

Hong Kong Harbour Area Treatment Scheme – A Successful Case

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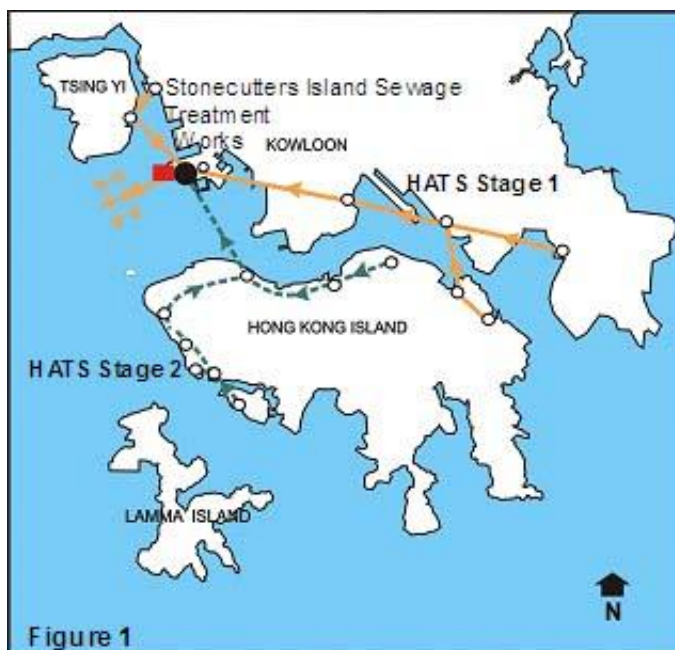
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Abstract

The Harbour Area Treatment Scheme (HATS) is a world-class sewage collection and treatment scheme for the Victoria Harbour area, Hong Kong's (HK) geographic and cultural eco-hub. HATS comprises a 45km deep tunnel conveyance system, primary and secondary treatment plants, and disinfection facilities for a maximum total capacity of 2.8 million m³/day. This paper presents how impact assessment has been used to support the implementation of HATS, which is essential for the long term sustainability of Victoria Harbour, custodian and symbol of human well-being in HK. Key issues cover international treatment process alternatives evaluation, transboundary cumulative water quality impacts, ecological and human health risks, odour and visual impacts. HATS is one of the most transparent public projects in HK, with unprecedented and extensive public engagement during the impact assessment process.



Introduction

Victoria Harbour is a precious natural asset of Hong Kong with tremendous socio-economic value. Rapid population growth in the past decades on both shores of Victoria Harbour resulted in water quality deterioration from the discharge of untreated sewage into the Harbour. The Harbour Area Treatment Scheme (HATS), as shown in Figure 1, is an overall sewage collection and treatment scheme for areas on both sides of Victoria Harbour. Construction of this world-class sewage treatment infrastructure is being carried out in several stages, viz Stage 1 (completed in 2001), Stage 2A and Stage 2B.

Stage 1 of HATS involved the construction of a 23.6 km-long system of tunnels deep underground, carrying currently 1.4 million tonnes of sewage each day from Kowloon and the northeastern part of Hong Kong Island to a chemically enhanced primary sewage treatment plant at Stonecutters Island. Stage 1 of HATS has brought about noticeable improvement to the water quality of the Victoria Harbour. Yet, sewage from the other densely populated parts of the Hong Kong Island is only subject to preliminary treatment (i.e., screening and de-gritting) before discharge into the harbour. This preliminarily treated sewage, coupled with the un-disinfected effluent from the SCISTW, is a source of current water quality problems, particularly in the western part of the harbour including bathing beaches in an area called Tsuen Wan.

