2. PROJECT DESCRIPTION

2.1 Project Background

2.1.1 The Sha Tin WTW was first commissioned in 1964. At that time, it comprised the current South Works and the Administration Building with a treatment capacity of 364,000 m^3/day. To cope with the rapid increase in the territory's water demand, the Sha Tin WTW underwent three stages of expansion in 1973, 1976 and 1983 that are collectively called the North Works. The Sha Tin WTW is the largest WTW in Hong Kong with a treatment capacity of 1,227,000 m^3/day, supplying about 30% of the total water demand of the territory serving over 2 million people.

2.1.2 The present operation of Sha Tin WTW can only maintain about 1,060,000 m^3/day average output, due to the aging of plant and equipment after more than 40 years of service. The plant therefore requires major renovation or replacement.

2.1.3 In addition, since the plant was first commissioned in 1964, the required treated water quality requirements have also been raised to meet the latest standards. The existing treated water quality standards as specified by WSD, the authority in Hong Kong, is based on the World Health Organization (WHO)'s Guidelines for Drinking-water Quality 2011, supplemented by additional parameters not included in the Guidelines.

2.1.4 Access to safe drinking water is essential to public health. Hong Kong enjoys one of the safest drinking water supply in the World with the quality complying fully with the World Health Organization's (WHO) Guidelines for Drinking-water Quality. The Water Supplies Department (WSD) is committed to providing a safe, clean and reliable water supply to customers in Hong Kong (HK). Stringent water treatment combined with comprehensive monitoring control of the treated water quality is essential steps in safeguarding public health. WSD has monitored the quality of our drinking water in accordance with the WHO's Guidelines for Drinking-water Quality 2011. Please refer to **Appendix 2.2** for the details of the drinking water quality standards.

2.1.5 The World Health Organization advocated for the first time in the Third edition of Guidelines for Drinking-water Quality to develop and implement a preventive Water Safety Plan (WSP) to provide an effective and proactive mechanism to ensure the safety of drinking water for the protection of public health. The WSP is based on the multiple-barrier approach and the Hazard Analysis and Critical Control Points principle to ensure the safety of drinking water supply. The plan identifies potential hazards and prevents risks of contamination of drinking water from source to consumers' taps and comprises key components including: system assessment, control measures, operational monitoring, verification, management plans, documentation and surveillance.

2.1.6 In February 2005, a working group consisting of senior professionals from various operational units in the Department was set up to develop a WSP for WSD. They assessed systematically possible risks of contamination within the water supply system, and identified control measures to minimise the risks. Based on WHO recommendations, the Department of Health and WSD have agreed on the adoption of a set of guideline values for chemical and bacteriological parameters as the health-based targets for the drinking water supply in HK.

2.1.7 In order to mitigate the risk of reduction in the supply quantity during reprovisioning of the South Works of the Sha Tin WTW, and also to achieve a more reliable and balanced territory-wide water supply system after the reprovisioning works, this Project only covers the reprovisioning of the South Works, the most aging part of the plant while maintaining the North Works in continuous operation. In addition, WSD would first increase the treatment capacity of Tai Po WTW from 250,000 m^3/day to a treatment capacity of 400,000 m^3/day (this uprating work forms part of a separate project) and then 800,000 m^3/day in two stages to tie in with the staged demolition of some of the facilities in the South Works to allow the Project to proceed. The reprovisioned capacity of the South Works will be increased from the original of 364,000 m^3/day to 550,000 m^3/day.

2.2 Project Objectives and Need

2.2.1 The key objectives of the Project are to:

- reprovide the South Works of the existing Sha Tin WTW with a treatment process that can continue to meet the latest treated water quality standards and enable a more reliable water supply to the territory;
- manage to provide a safe, reliable and sustainable water supply for the users;
- cope with the possible tightening on the drinking water quality by the WHO in the future;
- meet more stringent treated water quality objectives to be specified by WSD in the future; and
- use environmentally friendly and cost-effective methods to achieve the above objectives.

2.2.2 The existing Sha Tin WTW is a conventional water treatment plant which includes the following processes:

- coagulation with alum dosing to raw water to encourage formation of large particles;
- flocculator-clarifers to provide flocculation and settle the large particles;
- filtration to provide additional polishing for particulates in the clarified water; and
- primary disinfection using chlorine.

