk Yuen / Mr. Jimmy Lam)

Dear Sirs,

TDD Contract No.: HK 13/02
Wan Chai Development Phase II – Field Trials of Geosynthetic Containers
Application for Marine Dumping Permit
(Disposal Trial of Category L Dredged Sediment in Geosynthetic Containers)

I refer to your recent application for a marine dumping permit related to the captioned project. Please find the enclosed Permit No. EP/MD/04-030 issued under the Dumping at Sea Ordinance.

Marine dumping is restricted to a location within the East Sha Chau Contaminated Mud Disposal Site and in a manner as indicated in Figure 1 of the Method Statement. Short dumping is a serious offence liable to prosecution. You shall proceed with the disposal operation in accordance with the method statement and the relevant sections in the Additional Conditions on Disposal Trial of Sediment contained in Geosynthetic Containers at East Sha Chau Contaminated Mud Disposal Pits which may be modified from time to time by the Authority.

Your attention is also drawn to the condition no. 9 of the Permit that all barges listed in Section 11 of the permit shall be equipped with the Automatic Self-Monitoring Device which should comply with the performance specifications as per Appendix I of the permit. In case that the installation of the device involves structural and electrical modifications which may affect the safety of the barge, you should seek the approval of the Marine Department. Moreover, the Automatic Self-Monitoring Device installed on the barges should be maintained functional at all times, and the device together with its stored records should not be tampered with. Please note that failure to comply with the aforementioned condition is an offence liable to prosecution and the barge concerned will be automatically removed from the Permit.

According to condition no. 3 of the Permit, you shall provide copies of the Permit for inspection by the Authority at the waste production site, waste loading site and on board all vessels of the dumping operation. Please be reminded that all the documentary materials attached in the Permit including appendix, annex, drawing and other materials as specified in the content of the permit forms a complete Permit. Therefore, your produced copy of the Permit should include all the materials of the Permit.

In accordance with the conditions of the Permit, you are obliged to submit to us both the weekly report(s) of daily dumping records (after the Resident Engineer's endorsement) and monthly report(s) on the quantity of dumped materials. All your submissions should reach us within the first week after the respective reporting periods. Please find the attached daily and monthly report forms (Form A and Form B) for your use.

...../2

I also attach herewith a form titled "Application for Additional Vessels to be Employed for Dumping Operation under Valid Dumping Permit" together with the "Personal Information Collection Statement". Please complete and submit the application form to us at least two working days in advance when you would like to employ the vessels other than those listed in Section 11 of the Permit to carry out the dumping operation.

Please note that under section 27 of the Dumping at Sea Ordinance, a person who is aggrieved by a decision or direction of the Authority, an authorized officer or a public officer under the provisions of section 10 (issue of a permit) of the Ordinance may appeal to the Appeal Board within 21 days after he receives the notice or the decision. Please consult the Ordinance for further details.

Thank you for your attention.

Yours faithfully,

(Vincent Y. P. Kwong)
Environmental Protection Officer
for Director of Environmental Protection

c.c. CIP Ops/Marine Police Region (with 2 copies of Permit)
Secretary/MFC, GEO, CED (Attn.: Mr. W.W.Ding) (with first page of the permit) – Fax no.: 27140072
Maunsell Consultants Asia Ltd. (Attn.: Ms. Carmen Au) w/o encl.
Territory Development Department. (Attn.: Mr. Stephen Hou / Mr. Kelvin Cheng) w/o encl.

Internal: S(WP)5 w/e

環境保護署
Environmental Protection Department

香港灣仔軒尼詩道 130 號
修頓中心 28 樓
廢物保護署
廢物及水質監理組
傳真:2305 0453

Environmental Protection Department
Waste and Water Management Group,
28/F., Southorn Centre, 130 Hennessy Road,
Wan Chai, Hong Kong
Fax no.: 2305 0453

表格 A - 沉積物每日傾倒報告
Form A - Daily Sediment Dumping Report

1. 合約名稱及編號 Contract Title & No. : _____

2. 海上傾倒許可證編號 Marine Dumping Permit No. : EP/MD/ -

3. 挖泥地點 Location of Dredging Site : _____

4. 傾倒地點 Dumping Ground : _____

5. 日期 Date : _____

6. 傾倒沉積物方法類別 Sediment Disposal Option * :

- ☐ 第一類 - 開放式海洋棄置 Type 1 – Open Sea Disposal
- ☐ 第一類 - 開放式海洋棄置 (指定地點) Type 1 – Open Sea Disposal (Dedicated Site)
- ☐ 第二類 - 密閉式海洋棄置 Type 2 – Confined Marine Disposal
- ☐ 第三類 - 特別棄置處理 Type 3 – Special Treatment Disposal
- ☐ 非污染沉積物 Uncontaminated Sediment
- ☐ 污染沉積物 Contaminated Sediment
- ☐ 其他 (請註明) Others (Pls. specify) _____

傾倒沉積物的船隻牌照號碼 Licence No. of Sediment Dumping Vessel	啓航時間 Departure Time	傾倒時間 Dumping Time	傾倒數量 (立方米) Dumped Quantity (m^3)

注意: 如無傾倒沉積物，仍須填報本表格 **Note: Nil return is required**

茲聲明就本人所知及相信，上述資料全部屬實，正確無誤。
I hereby certify that the particulars given above are correct and true to the best of my knowledge and belief.

承辦商監督人:
Contractor's Supervisor: _____

姓名 (正楷):
Name in Block Letters: _____

承辦商名稱:
Contractor's Name: _____

日期:
Date: _____

駐駐工地工程師查核:
Checked by Resident Engineer: _____

姓名 (正楷):
Name in Block Letters: _____

工程監督公司名稱:
Site Supervision Company's Name: _____

日期:
Date: _____

註: 上述資料不可作爲任何付款基礎
Note: The above information does not constitute any basis for payment purpose.

(* 請在適用處加 ✓ 。 Please ✓ as appropriate.)

環境保護署
Environmental Protection Department

香港灣仔軒尼詩道 130 號
修頓中心 28 樓
環境保護署
廢物及水質監理組
傳真:2305 0453

Environmental Protection Department
Waste and Water Management Group,
28/F., Southorn Centre, 130 Hennessy Road,
Wan Chai, Hong Kong
Fax no.: 2305 0453

表格 B - 沉積物每月傾倒報告
Form B - Monthly Sediment Dumping Report

1. 合約名稱及編號 Contract Title & No. : _____

2. 海上傾倒許可證編號 Marine Dumping Permit No. : EP/MD/ -

3. 挖泥地點 Location of Dredging Site : _____

4. 傾倒地點 Dumping ground: *

- ☐ 沙洲東 East of Sha Chau
- ☐ 長洲南 South of Cheung Chau
- ☐ 果洲群島東 East of Ninepin Group
- ☐ 東龍島東 East Tung Lung Chau
- ☐ 大嶼山北 North Lantau
- ☐ 火小磨刀北 North Brothers
- ☐ 青衣南 South Tsing Yi
- ☐ 其他 (請註明) Others (Pls. specify) _____

5. 傾倒沉積物方法類別 Sediment Disposal Option *

- ☐ 第一類 - 開放式海洋棄置 Type 1 – Open Sea Disposal
- ☐ 第一類 - 開放式海洋棄置 (指定地點) Type 1 – Open Sea Disposal (Dedicated Site)
- ☐ 第二類 - 密閉式海洋棄置 Type 2 – Confined Marine Disposal
- ☐ 第三類 - 特別棄置處理 Type 3 – Special Treatment Disposal
- ☐ 非污染沉積物 Uncontaminated Sediment
- ☐ 污染沉積物 Contaminated Sediment
- ☐ 其他 (請註明) Others (Pls. specify) _____

數量 Quantity:

月份 / 年份 Month / Year	傾倒數量 (立方米) Dumped Quantity (m^3)	累積傾倒數量 (立方米) Cumulative Dumped Quantity (m^3)

注意: 如無傾倒沉積物，仍須填報本表格 **Note: Nil return is required**

承辦商監督人:
Contractor's Supervisor: _____

公司印章:
Company Chop:

姓名 (正楷):
Name in Block Letters: _____

職位:
Post: _____

承辦商名稱:
Contractor's Name: _____

日期:
Date: _____

(* 請在適用處加 ✓ 。 Please ✓ as appropriate.)

