Agreement No. CE 21/2012 (WS)

Desalination Plant at Tseung Kwan O - Feasibility Study

Construction and Demolition
Material Management Plan

8901/B&V/0021 Issue 3

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1 PROJECT OVERVIEW

1.1 Background

1.1.1 WSD has promulgated the Total Water Management (TWM) strategy in Year 2008 with emphasis on "save first and then increase". For the water supply, alternative resource of water supply is necessary to be identified to cater for unpredictable climate change such as dramatic change in rainfall.

1.1.2 Water Supplies Department (WSD) conducted a feasibility study and a pilot plant study on the development of desalination facilities in Hong Kong in 2002 and 2007 respectively. The studies confirmed the technical feasibility of desalination using reverse osmosis under local conditions to produce potable water complying with the World Health Organization (WHO) standards.

1.1.3 The proposed desalination plant in Tseung Kwan O (TKO), with a water production capacity of 135 million litres per day (MLD) expandable to 270 MLD is a pioneer fresh water production plant. It will provide a new water resource for Hong Kong daily consumption (about 5% to 10% of the total fresh water supply). It will also allow WSD to acquire practical experience and skills in the application of advanced water treatment technology such as reverse osmosis being practised in other parts of the world.

1.1.4 Black & Veatch Hong Kong Limited (B&V) was commissioned by WSD in December 2012 to study the feasibility and cost effectiveness of constructing a seawater reverse osmosis (SWRO) desalination plant at TKO Area 137, together with associated fresh water transfer facilities to the existing Tseung Kwan O Primary Fresh Water Service Reservoir (TKOPFWSR).

1.2 Project Description

1.2.1 The proposed site for the desalination plant is located in TKO Area 137 with a reserved site area of about 10 hectares. TKO Area 137 is located to the south of the Southeast New Territories (SENT) Landfill and the Tseung Kwan O Industrial Estate. It faces the Clearwater Bay Country Park to its east, the Joss House Bay to its south, and the Tathong Channel to its west.

1.2.2 The site is located within reclaimed land that was reclaimed between 1998 and 2000. According to the Tseung Kwan O Outline Zoning Plan (OZP) S/TKO/20, the TKO Area 137 is zoned as "Other Specified Use" (Deep Waterfront Industry) which is intended for special industries which require marine access, access to deep water berths, or water frontage.

1.2.3 No major permanent infrastructure is within or around the proposed site. Currently, three major facilities are located in the vicinity of the site. They include a temporary public fill bank, a temporary explosive magazine, and an explosive off-loading barging pier.

1.2.4 The scope of this Assignment comprises the following principal elements:

a. Construction of a desalination plant at TKO Area 137 with the initial capacity of 135 MLD and expandable to 270 MLD in the future. The plant comprises the following key elements:

- Seawater intake and outfall system
- Pre-treatment system

- Reverse Osmosis (RO) membrane treatment system
- Post-treatment system
- Backwash and chemical cleaning system
- Sludge handling system
- Concentrate discharge system
- Auxiliary systems

b. Construction of a dedicated trunk feed system from desalination plant to existing TKOFWPSR. The dedicated trunk feed system will supply potable water from the desalination plant to TKOFWPSR through a diameter 1200mm delivery pipe of about 9.2 km long.

c. Construction of all the associated civil, structural, geotechnical, electrical, mechanical, and other necessary works.

1.2.5 The location of the site boundary and its associated features are shown in **Appendix A**.

1.3 Purpose and Scope of C&D Material Management Plan

1.3.1 In accordance with Clause 6.25 of the Brief of Agreement, a Construction and Demolition Material Management Plan (C&DMMP) is required to be prepared for WSD agreement, CEDD Vetting Committee's endorsement, and Public Fill Committee's (PFC) approval.

1.3.2 The C&DMMP shall include the disposal arrangement for marine mud from the dredging works, for which agreement from Marine Fill Committee of CEDD has to be sought.

1.3.3 The C&DMMP has been prepared in accordance with the guidelines and requirements under Environment, Transport and Works Bureau Technical Circular (Works) ETWB TCW No. 33/2002 "Management of Construction and Demolition Material including Rock".

1.3.4 Purpose of this document include the following:

a. Encourage proper methods of reuse, reduction, recycling, handling, storage, transportation and disposal of construction and demolition (C&D) material generated from the Project as far as possible and practicable

b. Estimate the quantities of C&D material generated and their time of generation for future monitoring

c. Provide information for the contractor to prepare a Waste Management Plan in construction

1.4 Implementation Programme

1.4.1 The Project is currently in the Feasibility Study stage.

1.4.2 The detailed design will be carried out between 2015 and 2017.

1.4.3 Construction of Desalination Plant, Phase 1, with production capacity of 135 MLD, is tentatively scheduled to commence in mid-2017 for completion in end 2020.

1.4.4 The mainlaying of the delivery main is tentatively scheduled to commence in April 2016 and, for completion in end 2019.

1.4.5 Details of the tentative project programme are shown in Table 1-1. This implementation programme reflects the schedule for the construction of the Phase 1 desalination plant. At this time, no definitive programme has been established for expanding the desalination plant to the planned ultimate capacity of 270 MLD. The proposed programme for the project is shown in **Appendix B**.

Table 1-1 Implementation Programme of the Project

Phase	Contract No.	Contract Title	Date of Commencement	Date of Completion
1	A	Desalination Plant at Tseung Kwan O	July 2017	October 2020
1	B	Mainlaying of Delivery Main to TKOFWPSR	April 2016	December 2019

2 DEVELOPMENT CONSTRAINTS

2.1 General

2.1.1 Majority of the proposed water mains will be laid by the conventional method of trench excavation and backfilling. Where circumstances warrant, trenchless construction methods will be adopted for the laying of the proposed water mains.

2.1.2 The proposed desalination plant is located on a reclaimed land which is currently serving as a temporary fillbank area within the existing temporary government land allocations. The part of the land will be restored to a prescribed level before handing over to WSD for construction works and hence no substantial site formation is envisaged. When site works are commenced, conventional construction methods will be applied. The excavation for the sub-structures will be carried out by the conventional open cut and fill method with Excavation and Lateral Support system properly designed and installed. No blasting and tunneling works will be anticipated in construction work within the site boundary .

2.1.3 The arrangement, footprint and levels of tanks, and layout of buildings are governed by the selected treatment process and the associated hydraulics. Preliminary conceptual site layout and location of new buildings to be constructed at TKO Area 137 is shown in Drawing No. 178901/B/PDR/40003 in Appendix A.

2.1.4 For the design and construction of the desalination plant, there are several physical constraints which are the governing factors to be considered during the detailed design stage. These constraints are as follows:

a. Traffic impacts

b. Marine traffic impacts

c. Environmental considerations including air quality, noise, construction waste, water quality, ecology and cultural heritage

d. Utilities and services including water mains, gas mains, electricity, telecommunication, drainage and sewerage

e. Project interfaces

2.2 Traffic Impacts

2.2.1 A preliminary Traffic Impact Assessment (TIA) was carried out in July 2013. Preliminary Temporary Traffic Arrangement (TTA) Schemes have been developed to facilitate the proposed construction works. The potential traffic impacts of the proposed works on the existing road network were assessed. The results indicate that with the proposed TTA Schemes, most of the road networks and junctions will have adequate capacity to facilitate the construction works.

2.2.2 A detailed TIA will be conducted during the design phase of the project. The contractor for implementation of the proposed desalination plant construction works is required to follow the traffic requirements and TTA Schemes laid down for the development of detailed TTA Schemes at the construction stage. Proper planning and implementation of these schemes will be carried out to avoid any potential traffic impact on the adjacent road networks.

2.2.3 For the construction works identified to have adverse impacts on the adjacent road networks and junctions, these works are required to be carried out during off-peak periods or night time. Trenchless methods will be considered in order to minimise traffic disruption at critical road networks and junctions as well as the C&D material generation.

2.3 Marine Traffic Impacts

2.3.1 A preliminary Marine Traffic Impact Assessment (MTIA) was carried out in July 2013. The MTIA was conducted to ensure that any potential impacts and risks posed from the marine works could be successfully managed and minimized.

2.3.2 With regards to the development of desalination plant at TKO Area 137, it is observed that the proposed marine works may be conducted without imposing undue impacts on local marine activities or in turn, being adversely impacted by local marine activity.

2.3.3 Construction on the intake and outfall structures will utilize trenchless technologies with some limited dredging works. In consideration of the marine traffic pattern in proximity to the works site, it is not anticipated that the limited dredging works will impose any adverse impact on the relatively low volume of local marine traffic environment. A series of general marine operations and risk control measures have been proposed to safeguard the potential marine works.