Stage 2A of HATS will upgrade the preliminary treatment works (PTWs) around the northern and southwestern shore of Hong Kong Island and construct a 21 km-long deep tunnel system to convey

'IAIA10 Conference Proceedings'

The Role of Impact Assessment in *Transitioning to the Green Economy*

30th Annual Meeting of the International Association for Impact Assessment

6-11 April 2010, International Conference Centre Geneva - Switzerland (www.iaia.org)

the sewage from Hong Kong Island to Stonecutters Island Sewage Treatment Works (SCISTW), where the existing chemical treatment facilities will be expanded to a design capacity of 2.45 million m³/day and new disinfection facilities added. Stage 2B of HATS will involve the provision of biological treatment at the SCISTW to further improve the effluent quality. The timing of the Stage 2B implementation will be decided upon a review of water quality trends, population increases and sewage flow build up, to be undertaken in 2010-11.

This paper presents how impact assessment has been successfully used to support the implementation of HATS Stage 2A, with a transparent and extensive continuous public involvement programme, unprecedented in Hong Kong.

Public Concerns

After taking into account the public's views collected through a five-month consultation in 2004, the Hong Kong Government is committed to proceeding with Stage 2 of HATS in two phases, namely Stage 2A and Stage 2B. Continuous public consultation is on-going. However, a summary of the public's expressed key environmental issues is presented below.

Disinfection

- Need for disinfection
- Implementation of early biological treatment

Disinfection technologies

- Review of alternative methods of disinfection for HATS e.g. UV treatment, ozone
- Cost-effectiveness of different technologies
- Optimization of chemical dosage

Environmental impacts

- Toxicity effects of disinfection by-products on marine ecology and humans
- Hazard to life related to delivery and storage of chemicals
- Disposal of UV lamps
- Cumulative water quality impacts

Impact Assessment in Action

The Government commissioned an environmental Impact Assessment (EIA) study for the Advance Disinfection Facility (ADF), to identify if there is a need for disinfection, study alternative disinfection options, recommend an environmentally acceptable and cost-effective disinfection technology for HATS, and thoroughly assess potential environmental impacts. A separate EIA study for the whole of the Stage 2A works was also conducted shortly after the disinfection EIA. The two EIA studies were then used as a useful tool to address the above public concerns and incorporate environmentally friendly design into the project, in compliance with environmental regulations and standards, as illustrated below.

Consideration of Alternatives

Alternative Disinfection Technologies - A comprehensive review of international practices was conducted and various technologies evaluated. The feasible sewage disinfection options for HATS were concluded to be chlorination (with dechlorination) and UV radiation. Both options were found to be environmentally acceptable with water quality and ecological impacts able to be controlled to well within environmental criteria. Neither was superior to the other on all environmental aspects. The chlorination option was selected for HATS in terms of cost, reliability, flexibility to cater for uncertainties, and ease of implementation. The disinfection system design was developed and refined with iterative environmental inputs, eg. optimal chemical dosage.

Alternative Sewage Conveyance System (SCS) Alignments - Two major alternatives were considered. The selected alignment option would go more offshore and minimise impacts to inland environmental sensitive receivers/historic structures, and would also minimise encroachment on private lots and

thereby eliminate interfaces with private properties. This would result in the reduction of programming risk and hence duration of environmental impacts to the public. Although this alignment would be 0.5 km longer than the other alignment, increase of waste generation would not be a significant concern.

Alternative Construction Methods - Deep tunnelling for SCS was preferred from an environmental perspective because activities on the surface would be restricted to a relatively small number of production shafts, and hence construction stage environmental impacts would be much lower than shallow sewer pipes option (open trench excavation). Further, at these shaft locations, environmental noise, dust, and visual impacts could be effectively mitigated with a carefully designed enclosure.

Alternative Sequences of Construction - Despite potential longer work programme, the phased construction option was adopted. This was because it had lower noise and dust impacts as there was less concurrent construction activities on site at any given time, achieving compliance with environmental criteria.