環境保護署
Environmental Protection Department

海上傾倒物料條例
根據有效海上傾倒許可證申請增加僱用船隻以進行傾倒作業
DUMPING AT SEA ORDINANCE
APPLICATION FOR ADDITIONAL VESSELS TO BE EMPLOYED FOR DUMPING OPERATION UNDER VALID MARINE DUMPING PERMIT

A部: 申請人資料
PART A: DETAILS OF APPLICANT

1. 海上傾倒許可證編號 Marine Dumping Permit No. : EP/MD/ ___ - ___
2. 持證人姓名 Name of Permit Holder _____
3. 工程項目 Project _____
4. 聯絡人 Contact Person _____
5. 聯絡地址 Correspondence Address _____
6. 聯絡電話 Telephone No. _____ 傳真 Fax No.: _____

請在增加僱用船隻前，將已填妥的表格傳真至本署。待申請被批准後，本署將以傳真回覆申請人。本署傳真號碼: 2305 0453

Please send the completed form to EPD by fax no. 2305 0453 before the employment of additional vessels. If the application is approved, EPD will return the proforma to the applicant by fax.

B部: 增加僱用船隻的資料
PART B: DETAILS OF ADDITIONAL VESSELS TO BE EMPLOYED

Vessel Type 船隻類別	Vessel Licence No.船隻牌照號碼	Date of Employment 僱用日期

請注意船隻未持有由海事處所發出的有效牌照，將會自動從本許可證上除名。
Please note that vessels which do not have a valid marine licence will be automatically removed from the marine dumping permit.

C部: 聲明
PART C: DECLARATION

茲聲明就本人所知及相信，上述資料全部屬實，正確無誤。本人明白提供任何明知虛假或罔顧後果地作出虛假的資料以獲取此核准，該核准將被取消及本人可能被起訴。
I hereby certify that the particulars given above are correct and true to the best of my knowledge and belief. I understand that it is an offence to recklessly or knowingly provide false information for the purpose of procuring the grant of the approval, and this may lead to cancellation of such approval and may render me liable to prosecution.

簽署 Signature _____ 公司印鑑 Company Chop where appropriate _____ 日期 Date _____

姓名(正楷) Name in Block Letters _____ 職級 Capacity _____

D部: 核准 (只限本署使用)
PART D: APPROVAL BY THE AUTHORITY (For EPD Use Only) 參照號碼 Reference No.: EP/MD/ _____

監督在此核准以上增加僱用船隻連合於海上傾倒許可證編號 EP/MD/ _____ (許可證) 由 _____ 至 _____ / 該許可證期滿止*。此核准是許可證的部份，許可證持有人應放置此核准的副本連同許可證的副本於所有有關的船隻上以供環保署人員查核。當增加僱用船隻時，許可證持有人應遵守許可證內所有條款 及 附件I的附加條款*。許可證內規定的條款適用於已核准的增加船隻。
The Authority hereby approves the above additional vessel(s) to be employed in conjunction with marine dumping permit no. EP/MD/ _____ (the Permit) starting from _____ to _____ / until the expiry of the Permit*. This approval forms part of the Permit. The Permit Holder shall keep a copy of this approval together with a copy of the Permit on board all relevant vessel(s) for EPD's inspection. The Permit Holder shall comply with all the conditions of the Permit when he employs additional vessel(s). The conditions stipulated in the Permit and additional conditions in the attached Appendix I * are applicable to additional vessel(s) approved by the Authority.

本署蓋印 Signature with EPD chop : _____
姓名及職位 Name and Post : _____
日期及時間 Date and Time : _____
電話號碼 Telephone No. : _____

*將不適用者刪去 Delete where inappropriate
P:\DASO_FORM\Additional Vessels (Rev 01-2003).doc

序號 Series No.:

Personal Information Collection Statement

Purpose of Collection

1. The personal data provided by means of this form will be used by Environmental Protection Department for one or more of the following purposes:

   a. activities relating to the processing of your submission in this form;
   b. administration and enforcement of relevant environmental legislation;
   c. pollution complaint investigations;
   d. statistical and any other legitimate purposes; and
   e. to facilitate communications between Government and yourself.

2. The provision of personal data by means of this form is voluntary. If you do not provide sufficient information, we may not be able to process your application.

Classes of Transferees

3. The personal data you provided by means of this form:

   (i) may be disclosed to:

   a. other government bureaux and departments, and any other organisations for the purposes mentioned in paragraph 1 above, and
   b. other persons as permitted by the relevant legislation;

   (ii) and will be disclosed in a register open for inspection by the public for the purpose of making representations about control on the disposal of substances and articles at sea and the dumping of substances and articles in the sea and under the sea-bed, and for connected purposes.

Access to Personal Data

4. You have a right of access and correction with respect to personal data as provided for in section 18 and 22 and principle 6 of Schedule 1 of the Personal Data (Privacy) Ordinance. Your right of access includes the right to obtain a copy of your personal data provided by this form.

Enquiries

5. Enquiries concerning the personal data collected by means of this form, including the making of access and corrections, should be addressed to:

Senior Environmental Protection Officer (Management Support)
28/F, Southorn Centre
130 Hennessy Road
Wanchai
Hong Kong
Tel: 2835 1330
Fax: 2834 8845

個人資料收集聲明

收集個人資料的目的

1. 你在這份表格上提供的資料，環保署將用於下列一項或多項用途：
   a. 與處理本表格申請事項有關的工作；
   b. 有關環境法例的執行和檢法；
   c. 污染投訴調查；
   d. 統計及其他法定用途；以及
   e. 方便政府與你聯絡。

2. 是否在本表格上提供個人資料，純屬自願性質。如果你不提供足夠的資料，本署未必可以處理你的申請。

獲轉交個人資料人士的類別

3. 你在本表格上提供的個人資料，本署

   (i) 可向下列人士披露：

      a. 索取該等資料以作上文第 1 段用途的其他政府決策局及部門；以及
      b. 按有關法例規定的其他人士；

   (ii) 以及會在一登記冊上披露，公開給公眾查閱，以作對管制在海上棄置物質及物品，及將物質及物品傾倒入海及傾倒三海末下，以及就有關這事宜的申述。

查閱個人資料

4. 根據個人資料（私隱）條例第 18 條及第 22 條及附表 1 第 6 原則的規定，你有權查閱和更改個人資料。你查閱個人資料的權利，包括取得在這份表格上提供的個人資料副本。

查詢

5. 如欲查詢關本表格填報的個人資料，包括查閱和更改個人資料，可去信：
   香港高仔新尾詩道 130 號修頓中心 28 樓
   高級環境保護主任（管理支援）
   （電話：2835 1330
   傳真：2834 8845）

ENVIRONMENTAL PROTECTION DEPARTMENT
環境保護署

PERMIT ISSUED UNDER THE DUMPING AT SEA ORDINANCE
按照海上傾倒物料條例所發出的許可證

This permit issued by the Director of Environmental Protection (hereinafter referred to as the 'Authority') under the Dumping at Sea Ordinance authorizes the loading for dumping from Hong Kong and/or dumping in the sea of the material described in the sections below subject to due compliance and execution of the conditions overleaf.

本許可證是由環境保護署署長(以下簡稱「監督」)按照海上傾倒物料條例而發出。 許可證持有人若能適當遵守及執行背頁所載規條，可獲准在香港裝載下述物料上船以作傾倒，及/或將之傾入海中。

1. Permit number 許可證號碼： EP/MD/04-030	2. File reference 檔號： EP 62/D2/1/T13
3. Name and address of permit holder 許可證持有人的名稱及地址： Terraform-FGS Limited Unit 6, 10/F., Worldwide Ind. Ctr., 43-47 Shan Mei Street, Fo Tan, Shatin, N.T., Hong Kong (Attn: Mr. Ho Yuk Yuen / Mr. Jimmy Lam) (Tel. No.: 電話號碼 26971126 / 90203065)	4. Name and address of dumping operator 傾倒操作人的名稱及地址： Terraform-FGS Limited Unit 6, 10/F., Worldwide Ind. Ctr., 43-47 Shan Mei Street, Fo Tan, Shatin, N.T., Hong Kong (Attn: Mr. Ho Yuk Yuen / Mr. Jimmy Lam) (Tel. No.: 電話號碼 26971126 / 90203065)
5. Nature of material 物料的性質： Category L Dredged Sediment, and Polystyrene Spheres contained in 2 Geosynthetic Containers (Please see Condition Nos. 10 and 13 overleaf)	6. Contract no. & title (if any) TDD Contract No. HK13/02 工程合約編號及名稱(如有者)： Wan Chai Development Phase II - Field Trials of Geosynthetic Containers
7. Location where material is produced 物料的來源地點： CT9-Area A2 (Please see the attached Sketch No. SKETCH A)	8. Location where material is loaded 裝載物料的地點： Western Anchorage Area (or North Lamma Anchorage Area in case the Western Anchorage Area is not available) (Please see the Sketch No: ATTACHMENT C in the attached Method Statement)
9. Permit validity period 許可證有效期 3 month(s) 個月 From 由 14/07/2003 To 至 13/10/2003	10. Bulked quantity of material approved for dumping within permit validity period 許可證有效期內所批准傾倒物料的數量: 1,000 cu.m. 立方米 (以物料鬆散時體積計)

