7 SEWERAGE AND SEWAGE TREATMENT IMPLICATION

This Section presents an assessment of impact of sewage discharge to the existing sewerage system in the vicinity of the proposed Desalination Plant and examines the available capacity of the existing sewerage system in accordance with *Section 3.4.5* of the *Study Brief ESB-266/2013*. If there is no existing sewerage system in the vicinity to serve the desalination plant, the technical feasibility of providing a sewage disposal scheme will be assessed. This Sewerage and Sewage Treatment Implications Assessment (SSTIA) demonstrates that the proposed development is viable in terms of its impact on the sewerage system.

7.1 Relevant Legislative Requirements

7.1.1 The site area for the development of the proposed Desalination Plant is currently an exposed area for fill bank operated by CEDD. It is accessible by Wan Po Road. The description of how the site area is intended to be developed is described in *Section 3*.

7.1.2 The sewage flow discharge from the proposed Desalination Plant is based on the following standards, guidelines and reference for the sewerage and sewage treatment design:

- *Technical Memorandum on Effluent Standards (Water Pollution Control Ordinance, Cap. 358 section 21*);
- *Sewerage Manual* published by Drainage Services Department (DSD);
- *EPD Report No. EPD/TP 1/05 Guidelines for Estimating Sewage Flows for Sewerage Infrastructure Planning Version 1.0;* and,
- *Agreement No. CE55/2007 (DS) – Village Sewerage in Tseung Kwan O and Tuen Mun (Ka Loon Tsuen and Lung Kwu Tan).*

7.1.3 The objectives of this sewerage impact assessment are to:

- review and confirm whether the existing/planned sewerage systems and sewage treatment works in TKO District will provide adequate capacity for the Project;
- identify the preliminary appropriate alignment and layouts of the new sewerage to connect to the existing/planned/future sewerage systems in TKO District ; and
- formulate measures to mitigate any forecasted shortfalls in the sewerage system as a result of the project and provide recommendations on the design, operation and maintenance requirements for the proposed sewerage system.

7.2 Assessment Methodology

7.2.1 The SSTIA was undertaken in accordance with the criteria and guidelines for evaluating and assessing impacts on the downstream public sewerage treatment and disposal facilities as states in *Section 6.5* in *Annex 14* of the *Technical Memorandum on Environmental Impact Assessment Ordinance* (*TM-EIAO*). The following methodology was adopted for this SSTIA:

- Investigation of the existing and planned sewerage facilities in the proposed Desalination Plant development area.

- Calculation of the sewage flow generated from the proposed Desalination Plant.
- Investigation of sewage disposal strategy for the proposed Desalination Plant.

7.3 Existing Sewerage Facilities and Planned Sewerage in the Area

7.3.1 The proposed Desalination Plan is within an area where no public sewerage connection is available. Based on the Government's drainage record plan, the existing sewer serves the Television Broadcasts Ltd, Tseung Kwan O Industrial Estate, and LOHAS Park. The collected sewage is then carried to the Tseung Kwan O Preliminary Treatment Works (PTWs) at Shek Kok Road. The existing sewerage network and planned sewerage network are shown in ***Figures 7.1 & 7.2***.

7.4 Estimated Sewage Flow

The quantity of wastewater generated by the proposed Desalination Plant is calculated with reference to *Appendix III* of *Guidelines for Estimating Sewerage Flows for Sewage Infrastructure Planning* (the Guidelines) [1].

7.4.1 The general layout plan of the proposed Desalination Plant is illustrated in *Annex 7A*. The proposed Desalination Plant consists of an administrative building and other associated facilities. The sewage is expected to be generated from administrative building for sanitary use, such as toilet flushing and laundry. The sewage of the desalination plant will be generated by two components, sewage from internal staff, and visitor and neutralized chemical cleaning water from the Reverse Osmosis (RO) system. The sewage flow from the proposed Desalination Plant is calculated based on the assumption listed in ***Table 7.1***.

Table 7.1 Assumptions for Sewage Flow Calculation

Parameters	Unit
Occupied rate of office	100%
Gross Floor Area	3,132 m^2
No. of desalination plant staff	40 (1)
Unit flow staff (J2) (3)	0.33 m^3/day
No. of Visitor	60 (1)
Unit Flow (Student) (2)	0.04 m^3/day
RO Chemical Cleaning (m^3/cleaning)	514.8

(1) The maximum numbers of staff and visitor proposed by the consultant and agreed by WSD.
(2) Assume the Unit Flow generated by Visitor is equal to Student
(3) J2 – Employment categories and Job Types for Electricity, Gas and Water

7.4.2 The duration of the RO cleaning will take about 4-8 hours per cleaning and used cleaning chemical will be neutralised before discharge to public sewer. The neutralised RO cleaning water will be stored temporarily at the neutralisation tank and will be evenly discharged to the public sewer over 4 days. The average daily discharge by RO cleaning is about 128.7 m^3/day.

