

Summary

Agreement No. CE32/2015 (EP)
Further Enhancing Quality of Coastal Waters of
Victoria Harbour – Feasibility Study

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For and on Behalf of
Black & Veatch Hong Kong Limited

PREPARED FOR



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Table of Contents

	1.0 INTRODUCTION	1
	1.1 BACKGROUND	1
	1.2 OBJECTIVES AND SCOPE OF THE ASSIGNMENT	1
	2.0 SUMMARY OF REVIEWS AND SURVEY FINDINGS.....	3
	2.1 STUDY APPROACH.....	3
	2.2 OVERALL CONDITIONS OF NEARSHORE POLLUTION LEVELS	4
10	2.3 INVESTIGATIONS ON POLLUTION SOURCES.....	5
	2.4 OVERSEAS EXPERIENCE IN COMBATING NEARSHORE POLLUTION	6
	3.0 OVERALL FRAMEWORK TO COMBAT NEARSHORE POLLUTION	7
	3.1 FRAMEWORK STRUCTURE	7
	3.2 SOURCE CONTROL.....	8
	3.3 IN-SYSTEM MEASURES	10
	3.4 POLICY, PLANNING AND DESIGN	14
	3.5 MASTER IMPLEMENTATION PROGRAMME.....	15

List of Exhibits

20	Exhibit 1-1	Study Area.....	2
	Exhibit 1-2	Locations of Opportunity Areas and Areas of Concern	2
	Exhibit 2-1	Polluted Stormwater Outfall Locations	4
	Exhibit 2-2	Polluted Stormwater Manholes and Public Sewer Cross Connections Location Map	5
	Exhibit 2-3	Estimated BOD ₅ Pollution Load within the Surveyed Catchments	6
	Exhibit 3-1	Framework Structure.....	8
	Exhibit 3-2	Proposed Initiatives to Enhance the Enforcement Effectiveness	9
	Exhibit 3-3	Areas with Priority for Newly Designed Downstream DWFI	11
30	Exhibit 3-4	Summary of Recommended Measures for the Polluted Stormwater Outfall Locations	13
	Exhibit 3-5	Proposed Implementation Timeframe of the Programme	16



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1.0 Introduction

1.1 BACKGROUND

Harbour Area Treatment Scheme (HATS) Stages 1 and 2A have improved the water quality of the main water body of Victoria Harbour. However, residual pollution from a number of activities in the densely populated urban areas still discharges into the coastal waters.

With the development of new waterfront promenades on both sides, Victoria Harbour has become increasingly accessible to the public. The 2014 Policy Address announced the commissioning of consultancy study to enhance the quality of coastal waters of Victoria Harbour, with the long-term objective of enhancing its leisure and amenity value. The 2015 Policy Address also announced that the consultancy study would address on how to improve the problem of pollution and odour nuisance at urban coastal waters so as to provide venues for water activities along waterfront areas.

1.2 OBJECTIVES AND SCOPE OF THE ASSIGNMENT

Black & Veatch Hong Kong Limited (B&V) was appointed in January 2016 by the Environmental Protection Department (EPD) of the Hong Kong SAR Government to conduct *Agreement No. CE32/2015 (EP) - Further Enhancing Quality of Coastal Waters of Victoria Harbour – Feasibility Study* (hereinafter referred to as the Assignment).

1.2.1 Assignment Objectives

The objectives of the Assignment are:

- To explore various practicable and cost-effective options to effectively reduce nearshore pollution to improve the environment (both aesthetics and odour) along the coastal areas of Victoria Harbour; and
- To work out a programme to improve the environment of our popular waterfront areas, with the long-term objective of enhancing its leisure and amenity value.

1.2.2 Assignment Scope

The scope of the Assignment comprises the following components:

- To establish the water and odour pollution levels of coastal waters within the Study Area (**Exhibit 1-1**);
- To carry out the necessary studies and investigations to identify the sources of the aesthetic and odour problems and make recommendations for a range of engineering, legislative, planning, and management measures for mitigating the aesthetic and odour problems at the Opportunity Areas (**Exhibit 1-2**) for water activities; and
- To carry out studies and investigations to identify the sources of the aesthetic and odour problems and make recommendations on necessary follow up actions (e.g., engineering measures, cleaning programme, enforcement actions, and inspection arrangement, etc.) to mitigate the environmental problems at the Areas of Concern (**Exhibit 1-2**).