11. Vessels to be employed for dumping 用於傾倒作業的船隻

Motor tug: 機動拖船:	2084, 3114, 3454, 2954 and other vessels from time to time approved in writing by the Authority.
Hopper barge: 開底駁船:	21413V, 21414V, 22529Y and other vessels from time to time approved in writing by the Authority.
Others: 其他:	

12. The dumping operation shall only take place at: 傾倒作業只可在以下地點進行

An area within the East Sha Chau Contaminated Mud Disposal Site - Pit IVc. (沙洲東面)
(Please see the attached Sketch No. CV/2000/02-1 and the Drawing No. FIGURE 1 in the attached Method Statement)
(Please see Condition No. 10 overleaf)

Any accidental release of the materials carried on board the vessel due to mechanical failure of the vessel equipment or other unforeseen circumstances should be immediately notified to EPD at 28351287 during normal office hour, or pager no. 73070620 outside normal office hour.

(Vincent Y.P. Kwong)
for Director of Environmental Protection
Authority

監督 環境保護署署長
(鄺任平)

Date: *日期:* 10 JUL 2003

Original: Permit holder
正本：許可證持有人
1st copy: D of EP
第一副本分送：環境保護署署長
2nd & 3rd copies: Marine Police
第二及第三副本分送：水警

Conditions of Permit
許可證條件

1. This permit is issued subject to the information in Sections 3 to 11 overleaf. The Authority must be notified of any changes to the information and his written approval must be obtained before dumping continues.
本許可證是根據上頁第3至11項所載資料而發出。該等資料若有更改，許可證持有人須通知監督，並須先得到監督書面許可，然後方可繼續傾倒物料。

2. The Authority may vary, suspend or revoke this permit if it appears to the Authority that there has been a breach of the permit.
如監督覺得有人違反許可證的規定，可更改、暫時吊銷或撤銷本許可證。

3. The permit holder shall provide copies of this permit for inspection by the Authority at the waste production site, at the waste loading site and on board all vessels of the dumping operator. Dumping without a valid permit on board the vessel is an offence and is liable to prosecution.
許可證持有人須將本許可證的副本放在廢物產生地點、物料裝載地點及所有傾倒操作人的船隻上，以供監督查閱。若船隻上無有效許可證而進行傾倒物料，乃屬違法及會被檢控。

4. This permit does not remove the responsibility of the permit holder to comply with any legislation currently in force such as the Shipping and Port Control Ordinance (Cap. 313), the Dangerous Goods Ordinance (Cap. 295) and the Water Pollution Control Ordinance (Cap.358).
本許可證並沒有豁除許可證持有人免受現行法例，例如香港法例第313章船舶港口管理條例、香港法例第295章危險品條例及香港法例第358章水污染管制條例等的約束。

5. The permit holder shall permit and accompany the Authority to inspect all sites and vessels relating to the dumping operation at all reasonable times without prior notice.
許可證持有人得隨時在事先未獲通知的情況下，容許及陪同監督屬員，視察所有與傾倒物料作業有關的地點及船隻。

6. Only the vessels specified in Section 11 overleaf are allowed to carry out the dumping operation. The permit holder shall ensure that during the whole period of dumping operation, all the vessels listed in Section 11 overleaf are properly licensed to ply in the specified site for marine dumping. Vessels do not have a valid marine licence will be automatically removed from this permit.
只有列於上頁第11項所載的船隻方可獲准從事傾倒物料作業。許可證持有人須確保在傾倒物料工作進行的整段期間內，想已為所有列於上頁第11項所載的船隻領牌，以便往返指明的傾倒地點。船隻未持有由海事處所發出的有效牌照，將會自動從本許可證上除名。

7. The permit holder shall submit to the Authority a monthly report of the amount of material dumped at the specified site.
許可證持有人須按月向監督呈報於指明的地點傾倒物料的數量。

8. Dumping should be carried out only at the specified site as shown in Section 12 overleaf. Short dumping is an offence and is liable to prosecution.
傾倒物料只可在上頁第12項所指明的地點進行。若不在指定地點傾物入海，乃屬違法及會被檢控。

9. All barges listed in Section 11 overleaf shall be equipped with the automatic self-monitoring device which complies with the performance specification as per Appendix I. The device shall be maintained functional at all time, and the equipment together with its stored record shall not be tampered with. Failure to comply with this condition will be an offence liable to prosecution and the barge concerned will be automatically removed from this permit.
所有列於上頁第11項內的駁船必須安裝合乎附件(I)所載規格的自動監察儀器。該監察儀器必須全日保持在操作狀態，被監察儀器及其所記錄的資料不得受到破壞。如有違反本條件者，乃屬違法及會被檢控，而該駁船將會自動從本許可證上除名。

10. Only the material specified in Section 5 overleaf is allowed to be dumped at sea. The geosynthetic containers contained with mud and polystyrene spheres to be dumped in accordance with the Method Statement attached. The remnant Category L Dredged Sediment (portion remaining, if any, that is "uncontained" in geosynthetic containers) could also be dumped at sea under the guidance of the Management Team of the Civil Engineering Department at East Sha Chau.
只容許上頁第5項所指定的物料才准傾倒入海，其中裝載在geosynthetic containers內的沉積物及polystyrene球體，須根據夾附上棄置方案內的守則棄置。其餘殘餘的L類沉積物(於轉載過程中，未能完全裝載入Geosynthetic Containers內的L類沉積物)則須要按照土木工程署沙洲東污泥棄置場管理組的指示傾倒入海。

11. The source of the category L dredged sediment specified in section 5 overleaf is restricted to that specified in Section 7 overleaf.
上頁第5項所指定的L類沉積物來源限制在上頁第7項所指定的地點。

12. Any polystyrene spheres which are released to the sea during the dumping operation have to be collected. All other floatable materials which are released to the sea during the dumping operation have to be collected for proper disposal at landfills. Inspection vessels are required to be stationed in accordance with the Method Statement attached to collect any floatable materials after dumping.
在傾倒物料的過程，若有任何polystyrene球體釋放出海面，須將那些漂浮球體回收。而所有其他的漂浮物質，則須要收集及棄置於堆填區內。負責巡視的船隻須根據夾附上棄置方案內的守則，於指定地點留守觀察及收集傾倒物料後所產生的漂浮物質。

13. Other conditions:
其他：

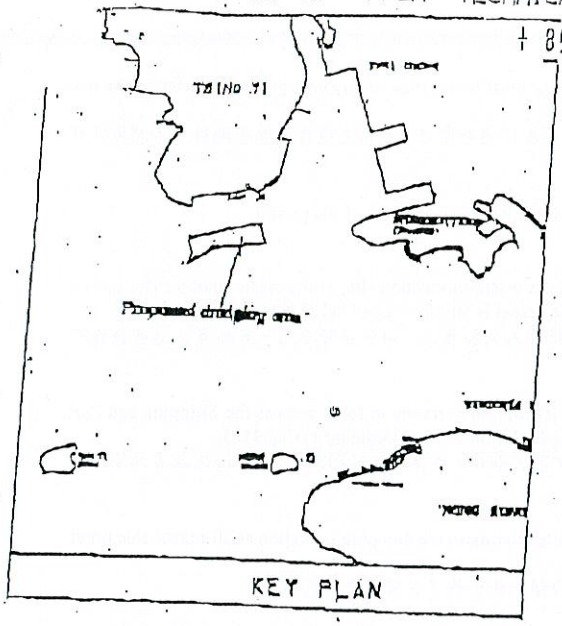
a. See the Additional Conditions on Disposal Trial of Sediment contained in Geosynthetic Containers at East Sha Chau Contaminated Mud Disposal Pits.
參閱東沙洲污泥棄置場試驗棄置裝載沉積物的附加條件。

b. The permit holder shall submit to the Authority a weekly report of daily dumping records.
許可證持有人須每週向監督呈交記錄列明每日傾倒物料的數量。

Note
注意

A person who dumps in contravention of the conditions of a permit is liable to prosecution under the Dumping at Sea Ordinance.
根據海上傾倒物料條例，任何人士若不遵照許可證的規定而傾倒物料，會被檢控。

