

**Table of Content**

Page

<b>1</b>	<b>Introduction.....</b>	<b>1</b>
1.1	Background .....	1
1.2	Purpose & Nature of the Project.....	1
1.3	Purpose of this EIA Report .....	2
1.4	Justification for the Need of the Project.....	3
<b>2</b>	<b>Project Description .....</b>	<b>4</b>
2.1	Project Location.....	4
2.2	Project Components and Layout.....	4
2.3	Project Programme .....	5
2.4	Consideration of Alternative Sites, Development Options, Construction Methods & Sequences .....	6
<b>3</b>	<b>Key Findings of the Environmental Impact Assessment.....</b>	<b>8</b>
3.1	Air Quality.....	8
3.2	Noise.....	8
3.3	Water Quality .....	9
3.4	Waste Management .....	10
3.5	Ecology.....	11
3.6	Fisheries .....	12
3.7	Landscape and Visual .....	13
3.8	Cultural Heritage .....	14
3.9	Environmental Monitoring and Audit.....	15
<b>4</b>	<b>Key Environmental Outcomes Of The Project .....</b>	<b>16</b>
4.1	Environmental Benefits of the Project and the Environmental Protection Measures Recommended....	16
4.2	Population and Environmentally Sensitive Area Protected .....	16
4.3	Environmentally Friendly Designs Recommended.....	16
4.4	Key Environmental Problems Avoided.....	17
<b>5</b>	<b>Overall Conclusion .....</b>	<b>18</b>

**Figure**

[Figure 1.1 Outlying Islands Sewerage Stage 2 – South Lantau Sewerage – General Layout Plan](#)

## **1 INTRODUCTION**

### **1.1 Background**

The Environmental Protection Department (EPD) completed the Outlying Islands Sewerage Master Plan (SMP) Study in 1994 and drew up a SMP for Lantau Island and other outlying islands. The proposed sewerage works of the SMP were divided into two stages. The proposed sewerage works for South Lantau falls under the Stage 2 Works.

The Stage 2 Works of the SMP were subsequently reviewed by EPD under the Outlying Islands Sewerage Master Plan Stage 2 Review (SMP Review Study) in 2001. The proposed sewerage works for South Lantau were further reviewed in 2008 under the Review of Sewerage Scheme for South Lantau (Review Study).

According to the Review Study, the proposed sewerage works for South Lantau would serve the unsewered areas of Shui Hau, Tong Fuk, Cheung Sha, San Shek Wan, Pui O and Ham Tin. The above sewerage works, namely Outlying Islands Sewerage Stage 2 – South Lantau Sewerage Works, are hereinafter referred to as the Project. The Project is to be implemented under Public Works Programme Item No. 4331DS – “Outlying Islands Sewerage Stage 2 – South Lantau Sewerage Works”.

The Drainage Services Department (DSD) is responsible for undertaking the Project. Black & Veatch Hong Kong Limited (B&V) was commissioned by the DSD under the study “Outlying Islands Sewerage Stage 2 – South Lantau Sewerage Works and Other Works – Design and Construction” (Agreement No. CE 17/2012 (DS)) to provide consultancy services in design and construction supervision for the Project. Environmental Resources Management (ERM) was the sub-consultant of B&V to undertake the Environmental Impact Assessment (EIA) of the Project.

The *EIA Report* addresses potential environmental impacts associated with the construction and operation of the Project. This *Executive Summary* summarises the key findings of the EIA.

### **1.2 Purpose & Nature of the Project**

The purpose of this Project is to construct and operate a sewerage system for proper collection, treatment and disposal of the sewage arising from South Lantau, which includes the areas in Shui Hau, Tong Fuk, Cheung Sha, San Shek Wan, Pui O and Ham Tin.

The proposed Project is proposed to be implemented as follows:

- **Village sewerage works.** It mainly comprises the construction of about 16 km long village sewerage to nine unsewered villages at Shui Hau, Tong Fuk, Cheung Sha Upper Village, Cheung Sha Lower Village, San Shek Wan, Pui O San Wai, Pui O Lo Wai, Pui O Lo Uk and Ham Tin in South Lantau for proper collection of sewage generated from these villages and conveyance to the trunk sewerage system mentioned below.
- **Trunk sewerage works.** It comprises the construction of trunk sewerage system, including about 7.5 km long trunk sewer, six sewage pumping stations associated

with about 7.5 km long twin rising mains along South Lantau Road for conveyance of sewage from the village sewerage system to the proposed San Shek Wan Sewage Treatment Works (STW).

- **San Shek Wan STW and associated submarine outfall.** It comprises the construction of a secondary STW at San Shek Wan with a design capacity of about 5,800 m<sup>3</sup>/day associated with facilities for effluent reuse within the STW and an about 1.1 km long submarine outfall for proper treatment and disposal of sewage.

The general layout plan of the Project is illustrated in [Figure 1.1](#).

The following components of the Project are regarded as Designated Projects under the Environmental Impact Assessment Ordinance (Cap. 499) (EIAO):

- A dredging operation which is less than 500 m from the nearest boundary of an existing or planned coastal protection area (*Item C.12 of Part I of Schedule 2 of EIAO*);
- Sewage treatment works with an installed capacity of more than 5,000 m<sup>3</sup> per day and a boundary of which is less than 200 m from the nearest boundary of an existing or planned residential area, site of special scientific interest, site of culture heritage, bathing beaches, etc. (*Item F.2 of Part I of Schedule 2 of EIAO*);
- Sewage pumping stations with an installed capacity of more than 2,000 m<sup>3</sup> per day and a boundary of which is less than 150 m from an existing or planned residential area, site of special scientific interest, site of culture heritage, bathing beaches, etc. (*Item F.3 of Part I of Schedule 2 of EIAO*);
- An activity for the reuse of treated sewage effluent from a treatment plant (*Item F.4 of Part I of Schedule 2 of EIAO*); and
- A submarine sewage outfall (*Item F.6 of Part I of Schedule 2 of EIAO*).