2.3.4 A detailed MTIA will be conducted in the design and construction stage after the detailed construction method and programme have been developed. Potential marine traffic impacts induced by the construction activities will be further analyzed.

2.4 Environmental Considerations

Air Quality

2.4.1 The site for the Project has been formed and is currently occupied by others for different uses. The current occupants will hand over the site to WSD for this project cleared of stockpiles and structures. No major earthwork or site formation works will be required.

2.4.2 Some level of dust nuisance is expected during project construction. The predominant dust sources on site will be the construction activities (e.g. excavation, material handling and vehicle movements on unpaved site areas, etc.).

2.4.3 No air sensitive receivers are identified in close proximity of the Project.

2.4.4 With the implementation of standard site practice and dust suppression measures stipulated under the Air Pollution Control (Construction Dust) Regulation, no unacceptable construction dust impact is anticipated.

Noise

2.4.5 Noise will be generated from construction activities which involve the use of powered mechanical equipment (PME) such as generators, excavators, concrete breakers, concrete lorry mixers, and mobile/tower cranes.

2.4.6 No noise sensitive receivers are identified in close proximity of the Project.

2.4.7 With the adoption of appropriate mitigation measures, potential noise impact is expected to be negligible.

Water Quality

2.4.8 Construction phase impacts of the Project are mainly associated with the installation of submarine structures including the submerged pipes for the intake and outfall.

2.4.9 The main concerns will be related to the release of suspended solids into the water column and potential effects on water quality sensitive receivers. Non-dredged or trenchless method, such as tunneling method, is proposed to be adopted for the installation works as far as practicable to minimize the extent of marine dredging and to reduce potential impacts.

2.4.10 No unacceptable changes in water quality due to submarine installation works are expected. Impacts on water quality arising from the proposed marine works will be largely confined to the specific works areas and of short duration. The elevations of suspended sediment due to the Project will not exceed any environmental standards.

2.4.11 Other minor water quality impact resulting from the construction works will be mainly related to construction site runoff and discharges, and sewage from the construction workforce. General site practice will be implemented in accordance with the Practice Note for Professional Persons on Construction Site Drainage (ProPECC PN1/94) and other relevant guidelines. No unacceptable water quality impact is anticipated.

Terrestrial Ecology

2.4.12 As the proposed desalination plant is situated on reclaimed land with no further encroachment into the surrounding natural habitats, construction activities of desalination plant are unlikely to cause any impacts on ecology.

2.4.13 Minor landslide mitigation works including stabilization of natural slopes and boulders will be proposed for the natural slope adjacent to the northeast boundary of the proposed desalination plant, which is within the boundary of the Clear Water Bay Country Park. Since the landslide mitigation works will be minor, unacceptable impact to the Clear Water Bay Country Park is not anticipated. Potential impact during construction stage may include direct loss of habitat and associated organisms, and disturbance to habitats and associated fauna due to construction activities. No trees are required to be cut or removed.

Marine Ecology

2.4.14 Potential impacts to marine ecological resources during submarine intake and outfall installation will include direct impacts on intertidal assemblages, subtidal benthic assemblages and corals (if any) within the works areas and indirect impacts to marine

ecological resources around the marine works areas as a result of perturbations to water quality.

2.4.15 Works nearby corals, if any, will be avoided as far as practical to minimize potential impacts. The loss of intertidal and subtidal organisms (directly) within the marine footprint is not considered to represent an unacceptable ecological impact.

2.4.16 No unacceptable impacts on water quality is expected during project construction. Indirect impacts to marine ecological resources are likely to be negligible.

Fisheries

2.4.17 Potential impacts to fishery resources and fishing operations may arise from disturbances to the fishery habitats during marine construction works or through changes in water quality as a result of the marine construction works.

2.4.18 The marine footprint of this Project is very small. The minor disturbance to fisheries resources or fishing operations, if any, is unlikely to result in unacceptable impacts.

2.4.19 The nearest Tung Lung Chau Fish Culture Zone (FCZ) is located at sufficient distances (1.5 km) from the proposed site. No unacceptable impact to this sensitive receiver is expected.

2.5 Utilities and Services

2.5.1 Existing utilities such as fresh watermains, salt watermains, storm drains, and sewers in the vicinity of the proposed watermains alignment might be affected or temporary diverted during construction. The feasibility of this arrangement will be investigated during the design phase of the Project. Consent from WSD and DSD will be sought prior to the construction.

2.6 Project Interfaces

2.6.1 CEDD

a. CEDD is currently operating a temporary fill bank facility at TKO Area 137. The temporary facility will occupy the site until 31 December 2018 under the current Temporary Government Land Allocation (TGLA).

b. While CEDD is applying an extension, CEDD has agreed to handover the site cleared of stockpile for the construction of the desalination plant by late 2015.

c. There may be interfaces with the operators during the site investigation works and construction stage.

2.6.2 MTR Corporation Limited (MTR)

a. MTR has set up a temporary explosive magazine for its Shatin to Central Link and Kwun Tong Line Extension projects at the TKO Area 137.

b. Whilst the site for the temporary explosive magazine encroaches considerably upon the reserved site for the desalination plant, the site will be returned to WSD by late 2015 for the construction of the desalination plant.

2.6.3 The Mines Division of CEDD

a. The Mines Division of CEDD is operating a barging pier at TKO Area 137 for off-loading of explosives (TGLA No. SK 567). The current TGLA will expire on 30 June 2015. The Mines Division plans to apply for an extension.

b. The TGLA No. SK567 contains a clause that the site will be returned at an earlier time if required by WSD for the construction of the RO plant by providing a 6-month written notice.

c. The coexistence of the explosive off-loading facilities and the desalination plant is being considered. A hazard to life assessment is being carried out to explore the feasibility of the coexistence.

2.6.4 CLP Power Hong Kong Limited (CLP)

a. CLP is planning to install a high voltage submarine cable after 2020 at Tathong Channel.

b. The boundary of the cable is located approximately 500 meters south of TKO Area 137. No conflict with CLP's proposed work is anticipated.

2.6.5 SENT Landfill Extension

a. SENT Landfill is located directly to the north to the desalination plant site.

b. SENT Landfill Extension will be considered as an existing facility.

c. A landfill leachate and gas hazard assessment will be carried out.

2.6.6 Other Projects

a. There are other on-going and planned projects such as the TKO Cross Bay Link, TKO – Lam Tin Tunnel and Associated Works, and C&D Material Handling Facility in the vicinity of the site and/or TKO area.

b. There are sufficient separation distances from these projects. Cumulative impacts are unlikely to occur.

2.6.7 No insurmountable interface problem is anticipated in the Project in view of the available and known interface projects above. Close liaison with corresponding parties will be maintained during the course of the Project to resolve such interface problems, if any.

2.6.8 For resolution of potential conflicts and possible nuisance to public due to repeated road or footpath opening or long construction period arising from the interface issues, the following measures will be adopted:

a. Entrust the proposed mainlaying works, which are in direct conflict with the works under other projects, or vice versa.

b. Allow sufficient time in the construction contract for completion of the waterworks under the interface project. The contractors in both projects shall coordinate their work programmes during the construction stage to avoid repeated road opening.

c. Introduce the construction of common trench with other utility laying projects.

3 DEVELOPMENT OPTIONS

3.1 Construction of Desalination Plant

3.1.1 In view of the treatment process, hydraulics, geotechnical and operational constraints, the conceptual design comprising the following buildings.

a. Seawater Intake Building

b. Pretreatment Clarifier Units

c. Pretreatment Media Filter Building

d. SWRO Building

e. Brine Collection Tank and Pump Station

f. Underground Clearwater Storage Tank

g. Fresh Water Pump Station

h. Chlorine Contact Tank

i. Chlorine Store

j. Chemical Building

k. Post Treatment Building

3.1.2 The layout of the plant will be dictated by fitting the footprint of the selected treatment processes within the proposed site boundary. Treatment process selection and plant layout are currently being developed during the course of the Feasibility Study.

3.1.3 Since the site will be cleared by CEDD to a desired formation level, the traditional open cut method will be adopted for constructing the substructure of the process building with proper Excavation and Lateral Support if necessary.

3.2 Construction of Intake and Outfall Systems

3.2.1 The proposed intake and outfall pipes will extend approximately 200 m to the east and about 300 to 350m to the south from the site respectively. It is anticipated that submerged intake and outfall pipes will be preferred.

3.2.2 Trenchless installation method, such as tunnelling method, will be utilized to minimize any potential environmental impacts.

3.2.3 Prefabricated intake and outfall structures, such as the diffuser heads, will be transferred and installed onsite using open-cut method.

3.2.4 Localized dredging works will be minimized as far as practicable during construction.

3.3 Construction of 1200mm Diameter Trunk Feed System

3.3.1 The proposed water mains pipe laying works will be carried out by installation of Excavation and Lateral Support (ELS) system.