SKETCH

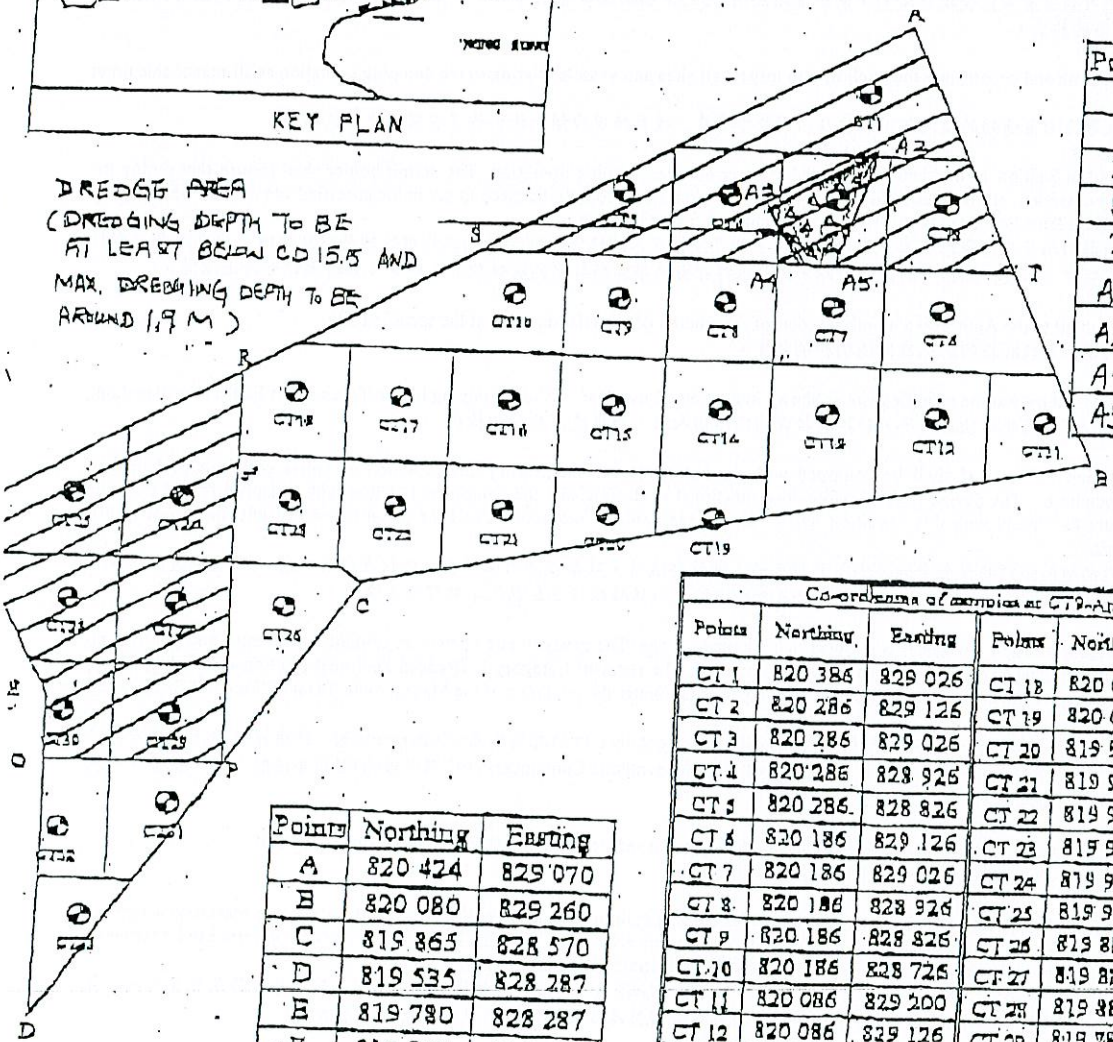


DREDGING AREA FOR FIELD TRIAL OF GEOSYNTHETIC CONTAINER (MAX. DREDGE VOLUME OF 3000 M³)

Sediments to be disposed at an type I disposal site

Sediments to be disposed of at type II disposal site

DREDGE AREA
(DREDGING DEPTH TO BE AT LEAST BELOW CD 15.5 AND MAX. DREDGING DEPTH TO BE AROUND 1.9 M)



Points	Northing	Easting
O	819 735	828 287
P	819 745	828 460
R	820 088	828 463
S	820 242	828 743
T	820 232	829 173
A2	820 322	829 040
A3	820 276	828 963
A4	820 236	828 985
A5	820 256	829 000

Points	Northing	Easting
A	820 424	829 070
B	820 080	829 260
C	819 865	828 570
D	819 535	828 287
E	819 780	828 287
F	819 939	828 198

Co-ordinates of corners at CT9-Area 2

Points	Northing	Easting	Points	Northing	Easting
CT 1	820 386	829 026	CT 18	820 086	828 526
CT 2	820 286	829 126	CT 19	820 000	828 926
CT 3	820 286	829 026	CT 20	819 986	828 826
CT 4	820 286	828 926	CT 21	819 986	828 726
CT 5	820 286	828 826	CT 22	819 986	828 626
CT 6	820 186	829 126	CT 23	819 986	828 526
CT 7	820 186	829 026	CT 24	819 986	828 426
CT 8	820 186	828 926	CT 25	819 986	828 326
CT 9	820 186	828 826	CT 26	819 886	828 526
CT 10	820 186	828 726	CT 27	819 886	828 426
CT 11	820 086	829 200	CT 28	819 886	828 326
CT 12	820 086	829 126	CT 29	819 786	828 426
CT 13	820 086	829 026	CT 30	819 786	828 326
CT 14	820 086	828 926	CT 31	819 686	828 400
CT 15	820 086	828 826	CT 32	819 686	828 326
CT 16	820 086	828 726	CT 33	819 586	828 326
CT 17	820 086	828 626			

Proposed Dredging Plan at CT9-Area 2

ENVIRONMENTAL PROTECTION DEPARTMENT (EPD)

Additional Conditions on Disposal Trial of Sediment contained in Geosynthetic Containers at East Sha Chau Contaminated Mud Disposal Pits

1. The permit holder shall not carry out any dumping without permission of the Management Team at East of Sha Chau or when the Management Team is not in operation.

2. The permit holder shall notify the Management Team in accordance with the attached "East Sha Chau Contaminated Mud Disposal Facility Site Management Scheme for Disposal Trail of Geosynthetic Containers".

3. The permit holder shall carry out the dumping operation in strict accordance with the attached method statement agreed by the Authority, any non-compliance with the agreed method shall be a breach of Conditions of Permit.

4. The permit holder shall design properly and maintain carefully all operational plant so as to minimize the risk of sediments or other pollutants being released into the water column and deposited in the seabed other than the specified site. The permit holder's work shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present in the water within the site.

5. The permit holder shall fit all barges and hopper dredgers with tight fitting seal to their bottom openings to prevent leakage of material.

6. The permit holder shall size all vessels such that adequate clearance is maintained between the seabed and vessels at all states of the tide, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash. Adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action.

7. The permit holder shall employ only barges equipped with the automatic self monitoring device for the dumping operation, and shall cooperate with and facilitate the Authority to inspect the device and retrieve the record stored in the device on a regular basis.

8. The permit holder shall provide experienced full time personnel on board all dumping vessels and provide suitable training to ensure that appropriate methods to minimise pollution are implemented. Records should be maintained to satisfy the Authority that there is no short dumping or dumping outside the specified site in Section 12 of the Permit. The permit holder shall also make available to the Authority and the Secretary of Marine Fill Committee (S/MFC), Civil Engineering Department, at any time upon the written request of the Authority, all information and records relevant to the dredging and disposal operation. This information shall include, but not be limited to, all data on the plant used by the permit holder, up-to-date periodic data on production rates and record copies of Notification of Dumping of Uncontaminated Mud at East Sha Chau which have been sent to the Management Team, etc.

9. The permit holder shall fully co-operate with Government officers to allow access to dredgers and other craft for the purpose of sampling dredged material and for the inspection of samples and other appropriate monitoring and control information.

10. The permit holder shall provide the Authority, the Management Team and the S/MFC a programme of the dredging and dumping operation through the Resident Engineer on a monthly basis. In addition, the permit holder shall provide the Authority and the S/MFC, within first week of each month, a monthly return of dumping records showing the number of barge loads and the quantity of sediment dumped at the disposal pit. A nil return shall be provided even if no dumping operation is carried out within that particular month unless the permit holder has informed the Authority of his completion of dumping operation.