### **1.3 Purpose of this EIA Report**

The purpose of this EIA study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project. This information will contribute to decisions by the Director of Environmental Protection (DEP) on:

- the overall acceptability of any adverse environmental consequences that are likely to arise as a result of the Project;
- the conditions and requirements for the detailed design, construction and operation of the Project to mitigate against adverse environmental consequences; and
- the acceptability of residual impacts after the proposed mitigation measures are implemented.

This *EIA Report* is prepared in accordance with the EIA Study Brief No. ESB-209/2009 and the Technical Memorandum of the Environmental Impact Assessment Process (EIAO-TM).

The specific objectives of the EIA Study are described in Clause 2 of the EIA Study Brief, and the detailed requirements of the EIA Study are set out in Clause 3 of the EIA Study Brief. As specified in the EIA Study Brief, the EIA Study has addressed the key environmental issues associated with the construction and operation of the Project.

#### **1.4 Justification for the Need of the Project**

In the South Lantau, there is currently no public sewerage system available. Most of the local premises are equipped with septic tanks or other private sewerage facilities for sewage treatment. If these are not properly operated or controlled, partially treated sewage may be disposed of indirectly into the nearby river courses through soakaway mechanism of the septic tanks. These septic tanks are maintained by their private owners and have been operated for many years. If they are not properly maintained or constructed (e.g. insufficient desludging), or sufficiently separated from nearby water bodies, sewage generated from these premises may overflow or be indirectly discharged to the environment thus affect the surrounding areas and cause pollution to the nearby river courses. To reduce the risk of such pollution and for improvement of environmental hygiene, the Government proposes to implement this Project to provide a public sewerage system for proper collection, treatment and disposal of the sewage for South Lantau. This sewerage scheme will serve nine villages/areas in South Lantau, namely Shui Hau, Tong Fuk, Cheung Sha Lower Village, Cheung Sha Upper Village, San Shek Wan, Pui O Lo Uk Tsuen, Pui O San Wai, Pui O Lo Wai and Ham Tin within the Project Catchment Area.

Upon completion and commissioning of this Project, sewage will be collected from the Project Catchment Area and conveyed to the proposed STW for central and proper treatment to the required environmental standards and disposal via a submarine outfall to outer bay of Pui O. This will reduce the risk and the pollution impacts due to overflow from insufficient desludging, thus safeguard the water of the adjacent beaches / stream courses along the South Lantau coast, and enhance living quality and environmental hygiene. It is anticipated that the overall village environment and environmental conditions within the Project Catchment Area can also be improved after commissioning of the works.

If this Project is not implemented, South Lantau will continue to rely on the septic tanks and private sewerage facilities for treatment of the sewage arising from the area. Consequently, it would be hard to avoid the risk of improper discharge causing pollution to the nearby river courses and coastline, deterioration in environmental hygiene and environmental nuisance.

## **2 PROJECT DESCRIPTION**

### **2.1 Project Location**

The catchment of the Project is located in the southern coast of Lantau Island and surrounded by the Lantau South Country Park. The Project Catchment Area covers the unsewered areas of South Lantau including traditional villages (Shui Hau, Tong Fuk, Cheung Sha Lower Village, Cheung Sha Upper Village, San Shek Wan, Pui O Lo Uk Tsuen, Pui O San Wai, Pui O Lo Wai and Ham Tin), residential developments, individual village houses, tourist spots and recreational facilities (bathing beaches, BBQ and camp sites, water sports centers, hiking trails, guesthouses, hostels and executive holiday houses), a correctional institution (Tong Fuk Correction Institution), schools, government institutions and utility facilities. South Lantau Road is the major access road of the Project Catchment Area.

### **2.2 Project Components and Layout**

Table 2.1 presents a summary of the project details.