Exhibit 1-1 Study Area

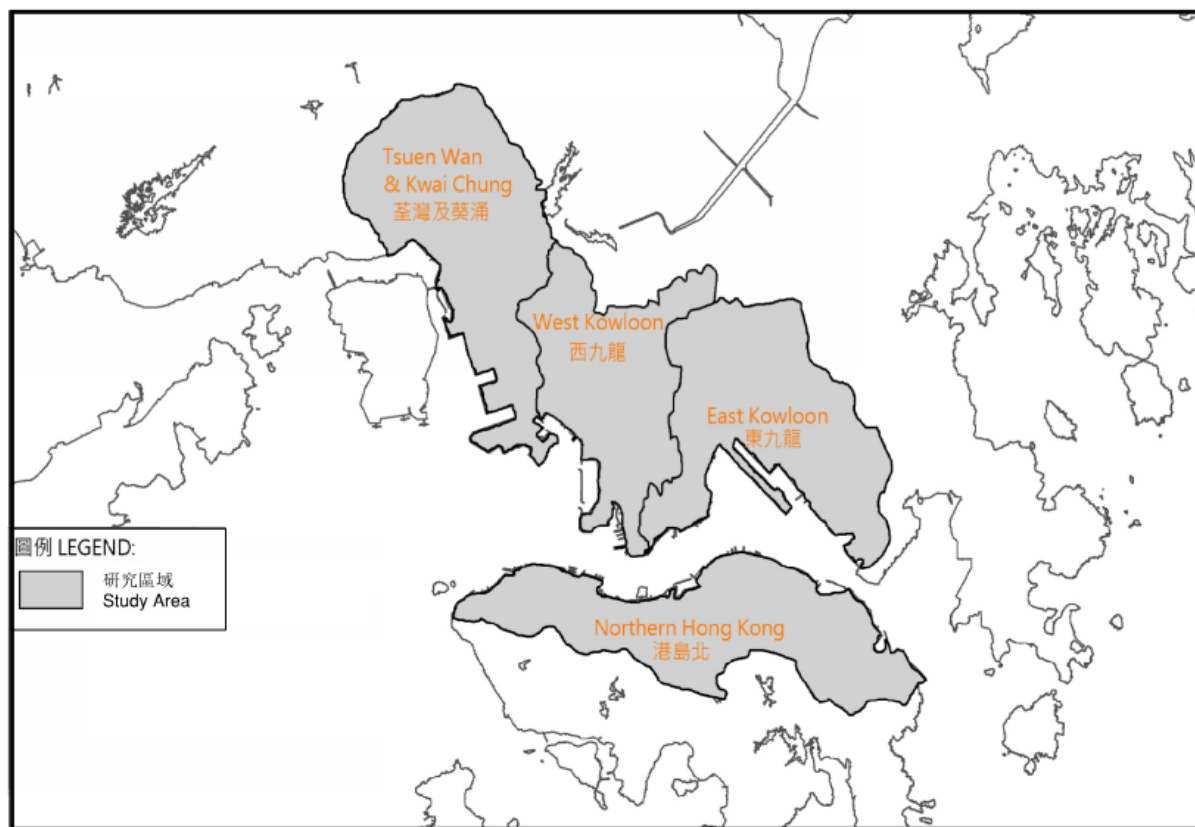


Exhibit 1-2 Locations of Opportunity Areas and Areas of Concern





1.2.3 Key Tasks

This Assignment has eight key tasks:

- Task 1 Establish the overall conditions of nearshore pollution levels in Victoria Harbour
- 5 ■ Task 2 Review overseas experience in combating nearshore pollution that may be applicable to Victoria Harbour
- Task 3 Carry out field surveys, environmental monitoring and investigations to identify pollution sources affecting coastal waters at Opportunity Areas for water activities
- Task 4 Carry out dedicated field surveys, environmental monitoring and investigations depending on the specific pollution concerns in Areas of Concern
- 10 ■ Task 5 Review and recommend improvements to the current programmes, planning and legislative provisions, and arrangements to combat nearshore pollution
- Task 6 Recommend engineering solutions for controlling and reducing pollution discharges and odour nuisance
- 15 ■ Task 7 Recommend initiatives to enhance public awareness in combating nearshore pollution
- Task 8 Formulate overall framework to combat nearshore pollution

2.0 Summary of Reviews and Survey Findings

2.1 STUDY APPROACH

Technical approach for undertaking the Assignment is described below:

- 20 i. **Investigate pollution condition of coastal waters and pollution sources:**
 - carry out Baseline Survey along the coastline of Victoria Harbour (include visual inspection, odour patrol, nearshore water/sediment sampling and analysis) to identify the polluted stormwater outfall locations and major potential pollution sources; and
 - 25 ■ carry out Condition Survey investigation along the upstream of polluted stormwater outfalls (include manhole survey, pollution flow & load survey, connectivity survey, etc.) to identify pollution sources.
- ii. **Identify improvement measures**
 - 30 ■ review overseas management, engineering and regulatory measures in combating nearshore pollution and identify measures that is applicable to Hong Kong;
 - review the existing administrative and regulatory provisions, programmes and arrangements implemented in Hong Kong, identify opportunities for improvements, and propose new initiatives to reduce nearshore pollution at source;
 - 35 ■ review the existing publicity programmes combating nearshore pollution and identify improvement measures in order to drive behavioural change to minimize pollution at source; and
 - review and propose engineering solutions to reduce pollution discharges and odour nuisance both at source and downstream of stormwater drainage catchments.

iii. Formulate implementation programme

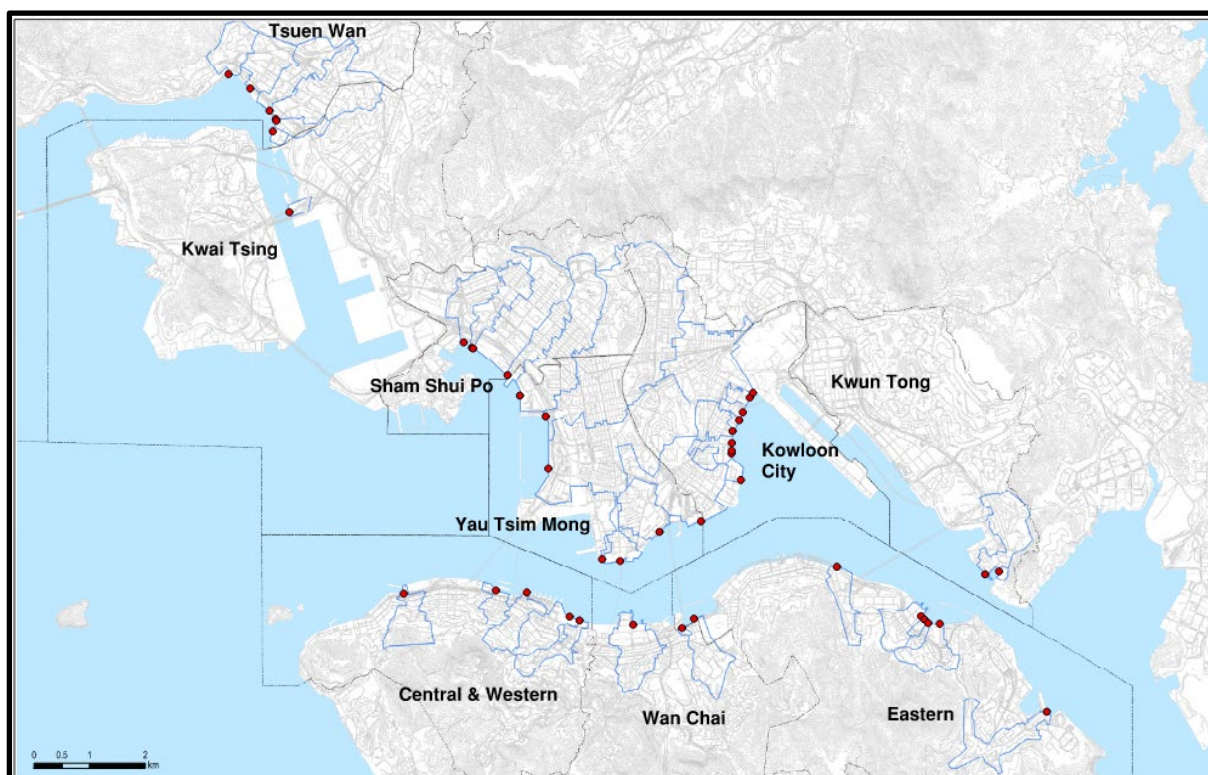
- formulate short-, medium- and long-term initiatives for relevant departments to follow up; and
- develop an overall framework to combat nearshore pollution, including an implementation plan.

2.2 OVERALL CONDITIONS OF NEARSHORE POLLUTION LEVELS

The overall conditions of nearshore pollution in the Study Area were established by reviewing the available environmental data as well as conducting the Baseline Survey under this Assignment.

235 major stormwater outfalls were surveyed under this Assignment. They have grouped into 155 stormwater outfall locations due to their proximity (i.e. A 4-cell box culvert, consisting of 4 outfalls located side by side, is group as 1 polluted outfall location). 43 polluted stormwater outfall locations with notable odour problem were identified and are presented in [Exhibit 2-1](#).