[1] http://www.epd.gov.hk/epd/english/environmentinhk/water/guide_ref/files/gesf.pdf

7.4.3 The calculations of Average Dry Weather Flow (ADWF) are shown in ***Table 7.2***. The volume of sewage that will be generated by the proposed desalination plant is approximately 144.3 m^3/day.

Table 7.2 Estimated Sewage Flow

Catchment: Desalination Plant	**Visitor**	**Employee (J2)**	**RO Chemical Cleaning**
Number	60	40	-
Unit Flow (m^3/day)	0.04	0.33	-
ADWF (m^3/day)	60 x 0.04 = 2.4	40 x 0.33 = 13.2	128.7
ADWF (m^3/s)	0.00003	0.00015	0.00149
Total Flow (m^3/day)	2.4 + 13.2 + 128.7 = 144.3		
Total Flow (m^3/s)	0.00003 + 0.00015 + 0.00149 = 0.00167		
Contribution Population	(2.4+13.2)/0.27 + 128.7/0.27 = 58+477		
Peak Flow (m^3/s) (Peak factor = 3)(1)	(0.00018 x 3)+0.00149 = 0.00203		
Peak Flow (m^3/s) (Peak factor = 6)(2)	(0.00018 x 6)+0.00149 = 0.00257		

(1) For sewage treatment work (STWs), preliminary treatment works (PTWs) and pumping station (PS) with population below 10,000 and excluding stormwater allowance
(2) For sewer with population below 1,000 and excluding stormwater allowance

7.5 Proposed Sewerage Disposal Strategy

7.5.1 The proposed plant lies within the catchment of the Tseung Kwan O PTWs and is in the vicinity of the urban sewer network in Tseung Kwan O. The estimated sewage generated from the proposed desalination plant is 144.3 m^3/day for ADWF or at a peak flow of 0.00203 (Peak factor (PF) = 3) m^3/s (see ***Table 7.2***). This is equivalent to about 0.03% of the design capacity of the Tseung Kwan O PTWs (design capacity of 6.85 m^3/s (1)). In view of the small volume of flow, it is unlikely that the Tseung Kwan O PTWs will be overloaded upon plant's commissioning.

7.5.2 It is proposed that sewage generated from the proposed desalination plant will be discharged by a new sewerage system (which may be gravity sewer or pumping station with rising mains). The new sewerage system will be connected to the existing 600 mm diameter trunk sewer along Wan Po Road. The estimated sewage generated from the proposed desalination plant is 144.3 m^3/day (ADWF), or a peak flow of 0.00257 m^3/s (PF =6) (see ***Table 7.2***). This is equivalent to about 1.35% of the design capacity of the existing sewer (design capacity of 0.19 m^3/s (2)). On this basis, the calculations indicate that this small increase will not lead to overloading of the downstream sewers as well as Tseung Kwan O PTWs.

7.5.3 Details of hydraulic calculation are enclosed in *Annex 7B.*

(1) Annex 3 of Appendix X - Part 2 of EPD/TP 1/05 Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0.

(2) This is adopted from the Utillity Record from Drainage Service Department (DSD)

7.5.4 A hydraulic model of the sewerage network of the TKO catchment has been adopted to examine the hydraulic performance of the downstream 600 mm diameter sewer along Wan Po Road under ultimate scenario. The sewerage hydraulic model was developed on the sewage catchment of Tsuen Kwan O under *Agreement No. CE55/2007 (DS) – Village Sewerage in Tseung Kwan O and Tuen Mun (Ka Loon Tsuen and Lung Kwu Tan)*. Under CE55/2007 (DS), various design scenarios were assessed, which include design years of 2008, 2016, 2021, 2031 and ultimate development scenario. The population estimate for the adopted hydraulic model was based on the 2006-based Territory Population and Employment Data Matrix (TPEDM). The ultimate development scenario of the hydraulic model is adopted for the hydraulic calculation of this EIA Study.

7.5.5 Results from the hydraulic model indicate that maximum depth along the downstream 600 mm diameter sewer arising from the discharge of the proposed project would only be increased by approximately 0.003 m with sufficient freeboard (> 1m) along the sewer. Result tables and hydraulic model are enclosed in *Annex 7C*.