*Table 2.1 – Summary of Project Description*

<b>Project Consideration</b>	<b>Details</b>
Proposed Sewerage Scheme	<ul style="list-style-type: none"> <li>Village sewerage works including gravity pipes and manholes in the unsewered areas of Shui Hau, Tong Fuk, Cheung Sha, San Shek Wan, Pui O and Ham Tin in South Lantau</li> <li>Trunk sewerage works including trunk sewers and twin rising mains along the South Lantau Road and Chi Ma Wan Road, and six sewage pumping stations in Shui Hau, Tong Fuk, Cheung Fu Street, Cheung Sha, San Shek Wan and Pui O</li> <li>Sewage treatment works including a secondary sewage treatment plant at San Shek Wan associated with facilities for effluent reuse within the STW and a submarine sewage outfall for discharging treated effluent to the outer bay of Pui O/Chi Ma Wan</li> </ul>
San Shek Wan Sewage Treatment Works (STW)	<ul style="list-style-type: none"> <li>Design flow = 5,800 m<sup>3</sup>/day Average Dry Weather Flow (ADWF)</li> <li>Installed capacity = 17,400 m<sup>3</sup></li> </ul>
Treatment Objectives of San Shek Wan STW	<ul style="list-style-type: none"> <li>Marine disposal of treated effluent via the submarine outfall</li> <li>Internal reuse of the reclaimed water for non-potable use within the San Shek Wan STW</li> </ul>
Treatment Process at San Shek Wan STW	Membrane Bioreactor (MBR)
Shui Hau Sewage Pumping Station	<ul style="list-style-type: none"> <li>Design flow = 620 m<sup>3</sup>/day Average Dry Weather Flow (ADWF)</li> </ul>
Tong Fuk Sewage Pumping Station	<ul style="list-style-type: none"> <li>Design flow = 1,880 m<sup>3</sup>/day Average Dry Weather Flow (ADWF)</li> </ul>
Cheung Fu Street Sewage Pumping Station	<ul style="list-style-type: none"> <li>Design flow = 2,470 m<sup>3</sup>/day Average Dry Weather Flow (ADWF)</li> </ul>
Cheung Sha Sewage Pumping Station	<ul style="list-style-type: none"> <li>Design flow = 920 m<sup>3</sup>/day Average Dry Weather Flow (ADWF)</li> </ul>
San Shek Wan Sewage Pumping Station	<ul style="list-style-type: none"> <li>Design flow = 3,840 m<sup>3</sup>/day Average Dry Weather Flow (ADWF)</li> </ul>
Pui O Sewage Pumping Station	<ul style="list-style-type: none"> <li>Design flow = 1,960 m<sup>3</sup>/day Average Dry Weather Flow (ADWF)</li> </ul>

<b>Project Consideration</b>	<b>Details</b>
Project Footprint	<ul style="list-style-type: none"> <li>• About 16 km of gravity pipes, 7.5 km of trunk sewers and 7.5 km of twin rising mains (the concerned road surface will be reinstated for public use)</li> <li>• Ranged between 100 – 300 m<sup>2</sup> for each sewage pumping station</li> <li>• About 280 m<sup>2</sup> and 1,620 m<sup>2</sup> for the administration building and operation building of San Shek Wan STW (building area)</li> <li>• About 1,100 m for the length of submarine outfall</li> </ul>
Construction Cut & Fill Requirements	
Gravity pipes, manholes, trunk sewers and twin rising mains	<ul style="list-style-type: none"> <li>• Excavated materials = about 200,000 m<sup>3</sup></li> <li>• Fill materials = about 169,000 m<sup>3</sup></li> <li>• Surplus materials = about 31,000 m<sup>3</sup></li> </ul>
Sewage pumping station (for a total of six)	<ul style="list-style-type: none"> <li>• Excavated materials = about 16,000 m<sup>3</sup> (about 2,670 m<sup>3</sup> each)</li> <li>• Fill materials = about 7,300 m<sup>3</sup></li> <li>• Surplus materials = about 8,700 m<sup>3</sup></li> </ul>
Sewage Treatment Works	<ul style="list-style-type: none"> <li>• Excavated materials = about 30,000 m<sup>3</sup></li> <li>• Fill materials = about 2,000 m<sup>3</sup></li> <li>• Surplus materials = about 28,000 m<sup>3</sup></li> </ul>
Area of Seabed Affected by Installation of Outfall Diffuser	About 1,300 m <sup>2</sup> (39m x 33m)
Marine Dredging Volume ( <i>in situ</i> volume)	About 4,700 m <sup>3</sup>
Project Operation	<ul style="list-style-type: none"> <li>• Sludge generation = approx. 2.56 m<sup>3</sup> per day</li> <li>• Treated Effluent discharged = 5,800 m<sup>3</sup> per day</li> <li>• Other solid wastes from regular cleaning/ maintenance activities = 2,600 m<sup>3</sup> per year</li> </ul>

## **2.3 Project Programme**

The proposed works are expected to be implemented in three works packages as follows:

- Package A comprises the construction of a sewage treatment works at San Shek Wan associated with facilities for effluent reuse and submarine outfall, a sewage pumping station in Pui O and sewerage to the unsewered areas of Pui O area. Construction works is anticipated to commence in mid 2017 for completion in early 2023.
- Package B the provision of sewerage to the unsewered areas of Ham Tin, San Shek Wan, Cheung Sha Upper & Lower Village and Cheung Fu Street region. Construction works is anticipated to commence in mid 2018 for completion in mid 2023. It involves construction of village sewers, a total of three sewage pumping stations in San Shek Wan, Cheung Sha and Cheung Fu Street region, and the associated twin rising mains for collection and conveyance of sewage to the proposed San Shek Wan STW for proper treatment and disposal.
- Package C comprises the provision of sewerage to the unsewered areas of Tong Fuk and Shui Hau. Construction works is anticipated to commence in early 2019 for completion in early 2024. It involves construction of village sewers, a total of two sewage pumping stations in Tong Fuk and Shui Hau, and the associated twin rising

mains for collection and conveyance of sewage to the proposed San Shek Wan STW for proper treatment and disposal.