11. The permit holder shall inform the Authority and the S/MFC by writing once the disposal trial dumping operation is completed.

12. The permit holder shall remove any substance which is found dumped outside the specified site by the permit holder or the disposal contractor.

環境保護署 (環保署)
東沙洲污泥棄置場試驗棄置袋裝沉積物的附加條件

1. 在未有東沙洲管理組人員在場或獲得管理組批准的情況下，許可證持有人不得進行傾倒作業。

2. 許可證持有人須依照夾附的由土木工程署填料管理部發出的「地盤管理方案之試驗棄置袋裝沉積物(Site Management Scheme for Disposal Trial of Geosynthetic Containers)」知會管理組。

3. 許可證持有人須嚴格依從經監督同意的夾附的沉積物棄置方案傾倒物料，若不符合經同意的方案便是違反許可證條件。

4. 許可證持有人須適當地設計及小心地保養所有運作機器以便減少沉積物或其他污染物溢流到水柱及積聚在指定地點以外的海床的危機。許可證持有人在指定地點內的水域不得造成任何可見的泡沫、油脂、垃圾或其他厭惡性物質。

5. 許可證持有人須密封駁船及扇斗挖泥船的船底開口，防止滲漏物料。

6. 許可證持有人須按船隻體積大小作出安排，以便在任何潮汐情況下，海床及船底之間維持足夠的距離，確保船隻航行或螺旋槳的拍打產生的湍流不會造成不適當的混濁情況。駁船上應保持足夠的乾舷，確保甲板不會被海浪沖濕。

7. 許可證持有人須使用裝有自動監察系統的駁船進行傾倒，並與監督合作，協助監督定期檢查設施及收取儲藏在系統內的紀錄。

8. 許可證持有人須提供有經驗的全職人員在所有傾倒物料船隻上工作，並提供適當的訓練以確保其會採取適當方法以減少污染。要保存紀錄以便讓監督確信在許可證第 12 項中訂明的指定地點外並無不在指定地點傾物入海。如監督在任何時間提出書面要求時，許可證持有人便須向監督及土木工程署海洋填料委員會秘書提供任何與挖掘及傾倒沉積物活動有關的資料及紀錄。這些資料包括，但不限於許可證持有人使用的設施的所有資料；關於生產率的最新時段數據；以及已交給管理組的傾倒未受污染沙泥通知書(Notification of Dumping of Uncontaminated Mud at East Sha Chau)紀錄副本等。

9. 許可證持有人須與特區政府人員全面合作，以便讓他們到達挖泥船及其他船隻，抽樣檢查挖出的物料，及取得樣本及查閱其他適當的監察及管制的資料。

10. 許可證持有人須每月透過駐工地工程師向監督、管理組及海洋填料委員會秘書呈交挖掘及傾倒物料的計劃。還有，許可證持有人要在每個月第一個星期內向監督及海洋填料委員會秘書呈交傾倒物料紀錄的每月傾倒報告，以顯示駁船載泥量及在棄置場傾倒沉積物數量。除非許可證持有人已告知監督已完成所有物料的傾倒的工序，否則即使在該特定的月份內並無進行傾倒也要呈交零數量的紀錄。

11. 許可證持有人須一旦完成傾倒棄置試驗的工序，即刻用書面告知監督及海洋填料委員會秘書。

12. 許可證持有人須清除在指定地點外任何由許可證持有人或傾倒物料承辦人傾倒的物料。

EAST SHA CHAU CONTAMINATED MUD DISPOSAL FACILITY
SITE MANAGEMENT SCHEME FOR DISPOSAL TRIAL OF GEOSYNTHETIC CONTAINERS

The Chief Geotechnical Engineer/Fill Management of the Civil Engineering Department administers the site management for capping to the contaminated mud disposal facility at East of Sha Chau. Users are required to comply with the following:

1. Notification of disposal - Before a vessel with uncontaminated sediment for capping purpose leaves the dredging site, the Resident Engineer shall notify the management team at East of Sha Chau by phone (6275 5230) with the following details

   (a) Disposal permit number
   (b) Tug number/name
   (c) Barge/trailer number/name
   (d) Quantity of uncontaminated sediment to be disposed of, and
   (e) Time leaving the dredging site and the anticipated arrival time/

   In addition, the above information shall be entered into the attached notification form. The form shall be duly signed by the staff of the supervising engineer and submitted to the Fill Management Division by fax (2714 0072) in weekly interval.

2. Reporting to the management team - On arrival, the tug/barge operator shall first contact the management team and wait for a guide boat before commencing any disposal operation.

3. Disposal - After receipt of permission from the management team to proceed with disposal, the tug/barge operator shall manoeuvre the vessel to the disposal location as specified in the agreed trial disposal proposal. The tug/barge operator shall then request the management team to check the barge location. Disposal shall proceed when the barge location is considered acceptable by the management team.

4. Vessels arriving without permit - Vessels without valid disposal permit will not be allowed to dispose and will be advised to leave the pit area after recording the relevant details.

5. Illegal disposal - If any vessel is found to disobey instructions and proceed with illegal disposal, its details will be recorded. Environmental Protection Department, Marine Police or Marine Department will take actions as appropriate.

6. Leaving the pit - After discharging, the tug/barge shall sail slowly away from the disposal site until leaving the pit.

7. Closure of pit - The disposal area will be closed during Lunar New Year Holidays, during the hoisting of Typhoon Signal No. 3 or higher or in an adverse weather or other conditions when the management team considers that its duties cannot be discharged safely and properly. There is no guarantee that prior notice will be given. Any vessels arriving when the pit is closed will be advised to leave the disposal area immediately.

8. Checking of permitted and allocated volume - The Consultant shall keep a running tally of the volume disposed of under both the permit and the allocation. If either the permitted or allocated volume is reached, he shall notify the management team and also stop sending vessels to the disposal ground.

9. For safety reasons, all tugs and barges shall turn on their lights while working in the vicinity of the mud pits at night or when visibility is poor.

Fill Management Division
Civil Engineering Department
April 2003

Notification of Dumping of Uncontaminated Mud at East Sha Chau

From:

To:

Management Team/East Sha Chau

Contract No. : _____

Contract Title : _____

_____

Telephone No. : _____ Fax No. : _____

EPD Dumping Licence No. (Allocation Volume m^3)	Dredging Location	Tug Name/No.	Hopper Barge Name/No.	Quantity (m^3)	Time leaving dredging site	Accumulated Quantity (m^3)	Anticipated arrival time at East Sha Chau

Note: The quantity entered should have allowed for bulking after dredging.

Official Use

Arrival date/time; _____

Remarks: _____

_____

Signature of Resident Engineer's Staff: _____

Name of Resident Engineer's Staff: _____

Date/Time: _____

OUR REF.: (YY) in EP/MD/03-154
+ 852 2305 0453 Headquarters
28th Floor, Southorn Centre,
130 Hennessy Road
Wan Chai, Hong Kong
香港灣仔
軒尼詩道
一百三十號
修頓中心廿八樓
YOUR REF.: H02 0328 05-3.1.2.8/L196/YY/cw
來函檔號
TEL NO.: 2835 1189
傳真
FAX NO.: 2305 0453
電子郵件
E-MAIL:
HOMEPAGE: http://www.info.gov.hk/epd/

06 May 2003

Terraform-FGS Limited
Unit 6, 10/F, Worldwide Industrial Centre,
43-47 Shan Mei Street,
Fo Tan, Shatin, N.T., Hong Kong.
(Attn.: Mr. Ho Yuk Yuen / Mr. Jimmy Lam)

Dear Sirs,

TDD Contract No.: HK 13/02
Wan Chai Development Phase II – Field Trials of ~~Geosynthetic Containers~~
Application for Marine Dumping Permit
(Disposal Trial of Category L Dredged Sediment in Geosynthetic Containers)

I refer to your recent application for a marine dumping permit related to the captioned project. Please find the enclosed Permit No. EP/MD/03-154 issued under the Dumping at Sea Ordinance.

Marine dumping is restricted to a location within the East Sha Chau Contaminated Mud Disposal Site and in a manner as indicated in Figure 1 of the Method Statement. Short dumping is a serious offence liable to prosecution. You shall proceed with the disposal operation in accordance with the method statement and the relevant sections in the Additional Conditions on Disposal Trial of Sediment contained in Geosynthetic Containers at East Sha Chau Contaminated Mud Disposal Pits which may be modified from time to time by the Authority.

