RELOCATION OF SHA TIN SEWAGE TREATMENT WORKS TO CAVERNS – INVESTIGATION, DESIGN + CONSTRUCTION

Hong Kong

RELEVANCE TO SIWWTP UPGRADE

- Schedule and performance goals driven by Hong Kong government, similar to consent decree criteria
- Extensive public outreach and complex stakeholder coordination
- Complicated cavern construction requiring multiple measures to address good flow equalization and to mitigate flooding
- Bio-sorption and step feed BNR
- Energy-efficient focus
- Small footprint

PHASE OF SERVICES

- ☑ Planning
- ☑ Design
- ☑ Services During Bidding/Construction

SIMILAR KEY CHALLENGES

- **B** Secondary Treatment System Selection / Design
- **C** Stakeholder Coordination + Communication
- **D** Wastewater Treatment Plant Footprint or Challenging Neighborhood Setting
- **E** Flow Equalization, Stormwater, High Groundwater, Flood Proofing, or Wetlands

Relevance to the SIWWTP Upgrade

The Sha Tin Sewage Treatment Works (STW) is the largest WWTP in Hong Kong and is currently located on prime real estate on the water front, in a heavily trafficked commercial and industrial area. The plant has small footprint and chemically and energy-efficient design requirements. The current contract, undertaken by AECOM, is to relocate the entire WWTP into manmade caverns in a nearby mountain and to recover and reuse the existing treatment site as high-end, commercial, waterfront property after site remediation.

Like the SIWWTP, the key considerations for the design of the new Sha Tin STW are capital and operating cost, footprint, safety, operability, maintainability, reliability, and providing an asset that can serve the residents and meet emerging regulatory demands for the next 100 years. The most significant impact on the capital cost is the footprint / space demand of the biological treatment process (smaller is better), and the most important aspects from an operational cost perspective are energy and chemical demands. To develop the optimal solution, AECOM has evaluated, piloted, and is designing a number of small footprint and energy-efficient technologies including the following:

- Bio-sorption for the primaries or A-stage to maximize the capture and redirection of carbon for green energy recovery (e.g., Captivator and similar bio-sorption concepts, such as a very short SRT high-rate contact stabilization activated sludge process similar to those at the Strass, Western Branch, and Blue Plains Advanced WWTPs).
- Small footprint, energy-efficient B-stage nutrient removal technologies, such as step feed BNR with selector zones; attached growth processes, such as MBBR and IFAS; MBR concepts; granular sludge processes, such as Nereda; the novel SANI® process that uses sulphur in the wastewater as an electron donor for autotrophic denitrification; and mainstream deammonification.

Adsorption/Bio-oxidation Process | Step Feed Activated Sludge | Selector Activated Sludge | Appurtenant Treatment Systems

Relocation of Sha Tin Sewage Treatment Works to Caverns – Investigation, Design + Construction

- Small footprint sidestream centrate deammonification and /or membrane processes (e.g., Ovivo) to reduce the effluent total nitrogen in an energy efficient manner.
- Small footprint advanced biosolids management technologies such DAF thickening; anaerobic pre-treatment technologies such as thermal hydrolysis; and dewatering technologies such as Bucher presses.
- Energy-and chemical-efficient odor control technologies.

The extensive evaluations, pilot studies, and design efforts conducted for Sha Tin STW are of direct relevance to the SIWWTP, which also requires a small footprint, energy- and chemically efficient treatment process that can be modified and upgraded in the future to meet emerging regulatory demands.

Secondary Treatment Plant Systems

The Sha Tin STW comprises three of the four secondary treatment plant systems listed in the City's RFQ, including step feed activated sludge, selector activated sludge, and adsorption/bio-oxidation process.

Appurtenant Treatment Systems

AECOM is providing engineering services at Sha Tin for the following appurtenant treatment systems:

- Biological nutrient removal
- Flow equalization
- Sewage lift station
- Primary and secondary sedimentation
- Anaerobic digestion
- Sludge thickening
- Energy conservation/recovery
- Solids handling
- Odor control

General Contract Background

AECOM was appointed by the Drainage Services Department of the Hong Kong Special Administrative Region Government to provide the feasibility study (first contract), concept design, detailed design, and construction supervision consultancy (second contract) for the relocation of Sha Tin STW from its current waterfront location to manmade caverns in a nearby mountain in Sha Tin, Hong Kong. The consultancy's lump sum fee is around $32 million, while the total contract value, including site supervision costs, amounts to $130 million. AECOM has been selected for each phase of the project through a competitive selection process and has been receiving excellent performance ratings for each phase of the work.

Project Challenges

With a sewage treatment capacity of 340,000 cubic meters per day, the relocated STW will be the biggest cavern sewage treatment works in Asia when completed, serving a population of over 800,000 in Sha Tin. This project also marks a new milestone in large-scale cavern development in Hong Kong as part of enhancing land supply strategy to free up land for housing and other beneficial uses.

AECOM Contract Scope

AECOM's scope of works includes engineering and environmental impact assessments, design of sewage treatment process, all aspects of engineering and architectural design in relation to the STW in caverns, preparation of tender documents, and construction supervision. AECOM will also assist the government in public engagement activities and provide preliminary design for the upstream sewerage networks and pumping facilities related to the relocation of the Sha Tin STW to caverns.

AECOM's Innovative Solutions

To design a sustainable STW located inside caverns that will meet the demands for the next 100 years, AECOM's cavern and process teams have developed advanced sewage- and sludge-treatment technologies to minimize the size of the caverns, energy consumption, carbon footprint, and sludge production, in order to optimize the cost of the entire life cycle.

Relocation of Sha Tin Sewage Treatment Works to Caverns – Investigation, Design + Construction

Many of the technologies identified by AECOM are at the forefront of the industry including bio-sorption, granular sludge, and the SANI® process, which uses various oxidative forms of sulphur in the wastewater as electron acceptors and donors for carbon oxidation, nitrification, and autotrophic denitrification. AECOM is operating a number of cutting-edge pilots currently to confirm operational reliability and maintenance requirements for these state-of-the-art technologies and to ensure that they work well for the local sewage characteristics, including high salinity due to the use of seawater for flushing in Hong Kong.

AECOM has taken the experience from the pilots to help develop a technology roadmap for to address future potential regulatory requirements. The facility is being designed looking forward to ensure that each baseline process can be easily upgraded to meet a range of possible future performance requirements and to also be easily modified to take advantage of emerging cost-saving opportunities, like mainstream deammonification.

The design work is scheduled for completion in 2017, and construction work will commence thereafter under AECOM's supervision.

Awards & Accomplishments

AECOM has enjoyed great success with continuously "Good" performance ratings from the client and was the recent recipient of the 2014 International Water Association Global Award in the Marketing and Communication category for an exceptional public outreach and communications program.

Client: Hong Kong Drainage Services Department

Total Cost: TBD (AECOM fee: $130M)

Work Completion: 2030

Team Member Experience:
- Dr. Beverley Stinson
- Bob Stallings, PE
- Dr. Greg Bowden
- Paul Moulton, PE
- Echo Leong
- Robert Chan