Water Quality

The water quality impacts to the Hong Kong waters from operation of the HATS Stage 2A were assessed using a state-of-the-art computer program that simulated three-dimensional flow and water quality processes, encompassing near-field and far-field regional models. The model results indicated that implementation of Stage 2A would lead to an overall reduction of all concerned parameters (e.g. ammonia nitrogen, inorganic nutrients, E. Coli, dissolved oxygen, suspended solids and biochemical oxygen demand) in the receiving waters, particularly at nearby water sensitive receivers such as beaches, fish cultural zones, seagrass beds, coral sites, and the Chinese White Dolphin and Green Turtle nesting grounds.

With reference to the chlorination/dechlorination disinfection design process developed, the total residual chlorine levels in the receiving waters would meet international criteria. Whole effluent toxicity tests also showed that the process did not introduce additional toxic effects to the test organisms. A comprehensive monitoring programme was recommended to confirm the model predictions made in the EIA and ensure compliance with the criteria.

Human Health and Ecological Risk

The existing SCISTW outfall location was chosen in an area with low ecological value. Detailed risk assessments were conducted to assess potential adverse human health and ecological effects that might result from exposure to toxic substances from the HATS effluent, based on the design developed alongside the EIA studies.

Risk to Human Health – Assessment results indicated that potential risk/hazard impact due to chlorination by-products (CBPs) and other contaminants present in the chlorinated/dechlorinated (C/D) HATS effluent would be negligible and acceptable under established assessment criteria in all project scenarios.

Risk to Aquatic Life & Risk to Marine Mammals - The potential risks due to CBPs present in C/D HATS effluent were predicted to be lower than established risk screening values, indicating that use of chlorination would not present unacceptable risks. Results of cumulative risks assessment, which included both CBPs and other pollutants present in the C/D HATS effluent, showed potential hazards that were in the same order as that of the ambient marine water, indicating that the effluent would not cause significant additional toxicity to the ambient condition. Results of whole effluent toxicity tests on C/D effluent were used to supplement the ecological risk assessment, showing compliance of established toxicity criteria in all project scenarios. Therefore, the potential risk of C/D effluent on aquatic life would be minimal and acceptable.

Odour

Odour emissions from the PTWs and SCISTW during the operation phase were predicted to be the main concern. Odour sources in the SCISTW include distribution channel, flocculation tanks, primary sedimentation tanks, drop shafts of the sedimentation tanks, effluent weirs, overflow chamber, flow distribution chamber and dewatered sludge. Solids handling areas are the main odour sources at the

PTWs. Following air dispersion modellings to simulate potential odour impacts on air sensitive receivers, it was found that all the identified odour sources would have to be enclosed or covered, with the foul air drawn through deodorization units for treatment. Regular odour monitoring would have to be carried out to verify that the odour criterion was met.

Hazard to Life

Hazard to life impacts associated with the proposed disinfection facilities at SCISTW were quantitatively assessed, with consideration of identified precautionary measures / operation procedures that would minimize the risks associated with the chemicals related operations. The individual risk and societal risk associated with the chemicals used during operations were found to be acceptable, in accordance with the risk guidelines, and the hazard to life impact due to the Project would also be acceptable.

Stakeholder Engagement

The EIA studies adopted a pro-active approach of Continuous Public Involvement (CPI). Through public consultation meetings and forums, the studies aimed to provide the public opportunities to know about the HATS 2A project and be reasonably conversant with the issues when providing opinions and suggestions. During the public consultation meetings and forums, the EIA teams introduced the EIA studies, briefed people on the latest progress, carried out discussion, listened to comments and views, and provided feedback to concerns. A total of six rounds of public consultation were conducted with green groups, academics and professional institutions for the HATS 2A EIA studies throughout different stages. Those consulted include:

Non-Government Organizations. *Six non-government organizations including Green Peace, the Hong Kong Marine Conservation Society, the Worldwide Fund for Nature Hong Kong, Green Power, the Hong Kong Conservancy Association, and the EarthCare.*

Academics. *Three tertiary institutions including the University of Hong Kong, the Hong Kong University of Science and Technology, and the Hong Kong Institute of Vocational Education.*

Professional Bodies. *Four professional bodies including the Hong Kong Institution of Engineers, the Hong Kong Institute of Environmental Impact Assessment, the Chartered Institution of Water and Environmental Management, and the Marine Biological Association of Hong Kong.*

A summary of these consultations is outlined below, in addition consultations with district councils.