#### **2.4 Consideration of Alternative Sites, Development Options, Construction Methods & Sequences**

An assessment was conducted to investigate the environmental considerations of alternative sites, development options, construction methods and sequences for this Project. The results of assessment are as follows:

- Numbers and locations of Sewage Pumping Station (SPS): Alternative sites and combinations of SPS have been considered, and where technically feasible, deep sewer option has been considered to minimize the total number of proposed SPS and hence the Project's physical footprint. Most of the sites of the proposed SPS have been selected in locations far away from existing village houses where practical to reduce potential impacts on sensitive receivers. In summary, six trunk SPS are proposed in Shui Hau, Tong Fuk, Cheung Fu Street, Cheung Sha, San Shek Wan and Pui O. The footprint of these six SPS has also been optimized taking into account the land take at each location. The omission of three SPS and the effluent pumping station from the original scheme proposed in the Review Study have significantly reduced the physical footprint and hence potential environmental impacts associated with this Project.
- Location of Sewage Treatment Works (STW): This site of the STW at San Shek Wan is adjacent to the South Lantau Road and is currently occupied by the China Light and Power Company as a depot under a short term tenancy. Owing to the limited availability of suitable lands and environmental and planning constraints in South Lantau, the site has been thoughtfully considered as the most suitable site for the STW. The footprint of the site has been minimized as far as practicable by housing the major and large scale facilities/equipment underground. The STW will also be designed with landscape and green features to blend in with the surrounding environment.
- Sewage Treatment Options for San Shek Wan STW: A review of five different biological treatment processes for the proposed STW had been carried out. Membrane Bioreactor (MBR) is recommended for its compact footprint, excellent effluent quality, the least amount of sludge generation and the highest reclaimed water reuse potential. It is adopted as the design of this Project.
- Alternative Construction Methods – Sewers and rising mains: Open-cut excavation in section-by-section will be the predominant method for the proposed sewerage construction works. This method is the most straight-forward method to avoid prolonged construction duration and hence reduces potential disturbance to the environment, local traffic and the public. Where practical, trenchless construction method will also be considered for laying of the proposed sewers and rising mains crossing major roads, road junctions or sensitive locations if necessary to minimize potential impacts to existing traffic or public.
- Alternative Construction Methods – submarine outfall: non-dredged method (Horizontal Directional Drilling (HDD)) has been proposed with a view to reducing the extent of marine dredging and hence the potential impacts on water quality, marine ecology and fisheries of the South Lantau area.

Based on the review and consideration of project alternatives, the preferred scheme taken forward to this EIA study is to provide village sewerage for unsewered villages/areas in South Lantau, trunk sewerage, and a STW at San Shek Wan associated with a submarine outfall for proper collection, treatment and disposal of sewage generated from this area.



### **3 KEY FINDINGS OF THE ENVIRONMENTAL IMPACT ASSESSMENT**

The potential environmental impacts associated with the Project are summarised in the following sections.

#### **3.1 Air Quality**

The air quality impact assessment has assessed construction and operation phase impacts of the Project in accordance with the criteria and guidelines stated in the EIAO–TM Annexes 4 and 12, and Air Pollution Control Ordinance (APCO) (Cap. 311). The Study Area for the air quality impact assessment is generally defined by a distance of 500 m from the boundary of the Project Site. A total of 43 Air Sensitive Receivers (ASRs) were identified.

Potential impacts of dust, gaseous emission from diesel-driven construction equipment and odour emissions from construction activities have been evaluated. With implementation of standard construction practices and mitigation measures, no unacceptable impact on ASRs is anticipated.

Potential odour impacts from the operation of the sewage pumping stations and the San Shek Wan STW have been assessed. With the implementation of good management practices and proper odour control measures, no unacceptable impact has been predicted to occur during the operation phase.

Regular site inspections and audits are recommended to be undertaken during the construction phase to verify that proposed mitigation measures are properly implemented. During operation phase, a commissioning test is recommended to be conducted to ascertain the effectiveness of the odour control measures at San Shek Wan STW and the proposed sewage pumping stations. Odour patrol is also proposed during the period of maintenance or cleaning of the activated carbon filter at Cheung Sha SPS.

#### **3.2 Noise**

The potential impacts of noise caused by construction and operation activities of this Project have been assessed in this EIA Report. The impacts have been identified and analysed to be in compliance with the criteria and guidelines stated in the EIAO-TM Annexes 5 and 13. In accordance with the EIA Study Brief Section 3.4.5.2 of the Project, the Study Area for the noise assessment includes all areas within 300 m from the Project Boundary. A total of 26 Noise Sensitive Receivers (NSRs) were identified.

For the construction of village sewers and trunk sewers/rising main, construction noise control measures such as use of quiet construction plant, movable noise barriers, noise insulation sheet and scheduling of construction activities, have been recommended. Predicted mitigated noise levels are in the range of 44 to 92 dB(A) at the representative NSRs. In view of the close proximity of some of the NSRs to the works sites, non-compliances of the daytime construction noise criteria due to construction of village sewers and trunk sewers/rising mains would exist even with the implementation of all practical mitigation measures. However, as the trunk sewers/rising mains and the village sewers will be constructed in segments of up to 40 m and 30 m in length respectively, it is anticipated that the noise exceedances will only occasionally arise on isolated locations during the maximum 2 months period required to

construct each segment. Based on the above, the residual impacts are anticipated to be localised, temporary, reversible, only lasted for a relatively short period of time, and the actual impact can be minimized through proper phasing of works and properly managed construction schedule. Regular noise monitoring at NSRs as part of the Environmental Monitoring and Audit (EM&A) programme during the construction stage is recommended. A systematic EM&A programme will be carried out to ensure proper implementation of both construction phase mitigation measures and the construction schedule of the works of trunk sewers/rising mains and village sewers.

Potential noise impacts from the operation of the SPS and the San Shek Wan STW have been assessed. The operational fixed plant noise levels at the representative NSRs are predicted to comply with the noise criteria. Attenuation measures, if required, will be provided to the fixed plant items for achieving the compliance of EIAO-TM noise criteria during the design stage. Regular noise monitoring at NSRs as part of the EM&A programme during testing and commissioning stage is also recommended.

