3 PROJECT DESCRIPTION

3.1 The Project

The Project is classified as a Designated Project under the Environmental Impact Assessment Ordinance (Cap. 499) (EIAO). The works that are the subject of the EIA Study include the construction and operation phases of the Project. The key components of the Project include the following:

- Construction of a new desalination plant in TKO Area 137 with a capacity of 135 million liter per day (Mld), expandable to 270Mld in the future (*Schedule 2, Part I, Item E.2*).
- Natural slope mitigation works consists of soil nailing, construction of flexible barrier and rock/boulder stabilization works at the natural slope within the Clear Water Bay Country Park (*Schedule 2, Part I, Q.1*).
- Storage of chlorine, carbon dioxide and other chemicals on site *(Schedule 2, Part I, Item K.13* – A dangerous good godown with a storage capacity exceeding 500 tonnes).

3.2 Project Design

The components and project layout for the proposed desalination plant will not be procured until the Detailed Design Phase, which will commence once the EIA has been approved. Therefore, a description of the likely components, project layout and their installation is provided in this EIA Report together with any alternatives (if necessary) and corresponding methods of installation. The assessment of environmental impacts will correspond to the component or process option giving rise to the maximum perceive impact.

The preferred scenario/ alternatives for the construction of desalination plant and installation of submarine pipelines and truck feed system to be taken forward in this EIA are described in *Section 2*. On the basis of the alternatives selection, the layout plan for the proposed developments is shown in ***Figure 3.1***. The desalination plant location, slope mitigation works and pipeline route are illustrated in ***Figure 1.1***, which are indicative only and will be confirmed during the Detailed Design Phase of the Project.

3.3 Project Components

The proposed Tseung Kwan O desalination plant is a Seawater Reverse Osmosis (SWRO) plant. SWRO is a mature and preferred technology, which dominates the market due to its reliability and progressive reduction in cost as the technology advances. The desalination plant comprises the following major facilities:

- Seawater intake system
- Pre-treatment system
- Reverse Osmosis (RO) treatment system

- Post-treatment system
- Backwash and chemical cleaning system
- Sludge handling system
- Concentrate discharge system
- Auxiliary systems

3.4 Construction of Project

3.4.1 Land-based Works

Desalination Plant

The construction works involved in this project include Civil & Structural works, E&M works and Building Services works. For foundation, piling is required since the site is a reclamation area with deep level of rock head. Bore-piling is preferred since it is a non-displacement piling method, which produces less noise and ground vibration then the other displacement piling methods.

In order to suit with hydraulic requirement of the process, some facilities are required to be constructed below the ground level and therefore, excavation for underground structures like basements and pile caps is required. Tradition excavation and cast-in-situ concreting will be adopted for pile caps, basements and superstructures constructions.

For E&M and Building Service works, general fixing and installation of treatment plants and facilities such as SWRO skid, high pressure pumps and small sized utilities installations such as pipe-laying, ducting and cabling will be conducted. As such, apart from Civil & Structural works, all the works involved in the Desalination Plant are considered to create no adverse impact to the environment.

Slope Mitigation Works

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 soil and rock stabilization works and provision of flexible debris barriers may be required to protect the new desalination plant for the landslide and boulder hazards from this slope. ***Figure 3.2*** shows the indicative area of potential landslide slope mitigation works.

For soil and rock stabilization works, temporary scaffolding, ladders and working platforms will be erected to provide access to the slope face. Soil nails and rock dowels will be installed in drill holes (typically 100 or 150mm diameter to a depth typical 4 to 8m for soil nail; 75mm diameter to depths 3 to 5m for rock dowels) into the lower portion of natural slopes within the country park area. Soil nails and rock dowels will be grouted, and the soil heads will be excavated and concreted. Soil bags with applied seeds will be placed on the affected soil slope. Some localized loose boulders and rocks will be stabilized by rock dowelling and providing buttresses on the base of the boulders/ rocks to prevent them from initiating movements down the slope.

The construction of flexible barrier at the toe and lower portion of the natural slope will involve the erection of tensioned steel meshes that are 4 to 5 m high across steel posts supported on foundation plates. The foundation (typically 600mm sq. and 500mm deep) will be made of concrete and will be formed by drilling into soil/rock using drill rigs erected on temporary working platforms. Similar foundation plates will also be constructed for anchoring of stay wires. The steel posts will be erected over the foundation plates by threading the stay wires. The wire mesh will then be pulled out and fixed to the top wire between the steel posts. The stay wires will also be tied from the top of the posts to the foundation plates.