2.2.3 Sha Tin WTW currently receives raw water from five blending sources during the day and throughout the year. Water from four of the sources goes through the supply basin flowing to Sha Tin WTW via two tunnels located at the north of the plant including (1) Dongjiang the main source; (2) the Plover Cove Reservoir; (3) the Shing Mun and Lower Shing Mun Reservoirs; (4) the catchment intakes of Plover Cove Stage I Tunnel and the catchment intakes of the High Island Main Tunnel. The remaining one source is water from the High Island Reservoir entering Sha Tin WTW at the south-western corner of the site near the alum saturation tanks and passes into the main inlet distribution channel. Currently, the energy associated with the water pressure by the draw-off from High Island Reservoir is dissipated using the energy dissipating chamber near the north-western corner of the Chlorination House. The locations of the existing facilities and the water flow schematics are illustrated in **Figure 2.2**, and the process diagram of the existing water treatment processes is in **Figure 2.3**.

2.2.4 The blended raw water from the five sources enters the main inlet distribution channel and the following chemicals are added:

- hydrated lime for pH control;
- alum for coagulation;
- powered activated carbon for tastes and odours control as necessary; and
- polyelectrolyte for assistance of coagulation and flocculation.

2.2.5 After mixing, the water passes through two distribution chambers located at both the South Works and the North Works via the dividing chamber/dividing chamber extension for water supply to the clarifiers No.1-4 in the South Works and the accelators No.1-6 in the North Works where flocculation of the particles in the water occurs. The clarifiers and accelators are playing the same role to provide opportunities for fine particles to coagulate into larger particles which can be subsequently settled as sludge. Then the supernatant from the clarifiers and accelators flows to the filters filled with media of sand and anthracite to remove the remaining particles.

2.2.6 The filtered water is dosed with the chemicals as below before going into the clearwater tanks which could not be shown clearly in Figure 2.2 were located under the filters:

- chlorine for disinfection;
- hydrated lime for pH control; and
- fluoride for dental protection.

2.2.7 The final treated water stored in the clearwater tank is pumped via the pumping stations to service reservoirs in Sha Tin and Lion Rock service reservoirs group in Kowloon for distribution to consumers.

2.2.8 Periodically the filters are cleaned by backwashing with compressed air and then water. The spent washwater is collected in the washwater recovery tanks for re-pumping to the inlet chamber for recycling. Sludge produced in the clarifiers is thickened by four sludge thickening tanks with polyelectrolyte and then conveyed to Sha Tin Sewage Treatment Works for further treatment prior to disposal.

2.2.9 Whilst the latest WHO's Guidelines for Drinking-water Quality Fourth Edition 2011 (WHO 2011) is a well-received international standard for safe drinking water, selection of the standards would have to take into account all countries globally. Hence, some of the more stringent requirements in the more advanced countries like US and UK are not included in the Guidelines. Being an international city with high standard of living, WSD reviewed other international standards including the US Environmental Protection Agency (EPA) standards. As a result, an additional 13 parameters have been selected to supplement the Guidelines as the treated water quality standards for the reprovisioned Sha Tin WTW South Works.

2.2.10 With over 40 years in service, the aging plant and equipment are approaching the end of their service life. This is compounded by increasing fault occurrences and unavailability of the spare parts caused significant maintenance problems. As a result of this, treated water from the plant based on a more than 40 years old design would not be able to cope with the possible tightening on the drinking water quality by the WHO in the future.

2.2.11 For the above reasons, replacement of the existing facilities is the only solution to meet the anticipated future water needs and quality.

2.3 Benefits of the Development

2.3.1 The main benefits of the proposed Project are: provide a safe and reliable water supply, improve water supply reliability to the territory, improved quality of life, development of environmentally sustainable design by applying low-carbon concept and other design features e.g. sustainable landscape design by incorporating planting native species, sustainable architectural design that features green building initiatives and energy efficiency. The visitor facilities will attract visitors by gaining a firsthand experience on the state-of-the-art treatment technologies and educate the public for water conservation.

2.3.2 The reprovisioned South Works together with new common facilities for both the South Works and the North Works will be able to provide enhanced treatment capability. The environmental benefits relative to existing conditions are elaborated below.