### **3.3 Water Quality**

The water quality impact assessment has assessed construction and operation phase impacts of the Project in accordance with the criteria and guidelines stated in the EIAO-TM Annexes 6 and 14, and applicable assessment standards/ criteria. The assessment, utilising water quality and hydrodynamic computational models, has mainly examined the potential impacts caused by marine dredging works and land-based activities during construction phase of SPSs and STW, and effluent discharge from the operation of SPSs and STW during operation phase.

Non-dredged method with localised minor dredging will be adopted as the preferred option for the construction of the proposed submarine outfall to reduce potential impacts of the marine dredging works on water quality, marine ecology and fisheries of the South Lantau area.

Computational modelling has been conducted to predict potential water quality impacts from the localized marine dredging for the construction of submarine outfall, including sediment solids (SS) elevation, sedimentation, dissolved oxygen (DO) depletion, release of nutrient, heavy metal and trace organic pollutants. The estimated dredged volume is about 4,700 m<sup>3</sup>. Full compliance of the relevant assessment criteria is predicted at all identified water sensitive receivers, thus unacceptable adverse impacts to water quality is not anticipated.

The use of secondary (biological) treatment with Membrane Bio-reactor (MBR) at San Shek Wan STW is warranted to maintain superior effluent quality from the STW for the protection of water quality sensitive receivers and beneficial uses in the Southern Water Control Zone. Therefore, unacceptable adverse water quality impact associated with the Project's normal operation is not envisaged. Discharge of untreated sewage in the event of emergency is rare given the adequate control measures (inclusive of standby units, standby power supply and emergency storage tanks) will be in place at the STW and SPSs. Nonetheless, the potential impact on water quality from emergency discharge was studied to allow the assessment of this unlikely event. The results indicated that the emergency discharge would have some changes on local water quality but water quality is predicted to resume to ambient levels within 1-2

day after the cessation of emergency discharge. Hence no long-term residual water quality impacts are anticipated in case of emergency discharge of untreated sewage.

Water quality monitoring is recommended for the construction and operation phases. The specific monitoring requirements are detailed in the EM&A Manual associated with the EIA Report. An Emergency Response Plan shall be prepared and implemented during the operation of this Project.

### **3.4 Waste Management**

The potential impacts to waste management caused by construction and operational activities of this Project have been assessed in this EIA Report. The impacts have been identified and analysed to be in compliance with the criteria and guidelines stated in the EIAO-TM Annexes 7 and 15. Legislative requirements and assessment criteria relevant to the waste management assessment have also been presented.

The wastes arising during the construction and operation phases include excavated material, construction and demolition material, marine sediments from dredging works, general refuse from daily operations, chemical waste from maintenance of plant and equipment and sludge from the STW operation. The quantity, quality and timing of these waste arising have been identified. It is estimated that the quantities of excavated materials to be generated from the construction of the sewage pumping stations (for a total of six), sewage treatment works, and gravity pipes, manholes, trunk sewers and twin rising mains are approximately 16,000 m<sup>3</sup>, 30,000 m<sup>3</sup> and 200,000 m<sup>3</sup> respectively. The reuse of inert excavated material will be maximised during the backfilling works where practicable, and surplus excavated material which is approximately 67,700 m<sup>3</sup> will be disposed of off-site at public fill reception facilities. The total quantity of marine sediments generated will be approximately 4,700 m<sup>3</sup>. Approximately a total of 784 m<sup>3</sup> of inert C&D materials and 196 m<sup>3</sup> of non-inert C&D materials will be generated from the construction of civil structures and buildings at the project site. During operation phase, typical waste types will be generated from the operational activities at STW and SPSs. Dewatered sludge from STW operation at the rate of 3m<sup>3</sup> per day will be removed for disposal at landfills or at the Sludge Treatment Facility in Tuen Mun. It is estimated that very small amount (about hundred litres) of used chemical wastes will be generated each month during the project operation for maintenance work, and they will be managed with good site practices. Other solid wastes from screening and grit removal (about 1m<sup>3</sup> per day) will be compacted and disposed at the Mui Wo Transfer Facility for disposal at landfills.

With good site practices, the potential environmental impacts associated with the storage, handling, collection, transport and disposal of the identified waste arising from the Project will be within acceptable limits set out in the EIAO-TM. Therefore, no adverse waste management implications are anticipated.

Regular site inspections and audits will be undertaken during the construction phase to verify that proposed mitigation measures are properly implemented.

### 3.5 Ecology

The EIA has assessed the impacts on terrestrial and aquatic ecological resources associated with the construction and operation of the Project as per the criteria and guidelines stated in the EIAO-TM Annexes 8 and 16.

A total of 15 habitat types were identified within the Study Area. They are terrestrial habitats (i.e. Fung Shui woodland, mixed woodland, plantation, shrubland-grassland, cultivated land, marsh, stream/channel and urbanised/disturbed area) and coastal habitats (i.e. mangrove, rocky shore, sandy shore, sand flat, subtidal hard bottom and soft bottom habitats and coastal/marine waters). Within the footprint of the SPSs and STW, the habitat composition included urbanised/disturbed area, cultivated land, plantation, shrubland-grassland and mixed woodland. A number of recognized ecologically important / sensitive sites are located within the Study Area. These include Lantau South Country Park, Coastal Protection Area, Green Belt, the mangroves in Pui O, Fung Shui woodlands in Tong Fuk and Shui Hau, proposed Site of Special Scientific Interest (SSSI) in Shui Hau Wan, Ecologically Important Streams (EIS) in Pui O and Tong Fuk and horseshoe crab nursery ground in Shui Hau.