3.3.2 If necessary, at critical junctions along Wan Po Road and Po Lam Road, trenchless pipe jacking method with micro-tunneling could be adopted. Pipelines will be advanced through the ground by a jacking station (jacking pit) in the main shaft. The pipes form and act as the finished tunnel liner. Locations of where trenchless method to be adopted will be determined during the detailed design stage.

3.3.3 The trenchless methods will be mainly applied for water mains crossing or along carriageways. Trenchless technique is not suitable for water mains with many tree branches, valves and bends. The determination of the method of construction will depend on many factors such as site condition, construction constraints, choice of material, traffic and environmental impact, etc.

3.3.4 The proposed application of open cut method and trenchless method in the Project are considered to be an optimum design taking all aspects into consideration and strike balance among the above development constraints.

3.4 Slope Stabilization Works

3.4.1 The natural slope overlooking the northeast boundary of the new desalination plant at TKO Area 137 has a history of minor landslides and contains some potentially unstable boulders.

3.4.2 Landslide and boulder hazard mitigation works including mainly passive debris barriers and boulder traps along the toe of the natural slope, some soil nailing at local steep spots on the slope, stabilization of individual boulders by buttressing and dowelling may be required to protect the new desalination plant for the landslide and boulder hazards from this slope. The proposed option is considered to be an optimum design taking all aspects into consideration and strike balance among the above development constraints.

4 MANAGEMENT OF C&D MATERIALS

4.1 Types of C&D Materials

4.1.1 Construction activities will result in the generation of a variety of C&D materials. The C&D materials are usually mixed consisting of inert components (public fill) such as soil, rock, concrete, brick and asphalt and non-inert components (C&D waste) comprising metal, timber, paper, plastic and general refuse.

4.1.2 It is expected that the Project will result in the generation of the following C&D materials:

a. Waste from site clearance;

b. Excavated materials (soil, rock and marine sediment) from the construction of seawater intake and outfall, foundation/ basement of desalination plant and water mains;

c. Dredged marine sediments from the construction of seawater intake and outfall and desalination plant;

d. Construction and demolition (C&D) material from construction of new buildings and civil structures;

e. Chemical waste from maintenance of construction plant and equipment; and

f. General refuse from the site workforce

4.1.3 The natural slope overlooking the northeast boundary of the new desalination plant at TKO Area 137 has a history of minor landslides and contains some potentially unstable boulders. Landslide and boulder hazard mitigation works including mainly passive debris barriers and boulder traps along the toe of the natural slope, some soil nailing at local steep spots on the slope, stabilization of individual boulders by buttressing and dowelling may be required to protect the new desalination plant for the landslide and boulder hazards from this slope. There will not be any tree removal and excavation works.

4.1.4 The CEDD is currently operating a temporary fill bank at TKO Area 137, which is stockpiled or filled with inert C&D materials with access roads between various parts of the site. The site will be occupied by the temporary fill bank until end of 2018. CEDD has agreed to hand over the 10 ha site cleared of stockpile for this Project by late 2015. Thus the quantity of site clearance waste (eg vegetation) is expected to be small.

4.2 Quantities of C&D Materials

4.2.1 As the plant is located on a flat reclaimed land without any existing buildings and slope cutting works, the quantity of C&D materials generated from the construction would be expected to be lower than conventional site of the same plant scale.

4.2.2 Some of the excavated materials and earthworks will be utilized on-site as backfill. The unsuitable excavated materials, which are not suitable for reuse, will be disposed off-site. A preliminary estimation of total volume of excavated materials likely to be generated from the Project works, based on the conceptual layout of the desalination plant, is given in Table 4-2 and Table 4-2. Detailed estimation is enclosed in Appendix C.

Table 4-1 Cut and Fill Requirement of the Seawater Intake & Outfall, Desalination Plant and Mains Laying

Location	Excavated Material Generated from Construction Works (m^3)	Excavated Materials Suitable for on-site Filling (m^3)	Fill Requirements (m^3)	Filled Materials Reused on Site (m^3)	Surplus Excavated Materials Disposed of at Fill Bank as Public Fill (m^3)	Surplus Excavated Materials Disposed of at Landfill as Construction Waste (m^3)	Surplus Excavated Materials Disposed of as Marine Sediments (m^3)
Seawater Intake	785	550	905	550	79	0	157
Seawater Outfall	402	402	4,320	402	0	0	0
Desalination Plant (included slope mitigation works)	183,776	118,896	0	0	180,173	2,744	859
Mains Laying	42,733	29,444	25,961	25,961	16,404	368	-
Total	227,696	149,292	31,186	26,913	196,656	3,112	1,016

Notes

(a) **Assuming 10% of the total excavated materials generated from the construction of seawater intake are Grade IV and V low quality rock unsuitable for on-site filling. The Surplus Excavated Materials Disposed of at Fill Bank as Public Fill = 785 m^3 X 10% = 79 m^3.**

(b) **Assuming 20% of the total excavated materials generated from the construction of seawater intake are marine sediments. The Surplus Excavated Materials Disposed of as Marine Sediments = 785 m^3 X 10% = 157 m^3.**

(c) **Assuming all the excavated materials generated from the construction of seawater outfall are high quality rock suitable for on-site filling.**

(d) **145,751 m^3 of the total excavated materials are generated from the construction of foundation/ basement of the desalination plant whilst 37,110 m^3 of the total excavated materials are generated from pilling works. The remaining 859 m^3 of the total excavated materials are marine sediments generated during the excavation. The Excavated Materials Generated from Construction Works = 145,751 m^3 + 37,110 m^3 + 859 m^3 = 183,720 m^3. The excavated material generated from the slope mitigation works is also included into this section and is about 56m^3. Therefore the total excavated material is 183,720m^3 + 56m^3 = 183,776m^3**

(e) **Assuming 30% of the total excavated materials (excluding marine sediments) generated from the construction of desalination plant and slope mitigation (i.e. [(145,751 m^3 + 37,110 m^3 + 56m^3) X30%] = 54,875 m^3) are unsuitable for on-site filling, of which 5% of the materials (i.e. 54,875 m^3 X 5% = 2,744 m^3) are non-inert construction waste, and another 5% (i.e. 54,875 m^3 X 5% = 2,744 m^3) are low quality rock. Assuming another 5% of the total excavated materials (excluding marine sediments) generated from the construction of desalination plant (i.e. [(145,751 m^3 + 37,110 m^3 + 56m^3) X 5%] = 9,146 m^3) are Grade I/II granite which is also unsuitable for on-site backfilling. In addition, assuming 859 m^3 of the total excavated materials generated from the construction of desalination plant are marine sediments. The excavated materials generated from the construction of desalination plant suitable for on-site filling = 183,776 m^3 - 54,875m^3 - 9,146 m^3 – 859 m^3 = 118,896 m^3**

(f) **Excavated Materials Disposed of at Fill Bank as Public Fill = 118,896 m^3 + 9,146 m^3 + 54,875m^3 - 2,744 m^3 = 180,173 m^3**

(g) **Assuming 5,928 m^3 of the excavated materials generated are Asphalt hot-mix (AHM) pavement, which is unsuitable for on-site backfilling. Of the remaining excavated materials from the construction of water mains (i.e. 42,733 m^3 - 5,928 m^3 = 36,805 m^3), 20% (i.e. 36,805 m^3 X 20% = 7,361 m^3) is considered to be unsuitable for on-site filling. Assuming 5% of that 7,361 m^3 of excavated materials (i.e. 7,361 m^3 X 5% = 368 m^3) are non-inert construction waste, and another 5% of that is low quality rock. The Excavated Materials Suitable for on-site Filling = 42,733 m^3 - 5,928 m^3 - 7,361 m^3 = 29,444 m^3**

(h) **Excavated Materials Disposed of at Fill Bank as Public Fill = 5,928 m^3 + 7,361 m^3 - 368 m^3 + 29,444 m^3 - 25,961 m^3 = 16,404 m^3**

Table 4-2 Estimated Quantities of C&D Materials Generated from Phase I Construction

Material	C&D Materials (m^3)	Filled Material Reused on Site (m^3)	Disposed of at Fill Bank as Public Fill (m^3)	Disposed of at Landfill as Construction Waste (m^3)
Inert C&D material (soft public fill)	211,232	26,912	184,320	0
Grade I/II Granitic Rock	9,146	0	9,146	0
Rock other than Grade I/II Granite	3,190	0	3,190	0
Broken concrete	0	0	0	0
Construction Waste	3,112	0		3,112
Total Volume (m^3)	**226,680**	**26,912**	**196,656**	**3,112**
Total Weight (tonnage)*	**459,528**	**53,824**	**399,480**	**6,224**

- figures to be obtained from Environmental Review Report

* - Converted by figures from WSD Vetting Committee on C&DMM's memo (Ref. (3) In WSD 1421/58/02 Pt. 17 TJ (1) dated 9 December 2010

- in-situ densities of rock and soil to be 2.5 tonnes/m^3 and 2.0 tonnes/m^3 respectively

Material	C&D Materials (m^3)	Filled Material Reused on Site (m^3)	Disposed of at Fill Bank as Public Fill (m^3)	Disposed of at Landfill as Construction Waste (m^3)
- densities of imported rock and soil to be 2.0 tonnes/m^3 and 1.8 tonnes/m^3 respectively - density of in-situ marine dredged sediment to be 2.2 tonnes/m^3				

4.2.3 The intention of reuse of C&D materials is to minimize the need of imported materials and the disposal quantity in the Project. Due to limitation of available site area and other site constraints, storage of excavated C&D materials is limited to certain extent considering the land requirement for sorting and processing on the materials on-site. Import fill could not be avoided at this stage.