The flexible barrier will align in alternative segments on either sides of the intended alignment, such that gaps between segments of the barriers will allow passage of wildlife. Temporary ladders will be provided for accessing the works area. In addition, construction materials will be lifted up using mobile cranes (with arms up to 35m) located at the temporary working platforms in front of the slope. No permanent access will be provided for the slope mitigation works. Temporary ladders will be erected during future maintenance works, if any.

Climbers, creepers and suitable replanting will be provided on and around the flexible barriers to restore the natural ground. Recessed soil nail heads with soil bags will allow regrowth of vegetation on the hillside surface. The affected soil slope will be restored with hydro-seeding and planting in order to provide greening effect. The detailed scheme of slope mitigation works is illustrated in ***Figure 3.3***.

While such mitigation works may be required to be implemented within 0.49 ha of the Clear Water Bay Country Park, the mitigation works will be avoided and minimized as far as practicable to minimize any potential environmental impact to the Country Park.

Trunk Feed System

Since the fresh water rising mains will be constructed along the carriageway to the TKOFWPSR, most of the delivery pipes will be constructed by cut and cover method. Cut and cover method is a common construction method for pipe laying by excavating the ground and backfill after laying the pipe. The construction mainlaying for the trunk feed system will be carried out for about 45 months. The fresh water main will be constructed in small sections using open cut method. The method involves soil excavation works and backfilling in small sections (ie, 40 m) to minimize the volume of excavated materials and number of construction plant to be deployed.

If the road sections or road junctions are not available for cut and cover method because of heavy traffic, trenchless method, such as pipe jacking by micro-tunnelling, will be adopted. The proposed location for using trenchless method is indicated on ***Figure 3.4***.

New freshwater mains must be cleaned and sterilized before being put into operation. Typically, water mains are sterilized by chlorination. The purpose of chlorination is to disinfect the water main, resulting in an absence of coliforms as confirmed by laboratory analysis, before they are placed in service. Chlorine solutions are normally used as the sterilizing agent. Procedures specified in WSD Departmental Instruction

No. 805: *Mainlaying - Cleaning and Sterilization of Fresh Water Mains* will be followed for the main sterilization works. Water used to clean the pipes would be properly treated to remove any solid flushed from the pipes before discharge to public sewer. Chlorine solution would also be dechlorinated to reduce total residual chlorine level to below 1 mg/L before disposal to public sewer.

3.4.2 Marine Works

It is anticipated that open onshore intake or submerged intake (approximately 200m – 250m long) and outfall pipes (approximately 300m - 350m long) will be constructed. Intake and outfall will be constructed with trenchless technologies. While minor dredging works will be limited to ~50m x 50m for the construction of intake structures and ~150m x 50m for the diffusers, dredging works will be minimized as far as practicable to avoid or reduce any potential environmental impacts. Furthermore, prefabricated intake and outfall structures (e.g. intake openings and diffuser heads) will be transferred and installed onsite.

Rock fill materials with low fines content will be used to provide support and protection to the systems.

3.5 Project Operation

Seawater will be drawn from the seawater intake system for the desalination process. Chlorine in form of hypochlorite is dosed periodically into the intake seawater for control of microbial growth at the intake and the associated screening system.

Seawater will be delivered to the pre-treatment system for pre-treatment by clarification followed by filtration prior to the Seawater Reverse Osmosis (SWRO) process. Coagulant/polymer will be added to feed water for coagulation and flocculation. Residual chlorine left over from the intake chlorination will be removed by dechlorination process. Process waste streams will be generated from the pre-treatment processes. The process waste streams will include sludge from clarifiers and backwash waste from filters (also known as residual streams).

High pressure feed pumps will drive the seawater through the RO system. The pressurized seawater will be split into two streams, a low pressure permeate stream (product stream) and a high pressure concentrate stream (RO concentrate or waste stream) which is the rejected flow from the RO membranes. The permeate produced in the RO system will be passed into the post-treatment system prior to pumping into the distribution system for potable water uses. The RO membranes will require cleaning with chemicals (i.e. clean-inplace or CIP) on periodic basis. The waste generated from the RO cleaning process is neutralized and treated to appropriate level before discharge to public sewer.

Post-treatment processes will include disinfection using chlorine and fluoridation, pH correction and remineralisation via hydrated lime and carbon dioxide dosing. A typical Process Flow Diagram of a SWRO desalination plant is illustrated in ***Figure 3.5***.