Regarding the species of conservation importance, seven flora species (i.e. Incense Tree *Aquilaria sinensis*, Hong Kong Pavetta *Pavetta hongkongensis*, Silver-back Artocarpus *Artocarpus hypargyreus*, Water Shamrock *Marsilea quadrifolia* and Water Spangles *Salvinia natans*, Luofushan Joint-fir *Gnetum luofuense* and *Zoysia sinica*), one mammal species (i.e. Japanese Pipistrelle *Pipistrellus abramus*), five bird species (i.e. Reef Egret *Egretta sacra*, Black Kite *Milvus migrans*, Collared Scops Owl *Otus lettia*, Greater Coucal *Centropus sinensis* and Hwamei *Garrulax canorus*), one amphibian species (i.e. Chinese Bullfrog *Hoplobatrachus chinensis*), one reptile species (i.e. Copperhead Racer *Elaphe radiata*), seven fish species (i.e. Japanese eel *Anguilla japonica*, Predaceous Chub *Parazacco spilurus*, Eye-spotted puffer *Takifugu ocellatus*, Sleepy goby *Psammogobius biocellatus*, Indo-pacific tropical sand goby *Favonigobius reichei*, Small snakehead *Channa asiatica* and Spotty band goby *Glossogobius olivaceus*), one crustacean species (*Pseudosesarma patshuni*), one hard coral species (i.e. *Oulastrea crispata*) and one horseshoe crab species (i.e. *Tachypleus tridentatus*) were recorded during the field baseline surveys. But, none of these species were found within the boundary of Project, except for the Incense Tree *Aquilaria sinensis* which was recorded at San Shek Wan SPS Alternative Site and San Shek Wan STW.

Construction impacts to marine ecological resources (i.e. natural rocky shore and subtidal hard bottom habitats) and marine sensitive receivers (i.e. Shui Hau sandflat) will largely be avoided by adopting non-dredging method (i.e. HDD method) for constructing the submarine outfall, proper planning design and execution of the works (i.e. optimisation of project construction schedule/ sequence, using good engineering/ industry practice, timely completion of construction works to reduce impact duration, etc.).

During the construction phase, construction activities may cause direct ecological impacts including habitat loss and vegetation removal, whereas indirect impacts on wildlife may include disturbances and changes in water quality. Loss of habitats is expected to occur in habitats of low and low to moderate ecological values, and approximately 0.52 – 0.55 ha of mixed woodland of moderate ecological value will be lost due to the construction of the proposed and alternative San Shek Wan SPSs, and the San Shek Wan STW and their

associated access roads. Impact to mixed woodland and associated flora of conservation importance (the Incense Tree *Aquilaria sinensis*) will be compensated by woodland compensation and transplantation, respectively.

Potential impacts of increased human activities and other disturbances due to the Project construction would not be significant given regular checks on construction site practices and boundaries will be conducted. In addition, in view of the availability of surrounding similar habitats, the potential impact on wildlife especially on the species of conservation importance as a result of habitat fragmentation and isolation is considered to be minimal.

The EIA sets out mitigation measures to reduce ecological impacts, such as avoidance, woodland compensation and transplanting, regular checks in construction site practices and boundaries, which will reduce potential disturbance to the surrounding environment. With the implementation of the proposed mitigation measures, no adverse residual impact due to the land-based and marine-based construction of proposed sewers, rising mains, SPSs and STW and submarine outfall is anticipated.

### **3.6 Fisheries**

The EIA has assessed the impacts to fisheries resources and fishing operations associated with the construction and operation of the Project as per the criteria and guidelines stated in the EIAO-TM Annexes 9 and 17.

The desktop review of baseline conditions of commercial fisheries resources and fishing operations indicate that the fishing ground within the Project's boundary is considered as of low commercial value and the waters of the Project area as of low importance to Hong Kong fishing industry.

Potential impacts of direct disturbance to fisheries resources and habitat, and permanent and temporary loss of fishing grounds, underwater sound and changes in water quality from construction activities have been considered. Potential impacts to fisheries resources and fishing operations during the construction phase may arise from the permanent loss of approximately 0.13 ha of within the physical footprint of the diffuser, the temporary disturbance to marginally larger marine construction works area, and underwater sound and changes in water quality from construction activities. There will be no permanent loss of fisheries production in the water column arising from the installation of outfall diffuser. No unacceptable impacts to fisheries are anticipated. Marine construction works will be designed to reduce potential impacts on water quality which will, in turn, reduce impacts on fisheries resources.

Potential impacts of treated effluent and emergency sewage discharge from the operation of the proposed Project have been assessed. Effluent discharged from the STW will comply with the relevant statutory standards and requirements. Potential impacts of treated effluent discharge are expected to be localized in the vicinity of the outfall which is about 10 km away from the Cheung Sha Wan FCZ, thus no unacceptable impact due to low DO or elevated TIN levels has been identified on the aquaculture activity as the FCZ. In case of emergency discharge of untreated sewage, the potential water quality changes were predicted to occur only for a very short period and localised to the proximity of the discharge locations, and

would return to ambient levels within 1 - 2 days, unacceptable adverse impacts to fisheries in the long term are not anticipated. Nonetheless, standby equipment, standby power supply and emergency storage will be provided at each of the SPS and STW. The standby equipment and standby power supply will maintain continuous operation of the system when the duty equipment or main power supply is broken down. In extreme situation when both the duty and standby equipment or standby power supply failed, sewage will be bypassed to the emergency storage tanks to prevent overflow. As such, discharge of untreated sewage in the event of emergency is of extreme low likelihood. Thus, no unacceptable fisheries impacts are expected to arise from project operation.