4.2.4 In order to minimize/avoid the need of imported materials in the Project, the contractors will be encouraged, under supervision by the resident site staff, to have proper site management to maximize available space for storage of C&D materials during the course of construction stage.

4.2.5 Installation of the precast intake riser and outfall multi-port diffuser channel will require the removal of marine sediment from the sea bed. The sediment will be removed by localized dredging operation. The calculations of estimated dredged sediments are shown in Appendix C. The estimated quantities shall be re-assessed after the design of the structures is further developed.

4.3 Quantity of Dredged Marine Sediment

4.3.1 The quantities of dredged marine sediments to be generated from dredging during the construction of seawater intake and outfall are approximately 1,740m^3 and 4,590m^3 , respectively. Taking account of the excavated marine sediments generated during the construction of sweater intake and piling of the desalination plant as mentioned in Table 4-1, the total quantity of marine sediments generated will be approximately 7,189m^3 .

4.3.2 In accordance with Environment, Transport and Works Bureau Technical Circular (Works) No. 34/2002, Management of Dredged/Excavated Sediment, the dredged sediment will go through a framework of quality assessment with respected management guidelines. Based on the marine ground investigation works, the contamination level of the sediment proposed to be dredged during the construction of intake and outfall are in category 'L' which is not toxic, which will be disposed to specified open sea area as instructed by the Technical Circular.

4.3.3 The method and programme of the disposal of the C&D materials and importation of fill material for this Project are shown in Table 4-3.

Table 4-3 Method and Programme of Disposal of C&D Materials and Import Fill Material

Method and Programme of Disposal of C&D Materials and Import Fill Material		Estimated quantity of generated C&D materials and imported fill materials		
		In-situ Volume (m^3)	Weight (tonne)	Bulk Volume (m^3)
2017				
Re-used	Inert C&D material (soft public fill)	6,700	13,500	7,500
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0

Method and Programme of Disposal of C&D Materials and Import Fill Material		Estimated quantity of generated C&D materials and imported fill materials		
		In-situ Volume (m^3)	Weight (tonne)	Bulk Volume (m^3)
Disposed off site to public filling areas	Inert C&D material (soft public fill)	60,100	120,200	67,300
	Grade I/II Granitic Rock	3,000	7,600	3,400
	Rock other than Grade I/II Granite	1,000	2,600	1,100
	Broken concrete	0	0	0
Disposed off site to landfill	C&D waste	1,000	2,100	1,200
Disposed off site to open sea	Marine dredged sediment	3,600	7,900	4,000
Import fill	Inert C&D material (soft public fill)	2,100	4,300	2,400
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
2018				
Re-used	Inert C&D material (soft public fill)	6,700	13,500	7,500
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
Disposed off site to public filling areas	Inert C&D material (soft public fill)	60,100	120,200	67,300
	Grade I/II Granitic Rock	3,000	7,600	3,400
	Rock other than Grade I/II Granite	1,000	2,600	1,100
	Broken concrete	0	0	0
Disposed off site to landfill	C&D waste	1,000	2,100	1,200
Disposed off site to open sea	Marine dredged sediment	3,600	7,900	4,000
Import fill	Inert C&D material (soft public fill)	2,100	4,300	2,400
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
2019				
Re-used	Inert C&D material (soft public fill)	6,700	13,500	7,500
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
Disposed off site to public filling areas	Inert C&D material (soft public fill)	60,100	120,200	67,300
	Grade I/II Granitic Rock	3,000	7,600	3,400
	Rock other than Grade I/II Granite	1,000	2,600	1,100

Method and Programme of Disposal of C&D Materials and Import Fill Material		Estimated quantity of generated C&D materials and imported fill materials		
		In-situ Volume (m^3)	Weight (tonne)	Bulk Volume (m^3)
	Broken concrete	0	0	0
Disposed off site to landfill	C&D waste	1,000	2,100	1,200
Disposed off site to open sea	Marine dredged sediment	0	0	0
Import fill	Inert C&D material (soft public fill)	0	0	0
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
2020				
Re-used	Inert C&D material (soft public fill)	6,700	13,500	7,500
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	Inert C&D material (soft public fill)	0	0	0
Disposed off site to public filling areas	Inert C&D material (soft public fill)	4,000	8,000	4,500
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	100	300	100
	Broken concrete	0	0	0
Disposed off site to landfill	C&D waste	100	200	100
Disposed off site to open sea	Marine dredged sediment	0	0	0
Import fill	Inert C&D material (soft public fill)	0	0	0
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0

Remarks:
1. The detailed programme and more accurate quantities of the disposal works will depend on the contractor's programme after the contract is awarded.
2. All the figures are rounded to the nearest 100 cubic metre or tonne.

4.4 Generation, Reuse and Recycle of C&D Materials

4.4.1 Ways to minimize the generation of C&D material include:

a. Layout and level of the proposed works should be properly designed.

b. Programming of works should be well defined.

c. Liaison should be strengthened between relevant supervising officers and site workers to minimize errors in construction to avoid unnecessary excavation.

d. All site staff and contractors should work together to avoid and minimize the generation of C&D material during construction.

e. Good site management should be maintained on site to minimize over ordering and cross contamination.

f. Working method/arrangement should be reviewed to minimize wastage where possible.

g. Steel formwork should be used as far as possible.

4.4.2 Way to maximize the use of inert C&D material includes:

a. The use of recycled aggregates for concrete should be fully utilized.

4.4.3 Ways to maximize the reuse of C&D material including soil or rock on site include:

a. Excavated soft spoil from mainlaying trenches should be re-used as fill material as far as possible to minimize off-site disposal.

b. Sorting should be carried out on site or in designated sorting area and separate C&D material into public fill and C&D waste, and sorting of C&D material by category to facilitate reuse/recycling/return.

c. The concrete/brick/aggregates should be broken up into suitable size for general fill material.

d. Good condition timber should be reused several times.

e. Remaining reusable wooden material should be sorted and used at other construction sites by the same contractor or sold to other construction sites.

f. Contractor should reuse or recycle construction/demolition waste with recyclable values such as reinforcement bars, steel mesh etc. These wastes should either be reused on site or collected by outside licensed waste recycling agents.

4.4.4 Ways to maximize the use of recycled C&D material include:

a. Dry concrete waste should be sorted out from other wastes and recycled at recycling plant to form aggregates for road sub-base.

b. Paper/cardboard, metal, others (e.g. plastic, foam board etc) should be collected and delivered to local recycling factories.

4.4.5 Where the construction process produces chemical waste, the contractor must register with EPD as a chemical waste producer. Storage, handling, transport and disposal of chemical waste should be arranged in accordance with the Code of Practice on the Packaging, Labelling and Storage of Chemical Waste issued by EPD.

4.4.6 Any unused chemicals or those with remaining functional capacity should be recycled. Chemical waste should be collected by licensed contractor for disposal at a licensed chemical waste treatment facility.

4.4.7 In construction stage, the contractor should prepare and submit a Waste Management Plan (WMP) as part of the Environmental Management Plan (EMP) for approval by the Engineer in

accordance with ETWB TCW No. 19/2005. The EMP should describe the arrangements for avoidance, reuse, recovery, recycling, storage, collection, treatment and disposal of different categories of C&D materials generated from the construction activities. The contractor shall implement the waste management practices in the EMP throughout the construction stage of the Project.

4.4.8 The contractor should refer and strictly follow the trip-ticket system in accordance with DEVB TCW No. 6/2010 to ensure all C&D materials are disposed of properly.

4.4.9 In addition, WSD will conduct site inspection to monitor the contractors' performance in the implementation of the EMP and other relevant specified requirements.