Your attention is also drawn to the condition no. 9 of the Permit that all barges listed in Section 11 of the permit shall be equipped with the Automatic Self-Monitoring Device which should comply with the performance specifications as per Appendix I of the permit. In case that the installation of the device involves structural and electrical modifications which may affect the safety of the barge, you should seek the approval of the Marine Department. Moreover, the Automatic Self-Monitoring Device installed on the barges should be maintained functional at all times, and the device together with its stored records should not be tampered with. Please note that failure to comply with the aforementioned condition is an offence liable to prosecution and the barge concerned will be automatically removed from the Permit.

According to condition no. 3 of the Permit, you shall provide copies of the Permit for inspection by the Authority at the waste production site, waste loading site and on board all vessels of the dumping operation. Please be reminded that all the documentary materials attached in the Permit including appendix, annex, drawing and other materials as specified in the content of the permit forms a complete Permit. Therefore, your produced **copy of the Permit should include all the materials of the Permit.**

In accordance with the conditions of the Permit, you are obliged to submit to us both the weekly report(s) of daily dumping records (after the Resident Engineer's endorsement) and monthly report(s) on the quantity of dumped materials. All your submissions should reach us within the first week after the respective reporting periods. Please find the attached daily and monthly report forms (Form A and Form B) for your use.

...../2

I also attach herewith a form titled "Application for Additional Vessels to be Employed for Dumping Operation under Valid Dumping Permit" together with the "Personal Information Collection Statement". Please complete and submit the application form to us at least two working days in advance when you would like to employ the vessels other than those listed in Section 11 of the Permit to carry out the dumping operation.

Please note that under section 27 of the Dumping at Sea Ordinance, a person who is aggrieved by a decision or direction of the Authority, an authorized officer or a public officer under the provisions of section 10 (issue of a permit) of the Ordinance may appeal to the Appeal Board within 21 days after he receives the notice or the decision. Please consult the Ordinance for further details.

Thank you for your attention.

Yours faithfully,

(Vincent Y. P. Kwong)
Environmental Protection Officer
for Director of Environmental Protection

c.c. CIP Ops/Marine Police Region (with 2 copies of Permit)
Secretary/MFC, GEO, CED (Attn.: Mr. W.W.Ding) (with first page of the permit) – Fax no.: 27140072
Maunsell Consultants Asia Ltd. (Attn.: Ms. Carmen Au) w/o encl. Fax 2691 2649
Territory Development Department. (Attn.: Mr. Stephen Hou / Mr. Kelvin Cheng) w/o encl. Fax 2777 5011

Internal: S(WP)5 w/e

ENVIRONMENTAL PROTECTION DEPARTMENT
環 境 保 護 署

PERMIT ISSUED UNDER THE DUMPING AT SEA ORDINANCE
按照海上傾倒物料條例所發出的許可證

This permit issued by the Director of Environmental Protection (hereinafter referred to as the 'Authority') under the Dumping at Sea Ordinance authorizes the loading for dumping from Hong Kong and/or dumping in the sea of the material described in the sections below subject to due compliance and execution of the conditions overleaf.

本許可證是由環境保護署署長(以下簡稱「監督」)按照海上傾倒物料條例而發出。 許可證持有人若能適當遵守及執行背頁所載規條，可獲准在香港裝載下述物料上船以作傾倒，及/或將之傾入海中。

1. Permit number 許可證號碼 : EP/MD/03-154	2. File reference 檔號 : EP 62/D2/1/T13
3. Name and address of permit holder 許可證持有人的名稱及地址 : Terraform-FGS Limited Unit 6, 10/F., Worldwide Ind. Ctr., 43-47 Shan Mei Street, Fo Tan, Shatin, N.T., H.K. (Attn: Mr. Ho Yuk Yuen / Mr. Jimmy Lam) (Tel. No.: 電話號碼 26971126 / 90203065)	4. Name and address of dumping operator 傾倒操作人的名稱及地址 : Terraform-FGS Limited Unit 6, 10/F., Worldwide Ind. Ctr., 43-47 Shan Mei Street, Fo Tan, Shatin, N.T., H.K. (Attn: Mr. Ho Yuk Yuen / Mr. Jimmy Lam) (Tel. No.: 電話號碼 26971126 / 90203065)
5. Nature of material 物料的性質 : Category L Dredged Sediment, and Polystyrene Spheres contained in 4 Geosynthetic Containers (Please see Condition Nos. 10 and 13 overleaf)	6. Contract no. & title (if any) TDD Contract No. HK13/02 工程合約編號及名稱(如有者) : Wan Chai Development Phase II - Field Trials of Geosynthetic Containers
7. Location where material is produced 物料的來源地點 : CT9-Area A2 (Please see the attached Sketch No. SKETCH A)	8. Location where material is loaded 裝載物料的地點 : Western Anchorage Area (or North Lamma Anchorage Area in case the Western Anchorage Area is not available) (Please see the Sketch No: ATTACHMENT C in the attached Method Statement)
9. Permit validity period 許可證有效期 3 month(s) 個月 From 由 06/05/2003 To 至 05/08/2003	10. Bulked quantity of sediment approved for dumping within permit validity period 3,900 cu.m. (Please see Condition Nos. 10 and 13 overleaf) 許可證有效期內所批准傾倒物料的數量: 立方米 (以物料鬆散時體積計)
11. Vessels to be employed for dumping 用於傾倒作業的船隻 Motor tug: 機動拖船: 2614, 2654 and other vessels from time to time approved in writing by the Authority. Hopper barge: 開底駁船: 21413V, 21414V, 22529Y and other vessels from time to time approved in writing by the Authority. Others: 其他:	
12. The dumping operation shall only take place at: 傾倒作業只可在以下地點進行	An area within the East Sha Chau Contaminated Mud Disposal Site - Pit IVc. (Please see the attached Sketch No. CV/2000/02-1 and the Drawing No. FIGURE 1 in the attached Method Statement) (沙洲東面) (Please see Condition No. 10 overleaf)

(CHEUNG Wai-cheong)
for Director of Environmental Protection
Authority

監督 環境保護署署長
(張偉 代)

Date:
日期: - 6 MAY 2003

ENVIRONMENTAL PROTECTION DEPARTMENT 環境保護署 HONG KONG

Original: Permit holder
正本 : 許可證持有人
1st copy: D of EP
第一副本分送 : 環境保護署署長
2nd & 3rd copies: Marine Police
第二及第三副本分送 : 水警

Any accidental release of the materials carried on board the vessel due to mechanical failure of the vessel equipment or other unforeseen circumstances should be immediately notified to EPD at 28351287 during normal office hour, or pager no. 73070630 outside normal office hour.

Conditions of Permit
許可證條件

1. This permit is issued subject to the information in Sections 3 to 11 overleaf. The Authority must be notified of any changes to the information and his written approval must be obtained before dumping continues.
本許可證簽發根據上頁第3至11項所載資料而簽發。該等資料若有更改，許可證持有人須通知監督，並須先徵得監督書面許可，然後方可繼續傾倒物料。

2. The Authority may vary, suspend or revoke this permit if it appears to the Authority that there has been a breach of the permit.
如監督覺得有人違反許可證的規定，可更改、暫時吊銷或撤銷本許可證。

3. The permit holder shall provide copies of this permit for inspection by the Authority at the waste production site, at the waste loading site and on board all vessels of the dumping operator. Dumping without a valid permit on board the vessel is an offence and is liable to prosecution.
許可證持有人須將本許可證的副本放在廢物產生地點、物料裝載地點及所有傾倒操作人的船隻上，以供監督查閱。若船隻上無有效許可證而進行傾倒物料，乃屬違法及會被檢控。

4. This permit does not remove the responsibility of the permit holder to comply with any legislation currently in force such as the Shipping and Port Control Ordinance (Cap. 313), the Dangerous Goods Ordinance (Cap. 295) and the Water Pollution Control Ordinance (Cap.358).
本許可證並沒有豁除許可證持有人免受現行法例，例如香港法例第313章船舶港口管理條例、香港法例第295章危險品條例及香港法例第358章水污染管制條例等的約束。

5. The permit holder shall permit and accompany the Authority to inspect all sites and vessels relating to the dumping operation at all reasonable times without prior notice.
許可證持有人得隨時在事先未獲通知的情況下，容許及陪同監督屬員，視察所有與傾倒物料作業有關的地點及船隻。