- Treated water quality will be enhanced to meet the latest treated water quality standards;
- Regarding the landscape and visual aspect, the Project creates an attractive environment for users and visitors. Architectural design of the buildings will include green roofs and boundary evergreen planting. Elevated walkway and improved accesses will provide a pleasant aesthetic appearance;
- In addition to aesthetic considerations, enhancement of the proposed trees and shrub planting would act as visual screen, noise and dust barriers separating the plant and the community users in the vicinity; and
- Concerning sustainability, the Project would adopt the most energy efficiency mode of operation appropriate to the required water treatment processes. Renewable energy facilities will also be installed to reduce the carbon footprint for the operation phase of the Project.

2.4 Project Location and Site History

2.4.1 The Project is situated at the existing Sha Tin WTW. The Project location as well as the major scope of works, are shown in **Figure 2.1**. The site area comprises predominately the developed areas of the existing Sha Tin WTW in about 10 hectares. The setting of Sha Tin WTW is within the natural valley encompassed by mountains from three sides. Woodland is located on these hillsides. Lion Rock Ridgeline to the south is a significant feature. On the east of Sha Tin WTW are the developed residential areas of Hin Keng Estate and road network namely Keng Hau Road and Che Kung Miu Road.

2.4.2 The existing Sha Tin WTW was constructed in 1964, currently called the South Works. The three subsequent stages of expansion in 1973, 1976 and 1983 formed the North Works. Before development, the land for the existing area was a typical rural and hilly area generally covered with vegetation. No residential was recorded there. After the last expansion in 1983, the Sha Tin WTW has been modified several times up to 1994, since then the building and facilities have been generally maintained as the condition at present.

2.5 Scope of the Project

2.5.1 The Project comprises the following key elements:

(i) Demolition of the existing facilities of the South Works and common facilities for both the South Works and the North Works in phases;

(ii) Reprovisioning of the South Works; and

(iii) Construction of new common facilities for both the South Works and the North Works.

2.5.2 In order to maintain water supply to the existing users, the operation of the existing North Works of the Sha Tin WTW would be undisturbed during construction of the Project. The future North Works reprovisioning, if it considers necessary at a later stage, will be outside the scope of this EIA study.

2.5.3 Existing major facilities and the treatment process of the South Works include:

(i) South Works Clarifiers

Raw water from the main inlet distribution channel is distributed to the four clarifiers. With the aid of dissolved alum and polyelectrolyte, fine particles in the raw water will coagulate into larger particles which will subsequently settle as sludge in the clarifiers.

(ii) South Works Filters

The clarified water will then flow by gravity to the filters for removal of the more finely divided particles.

(iii) South Works Clearwater Tank

The filtered water flows to the western end of the filter blocks and drops into the South Works clearwater tank underneath, where post-lime and post-chlorine are added to provide disinfection and adjustment of pH and alkalinity of the final treated water. Fluoride is also added for dental protection. The treated water is then stored in the clearwater tank.

(iv) Filtered Water Pumping Station (South Works) and Power Supply

Treated water from the South Works clearwater tank is pumped to the distribution network from this pumping station.

Major facilities locations are provided in **Figure 2.1**.

2.5.4 The major scope of works for the Project, with reference to section 1.2 of the EIA Study Brief, includes:

(1) Isolation and demolition of the existing facilities of the South Works in phases comprising clarifiers, filter beds with clearwater tank underneath, filtered water pumping station (South Works), as well as common facilities for both the South Works and the North Works including chemical house, alum saturation tanks, washwater recovery tanks, administration building and the dangerous goods (DGs) store;

(2) Construction of the new common facilities for both the South Works and the North Works including an Administration Building cum Mainland East Laboratory with visitor facilities, pre-treatment facilities, Water Treatment Works Logistics Centre, switchgears and power supply, South Works Pumping Station and washwater recovery facilities;

(3) Cut-back of the existing engineered slope located to the west of the existing clarifiers for reprovisioning of chemical house to Water Treatment Works Logistics Centre where Incense Tree (*Aquilaria sinensis*) as listed under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) was identified;

(4) Construction of new access roads for both construction and normal operation of the plant;

(5) Reprovisioning of the South Works as mentioned in section 2.5.1 to the proposed output of 550,000 m^3/day; and

(6) Provision of all other associated civil, geotechnical, mechanical and electrical works.

