

## 6 Sewerage and Sewage Treatment Implications

### 6.1 Introduction

This section presents the assessment of impacts on the sewerage system, sewage treatment and disposal arising from the Project, in accordance with the requirements specified in Section 3.4.5 and Appendix E of the EIA Study Brief (ESB-276/2014).

The construction phase sewerage impacts generated by the workforce are considered separately as part of the potential water quality impacts in *Chapter 5*. A sewerage impact assessment (SIA) was undertaken to determine and assess the operation phase sewerage impacts of the Project.

### 6.2 Environmental Standards and Guidelines

The sewage flows generated by the Project have been estimated using the following standards and guidelines:

- Sewerage Manual (Drainage Services Department)
- Guidelines for Estimating Sewage Flows (GESF) for Sewerage Infrastructure Planning, Environmental Protection Department (EPD) Report No. EPD/TP 1/05, Version 1.0, 2005.

### 6.3 Assessment Methodology

The assessment has been conducted in accordance with the guidelines listed in Section 6.2, as well as Section 6.5 of Annex 14 of the EIAO-TM to ensure the impacts on the downstream sewerage system, sewage treatment works and disposal facilities are adequately considered.

The following approach and methodology was adopted to assess the impacts on the existing sewerage system and treatment capacity of sewage treatment facilities:

- Investigate the existing sewerage infrastructure and sewage flows
- Determine the sewage flows to be generated by the Project and identify spare capacities
- Assess the potential impacts of Project-related sewage flows on the existing sewerage infrastructure
- Identify suitable measures to mitigate the impacts on the sewerage infrastructure.

### 6.4 Existing Sewerage Conditions

The current use of the Project area is a mixture of temporary structures and pig farming (agriculture). The Project site is not currently served by the public sewerage network, instead a septic tank is used to collect the sewage generated by the estimated 5 Nos. villagers, 5 Nos. agricultural employees and the 600 animals at the pig farm. The surrounding wastewater catchment is served by the Shek Wu Hui Sewage Treatment Works (SWHSTW). The existing sewage flows are estimated using the following unit flow factors (UFF):

- Villagers – 0.27 m<sup>3</sup>/day (per person)<sup>1</sup>
- Agricultural employees – 0.08 m<sup>3</sup>/day (per person)<sup>1</sup>
- Pig farm – 0.015 m<sup>3</sup>/day (per animal)<sup>2</sup>.

The total estimated sewage flows currently arising from the Project site are 10.75 m<sup>3</sup>/day.

The existing police training facilities are also served by SWHSTW including Lo Wu and Ma Tso Firing Ranges, Police Driving and Traffic Training Facilities (PD&TTF), Weapons Training Facilities at Fan Garden and Helipad at Lo Wu Firing Range.

The closest public sewer to the Project site is a 250mm diameter rising main running from the NENT sewerage scheme to SWHSTW as shown in **Figure 6.1**, situated approximately 1 km southwest of the Project site along the Man Kam To Road. The rising main is served by several pumping stations, the closest of which is Sha Ling leachate pumping station No. 3 (PS3), with an installed pumping capacity of 56 l/s.

## 6.5 Estimation of Project-related Sewage Flows

### 6.5.1 Assumptions and Parameters

#### 6.5.1.1 Unit Flow Factor (UFF)

The UFF adopted to estimate the sewage flows for the 536 proposed users, staff and trainees of the Project facilities during the operation phase is 0.28 m<sup>3</sup>/person/day. The value of the UFF was based on category J11 in EPD's GESF Appendix V Annex 1, in view of the flow from 'Government facilities – Others' is classified as J11 trade discharge.

#### 6.5.1.2 Catchment Inflow Factor (Pcif)

In the absence of an existing sewerage system at the Project site, catchment inflow factors (Pcif) such as infiltration of water or sewage are not considered relevant in the estimation of planned sewerage flows. Pcif is therefore not considered to be applicable to new sewerage systems, and a factor of 1 has been applied.

#### 6.5.1.3 Peaking Factors

Peaking factors account for seasonal and diurnal variations in sewage flows with an allowance for infiltration. In accordance with the GESF, the peaking factors adopted for the estimation of sewage flows are presented in **Table 6.1**.

<sup>1</sup> Unit Flow Factor derived from EPD's Guidelines for Estimating Sewage Flows (GESF).

<sup>2</sup> Unit Flow Factor for pig farming activities of 15 litres per animal/day as cited in Section 3 of the "Code of Practice – Livestock Waste Management". Environmental Protection Department, Hong Kong SAR Government, 2002.

Table 6.1: Peaking Factors Adopted to Estimate Project-related Sewage Flows

Population Range	Peaking Factor (excluding Stormwater Allowance) for facility with existing upstream sewerage
<b>Sewers:</b>	
< 1,000	6
<b>Sewage Treatment Works, Preliminary treatment Works and Pumping Stations:</b>	
< 10,000	3

Source: Derived from GESF – EPD, 2005

Notes: N = Contributing population in thousands.