6. Only the vessels specified in Section 11 overleaf are allowed to carry out the dumping operation. The permit holder shall ensure that during the whole period of dumping operation, all the vessels listed in Section 11 overleaf are properly licensed to ply in the specified site for marine dumping. Vessels do not have a valid marine licence will be automatically removed from this permit.
只有列於上頁第11項所載的船隻方可獲准從事傾倒物料作業。許可證持有人須確保在傾倒物料工作進行的整段期間內，經已為所有列於上頁第11項所載的船隻領牌，以便往返指明的傾倒地點。船隻未持有由海事處所發出的有效牌照，將會自動從本許可證上除名。

7. The permit holder shall submit to the Authority a monthly report of the amount of material dumped at the specified site.
許可證持有人須按月向監督呈報於指明的地點傾倒物料的數量。

8. Dumping should be carried out only at the specified site as shown in Section 12 overleaf. Short dumping is an offence and is liable to prosecution.
傾倒物料只可在上頁第12項所指明的地點進行。若不在指定地點傾物入海，乃屬違法及會被檢控。

9. All barges listed in Section 11 overleaf shall be equipped with the automatic self-monitoring device which complies with the performance specification as per Appendix I. The device shall be maintained functional at all time, and the equipment together with its stored record shall not be tampered with. Failure to comply with this condition will be an offence liable to prosecution and the barge concerned will be automatically removed from this permit.
所有列於上頁第11項內的駁船必須安裝合乎附件(I)所載規格的自動監察儀器。該監察儀器必須全日保持在操作狀態，該監察儀器及其所記錄的資料不得受到破壞。如有違反本條件者，乃屬違法及會被檢控，而該駁船將會自動從本許可證上除名。

10. Only the material specified in Section 5 overleaf is allowed to be dumped at sea. The geosynthetic containers contained with mud and polystyrene spheres to be dumped in accordance with the Method Statement attached. The remnant Category L Dredged Sediment (portion remaining, if any, that is "uncontained" in geosynthetic containers) could also be dumped at sea under the guidance of the Management Team of the Civil Engineering Department at East Sha Chau.
只容許上頁第5項所指定的物料才准傾倒入海。其中裝載在geosynthetic containers內的沉積物及polystyrene球體，須根據夾附上棄置方案內的守則棄置。其餘殘餘的L類沉積物(於轉載過程中，未能完全裝載入Geosynthetic Containers內的L類沉積物)則須要按照土木工程署沙洲東污泥棄置場管理組的指示傾倒入海。

11. The source of the category L dredged sediment specified in section 5 overleaf is restricted to that specified in Section 7 overleaf.
上頁第5項所指定的L類沉積物來源限制在上頁第7項所指定的地點。

12. Any polystyrene spheres which are released to the sea during the dumping operation have to be collected. All other floatable materials which are released to the sea during the dumping operation have to be collected for proper disposal at landfills. Inspection vessels are required to be stationed in accordance with the Method Statement attached to collect any floatable materials after dumping.
在傾倒物料的過程，若有任何polystyrene球體釋放出海面，須將那些漂浮球體回收。而所有其他的漂浮物質，則須要收集及棄置於堆填區內。負責巡視的船隻須根據夾附上棄置方案內的守則，於指定地點留守觀察及收集傾倒物料後所產生的漂浮物質。

13. Other conditions:
其他：

a. See the Additional Conditions on Disposal Trial of Sediment contained in Geosynthetic Containers at East Sha Chau Contaminated Mud Disposal Pits.
參閱東沙洲污泥棄置場試驗棄置袋裝沉積物的附加條件。

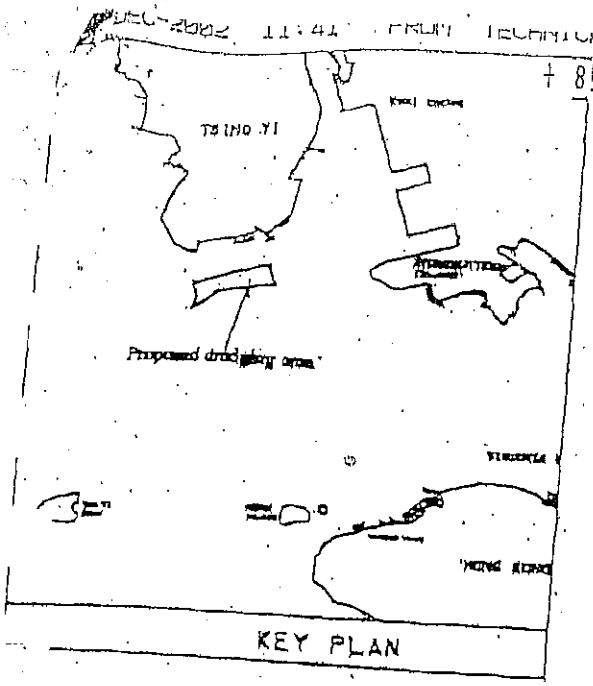
b. The permit holder shall submit to the Authority a weekly report of daily dumping records.
許可證持有人須每週向監督呈交記錄列明每日傾倒物料的數量。

Note
注 意

A person who dumps in contravention of the conditions of a permit is liable to prosecution under the Dumping at Sea Ordinance.
根據海上傾倒物料條例，任何人士若不遵照許可證的規定而傾倒物料，會被檢控。

+ 852 2760 5702

SKETCH "A"

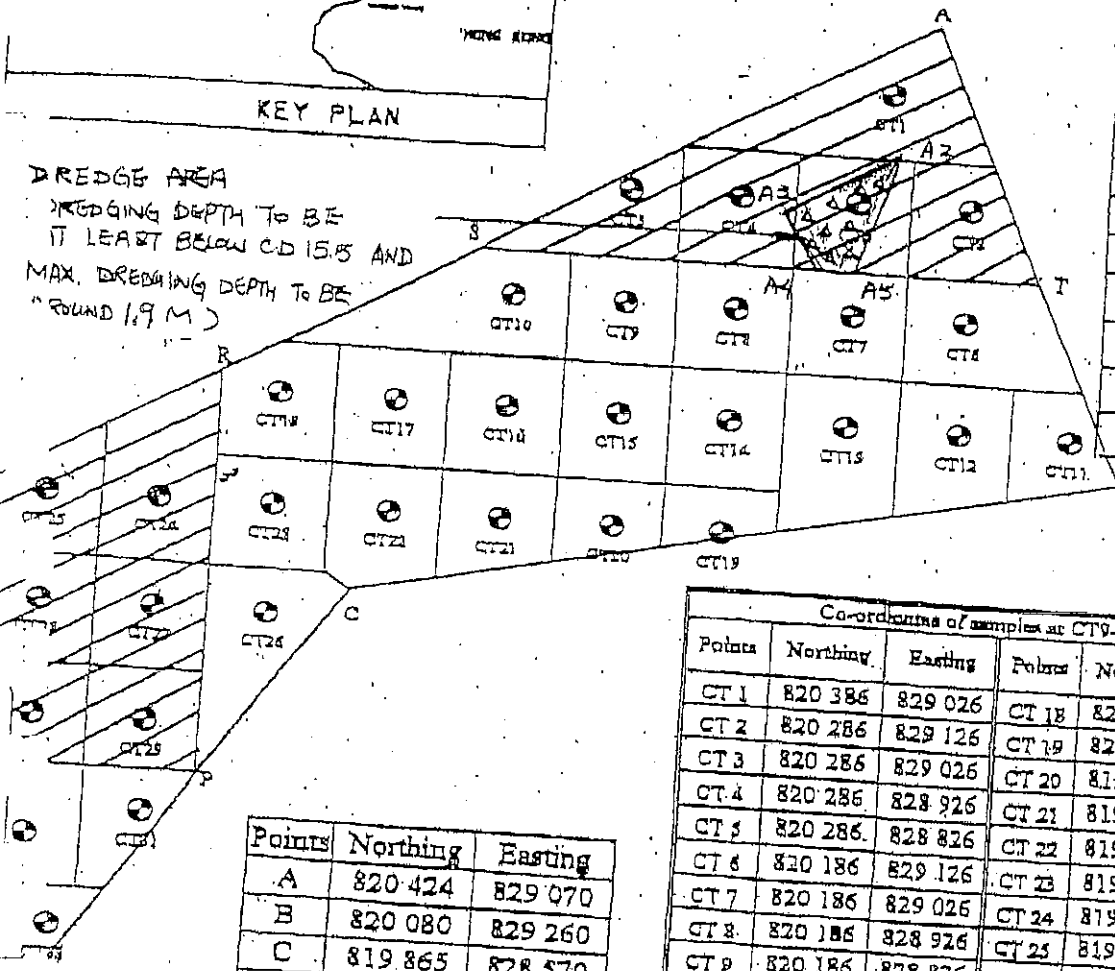


DREDGING AREA FOR FIELD TRIAL OF GEOSYNTHETIC CONTAINER (MAX. DREDGE VOLUME OF 3000 M³)