General layout of the facilities mentioned above in current operation stage and construction stage are presented in **Figure 2.5** and **Figure 2.6** respectively.

2.5.5 Due to space constraints on the existing site and to allow a more appropriate chemical delivery time from the chemical house to the various treatment units in response to the incoming raw water quality, it is proposed to reprovide a chemical house (named as Water Treatment Works Logistics Centre) to be placed in a central location of the site. As a result, it is necessary to cut-back the above mentioned engineered slope. This has been presented and agreed in-principle with the Sha Tin District Council in its Development and Housing Committee (D&HC) meeting held on 3 September 2009.

2.5.6 The existing staff quarters are proposed to be used as a site office during construction. No major construction works will be undertaken in this location but minor refurbishment work to be required.

2.5.7 The reprovisioned South Works will comprise treatment processes including pre-ozonation, coagulation, mechanical flocculation, high rate sedimentation, intermediate ozonation, biological filters, second stage granular media filters, UV disinfection system, treated water storage and pumping, as well as residual management facilities. The process diagram of the reprovisioned water treatment processes is shown in **Figure 2.4**. The general layout of the reprovisioned facilities is illustrated in **Figure 3.1**.

2.5.8 Raw water from the inlet channel enters the pre-ozonation contactors (Item No.1 in **Figure 3.1**). Rapid mixers will be located at the downstream of the pre-ozonation contactors and the following chemicals are added:

- hydrated Lime for pH control; and
- alum for coagulation.

2.5.9 Water then flows into the flocculation tanks for slower mixing to help the charged particles to come together to form larger particles (Item No.2 in **Figure 3.1**). Polyelectrolyte is added to facilitate the flocculation.

2.5.10 The larger particles are removed in the high rate sedimentation tanks (Item No.3 in **Figure 3.1**) and dropped to the bottom of the tank.

2.5.11 The clarified water from the sedimentation tanks is conveyed to the intermediate ozone contactors (Item No. 4 in **Figure 3.1**) where natural organic molecules are broken down for subsequent biological filtration process. Sodium bisulphite will be dosed to react with the residual dissolved ozone in the water.

2.5.12 Biological filters (Item No.5 in **Figure 3.1**) are the key parts of the treatment process where ammonia nitrogen and natural organic matters are removed, and the following chemicals are added:

- ammonium sulphate as nutrients for biomass;
- sodium phosphate as nutrients for biomass; and
- polyelectrolyte to assist the filtration.

2.5.13 The water is then filtered through the second stage granular media filters (Item No.7 in **Figure 3.1**) to provide additional removal of particles. Polyelectrolyte is added to facilitate the filtration process.

2.5.14 Filtered water from the second stage granular media filters then passes through ultraviolet reactors where ultraviolet light is used for primary disinfection. The following chemicals are further added:

- chlorine to provide residual disinfection of treated water in the distribution system;
- hydrated Lime for pH control; and
- fluoride for dental protection.

2.5.15 The final treated water is stored in the clearwater tanks and pumped by the new pumping station (Item No.6 in **Figure 3.1**) to existing service reservoirs.

2.5.16 The spent washwater for periodical cleaning of biological filters and second stage granular media filters is diverted to the residual management facilities (Items No. 8 and 9 in **Figure 3.1**) for further treatment before recycling back to the inlet channel. Water entering the residual management system passes through the process of dissolved air floatation (DAF) or other high rate sedimentation process to remove the light fraction solids. Water is fed with air which adheres to the particles and floats them to the surface of the tank for removal.

2.5.17 The differences of treatment processes between the existing and the proposed treatment processes for the reprovisioned South Works are presented in **Table 2.1** below.