Exhibit 2-1 Polluted Stormwater Outfall Locations



Among these 43 polluted stormwater outfall locations, high level of 5-Day Biological Oxygen Demand (BOD₅) and *Escherichia Coli* (*E. coli*) were recorded¹ at 13 stormwater outfall locations in the following areas (the numbers in brackets show the number of stormwater outfall locations with high level of BOD₅ and *E. coli*) :

- Central & Western District: Central Pier (1) & Tamar Park (1)
- Wan Chai District: East of Hong Kong Convention and Exhibition Centre (1) & Causeway Bay Typhoon Shelter (1)

¹ High level of BOD₅ means average value of all sampling events >10mg/L. High level of *E. coli* is ranked if geometric mean of all sampling events >80,000cfu/100 mL. The ranking is developed based on the baseline survey results.



- Eastern District: Shau Kei Wan Typhoon Shelter (2)
- Yau Tsim Mong District: New Yau Ma Tei Typhoon Shelter (1) & Tsim Sha Tsui Promenade (1)
- Kowloon City District: To Kwa Wan (4)
- Kwun Tong District: Lei Yue Mun Typhoon Shelter (1)

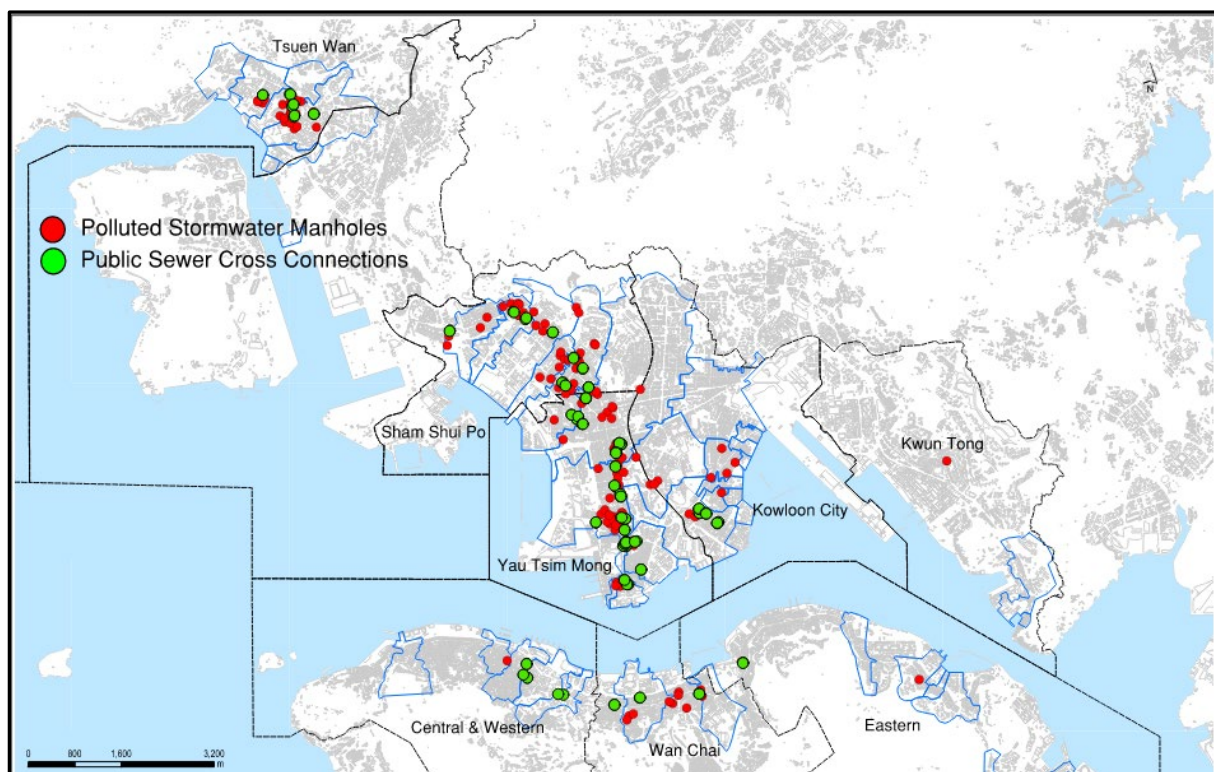
5 The findings of the Baseline Survey suggest that the odour problem is mainly caused by pollutants discharged from stormwater outfalls. It also shows that the sediment at the polluted stormwater outfalls, typhoon shelter and embayment locations may have the potential of odour generation, if it is exposed to the atmosphere. However, as the sediment is submerged in seawater all the time during the survey, even during low tide condition, it is considered that sediment is not the major odour source.