Where,

$$\text{Contributing Population} = \frac{\text{Calculated Total Average Flow (m}^3/\text{day)}}{0.27 \text{ (m}^3/\text{day)}}$$

A concurrent project with an approved EIA report, Organic Waste Treatment Facilities - Phase 2 (OWTF2) (AEIAR-180/2013), is proposed in an area adjacent to the Project site. This project will generate sewage flows during its operation requiring a connection to PS3 for transfer to SWHSTW for treatment. A peaking factor of 2 has been assumed for these proposed sewage flows and is accounted for in the flow estimation.

## 6.5.2 Sewage Flow Estimation

The Project site will comprise a 19 ha development area to be used by approximately 192 staff and 344 police trainees. As a result, the Project will generate additional sewage flows to the SWHSTW sewerage catchment, and as the area is currently unsewered, a new connection is required to the existing sewerage system.

The calculated sewage flows for the Project are presented in **Table 6.2** and the design parameters adopted are discussed in **Section 6.5.1**.

Table 6.2: Sewage Flows for the Project

Project Component	Population Type	Population Number	ADWF (m <sup>3</sup> /day)	Peak Flow <sup>1</sup> (l/s)
Lo Wu Firing Range	Staff	10	21.00	1.46
	Trainee	65		
Ma Tso Firing Range	Staff	5	5.88	0.41
	Trainee	16		
Police Driving and Traffic Training Facilities at Fan Garden	Staff	82	40.60	2.82
	Trainee	63		
Weapons Training Facilities at Fan Garden	Staff	35	37.80	2.62
	Trainee	100		
Proposed Police Training Facility	Staff	35	37.80	2.62
	Trainee	100		
Helipad at Lo Wu Firing Range	Staff	25	7.00	0.49
	Trainee	0		
<b>Total</b>		<b>536</b>	<b>150.08</b>	<b>10.42</b>

Note:

<sup>1</sup>A peaking factor of 6 has been applied to sewage generated by the Project.

The average dry weather flows (ADWF) from the Project site are estimated to be 150.08 m<sup>3</sup>/day, or 1.74 l/s, and the peak sewage flows are estimated at 900.46 m<sup>3</sup>/day, or 10.42 l/s.

## **6.6 Evaluation of Sewerage Impacts**

### **6.6.1 Capacity of the Sewerage System**

#### **6.6.1.1 New Sewer from the Project Site**

The existing septic tank facilities at the Project site are not considered suitable for the requirements of the Project, therefore a new sewer to convey sewage flows to the existing public sewerage system for treatment at an STW is required.

The sewage flows generated by the Project will be transferred via a new approximately 1.5km sewer pipeline to the upgraded PS3 and conveyed to SWHSTW for treatment, as shown in **Figure 6.2**. Sewage will be transferred from the terminal manhole at the Project site via a new SPS and associated twin 100 mm diameter rising mains, connecting to a new gravity sewer where the topography allows. This will convey flows to PS3 located along the existing rising main to SWHSTW on Man Kam To Road.

The proposed Project sewer will interface with the proposed sewer from EPD project OWTF2 (Agreement No. CE34/2011(EP)) approximately 1 km along Kong Nga Po Road from Man Kam To Road, contributing a peak flow of 6.25 l/s and requiring a communal sewer along this section. The communal sewer pipeline would be sized to accommodate sewage flows generated from both projects (a combined peak flow of 16.67 l/s), as agreed with EPD, with a diameter of 300 mm. The proposed sewer pipeline hydraulic calculations are provided in **Appendix 6.1**.

This communal sewer will be installed by either CEDD under this Project or by EPD (under the OWTF2). Further liaison with the works agent of OWTF2 will be carried out during the detailed design stage.

#### **6.6.1.2 PS3 and Existing Rising Main**

The existing PS3 and associated rising main to SWHSTW does not currently have sufficient capacity to pump the additional flows generated by the Project and the OWTF2 Project, a combined peak flow of 16.67 l/s, therefore upgrade works are required. Upgrades to the existing PS3 and rising main will be managed by DSD under a separate ongoing contract (Agreement No. CE1/2015(DS)) and the additional flows generated by the Project will be incorporated into both upgrade designs, as agreed by DSD.

The tentative construction programme for the upgrade works under CE1/2015(DS) is scheduled to commence in 2018 for completion by 2023. Close liaison will be maintained between CEDD and DSD on the programming of the upgrading works. In the event of a programming mismatch, a contingency measure could be implemented whereby sewage flows generated by the Project are discharged to the sewer during non-peak hours, to avoid overloading PS3 during peak hours. Details of the contingency measures

including a contingency plan, if required, will be determined during detailed design stage when further details of the construction programme for CE1/2015(DS) are available.