5 FINDINGS AND RECOMMENDATIONS

5.1 Summary of Findings

5.1.1 This C&DMMP summarizes the expected quantities of gross and surplus wastes likely to arise from the implementation of the Project and feasible ways to minimize, re-use, recycle and appropriately dispose of surplus C&D materials. The intention of reuse of C&D materials is to minimize the need of imported materials in the Project.

5.1.2 Due to limitation of available site area and other site constraints, storage of excavated C&D materials is limited to certain extent considering the land requirement for sorting and processing on the materials on-site. Import fill could not be avoided.

5.2 Summary of Recommendations

5.2.1 In order to minimize / avoid the need of imported materials in the Project, the contractors shall be encouraged, under supervision by the Resident Site Staff, to have proper site management to maximize available space for storage of C&D materials during the course of construction stage.

5.2.2 The management measures to be adopted for C&D materials can be enforced by incorporating them into a Waste Management Plan (WMP) as part of the contract document. Environmental monitoring and audit will be necessary to ensure the proper implementation of the proposed measures during construction.

5.2.3 If appropriate management measures are implemented properly during the handling, collection and disposal of C&D materials, the residual environmental impacts would be reduced to acceptable levels.

5.2.4 In accordance with the requirements stipulated in the ETWB TC(W) No. 33/2002, it is recommended that the Project Office and the Consultant should monitor the implementation of this C&DMMP and prepare half yearly status report and submit to Public Fill Committee (PFC) for their information. The requirements of the status report are detailed in the Technical Circular.

5.2.5 It is recommended that this C&DMMP be reviewed and updated regularly by the Project Office, the Consultant and the contractor throughout the Project. If there is any significant increase in amount of inert and/or non-inert materials to be disposed off site, the plan should be revised and re-submitted for endorsement.

5.2.6 The contractor will be provided with information from the C&DMMP in order to facilitate them in the preparation of the WMP, which is required under the Environmental, Transport

and Works Bureau Technical Circular (Works) No. 19/2005 – Environmental Management on Construction Sites. As part of the WMP, the contractor shall establish a mechanism to record the quantities of C&D materials generated each month and report the quantities to the Project Office. In addition, the contractor shall provide estimated quantities of C&D materials that will be generated each year from the site. The contractor is also required to set up disposal recording system as part of the WMP by adopting the trip-ticket system as stipulated in DEVB TC(W) No. 6/2010, in order to ensure proper disposal of C&D materials at designated outlets.

END OF TEXT

Appendix A

佛堂澳
FAT TONG O

N

846 200 E
846 400 E
846 600 E
846 800 E
847 000 E

814 600 N
814 400 N
814 200 N
814 000 N

SWITCHROOM/ELEC. 3
132kV SUBSTATION
STAND BY GENERATOR & SWITCH GEAR ROOM
INCOMING SWITCHGEAR ROOM
BOUNDARY
EMERGENCY ACCESS
SLUDGE THICKENERS
SLUDGE FILTER PRESS BUILDING
SECOND PASS BUILDING
SWITCHROOM/ELEC. 2
SWRO/FILTER STACKED BELOW SWRO BUILDING (I)
BRINE COLLECTION TANK/PUMPS
SWRO/FILTER STACKED BELOW SWRO BUILDING (II)
CONTROL ROOM
MEDIA FILTER (I)
MEDIA FILTER (II)
CLARIFIER-DAF (I) & VISTOR/ADMIN/LAB
CLARIFIER-DAF (II)
MAIN ENTRANCE
CARPARK

TREATED WATER TANK
TREATED WATER PUMPING STATION
CHLORINE CONTACT TANK (I) & (II)
CO_2 TANKS
CHEMICAL BUILDING
POST TREATMENT (I) & (II)
CHLORINE BUILDING
MAINTENANCE WORKSHOP & SPARE PART STORAGE
BRIDGE (CONNECTING FILTER GALLERY AND SWRO BUILDING)
SODIUM HYPOCHLORITE STORAGE TANK
SODIUM HYPOCHLORITE DOSING STATION
INLET WORKS
ENTRANCE
PHYSICAL FENCES
ACCESS ROAD TO EXPLOSIVES OFF-LOADING PIER
ENTRANCE TO EXPLOSIVES OFF-LOADING PIER

A
B

CLEAR WATER BAY COUNTRY PARK

觀仔
KWUN TSAI

鐵箐洲
TIT CHAM CHAU

WIP May 2011

MAP NOS. 12SW11D, 12SW12C, 12SW16B & 12SW17A

LEGEND:

- DESALINATION PLANT SITE BOUNDARY
- CLEAR WATER BAY COUNTRY PARK BOUNDARY
- TREES/SHRUBS
- PERIMETER FENCE

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	YLC	CKH	SZ	WLS
Date	07/13	07/13	07/13	07/13

Approved

Agreement No.
CE 21/2012 (WS)

Contract Title
DESALINATION PLANT AT TSEUNG KWAN O – FEASIBILITY STUDY

Drawing Title
GENERAL LAYOUT PLAN

Drawing No.
178901/B/PDR/40003

Revision
F

Scale
A1 1 : 1500
A3 1 : 3000

水務署
Water Supplies Department

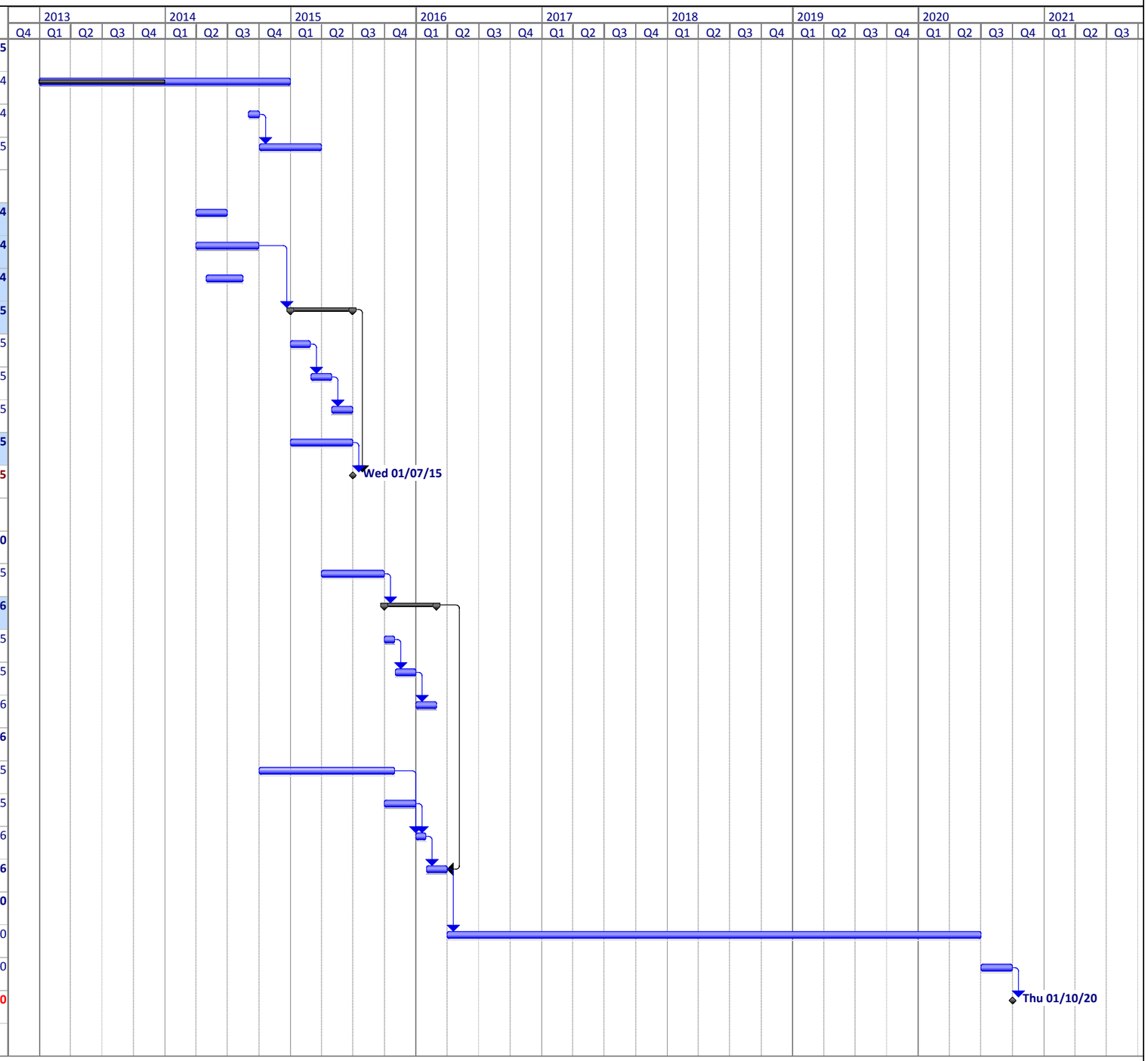
BLACK & VEATCH HONG KONG LIMITED
博威工程顧問有限公司