- December 2005 – early consultation to collect initial views from stakeholders on HATS disinfection
- March 2006 – second consultation to present selection of the disinfection process for HATS and to collect views from stakeholders
 - ◆ Academia and professionals generally accepted the need for disinfection and were supportive of the selected option i.e. chlorination/dechlorination using direct purchase of sodium hypochlorite
 - ◆ Views from green groups were mixed: some showed support, some expressed reservation and others did not give a definite view
- October 2006 - third public consultation to present preliminary findings of detailed impact assessment based on the selected disinfection option
- February 2007 – fourth round of consultation to collect initial views from stakeholders on HATS 2A's SCS, PTWs upgrading and SCISTW expansion components
- May 2007 – fifth consultation to present disinfection EIA findings, prior to formal submission of report under the EIA Ordinance
- June 2007 - consulted Legislative Council's Panel on Environmental Affairs
- September 2007 - consulted Advisory Council on the Environment regarding the disinfection EIA
 - ◆ Environmental Permit for the disinfection works was granted in November 2007
- January 2008 – sixth round of consultation to present the overall Stage 2A works EIA findings and solicit views and comments for finalisation of the EIA Study

- September 2008 - consulted Advisory Council on the Environment regarding the Stage 2A EIA
 - ◆ Environmental Permit for the Stage 2A works was granted in November 2008

A key to the success of the EIA studies was that public concerns expressed in consultations were fully considered and responded to through follow-up communications and meetings. This was well documented in the EIA reports. At the final stage of the EIA studies, the EIA reports obtained smooth approval from the authorities with minimal public objections.

Benefits of HATS Stage 2A

The EIA reports demonstrated the need for the HATS Stage 2A works (in progress at time of writing) to further improve the water quality of the Harbour, beyond those achieved in Stage 1, including

- Preventing another 190 to 500 tonnes of sewage sludge (at commissioning and ultimate flow conditions respectively) from being dumped into the harbour each day
- Reducing toxic ammonia by 10% on average
- Reducing total inorganic nitrogen and phosphorus by 5% and 8% respectively
- Increasing dissolved oxygen levels by 5%
- Facilitating re-opening of the closed Tsuen Wan beaches

HATS Stage 2A will substantially improve the water quality conditions compared to the scenario of 'no HATS Stage 2A'. Improved harbour water quality will benefit society in many different ways, including for example, enhanced recreational opportunities, scenic quality, aesthetics, public health and safety, and ecological and fishery resources, as well as commercial activities. Besides these, completion of Stage 2A, together with other sewerage programmes in the area, should enable the closed Tsuen Wan beaches to be re-opened promptly. Completion of Stage 2A will also provide a much-improved environment for marine life and the possibility of staging water events.

With improved water quality after Stage 2A, the Harbour would once again continue to boost benefits to human well-being. If HATS Stage 2A were not to proceed, the water quality would resume a deteriorating trend in the near future as the population continues to grow along with development on both sides of the harbour. Hence, there is a need for maintaining such efforts to clean up the harbour through implementation of the remaining stage of HATS.

Conclusion

The paper has demonstrated how impact assessment has been successfully used to support the implementation of a mega sewage treatment scheme. It has presented how sustainability was planned for and is in the process of being achieved. Sustainability has come about through impact assessment, covering rigorous treatment processes evaluation, responsive design, and robust assessments of strategic water quality, ecological and human health risks. Effective communication with stakeholders throughout the impact assessment process was a key to the success of the planning and design phases, engaging participation and winning public support for the treatment scheme's implementation and thus for the long term sustainability of Victoria Harbour and the well-being of the people who use it.

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