2.3 INVESTIGATIONS ON POLLUTION SOURCES

To identify the pollution sources, a Condition Survey was carried out by tracing along the stormwater drainage network from the polluted stormwater outfalls to further upstream progressively. Surveys including walkover survey, manhole survey, pollution flow & load survey, mis-connection survey, dry weather flow interceptor survey and non-point source pollution survey, etc. were carried out under the Condition Survey.

In this Assignment, around 4,700 stormwater manholes were surveyed. Of these manholes, about 3% were found to have relatively high pollution loading. The pollution load may be contributed from public sewer cross connections, building expedient connections, and non-point sources (e.g. leakage from ageing sewers, street-side activities, cleansing of public places, etc). Polluted stormwater manholes and public sewer cross connections identified under this Assignment are shown in [Exhibit 2-2](#).

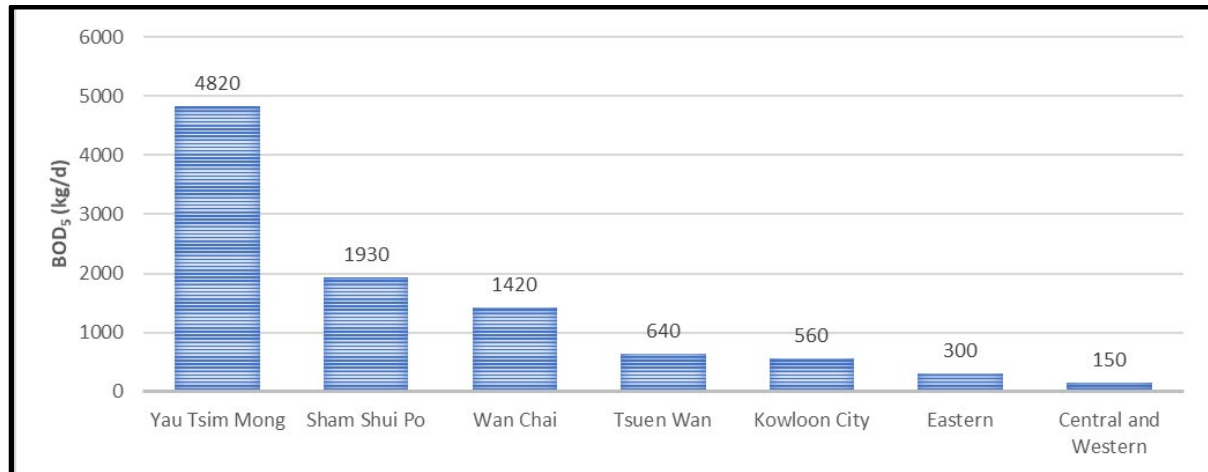
Exhibit 2-2 Polluted Stormwater Manholes and Public Sewer Cross Connections Location Map





Based on the BOD₅ results at the first-tier manholes (i.e. the first manhole at the major branches of the box culvert), the total BOD₅ load of the surveyed stormwater drainage catchments is estimated to be 9,820 kg/day. The pollution load distribution by districts is presented in [Exhibit 2-3](#).

5 Exhibit 2-3 Estimated BOD₅ Pollution Load within the Surveyed Catchments



Based on the walkover survey result, non-point source discharge types to the stormwater drainage system such as on-street washing activities, food premises/food shop units and construction sites were observed. The public sewer cross connection cases identified under this Assignment have been referred to relevant government departments for follow up.

It is believed that if rectification of pollution sources is successfully conducted, it can reduce nearshore pollution and odour problems, and improve the environmental quality and amenity value along the coastal areas of Victoria Harbour.

2.4 OVERSEAS EXPERIENCE IN COMBATING NEARSHORE POLLUTION

Five overseas cities: Singapore, Sydney, London, New York and Vancouver implemented extensive regulatory, administrative and technical in-system measures to combat nearshore pollution. This Study reviewed the regulatory, administrative and technical in-system measures taken by these five overseas cities. These selected cities are urbanized cities with a generally high level of water quality achievement, similar level of economic development and well-established urban stormwater management regime, which are similar to Hong Kong's situation. Overseas experience in combating nearshore and stormwater pollution was reviewed and those measures that may be applicable to Hong Kong have been identified.

The common theme observed from the various overseas stormwater management strategies is the adoption of green and sustainable measures (often referred to water sensitive urban design (WSUD) or sustainable urban drainage) that stormwater runoff was managed close to the source with integrated natural drainage features, where feasible.