Y:\Daily Work\20150521c\178901-B-PDR-40003.dwg, 5/21/2015 2:36:56 PM, xu48127

Appendix B

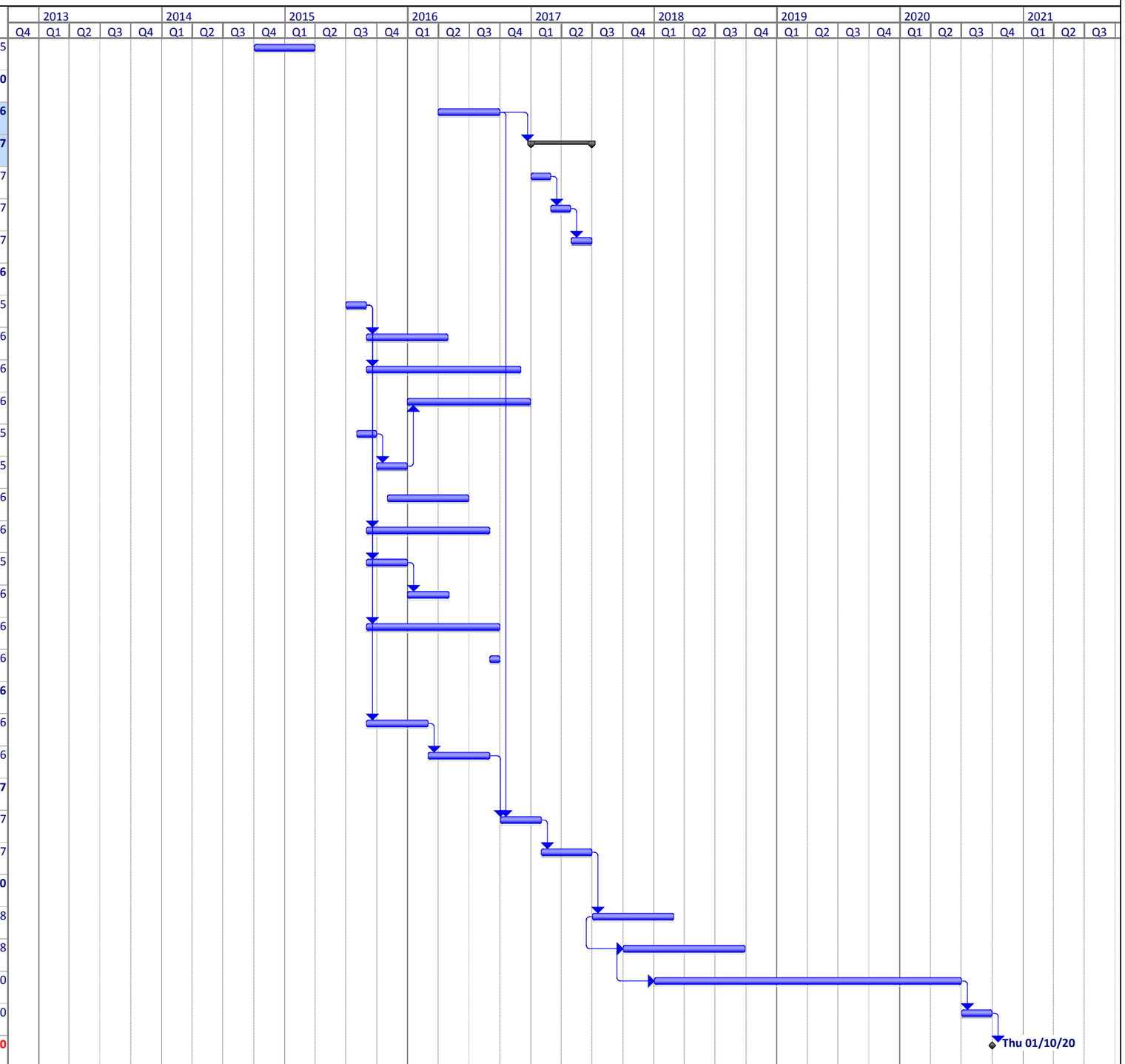
Design and Construction for the First Stage of the Desalination Plant at Tseung Kwan O

ID	Task Name	Durat'n	Start	Finish
1	**Feasibility Study**		**Mon 31/12/12**	**Tue 31/03/15**
2	Feasibility Study	24 mo	Mon 31/12/12	Wed 31/12/14
3	DC Consultation	1 mo	Mon 01/09/14	Thu 02/10/14
4	Approval of EIA Report	6 mo	Fri 03/10/14	Tue 31/03/15
5				
6	**PDS**	**3 mo**	**Tue 01/04/14**	**Mon 30/06/14**
7	**2014 RAE Bid**	**6 mo**	**Tue 01/04/14**	**Tue 30/09/14**
8	**TFS**	**3.5 mo**	**Thu 01/05/14**	**Fri 15/08/14**
9	**Funding Approval for IDC Consultancy**	**6 mo**	**Thu 01/01/15**	**Tue 30/06/15**
10	Development Panel Meeting	2 mo	Thu 01/01/15	Fri 27/02/15
11	PWSC Meeting	2 mo	Mon 02/03/15	Thu 30/04/15
12	FC Meeting	2 mo	Fri 01/05/15	Tue 30/06/15
13	**Selection of Consultants for IDC**	**6 mo**	**Thu 01/01/15**	**Tue 30/06/15**
14	**IDC Consultancy Commence**		**Wed 01/07/15**	**Wed 01/07/15**
15				
16	**Mainlaying Package (by In-house Resource)**		**Thu 02/10/14**	**Thu 01/10/20**
17	**2015 RAE Bid for BU**	6 mo	Wed 01/04/15	Wed 30/09/15
18	**Funding Approval for Works**		**Thu 01/10/15**	**Mon 29/02/16**
19	Development Panel Meeting	1 mo	Thu 01/10/15	Fri 30/10/15
20	PWSC Meeting	2 mo	Mon 02/11/15	Thu 31/12/15
21	FC Meeting	2 mo	Fri 01/01/16	Mon 29/02/16
22	**Design**		**Thu 02/10/14**	**Fri 29/01/16**
23	Design	13 mo	Thu 02/10/14	Fri 30/10/15
24	Tender preparation, Incl. Input by NEC advisor	3 mo	Thu 01/10/15	Thu 31/12/15
25	Tendering	1 mo	Fri 01/01/16	Fri 29/01/16
26	**Tender Assessment**	**2 mo**	**Mon 01/02/16**	**Thu 31/03/16**
27	**Construction**		**Fri 01/04/16**	**Thu 01/10/20**
28	Construction - M/L package	51 mo	Fri 01/04/16	Wed 01/07/20
29	Testing and Commissioning	3 mo	Thu 02/07/20	Wed 30/09/20
30	**Delivery of Desalinated Water to Customers**		**Thu 01/10/20**	**Thu 01/10/20**
31				



Design and Construction for the First Stage of the Desalination Plant at Tseung Kwan O