7.5.6 The plant lies within the catchment of Tseung Kwan O PTWs. Discharge of sewage directly via a sewerage system to the PTWs is a feasible option and is in line with Government's sewage treatment and disposal strategies. The rationale is that it would tie in with the long term objective of the Victoria Harbour water pollution control strategy to reduce the pollution load to Victoria Harbour.

7.5.7 The preliminary proposed strategy involves construction of buried pipes to connect to the existing sewer at underneath Wan Po Road by gravity sewer. Future sewer network will have connection at an existing manhole (FMH4035449) under Wan Po Road (***Figure 7.2***). Wayleaves along the public road will be required for construction of the proposed connection sewer. The full section of the connection sewer will run along government land. It is not envisaged that requisition of private lot would be required for construction nor future operation. In summary, the proposed strategy is considered viable in terms of land.

7.5.8 The proposed strategy involves discharge to public sewers via new sewer constructed. In view of the small volume of flow, it will have insignificant environmental impact as the full section of the sewer will be laid underground.

7.5.9 Construction of the section of gravity sewer from the plant to connect with the existing public sewer *(**Figure 7.2**)* would mainly involve conventional technology such as cut and cover excavation techniques. There is no significant constraint in terms of complexity by general civil contractors.

7.5.10 The sewerage facilities provided as part of the proposed plant will be maintained by the government after completion. No specific maintenance operations are envisaged but it is considered desirable that the facilities will be inspected regularly to ensure that these sewers can function properly. The maintenance responsibility of those proposed sewerage facilities will be confirmed with relevant authorities in the detailed design stage of this project.

7.6 Mitigation Measures

7.6.1 As discussed in *Section 7.5*, the sewage flow generated from the proposed Desalination Plant is smaller than the flow allowed in Tseung Kwan O PTWs and the existing sewerage system are adequate for the proposed development, thus no adverse impact to the local sewerage network is anticipated, which should have sufficient capacity to cater for the sewage flow generated from the proposed Desalination Plant.

7.6.2 The design of the gravity sewer should follow the guidelines stipulated in:

- Stormwater Drainage Manual by DSD
- Sewerage Manual Part 1 & Part 2 by DSD
- Drainage Services Department Standard Drawings

7.6.3 The proposed sewerage system will be constructed by WSD during the construction period and the system will handover to DSD for further maintenance. The detailed design of the proposed sewerage system should be circulated to DSD, EPD and other relevant parties for comment during planning and detailed design stage to ensure acceptance by relevant parties. Access for sewers, equipment and personnel for maintenance of the works should be adequately provided. The maintenance responsibility of those proposed sewerage facilities will be confirmed with relevant authorities in the detailed design stage of this project.

7.6.4 Some general design guidelines for the sewerage system design are summarized as below.

7.6.5 The gravity sewer should be designed to avoid under surcharge condition. 1m freeboard should be provided if surcharge condition cannot be avoided. The flow velocity of the sewer should be not less than 1m/s under full bore flow for self-cleansing purpose. The maximum velocity should be limited to 3m/s. The structural and bedding design of the sewer should in accordance with *Section 6* of the *Sewerage Manual Part 1*.

7.6.6 The design of manhole should be in accordance with *Section 7* of *Sewerage Manual Part 1* and manhole should be provided at intersection of sewers, location where sewer changes location and junction between different size/gradient of sewers.

7.7 Environmental Monitoring and Audit

7.7.1 With the implementation of the proposed sewerage system according to the requirements stated in *Section 7.6*, no sewerage or sewage treatment implications are anticipated. No specific sewerage monitoring programme is thus required for the proposed Desalination Plant.

7.8 CONCLUSION

7.8.1 The proposed strategy, discharge of sewage directly via a sewerage system to the Tseung Kwan O PTWs, is considered feasible in terms of regional sewerage strategy, land, environmental impact and construction considerations. The proposed plant is considered sustainable in terms of sewerage.

7.8.2 The configuration and alignment of the proposed new sewerage system will be confirmed in the detail design stage of this project, while the infrastructure design especially the road alignment and sewerage system of TKO Area 137 is proposed. Gravity sewer is a preferable option in term of cost-benefit consideration by constructing the sewer from the plant to connect the existing manhole.

7.8.3 Based on the above, there is no unacceptable sewerage impact would be anticipated to the existing sewerage system arising from the proposed Desalination Plant.