### 6.6.2 Capacity of the Shek Wu Hui Sewage Treatment Works

The sewage flows from the components of the Project that are existing and are to be co-located as part of this Project were all considered in the approved EIA report for the North East New Territories New Development Areas (NENT NDA) (AEIAR-175/2013). As part of the Project, the sewage flows have been estimated to show the differences between the reserved sewage flows in the NENT NDA EIA, and the estimated average dry weather flows (ADWF) for the Project. **Table 6.3** summarises these sewage flow allocations, which are expected to remain consistent throughout the operation stage of the Project, projected from the year 2022 and beyond.

**Table 6.3: Summary of Sewage Flows generated by the Project to SWHSTW**

Project Component	Relocated or New Population	ADWF (m <sup>3</sup> /day)	Reserved Flow (m <sup>3</sup> /day)	Additional Flow (m <sup>3</sup> /day)
Lo Wu Firing Range	Relocated	21.00	75.60	-54.60
Ma Tso Firing Range	Relocated	5.88	8.40	-2.52
Police Driving and Traffic Training Facilities at Fan Garden	Relocated	40.60	20.44	20.16
Weapons Training Facilities at Fan Garden	Relocated	37.80	25.20	12.60
Proposed Police Training Facility	New facility	37.80	-	37.80
Helipad at Lo Wu Firing Range	Relocated	7.00	-	7.00
<b>Total</b>		<b>150.08</b>	<b>129.64</b>	<b>20.44</b>

Although the additional sewage flows generated by the Project are unaccounted for in the NENT NDA approved EIA report, it is considered that there will be sufficient public sewage treatment capacity at SWHSTW by the time the Project is operational in 2022, as the treatment capacity of the SWHSTW will be upgraded to 133,000 m<sup>3</sup>/day (under the SWHSTW Phase 1A expansion). As advised by EPD, the SWHSTW is able to take up the 150.08 m<sup>3</sup>/day sewage flow from the proposed development in 2022 subject to substantial completion of the SWHSTW Phase 1A expansion tentatively scheduled in 2022. As such, it is considered that no adverse sewerage impact on the SWHSTW is expected due to the Project.

### 6.7 Mitigation Measures to Minimise Adverse Sewerage Impacts

As presented in **Section 6.6**, liaison with interfacing projects including OWTF2, CE1/2015(DS) and SWHSTW Phase 1A will be maintained to ensure the communal / public sewerage network and the SWHSTW has adequate capacity to handle the sewage flows generated by the Project.

To minimise the risk of overflows and emergency discharge of untreated effluents from the on-site SPS of the Project, the following mitigation measures will be implemented:

- The on-site SPS will be equipped with three pumps; 2 duty and 1 standby with an installed capacity of up to 9.4 l/s (almost twice the estimated peak flows from the Project site)
- Retention tank with the capacity to store 2 hours of peak sewage flows

- Standby power supply for the SPS.

Separately, the design of twin rising mains connecting to the communal sewer will enable maintenance works to be carried out on one pipeline while the other remains in operation, thereby improving the resilience and operability of the sewer pipeline carrying sewage from the new on-site SPS.

In addition to the above, the SPS will be designed to incorporate relevant mitigation measures from the EPD Guidance Note "Environmental Guidance Note for Sewage Pumping Stations which is not a Designated Project", to further minimise the impact of emergency discharges of untreated sewage from the on-site SPS.

With the above design measures, the risk of overflows and emergency discharge will be adequately minimised.

## **6.8 Environmental Monitoring and Audit**

With the implementation of the recommended design and operation measures, all potential impacts would be adequately controlled. Therefore, no adverse sewerage and sewage treatment implications are expected, and no specific monitoring is required.

## **6.9 Conclusion**

The Project site is not currently served by a public sewerage connection, the existing septic tank facility is not considered to be sufficient to accommodate the sewage flows generated by the Project, hence conveyance to SHWSTW is required. The sewage flows from the Project are estimated to be 1.74 l/s ADWF and 10.42 l/s peak flow.

The conveyance of these sewage flows to the SWHSTW will be facilitated through the connection of a new on-site SPS and sewer pipeline to connect to the planned communal sewer with OWTF2, before discharging to existing sewerage facilities (PS3 and associated rising main) along Man Kam To Road. The planned communal sewer will be implemented by either this Project or by OWTF2 project (subject to further liaison between CEDD and EPD during detailed design stage) while upgrades to the existing facilities will be managed under a separate contract (CE1/2015(DS)) by DSD, with agreement that the upgrades will take into account the combined additional sewage flows generated by the Project and the OWTF2.

The treatment capacity of SWHSTW will be increased under its Phase 1A expansion and will have sufficient treatment capacity for the Project-related sewage flows by the time of operation in 2022.

With implementation of the proposed new sewerage facilities and upgrades to existing facilities (by others), adverse sewerage impacts are not anticipated as a result of the Project.