Monitoring activities designed to detect and mitigate any unacceptable impacts to water quality during construction phase are also expected to serve to protect against unacceptable impacts to fisheries. No fisheries-specific monitoring measures are required during construction or operation activities.

### **3.7 Landscape and Visual**

The EIA has assessed the landscape and visual impacts associated with the construction and operation of the Project as per the criteria and guidelines stated in the EIAO-TM Annexes 10 and 18, and EIAO Guidance Note No. 8/2010.

For the proposed sewers works, the proposed village sewers, trunk sewers and rising mains will mainly be laid underground along the existing carriageway, footpaths and village alleys. The construction works will be carried out section-by-section in localized areas with a short period of time in order to reduce the disturbance to the surrounding areas and nearby residents. The works area will be reinstated to its original conditions and not considered to cause significant operational visual impact. The main causes of landscape and visual impact would be due to the small built structures of the SPSs, and STW.

A total of 10 Landscape Resources (LRs) and four Landscape Character Areas (LCAs) have been identified within the study area. The magnitudes of change on the LCAs and LRs during construction and operation are expected vary from negligible to intermediate. Appropriate landscape measures are proposed to mitigate these landscape impacts and the significance of residual landscape impacts assessed. After mitigation at Day 1 of operation, slight landscape impact significance will be experienced by LR3, LR4 and LR5, while LR1 will experience moderate landscape impact significance. But with the maturing of soft landscape mitigation vegetation, residual impact significance of all LRs and LCAs will reduce to insignificant by Year 10 of operation, except LR1, which will be reduced to slight.

Visually, some residential VSRs around Tong Fuk (H2), Cheung Sha (H3), Pui O (H5), Ham Tin (H6) and near lower Cheung Fu Street (H7) are predicted to experience moderate visual impacts, as are the Travellers on South Lantau Road (T1) largely due to laying of the pipe works associated with the Project and these impacts will remain moderate even upon implementation of some mitigation. By Day 1 of operation however, most of these impacts will reduce to slight if the suggested mitigation measures are implemented, with the exception of viewers around Tong Fuk (H2) and Cheung Fu Street (H7) where the impact will remain moderate at Day 1. By Year 10, all residual visual impacts are considered to be insignificant with the implementation of suitable mitigation measures, with the exception of the impact on

the residents of Tong Fuk who will still experience slight impact due to the SPS as well as a house in front of the proposed Cheung Fu Street Trunk SPS on lower Cheung Fu Street where the impact is considered slight as the current view of a planted garden area would change to a view of the proposed SPS..

Based on the results of tree survey, approximately 400 trees are affected in the proposed sites. At detailed design stage, the Project will aim at avoiding tree felling as far as practicable, but if unavoidable, a tree felling application will be submitted to the relevant authorities for approval in accordance with the relevant guidelines/requirements. The loss of trees will be compensated at a ratio of 1:1 according to DEVB TC(W) No. 7/2015.

Besides mitigation measures for protection, preservation, transplantation and compensation of any felled trees, other landscape and visual mitigation measures are proposed including reuse of top soil, detailed design considerations to reduce landscape footprint and blend visibility of structures with the surrounding environment. Vertical greening and green roof and light control are also recommended as mitigation measures to minimize visual impacts and enhance overall greenery provision.

With implementation of these appropriate mitigation measures, the residual landscape impacts are considered to be insignificant by year 10 of operation when all soft landscaping has reached maturity. The residual visual impacts are considered to be slight at worst by year 10 of operation.

Therefore landscape and visual impacts are considered to be acceptable with mitigation measures.

### **3.8 Cultural Heritage**

The EIA has assessed the cultural heritage impact associated with the construction and operation of the Project as per the criteria and guidelines stated in the EIAO-TM Annexes 10 and 19.

A desktop review supplemented by geophysical survey in the study area of Marine Archaeological Investigation (MAI) suggested that no underwater archaeological or cultural heritage features on or below the seabed is located. Therefore, no impact on marine archaeological resources is anticipated.

A desktop review supplemented by field surveys identified a number of sites of cultural heritage within the Study Area. These include built heritage features comprising two Grade 3 and one proposed Grade 3 historic building, one nil grade historic building, 38 historic built structures, 14 historic graves and one historic landscape feature. Also, four sites of archaeological interest were identified. Within the proposed Project Site, the Cheung Sha site of archaeological interest is area of medium to low archaeological potential, and Shui Hau, Tong Fuk, Pui O sites of archaeological interest are of low archaeological potential.

Out of all the identified built heritage features, potential impact to a total of 20 built heritage features have been identified and appropriate mitigation measures have been recommended for the concerned built heritage features to avoid and minimise potential impacts from

construction activities. These mitigation measures include refinement of proposed alignment of sewers, baseline condition survey and baseline vibration impact assessment to be conducted by a qualified building surveyor and a qualified structural engineer prior to construction commencement, control of mechanical equipment operation, use of handheld tools within 20 m from concerned built heritage features and adoption of proper protection measures for works close to concerned built heritage features.