Sediments to be disposed of at type I disposal site

Sediments to be disposed of at type II disposal site

DREDGE AREA
DREDGING DEPTH TO BE AT LEAST BELOW CD 15.5 AND MAX. DREDGING DEPTH TO BE ROUND 1.9 M)



Points	Northing	Easting
O	819 735	828 287
P	819 745	828 460
R	820 088	828 463
S	820 242	828 743
T	820 232	829 173
A2	820 322	829 040
A3	820 276	828 963
A4	820 236	828 985
A5	820 236	829 000

Points	Northing	Easting
A	820 424	829 070
B	820 080	829 260
C	819 865	828 570
D	819 535	828 287
E	819 780	828 287
F	819 939	828 198

Co-ordinates of samples at CT9-Area 2

Points	Northing	Easting	Points	Northing	Easting
CT 1	820 386	829 026	CT 18	820 086	828 526
CT 2	820 286	829 126	CT 19	820 000	828 926
CT 3	820 286	829 026	CT 20	819 986	828 826
CT 4	820 286	828 926	CT 21	819 986	828 726
CT 5	820 286	828 826	CT 22	819 986	828 626
CT 6	820 186	829 126	CT 23	819 986	828 526
CT 7	820 186	829 026	CT 24	819 986	828 426
CT 8	820 186	828 926	CT 25	819 986	828 326
CT 9	820 186	828 826	CT 26	819 886	828 526
CT 10	820 186	828 726	CT 27	819 886	828 426
CT 11	820 086	829 200	CT 28	819 886	828 326
CT 12	820 086	829 126	CT 29	819 786	828 426
CT 13	820 086	829 026	CT 30	819 786	828 326
CT 14	820 086	828 926	CT 31	819 686	828 400
CT 15	820 086	828 826	CT 32	819 686	828 326
CT 16	820 086	828 726	CT 33	819 586	828 326
CT 17	820 086	828 626			

Proposed Dredging Plan at CT9-Area 2

環境保護署 (環保署)
東沙洲污泥棄置場試驗棄置袋裝 沉積物的附加條件

1. 在未有東沙洲管理組人員在場或獲得管理組批准的情況下，許可證持有人不得進行傾倒作業。

2. 許可證持有人須依照夾附的由土木工程署填料管理部發出的 「地盤管理方案之試驗棄置袋裝沉積物(Site Management Scheme for Disposal Trial of Geosynthetic Containers)」 知會管理組。

3. 許可證持有人須嚴格依從經監督同意的夾附的沉積物棄置方案傾倒物料，若不符合經同意的方案便是違反許可證條件。

4. 許可證持有人須適當地設計及小心地保養所有運作機器以便減少沉積物或其他污染物溢流到水柱及積聚在指定地點以外的海床的危機。許可證持有人在指定地點內的水域不得造成任何可見的泡沫、油脂、垃圾或其他厭惡性物質。

5. 許可證持有人須密封駁船及扇斗挖泥船的船底開口，防止滲漏物料。

6. 許可證持有人須按船隻體積大小作出安排，以便在任何潮汐情況下，海床及船底之間維持足夠的距離，確保船隻航行或螺旋槳的拍打產生的湍流不會造成不適當的混濁情況。駁船上應保持足夠的乾舷，確保甲板不會被海浪沖濕。

7. 許可證持有人須使用裝有自動監察系統的駁船進行傾倒，並與監督合作，協助監督定期檢查設施及收取儲藏在系統內的紀錄。

8. 許可證持有人須提供有經驗的全職人員在所有傾倒物料船隻上工作，並提供適當的訓練以確保其會採取適當方法以減少污染。要保存紀錄以便讓監督確信在許可證第 12 項中訂明的指定地點外並無不在指定地點傾物入海。如監督在任何時間提出書面要求時，許可證持有人便須向監督及土木工程署海洋填料委員會秘書提供任何與挖掘及傾倒沉積物活動有關的資料及紀錄。這些資料包括，但不限於許可證持有人使用的設施的所有資料；關於生產率的最新時段數據；以及已交給管理組的傾倒未受污染沙泥通知書(Notification of Dumping of Uncontaminated Mud at East Sha Chau)紀錄副本等。

9. 許可證持有人須與特區政府人員全面合作，以便讓他們到達挖泥船及其他船隻，抽樣檢查挖出的物料，及取得樣本及查閱其他適當的監察及管制的資料。

10. 許可證持有人須每月透過駐工地工程師向監督、管理組及海洋填料委員會秘書呈交挖掘及傾倒物料的計劃。還有，許可證持有人要在每個月第一個星期內向監督及海洋填料委員會秘書呈交傾倒物料紀錄的每月傾倒報告，以顯示駁船載泥量及在棄置場傾倒沉積物數量。除非許可證持有人已告知監督已完成所有物料的傾倒的工序，否則即使在該特定的月份內並無進行傾倒也要呈交零數量的紀錄。

11. 許可證持有人須一旦完成傾倒棄置試驗的工序，即刻用書面告知監督及海洋填料委員會秘書。

12. 許可證持有人須清除在指定地點外任何由許可證持有人或傾倒物料承辦人傾倒的物料。

EAST SHA CHAU CONTAMINATED MUD DISPOSAL FACILITY
SITE MANAGEMENT SCHEME FOR DISPOSAL TRIAL OF GEOSYNTHETIC CONTAINERS

The Chief Geotechnical Engineer/Fill Management of the Civil Engineering Department administers the site management for capping to the contaminated mud disposal facility at East of Sha Chau. Users are required to comply with the following:

1. Notification of disposal - Before a vessel with uncontaminated sediment for capping purpose leaves the dredging site, the Resident Engineer shall notify the management team at East of Sha Chau by phone (6275 5230) with the following details

   (a) Disposal permit number
   (b) Tug number/name
   (c) Barge/trailer number/name
   (d) Quantity of uncontaminated sediment to be disposed of, and
   (e) Time leaving the dredging site and the anticipated arrival time/

   In addition, the above information shall be entered into the attached notification form. The form shall be duly signed by the staff of the supervising engineer and submitted to the Fill Management Division by fax (2714 0072) in weekly interval.

2. Reporting to the management team - On arrival, the tug/barge operator shall first contact the management team and wait for a guide boat before commencing any disposal operation.

3. Disposal - After receipt of permission from the management team to proceed with disposal, the tug/barge operator shall manoeuvre the vessel to the disposal location as specified in the agreed trial disposal proposal. The tug/barge operator shall then request the management team to check the barge location. Disposal shall proceed when the barge location is considered acceptable by the management team.

4. Vessels arriving without permit - Vessels without valid disposal permit will not be allowed to dispose and will be advised to leave the pit area after recording the relevant details.

5. Illegal disposal - If any vessel is found to disobey instructions and proceed with illegal disposal, its details will be recorded. Environmental Protection Department, Marine Police or Marine Department will take actions as appropriate.

6. Leaving the pit - After discharging, the tug/barge shall sail slowly away from the disposal site until leaving the pit.

7. Closure of pit - The disposal area will be closed during Lunar New Year Holidays, during the hoisting of Typhoon Signal No. 3 or higher or in an adverse weather or other conditions when the management team considers that its duties cannot be discharged safely and properly. There is no guarantee that prior notice will be given. Any vessels arriving when the pit is closed will be advised to leave the disposal area immediately.

Checking of permitted and allocated volume - The Consultant shall keep a running tally of the volume disposed of under both the permit and the allocation. If either the permitted or allocated volume is reached, he shall notify the management team and also stop sending vessels to the disposal ground.

For safety reasons, all tugs and barges shall turn on their lights while working in the vicinity of the mud pits at night or when visibility is poor.

Management Division
vil Engineering Department
2003

Notification of Dumping of Uncontaminated Mud at East Sha Chau

From:

To:

Management Team/East Sha Chau

Contract No. : _____

Contract Title : _____

_____

Telephone No. : _____ Fax No. : _____

EPD Dumping Licence No. (Allocation Volume m^3)	Dredging Location	Tug Name/No.	Hopper Barge Name/No.	Quantity (m^3)	Time leaving dredging site	Accumulated Quantity (m^3)	Anticipated arrival time at East Sha Chau

Note: The quantity entered should have allowed for bulking after dredging.

Official Use

Arrival date/time; _____

Remarks: _____

_____

Signature of Resident Engineer's Staff: _____

Name of Resident Engineer's Staff: _____

Date/Time: _____