Table 2.1 Comparison of the Existing and the Reprovisioning Treatment Processes

Existing Treatment Facilities	Reprovisioning Treatment Facilities	Benefits from the Reprovisioning
-	Pre-ozonation	Reduce chlorine consumption by oxidizing manganese using ozone in lieu of chlorine. The use of ozone at this stage of the treatment has the added benefit of reducing taste and odour problems.
Coagulation	Enhanced coagulation with rapid mixers	Provide sufficient mixing for optimized coagulation
Flocculator-clarifiers	Mechanical flocculation with mixers	Enhance the efficiency for large particles formation
	High rate sedimentation	Increase the treatment capacity of the sedimentation tanks, therefore reduce the required construction footprint
-	Intermediate ozonation	Break down organics in the water to facilitate better process performance downstream, and reduce chlorine consumption
-	Biological filter	Reduce chlorine consumption by removing ammonia using a biological process
Rapid gravity filter	Second stage granular media filter	Provide additional barriers for particles removal
-	UV Disinfection	Enhance the removal efficiency for virus and reduce chlorine usage

Existing Treatment Facilities	Reprovisioning Treatment Facilities	Benefits from the Reprovisioning
Chlorination	Chlorination	Provide residual disinfection in the distribution system with lower dosage of chlorine
-	Residual management for spent filter backwash water	Enhance water quality of the spent washwater before recycling to the inlet raw water

2.6 Study Area

2.6.1 The study areas for some aspects of the assessment are follows:

- Air quality impact assessment study area is 500 m from the boundary of the Project site.
- Noise impact assessment study area is 300 m from the boundary of the Project site.
- Water quality impact assessment study area is 500 m from the boundary of the Project site.
- Waste management and land contamination assessment will focus on areas within the boundary of the Project site.
- Ecological impact assessment study area would include areas within 500 m from the site boundary of the Project site and also any other areas likely to be impacted by the Project.
- Landscape impact assessment would include all areas within 500 m of the boundary of the Project site, whereas the visual envelope would define the visual impact study area boundary.
- Cultural heritage impact assessment would include areas within 300 m of the boundary of the Project Site.
- The study area for hazard assessment is the 1-km Consultation Zone of Sha Tin WTW and the chlorine transport route from Sham Shui Kok dock (North Lantau) to Sha Tin WTW.

2.7 Works Programme and Implementation

2.7.1 The construction works of the Project are anticipated to commence on site in 2015, with completion of the Project by 2021. A construction programme is presented in **Appendix 2.1** for reference. The assessments in this report are based on this programme, using reasonable worst-case scenarios and, where necessary, any implications of the programme have been highlighted in the relevant sections.

2.8 Concurrent Projects Having Potential for Cumulative Effects

2.8.1 The following nearby project would undergo construction at the same time:

(i) Shatin to Central Link – Tai Wai to Hung Hom Section

The cumulative impacts arising from above nearby project operating concurrently have been assessed and are described in the relevant technical section of this EIA report.

2.9 Public Consultation

Public Consultation during Project Preparation

2.9.1 Formal public consultation to the D&HC of the Sha Tin District Council was carried out during the Project preparation on 3 September 2009. Subsequently, two meetings were held on 26 January 2011 with representatives from Hin Keng Estate and 12 August 2011 with Sha Tin District Council members.

Public Consultation during the Course of the EIA

2.9.2 On 26 January 2011 during the scoping stage of the EIA study, WSD posted an advertisement on the Chinese Mingpao and the English Standard newspaper for the availability of the Project Profile and the arrangement for its public inspection as statutorily required under the EIAO. It is expected another round of similar advertisements to be posted for the EIA when the report is considered by the DEP as meeting the EIA study brief and the TM on EIA Process. When required, WSD will present the EIA report to the EIA Sub-committee of Advisory Council on the Environment.

2.9.3 Considerations of comments from the perspective of the public on the hazard to life due to the construction and operation of the reprovisioned South Works, including the transport, storage and use of chlorine and other relevant hazardous materials as well as cumulative impacts from gas installations, gas pipelines and use of explosives in the vicinity, are given in Section 12. In addition to the considerations of alternatives in Section 3, whilst the emergency response plan had already been implemented and included in the risk assessment as detailed in Section 12.13.5 and Table 12.36 of Section 12.26, the benefits of the proposed treatment process with further reduction on chlorine consumption as well as chlorine storage following the reprovisioning are presented in Table 2.1 of Section 2 and Sections 12.4.3, 12.12.18, and 12.14.7. The potential hazards to/from other installations are also assessed in Sections 12.9.17 to 12.9.32 and 12.30. The assessment results show that the chlorine-related risks for surrounding population will be reduced and comply with the Hong Kong Risk Guidelines (HKRG).

~ End of Section 2 ~