For Vancouver and New York, they are using combined drainage and sewerage systems which are different from Hong Kong, making some of the measures not entirely applicable to Hong Kong. Hong Kong is highly urbanised with limited open space in urban area and many street activities. At present, green stormwater pollution control measures (e.g. rain gardens, bio-swales, constructed wetlands) have not been proven or matured enough for wide-scale adoption in Hong Kong. As a result, the adoption of green stormwater pollution control measures in Hong Kong has been rather limited. At present, there have been initiatives introduced to increase green spaces and green roofs. In long term, a systematic change is required to develop and adopt these measures for new or re-development areas and improvement projects.



This Assignment has identified the following key stormwater management strategy and measures, which are applicable to Hong Kong:

- Consider adopting integrated water management approach in stormwater management (e.g. encourage WSUD for new development / redevelopment areas);
- 5 ■ Establish nearshore water quality monitoring programme;
- Continue enforcement of regulations to control water pollution and marine refuse; and
- Further study and trial on Gross Pollutant Trap (GPT) at non-point source black spots.

3.0 Overall Framework to Combat Nearshore Pollution

10 Enhancing the quality of coastal waters of Victoria Harbour in Hong Kong requires stormwater management in a highly congested urban environment, which is a very complex and challenging work.

To effectively combat nearshore pollution, co-ordination among bureaux and departments (B/Ds), and engagement with stakeholders at all levels of the society and the public are essential. In this connection, we have developed an overall framework to enhance the quality of coastal waters of Victoria Harbour.

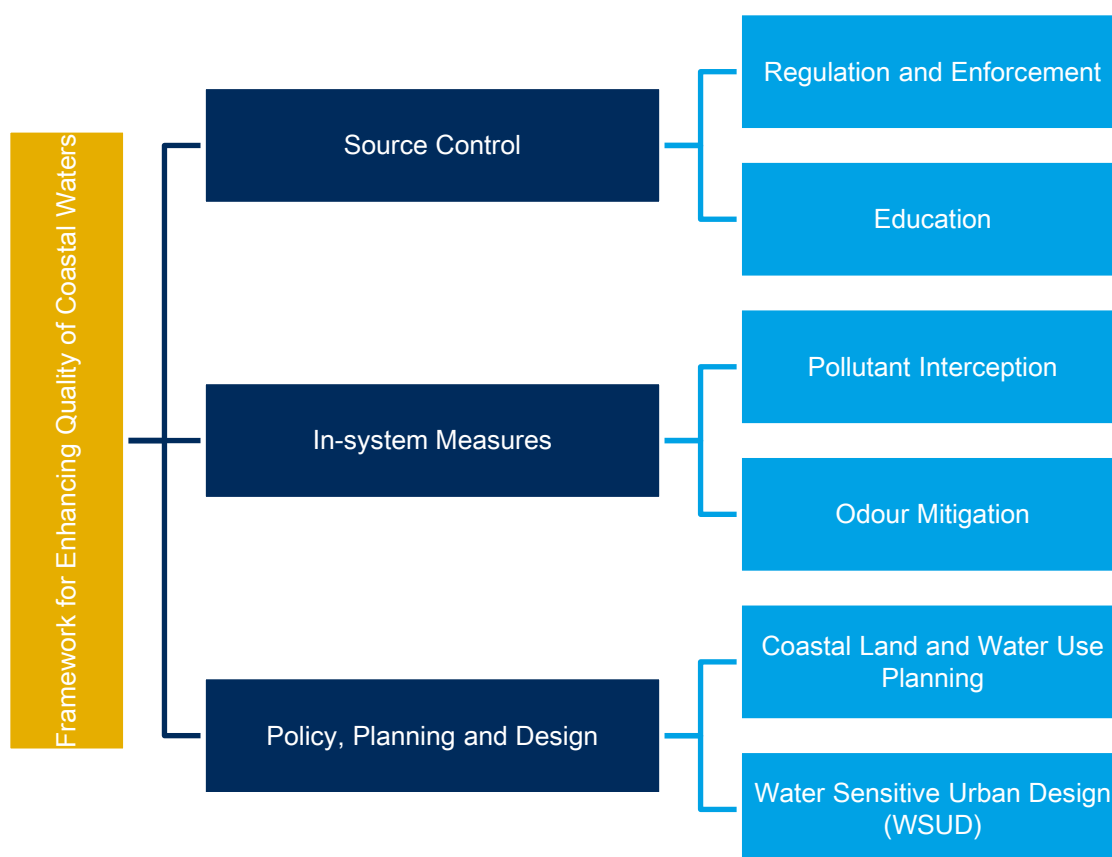
3.1 FRAMEWORK STRUCTURE

Taking into account the international experience on integrated catchment management, the framework covers three major aspects ([Exhibit 3-1](#)):