As described above, a number of chemicals are required for the efficient and effective operation of the desalination plant. The actual chemical dosing regime will be assessed in *Section 6 Water Quality* of this EIA study. Chemicals that may be dosed in the water stream for main treatment are summarized in ***Table 3.1***.

Table 3.1 Chemicals that may be Dosed in the Potable Water Stream

Chemical	Purpose
Sodium Hypochlorite	Pretreatment - Bio growth control
Ferric Chloride or Alum	Pretreatment - Coagulation
Sulphuric Acid	Pretreatment - pH Adjustment
Polymer	Pretreatment - Flocculation
Sodium meta Bisulphite	Pretreatment - Dechlorination
Antiscalant	RO membranes - Scaling control
Sodium Hydroxide	RO membranes - pH adjustment (if required)
Carbon Dioxide	Post Treatment - pH adjustment and remineralisation
Hydrated Lime	Post Treatment - pH adjustment and remineralisation
Sodium Silicofluoride	Post Treatment - Fluoridation
Liquid Chlorine	Post Treatment - Final disinfection
Polymer	Sludge Conditioning - Sludge Thickening/Dewatering

In addition to the above chemicals the cleaning chemicals for RO include sodium hydroxide, citric acid, hydrochloric acid, and sodium laurel sulphate. Chemical cleaning of RO membranes are typically carried out once a month. Such cleaning waste will be neutralized and treated appropriately to stabilize the pH before discharge to public sewer.

Process waste streams, including the concentrate produced as the result of RO process and supernatants from residual processes will be discharged via the concentrate discharge system to the outfall. Wastewater from chemical cleaning would be disposed into public sewer, which leads to the Tseung Kwan O Preliminary Treatment Plant.

In accordance with EPD Waste Disposal Ordinance, sludge generated from clarification and filter backwash will be thickened and dewatered to 30% solids content for subsequent disposal to landfill. Traces of chemicals that are not captured by the sludge generated may be found in the supernatants of these residual processes. Any residual chlorine left in the streams will be quenched (or removed) using sodium meta bisulphite before discharge to the sea through the outfall. RO concentrate will represent a significant portion of these streams (i.e. about 90% of flow). Since RO concentrate is free from particulate contaminants (which are removed in pre-treatment processes), the only constituents that are present are soluble cations/anions. The key constituents that may be found in the RO concentrate discharge stream blended with supernatants from residuals streams are described in detail in *Section 6.8.2* and the associated *Annex 6A*.

3.6 Project Summary

Table 3.2 presents a summary of the project details. The footprint of the proposed desalination plant development at Tseung Kwan O Area 137 will be approximately 10 ha, with the trunk feed system consisting of a 9.5 km of 1,200 mm in diameter of fresh water rising main along Wan Po Road. A maximum total marine dredging volume of 6,330 m^3 (in situ) of marine sediments will be generated from the two submarine utilities. Natural slope mitigation works will be undertaken within 0.49 ha of the Clear Water Bay Country Park.

Table 3.2 Summary of Project Description

Details	Preliminary Design Information
Submarine Utilities	
Area of seabed affected by pipeline footprint	
• Intake	0.045 ha
• Outfall	0.065 ha
Marine Dredging volume (*in situ* volume)	
• Intake	1,740 m^3
• Outfall	4,590 m^3
Rock fill volume (*in situ* volume)	
• Intake	905 m^3
• Outfall	4,320 m^3
Length of Submarine Utilities (m)	
• Intake	~ 200 to 250 m
• Outfall	~ 300 to 350 m
Diffuser	
• Number of discharge port	A total of 36 discharge ports with diameter of 150 mm
• Length of diffuser	152 m with port spacing of 4.2 m
• Configuration	alternating and inclined at 60° to horizontal
Desalination Plant	
Area of foundation occupied by the plant	10 ha
Building parameters	17 components with building height ranged between 2 m to 20 m
Trunk Feed System	
Area of land affected by the freshwater rising mains	1.14 ha
Excavation volume	42,733 m^3
Length of the freshwater rising main	9,500 m
Diameter of the freshwater rising main	1,200 mm
Natural Slope Mitigation Works	
Area of slope mitigation works	0.49 ha within the Clear Water Bay Country Park

3.7 Project Programme

The preliminary construction programme is provided in ***Figure 3.6***.

The *EIAO-TM* specifies the priorities for addressing impacts is avoidance and minimization. This philosophy was referred to in designating the works construction programme by reducing the overall duration of construction works.