ID	Task Name	Durat'n	Start	Finish
32	Approval of EIA Report	6 mo	Fri 03/10/14	Tue 31/03/15
33	**Desalination Plant (Design-and-Build)**		**Thu 02/07/15**	**Thu 01/10/20**
34	**2016 RAE Bid for BU**	**6mo**	**Fri 01/04/16**	**Fri 30/09/16**
35	**Funding Approval for Works**		**Mon 02/01/17**	**Fri 30/06/17**
36	Development Panel Meeting	2 mo	Mon 02/01/17	Tue 28/02/17
37	PWSC Meeting	2 mo	Wed 01/03/17	Fri 28/04/17
38	FC Meeting	2 mo	Mon 01/05/17	Fri 30/06/17
39	**Pre-Design-and-Build**		**Thu 02/07/15**	**Fri 30/12/16**
40	Investigation Review	2 mo	Thu 02/07/15	Mon 31/08/15
41	Further Site Investigation	8 mo	Tue 01/09/15	Fri 29/04/16
42	CAF/Land Allocation	15 mo	Tue 01/09/15	Thu 01/12/16
43	OZP amendment	12 mo	Thu 31/12/15	Fri 30/12/16
44	Prepration of Hazard Assessment, Planning Study and Action Plan	2 mo	Mon 03/08/15	Wed 30/09/15
45	CCPHI Submission	3 mo	Thu 01/10/15	Wed 30/12/15
46	SOA Approval	8 mo	Mon 02/11/15	Thu 30/06/16
47	FSRO Gazettal	12 mo	Tue 01/09/15	Wed 31/08/16
48	GEO Submission	4 mo	Tue 01/09/15	Thu 31/12/15
49	Country Park Authority Approval	4 mo	Fri 01/01/16	Mon 02/05/16
50	Reference Design	13 mo	Tue 01/09/15	Fri 30/09/16
51	DC Consultation	1 mo	Thu 01/09/16	Fri 30/09/16
52	**Prequalification of Contractors**		**Tue 01/09/15**	**Wed 31/08/16**
53	Prepare Prequal Doc	6 mo	Tue 01/09/15	Tue 01/03/16
54	Conduct Prequalification	6 mo	Wed 02/03/16	Wed 31/08/16
55	**Tender**		**Mon 03/10/16**	**Fri 30/06/17**
56	Tendering	4 mo	Mon 03/10/16	Tue 31/01/17
57	Tender Assessment	5 mo	Wed 01/02/17	Fri 30/06/17
58	**Construction (Design-and-Build)**		**Mon 03/07/17**	**Wed 30/09/20**
59	Design Submissions - AIP	8 mo	Mon 03/07/17	Wed 28/02/18
60	Design Submissions - DDA	12 mo	Mon 02/10/17	Fri 28/09/18
61	Construction	30 mo	Wed 03/01/18	Wed 01/07/20
62	Testing and Commissioning	3 mo	Fri 03/07/20	Wed 30/09/20
63	**Delivery of Desalinated Water to Customers (DB)**		**Thu 01/10/20**	**Thu 01/10/20**



Appendix C

DN 1200 Pipe for 9km water main

Average Diameter	=	1,200 mm
Trench width	=	2,400 mm
Assumed Depth of Trench	=	2.2 m
Length of open cut	=	7,600 m
Length of trenchless section	=	1,900 m
Thickness of Pavement	=	0.3 m

Total volume of AHM (pavement) = 7,600 x (2.4 + 0.2) x 0.3

(assume average 300mm thick) = 5,928 m^3

Total Volume of excavation (trench and trenchless) = 7,600 x (2.2 - 0.3) x 2.4 + 1,900 x $\frac{1.2^2 \times PI}{4}$

= 36,805 m^3

Assume 20% of unsuitable material = 20% x 36,805

= 7,361 m^3

Assume 5% as non-inert C&D waste from 25% of unsuitable material = 5% x 7,361

= 368 m^3

Assume 5% as low quality rock from 25% of unsuitable material = 5% x 7,361

= 368 m^3

Total volume of material can be used as backfill = 36,805 - 7,361

= 29,444 m^3

Total backfill material needed = 36,805 - $\frac{1.2^2 \times PI}{4}$ x 9,500 - 2.4 x 0.3 x 7,600

= 25,961 m^3

Backfill material in excess = 29,444 - 25,961

= 3,483 m^3

Therefore:

(i) Total volume excavated = 5,928 + 36,805 = 42,733 m^3

(ii) Volume reuse on site = 25,961 m^3

(iii) Volume import to site = 0 m^3

(iv) Volume delivery to public fill = 5,928 + (7,361 - 368) + 3,483 = 16,404 m^3

(i) Volume disposal at landfill = 368 m^3

Pipe for 250m intake (Phase I & II)

Average Diameter	=	1,800	mm
Drilling width	=	2,000	mm
Length of intake	=	250	m

Total Volume of excavation (trenchless) (granular) $= 250 \times \left(\frac{2^2 \times PI}{4}\right)$

$= 785\ m^3$

Based on the Geological Profile along the proposed alignment of Intake in Site Investigation Report (8901/B&V/0034)

About 20% of marine sediment = 20% x 785

$= 157\ m^3$

Assume 10% as low quality rock (Grade IV and V) = 10% x 785

$= 79\ m^3$

Total volume of granular material can be used as backfill = 785 - 236

$= 550\ m^3$

Backfill material in excess = 550 - 0

$= 550\ m^3$

Therefore,

(i) Total volume excavated	=	785	+	1,583	=	2,369 m^3
(ii) Volume reuse on site	=	550 m^3				
(iii) Volume import to site	=	355 m^3				
(iv) Volume delivery to public fill	=	79 m^3				
(i) Volume disposal at landfill	=	0 m^3				

With dredging:

Assuming offshore precast intake screeing units will be installed with size = Area of intake screen x Depth

= 113 x 6 = 679 m^3

Volume of dredging with 45^o inclination $= \frac{1}{3} \times PI \times H \left[12^2 + (12 \times 6) + 6^2 \right]$

$= 1,583\ m^3$

Total volume of sediment can be re-used = 0 m^3

Granular Fill required to fill the void at the sides of the riser = 1,583 - 679 = 905 m^3

Backfill left from above pipeline excavation = 550 m^3

Extra backfill to be imported = 905 - 550 = 355 m^3

Based on the Marine GI result at the proposed dredging area sediment shows no contamination, therefore,

(ii) Volume reuse on site(as above) = 550 m^3

(iii) Volume import to site(as above) = 355 m^3

(vi) Volume disposal at to open sea = 1,740 m^3 say 1800m^3

DN1500 Pipe for 350m outfall (Phase I & II)

Average Diameter = 1,500 mm
Drilling width = 1,600 mm
Length of outfall = 200 m

Total Volume of excavation (trenchless) (granular) = $200 \times \left(\frac{1.6^2 \times PI}{4}\right)$

= 402 m^3

Based on the Geological Profile along the proposed alignment of Intake in Site Investigation Report (8901/B&V/0034)

Assume 100% high quality rock = 100% x 402

= 402 m^3

Total volume of granular material can be used as backfill = 402 - 0

= 402 m^3

Backfill material in excess = 402 - 0

= 402 m^3

Therefore,

(i) Total volume excavated = 402 + 4590 = 4992 m^3
(ii) Volume reuse on site = 402 m^3
(iii) Volume import to site = 3918 m^3
(iv) Volume delivery to public fill = 0 m^3
(i) Volume disposal at landfill = 0 m^3

With dredging:

Assume Multi-port diffuser to be used,

with diffuser length = 153 m

Volume of dredging with 45° inclination = $\frac{1}{2}$ x (12+3) x 4 x 153

= 4,590 m^3

Total volume of sediment can be re-used = 0 m^3

Assuming diffuser pipe with diameter 1500mm to be used, volume of tubes = $\frac{1.5^2 \times PI}{4}$ x 153 = 270 m^3

Granular Fill required to fill the void at the sides of the diffuser tubes = 4,590 - 270 = 4,320 m^3

Backfill left from above pipeline excavation = 402 m^3

Extra backfill to be imported = 4,320 - 402 = 3,918 m^3

Based on the Marine GI result at the proposed dredging area sediment shows no contamination, therefore,

(ii) Volume reuse on site(as above) = 402 m^3
(iii) Volume import to site(as above) = 3,918 m^3
(vi) Volume disposal at to open sea = 4,590 m^3

Plant Site

Building/ Facility [3]	Length(m)	Width(m)	Area(m^2)	Below Ground Level (m)	Foundation excavation(m)	Volume of excavation(m^3)
Incoming Switcher Room	40	10	400	0	2	800
132kV Substation	36	18	648	0	2	1,296
Chemical Building	78	45	3,510	0	2	7,020
Maintenance Workshop	34	13	442	0	2	884
Standby Generator & Switchgear Room	9	9	81	0	2	162
Sodium Hypohclorite Storage Tanks	20	14	280	0	2	560
Sodium Hypohclorite Dosing Station	17	12	204	0	2	408
Visitor/ Admin/ Lab	36	29	1,044	0	2	2,088
Clarifier (I)	77	56	4,312	0	2	8,624
Media Filter (I) + Control Room	60	56	3,360	3	2	16,800
SWRO/ Filter Stacked below SWRO Building (I)	104	55	5,720	6	2	45,760
Chlorine Storage (I) and (II)	82	34	2,788	0	2	5,576
Sludge Thinkeners	39	39	1,521	0	2	3,042
Sludge Filter Press Building	47	35	1,645	0	2	3,290
Post Treatment (I)	35	29	1,015	0	2	2,030
Chlorine Contact Tank (I)	34	25	850	9	2	9,350
Inlet Pumping Station	46	33	1,518	12	2	21,252
Treated Water Pumping Station	61	13	793	11	2	10,309
Underground Clear Water Storage Tank (I)	25	20	500	11	2	6,500
					Total	145,751

Volume of excavation for bore-piles

Assuming a total no. of 210 bore piles are needed for whole plant, with 2.5m diameter and 40m depth,

Total volume = 1/4 x 2^2 x π x 40 x 210

= 37110 m^3

Volume of excavation for soil-nail

Assuming a total no. of 517 nos. of soil nails are need for slope mitigation works with the size about 0.6 x 0.6 x 0.3

Total Volume = 0.6 x 0.6 x 0.3 x 517

= 56 m^3

Total volume of excavation = 145,751 + 37,110 + 56

= 182,917 m^3

Note:

1. All Dimensions measured from Drawing No. 178901/B/PDR/40003)
2. The underground clear water storage tank is 11m deep in the ground.
3. All buildings are assumed to be built on deeper(2m thick) base slab to enchance spreading of loads.