- Source Control
- 20 ■ In-system Measures
- Policy, Planning and Design



Exhibit 3-1 Framework Structure



3.2 SOURCE CONTROL

In order to control pollution of coastal waters of Victoria Harbour at source, it requires on-going efforts on the identification and rectification of the pollution sources². To succeed, continuous collation and cooperation between the Government and the public is essential.

3.2.1 Improvements to Administrative and Regulatory Arrangement

The key ordinances relevant to the improvement of water quality in the coastal waters include:

- Water Pollution Control Ordinance (Cap 358) and subsidiary regulations: to control all discharges or deposits into the waters of Hong Kong in a water control zone by a licensing system with a view to maintain the water quality that should be achieved and maintained in order to promote the conservation and best use of the waters of Hong Kong in the public interest ;
- Buildings Ordinance (Cap 123) and subsidiary regulations: to take enforcement action against defective drainage or unauthorised drainage works;
- Public Health and Municipal Services Ordinance (Cap 132) and subsidiary regulations: to take enforcement actions against littering in public place;
- Fixed Penalty (Public Cleanliness and Obstruction) Ordinance (Cap 570) and Summary Offences Ordinance (Cap 228): to issue fixed penalty notice for offences and take enforcement action against marine littering on marine refuse found in marine water;

² Includes public sewer cross connection, building expedient connection and non-point source pollution.



- Merchant Shipping (Prevention and Control of Pollution) Ordinance (Cap 413): to prevent and minimize pollution from vessels and to control discharge of oil and mixture containing oil from all ships and garbage from all ships into waters of Hong Kong;
 - Merchant Shipping (Local Vessels) Ordinance (Cap 548): to take enforcement actions against a person, local vessel or place on land discharging oil or mixture containing oil into waters of Hong Kong; and
 - Shipping and Port Control Ordinance (Cap 313): to take enforcement actions against a person, vessel or place on land discharging oil or mixture containing oil into waters of Hong Kong.
- 10 These ordinances cover various activities that contribute to the pollution of the coastal waters and considered adequate to cover the potential sources of pollution. The implementation of these ordinances by the relevant government departments are on-going to improve water quality in the coastal waters.
- 15 To enhance the enforcement effectiveness, a list of initiatives are recommended for B/D's consideration ([Exhibit 3-2](#)). The detailed procedures and timeframe to follow up with these initiatives shall be further studied by individual B/Ds taking into account their departmental service and resource allocation priority.

Exhibit 3-2 Proposed Initiatives to Enhance the Enforcement Effectiveness

ASPECTS	INITIATIVES
Prevention of water pollution from private buildings	Leverage on findings from this Assignment and department's drainage and sewerage inspection to prioritise the catchments for further investigation
	Enhance building expedient connections investigation through outsourcing
Prevention of water pollution from communal stormwater drains	Conduct drainage system inspections and prioritise polluted catchments identified in this Assignment for rehabilitation of underground sewers
	Leverage on field investigation findings from this Assignment to rectify public sewer cross connections in the drainage and sewerage systems
	During public works construction, record any temporary bypass, and properly demolished and restore the drainage system.
Prevention of water pollution from commercial activities	Initiate campaigns to deter illegal wastewater discharge. For example, joint-task force could step up the enforcement actions by launching territory-wide operation for a period of time to combat illegal wastewater discharge in various potential polluted spots (e.g. on-street wet markets)
	Adopt clearly visible signage for roadside gullies and stormwater manholes for future public works project
	Promote to the licensees or operators of licensed food premises on proper discharge of wastewater.
	Enhance trade and public awareness on proper discharge of wastewater through briefings, social media and Announcements in the Public Interest.
Prevention of water pollution from municipal activities	Enhance education to refuse collection point (RCP) users and on-street wet market users on the best practice of wastewater discharge.
	Review the drainage requirement for refuse storage and material recovery chamber in private buildings
	Explore technologies and best practical means in street and road cleansing
Prevention of pollution from waterfront wholesale markets	Enforce Fixed Penalty (Public Cleanliness and Obstruction) Ordinance Cap. 570 against marine littering at wholesale food markets
Prevention of water pollution from vessels	Distribute information on best practices on pollution prevention to vessel operators
	Improve sanitary facilities on adjacent shores via harbourfront development projects should opportunities arise