The construction for the project will be separated into two major contracts. Package A is for plant and other ancillary facilities and Package B is for mainlaying of the trunk feed. The Package A contract is scheduled to commence in Q3 2017 for completion of the construction in Q3 2020. The Package B contract is scheduled to commence in Q2 2016 for completion of the construction in Q4 2019. The major construction activities for the Project would comprise site clearance, excavation and backfilling, erection of formwork and reinforcement, concreting, fabrication of steelwork, and testing and commissioning.

Figure 3.6 Preliminary Construction Programme of this Project

Year	2016												2017												2018												2019												2020											
Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Package B - Mainlaying																																																										
Section A (Desalination Plant to Shek Kok Rd)																																																										
Section B (Shek kok Rd to Po Shun Rd)																																																										
Section C (Po Shun Rd to TKOFWPSR)																																																										
Package A - Desalination Plant																																																										
Site Clearance and Ground Investigation																																																										
Foundation and Pilling																																																										
Building Works																																																										
Architectural and Landscaping Work																																																										
Submarine Intake and Outfall																																																										
Slope Mitigation																																																										
E&M Installation, Testing and Commissioning																																																										

3.8 Concurrent Projects

At present the identified potential concurrent projects in sufficient proximity of the proposed desalination plant and submarine utilities are the following projects:

Cross Bay Link (CBL), Tseung Kwan O (*EP-459/2013*), the project is to construct an approximately 1.8 km long dual two-lane road mainly on viaduct with a footpath and a cycle track. The Cross Bay Link is located across Joss House Bay at > 3 km from the proposed desalination plant and submarine pipelines. The preliminary construction programme is anticipated between January 2017 and July 2020.

Tseung Kwan O – Lam Tin Tunnel and Associated Works (*EP-458/2013*), the project is to construct a dual two-lane highway connecting Tseung Kwan O at Po Yap Road in the east with Trunk Road T2 in Kai Tak Development in the west and Lei Yue Mun Road Underpass. The project involves a 4.8 km long highway with about 3 km of the highway in the form of a tunnel. The Tseung Kwan O – Lam Tin Tunnel will connect Cross Bay Link to form a new external road link to meet the anticipated traffic flow in connection with further population intake and development in Tseung Kwan O New Town. This project is located at > 4 km from the proposed desalination plant and submarine pipelines. The preliminary construction programme is anticipated between February 2016 and April 2020.

Truck Road T2 (*EP-451/2013*), the project is to construct a dual two-lane trunk road of approximately 3 km long with about 2.7 km of the trunk road in form of tunnel between Cha Kwo Ling and South Apron of the former Kai Tak Airport. The project is located at > 6 km from the proposed desalination plant and submarine pipelines. The preliminary construction programme as per the approved EIA Report is between early 2015 and early 2020.

South East New Territories (SENT) Landfill Extension (*EP-308/2008/A*), the project is to construct and operate of a landfill extension of about 45 hectares with a target void space of about 6.5 million cubic metres on the southern side of the existing SENT Landfill. The infrastructure area of the project is located in the close proximity (about 100m) from the proposed desalination plant. The preliminary construction programme as per the approved EIA Report is between early 2011 and late 2020. However, the programme of the SENT Landfill Extension is uncertain at the moment, but it has been considered as sensitive receivers, where appropriate in this EIA.

Fill Bank at Tseung Kwan O Area 137 (*EP-134/2002/K*), the project is to construct, operate and remove a temporary fill bank covering an area of approximately 104 hectares at Area 137 of Tseung Kwan O. About 10 hectare of the fill bank area is earmarked for the proposed desalination plant which lies along the northwest boundary of the Clear Water Bay Country Park. CEDD has agreed to hand over the 10 ha site cleared of stockpile for the construction of the Project. Based on the latest environmental permit, apart from the 10 hectares project area, the fill bank will be operated until late 2018.

A barging pier at TKO Area 137 for off-loading explosives is operated (TGLA No. SK 567) by the Mines Division of the CEDD. There is a potential for the possible

coexistence of the explosive off-loading facilities with this Project. The potential impacts of the coexistence of the explosive off-loading facilities and the desalination plant are assessed in the hazard to life assessment (*Section 13*).

The MTR Corporation Limited has currently set up a temporary explosive magazine for its Shatin to Central Link and Kwun Tong Line Extension projects at the TKO Area 137. 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. As such no interaction with this Project is expected.