Plant Site

Total volume of excavation	=	182,917 m^3						
Based on the Geological Profile of the Site Area in Site Investigation Report (8901/B&V/0034)								
Assume 30% of unsuitable material	=	30%	x	182,917				
	=	54,875 m^3						
Assume 5% as non-inert C&D waste from 30% of unsuitable material	=	5%	x	54,875				
	=	2,744 m^3						
Assume 5% as low quality rock from 30% of unsuitable material	=	5%	x	54,875				
	=	2,744 m^3						
Assume 5% of total excavation as Grade I/ II Granite during pilling	=	9,146 m^3						
Total volume of material can be used as backfill	=	182,917	-	54,875	-	9,146		
	=	118,896 m^3						
Total backfill material needed	=	0 m^3						
Backfill material in excess	=	118,896	-	0				
	=	118,896 m^3						
Therefore:								
(i) Total volume excavated	**=**	**182,917 m^3**						
(ii) Volume reuse on site	**=**	**0 m^3**						
(iii) Volume import to site	**=**	**0 m^3**						
(iv) Volume delivery to public fill	**=**	**182,917**	**-**	**2,744**		**=**	**180,173 m^3**	
(i) Volume disposal at landfill	**=**	**2,744**						

Based on the Geological Profile of the Site Area in Site Investigation Report (8901/B&V/0034), a layer of marine clay is identifed at the northern boundary of the site and may excavate during the pilling works

Thickness of layer	=	7 m
No. of pile impacted	=	25 nos.
Volume of marine sediment will be excavated	**=**	**859 m^3**

C&D Material Management - Baseline Quantities for Desalination Plant Phase I

	Baseline Quantity (m^3)				Year			
	Mainlaying	Intake & Outfall	Plant Site	Total	2017	2018	2019	2020
Gross total C&D Material Generated								
(a) Inert C&D material (soft public fill)	41,997	952	168,284	**211,232**	66,832	66,832	66,832	10,737
(b) Grade I/II Granitic Rock	0	0	9,146	**9,146**	3,049	3,049	3,049	0
(c) Rock other than Grade I/ II Granite	368	79	2,744	**3,190**	1,026	1,026	1,026	112
(d) Broken concrete	0	0	0	**0**	0	0	0	0
(e) C&D waste	368	0	2,744	**3,112**	1,007	1,007	1,007	92
(f) Marine dredged sediment	0	6,330	1,016	**7,346**	3,673	3,673	0	0
Total	42,733	7,361	183,933	**234,026**	75,586	75,586	71,913	10,941
	18%	3%	79%		32%	32%	31%	5%
Surplus C&D Material Generated (Gross Total minus Reuse on Site):								
(a) Inert C&D material (soft public fill)	16,036	0	168,284	**184,320**	60,104	60,104	60,104	4,009
(b) Grade I/II Granitic Rock	0	0	9,146	**9,146**	3,049	3,049	3,049	0
(c) Rock other than Grade I/ II Granite	368	79	2,744	**3,190**	1,026	1,026	1,026	112
(d) Broken concrete	0	0	0	**0**	0	0	0	0
(e) C&D waste	368	0	2,744	**3,112**	1,037	1,037	1,037	92
(f) Marine dredged sediment	0	6,330	1,016	**7,346**	3,673	3,673	0	0
Total	16,772	6,409	183,933	**207,114**	68,889	68,889	65,216	4,213
	8%	3%	89%		37%	33%	31%	2%
Imported Fill Material:								
(a) Inert C&D material (soft public fill)	0	4,273	0	**4,273**	2,136	2,136	0	0
(b) Rock (excluding armour)	-	-	-	**NIL**	-	-	-	-
(c) Sand fill	-	-	-	**NIL**	-	-	-	-
Total	0	4,273	0	**4,273**	2,136	2,136	0	0
	0%	100%	0%		50%	50%	0%	0%

Notes and assumptions:

1. Construction of water mains will be evenly distributed from 2017 to 2020.
2. Excavation work of site plan will be done by 2018, assuming 50% of excavation will be done in 2017 and in 2018 respectively.
3. The existing area for plant site formation are formed by reclamation of public fill.
4. In the plant site excavation materials, 10% are Grade I/ II Granite from pilling works.
5. No broken concrete will be generated form the whole construction phase.

Table 1. Estimated Quantities of Different C&D Materials Generated

(Note: Round up figures of bulk volume used)

Material	C&D Materials (m^3)	Reused on Site (m^3)	Disposed off Site (m^3)
Phase I			
Inert C&D material (soft public fill)	211,232	26,912	184,320
Grade I/II Granitic Rock	9,146	0	9,146
Rock other than Grade I/II Granite	3,190	0	3,190
Broken concrete	0	0	0
C&D waste	3,112	0	3,112
Total Volume (m^3)	**226,680**	**26,912**	**199,768**
Total Weight (tonnage)*	**475,345**	**53,824**	**405,704**

** - Converted by figures from WSD Vetting Committee on C&DMM's memo (Ref. (3) In WSD 1421/58/02 Pt. 17 TJ (1) dated 9 December 2010*

in-situ densities of rock and soil to be 2.5 tonnes/m^3 and 2.0 tonnes/m^3 respectively

densities of imported rock and soil to be 2.0 tonnes/m^3 and 1.8 tonnes/m^3 respectively

Table 2 Method and Programme of Disposal of C&D Materials and Import of Fill Material

(Rounded to nearest hundredth place)

		Estimated quantity of generated C&D materials and imported fill materials		
		In-situ Volume (m^3)	Weight (tonne)	Bulk Volume (m^3)
2017				
Re-used	Inert C&D material (soft public fill)	6,700	13,500	7,500
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
Disposed off site to public filling areas	Inert C&D material (soft public fill)	60,100	120,200	67,300
	Grade I/II Granitic Rock	3,000	7,600	3,400
	Rock other than Grade I/II Granite	1,000	2,600	1,100
	Broken concrete	0	0	0
Disposed off site to landfill	C&D waste	1,000	2,100	1,200
Disposed off site to open sea	Marine dredged/excavated sediment	3,600	7,900	4,000
Import fill	Inert C&D material (soft public fill)	2,100	4,300	2,400
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
2018				
Re-used	Inert C&D material (soft public fill)	6,700	13,500	7,500
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
Disposed off site to public filling areas	Inert C&D material (soft public fill)	60,100	120,200	67,300
	Grade I/II Granitic Rock	3,000	7,600	3,400
	Rock other than Grade I/II Granite	1,000	2,600	1,100
	Broken concrete	0	0	0
Disposed off site to landfill	C&D waste	1,000	2,100	1,200
Disposed off site to open sea	Marine dredged/excavated sediment	3,600	7,900	4,000
Import fill	Inert C&D material (soft public fill)	2,100	4,300	2,400
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
2019				
Re-used	Inert C&D material (soft public fill)	6,700	13,500	7,500
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
Disposed off site to public filling areas	Inert C&D material (soft public fill)	60,100	120,200	67,300
	Grade I/II Granitic Rock	3,000	7,600	3,400
	Rock other than Grade I/II Granite	1,000	2,600	1,100
	Broken concrete	0	0	0
Disposed off site to landfill	C&D waste	1,000	2,100	1,200
Disposed off site to open sea	Marine dredged/excavated sediment	0	0	0
Import fill	Inert C&D material (soft public fill)	0	0	0
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0
2020				
	Inert C&D material (soft public fill)	6,700	13,500	7,500
	Grade I/II Granitic Rock	0	0	0

		Estimated quantity of generated C&D materials and imported fill materials		
		In-situ Volume (m^3)	Weight (tonne)	Bulk Volume (m^3)
Re-used	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	Inert C&D material (soft public fill)	0	0	0
Disposed off site to public filling areas	Inert C&D material (soft public fill)	4,000	8,000	4,500
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	100	300	100
	Broken concrete	0	0	0
Disposed off site to landfill	C&D waste	100	200	100
Disposed off site to open sea	Marine dredged/excavated sediment	0	0	0
Import fill	Inert C&D material (soft public fill)	0	0	0
	Grade I/II Granitic Rock	0	0	0
	Rock other than Grade I/II Granite	0	0	0
	Broken concrete	0	0	0
	C&D waste	0	0	0