Potential archaeological impact has been identified at an area with medium archaeological potential and four areas with low archaeological potential. Appropriate mitigation measures such as a Communication Plan, proper site staff briefing and survey-cum-rescue excavation have been recommended to be conducted before the commencement of the excavation of the proposed alignment to mitigate the impacts.

With the implementation of the recommended mitigation measures, it is anticipated that there would be no construction and operational residual impacts and the adverse cultural heritage impact is anticipated to be within acceptable level.

### **3.9 Environmental Monitoring and Audit**

Environmental monitoring and audit requirements have been identified and recommended to ensure the effectiveness of the recommended mitigation measures. These requirements are specified in the EM&A Manual. The monitoring requirements cover the area of odour monitoring, noise, water quality and cultural heritage. Regular site audits throughout the construction and operation of the Project have also been recommended to ensure that all the proposed mitigation measures are fully implemented.



## **4 KEY ENVIRONMENTAL OUTCOMES OF THE PROJECT**

### **4.1 Environmental Benefits of the Project and the Environmental Protection Measures Recommended**

At present, there is no public sewerage in South Lantau. Sewage from this unsewered area is now treated and disposed of by means of private on-site treatment facilities (such as septic tanks and soakaway (STS) systems). These facilities are however often ineffective in removing pollutants due to their proximity to watercourse and inadequate maintenance. Sewage from these unsewered areas has therefore been identified as a source of water pollution to the nearby watercourses as well as the receiving waters of Southern Water Control Zone. With implementation of this Project which involves provision of village and trunk sewerage system, and a sewage treatment works, sewage generated from this area will be properly collected, treated and disposed. The capacity of the sewerage system will be designed to cope with the population growth and future development. Discharge of low quality effluent to the receiving water body will be reduced in South Lantau. Furthermore, hygiene problems within the catchment area arising from the use of STS systems will be largely reduced with the provision of public sewers to currently unsewered villages, villa, bungalows, residential areas, beach facilities, public institutions, etc., where practicable.

### **4.2 Population and Environmentally Sensitive Area Protected**

The marine waters near South Lantau and the two ecologically important streams at Tong Fuk and Pui O are protected by the provision of a public sewerage system with adequate capacity to cope with population growth and future development as a result of proper collection, treatment and disposal of sewage generated from the area. The residential areas, villages, villa, bungalows, beach facilities, public institutions, etc. which are currently unsewered are also protected by provision of sewers under this Project.

### **4.3 Environmentally Friendly Designs Recommended**

The proposed sewerage system is designed to be environmentally friendly and the essential elements of the environmentally friendly design comprise the following:

- The trunk sewers and rising mains are proposed to be constructed underneath the South Lantau Road to minimize disturbance to sensitive receivers and natural habitats which are mainly located at the hilly area and coastal lines alongside the South Lantau Road;
- Trenchless construction method where practicable would be adopted to laid the trunk sewers and rising mains underneath the South Lantau Road and at locations crossing road junctions or watercourses that will reduce disturbance to the road users and surrounding environment;
- The laying of trunk and village sewers will be implemented in non-overlapping workfronts that can reduce disturbance to the local public due to concurrent works;
- The elimination of three SPS and the effluent pumping station as a result of review on the Review Study significantly reduce the Project's physical footprint and hence potential environmental impacts on sensitive receivers;

- Submersible type pumping stations are proposed to minimize the scale and size of above-ground structures, and hence reduce the footprint of the SPS;
- Compacted sewage treatment process, MBR is recommended for the STW that can reduce the footprint and the amount of sludge generation to a minimum. At the same time, it can provide superior quality of effluent and the highest reclaimed water reuse potential. The overall footprint of the STW can hence be reduced to minimize encroachment on surrounding environment;
- The scale and size of above-ground structure of the STW are minimized by housing large scale facilities underground that results in a single multi-storey structure for enclosing all the necessary equipment;
- The provision of standby parts, standby power supply and emergency storage for each of the SPS and STW will improve the reliability of the sewerage system, while the provision of deodorization units inside the SPS and STW could reduce the possible odour impact to the adjacent sensitive receivers;
- The SPS and STW will be designed with landscape and green features to blend them in with the adjacent environment. Green roof will be designed for the STW and more trees will be planted within the SPS and STW to enhance greenings and improve visual appearances;
- Non-potable reuse of effluent within the STW will be proposed to reduce the consumption of water;
- The alignment and length of the submarine outfall are at sufficient distances from sensitive receivers to reduce potential impacts on water quality and marine ecology; and
- The use of HDD for construction of submarine outfall will significantly reduce the extent of seabed dredging and dredging volume, thereby reduce the marine footprint of this Project and the potential impacts on water quality and marine ecology.

#### **4.4 Key Environmental Problems Avoided**

Potential deterioration of marine waters near South Lantau due to the unavailability of proper sewage collection, treatment and disposal will be avoided by provision of a sewerage system of adequate design and capacity to cope with population growth and future development in the area. Furthermore, the hygiene problems arising from the use of STS systems will be largely relieved by provision of public sewers to currently unsewered villages, villa, bungalows, residential areas, beach facilities, public institutions, etc., where practicable.

## **5 OVERALL CONCLUSION**

Upon completion of the Project, there will be improvement in environmental hygiene of the South Lantau. The EIA study concludes that with incorporation of the recommended mitigation measures and the proper implementation of the EM&A programme, the Project will not impose adverse impacts on the neighbouring environment during construction and operational phases.