ASPECTS	INITIATIVES
Prevention of pollution from general land- and marine-based activities	Establish inter-departmental action plans or pollution abatement plans at black spots and designated marine areas for water recreation activities, as necessary Set up monitoring programme of nearshore waters at popular waterfront
Note: The above initiatives should be considered by respective B/Ds including Agriculture, Fisheries and Conservation Department, Building Department, Drainage Services Department, Environmental Protection Department, Food and Environmental Hygiene Department, Marine Department, Leisure and Cultural Services Department and Architectural Services Department	

3.2.2 Education

The existing publicity programmes combating nearshore pollution were reviewed under the Assignment. A summary of the key findings and opportunities for improvement is presented below:

- 5 ■ Some existing publicity materials should be reviewed and updated by relevant departments, in terms of content and design, to educate public the best practices on avoiding coastal water pollution;
- Public awareness campaigns should be specifically designed for target groups, to change the behaviour on littering and illegal discharges to stormwater drains; and
- 10 ■ Government B/Ds should select the most effective media channel (e.g. traditional and social media) subject to target group of audience and the timing when behaviour can be influenced.

Public awareness plan is proposed for relevant Government B/Ds for reference. Based on the review of local and international experiences on public awareness campaigns, recommendations on the design of public awareness campaigns are proposed as below:

- 15 ■ Update existing promotion materials, exhibitions and programme, using more attractive graphics design and simple infographics, and adding core message of avoidance of stormwater drainage pollution;
- Make use of social media to disseminate core messages;
- Roll out new publicity programmes related to prevention of stormwater pollution; and
- 20 ■ Provide guidelines on best management practices for the stakeholders and improve their engagement in pollution control

3.3 IN-SYSTEM MEASURES

- Despite the concerted efforts of government departments concerned taken in combating water pollution, complete elimination of residual water pollution, in particular for those caused by non-point sources, could not be fully achieved without behavioural changes of the polluters. In-system measures are recommended to enhance the existing stormwater drainage system. The measures aim to intercept as far as possible the polluted flow in the stormwater drains. As a result, the pollutants discharged into Victoria Harbour and the odour and aesthetic problems would be reduced and mitigated. The measures are summarised below and can be applied across catchment areas or districts according to the actual circumstances.

3.3.1 Pollutant Interception

3.3.1.1 Investigation and Rectification of Public Sewer Cross Connection and Building Expedient Connections

- Public sewer cross connection cases identified under this Assignment have been referred to the Drainage Services Department (DSD) for follow up. Other than this Assignment, EPD also referred cases identified during their operations and investigations to DSD for follow up. Besides, identified polluted stormwater manholes have been passed to EPD for reference and follow up.



For building expedient connections, actions against the owners under the provisions of the Buildings Ordinance (e.g. issue of statutory order) will be carried out by the Building Department (BD).

3.3.1.2 Newly Designed Downstream Dry Weather Flow Interceptor (DWFI)

- 5 In general, conventional DWFI intercepts the polluted dry weather flow (DWF) from the stormwater drainage system via the Flow Interception Device (FID) and divert it into sewerage system. In order to preserve the sewage treatment capacity for growth in sewage loadings from projected population growth, newly designed downstream DWFI is proposed to intercept the polluted DWF from the box culvert via the FID for screening and filtration prior to discharge to
- 10 Victoria Harbour. Under the Assignment, 11 potential locations were prioritised and recommended for implementation of newly designed downstream DWFI (**Exhibit 3-3**).

Exhibit 3-3 Areas with Priority for Newly Designed Downstream DWFI

DISTRICTS	AREAS WITH PRIORITY FOR NEWLY DESIGNED DOWNSTREAM DWFI
Wan Chai	Wan Chai East
	Causeway Bay Typhoon Shelter
Eastern	Shau Kei Wan Typhoon Shelter
Central & Western	Central Pier
	New Central Harbourfront
Yau Tsim Mong	Hung Hom
	New Yau Ma Tei Typhoon Shelter
	Tai Kok Tsui
Tsuen Wan	Tsuen Wan Bay
Kowloon City	To Kwa Wan
Sham Shui Po	Cheung Sha Wan

- 15 A newly designed downstream DWFI project, including the detail investigation and design, statutory approvals and construction, is expected to take approximately 7 to 8 years in general after it is included in the Public Works Programme.

The newly designed downstream DWFI at Hung Hom, Wan Chai East, Causeway Bay Typhoon Shelter, Tsuen Wan Bay and Shau Kei Wan Typhoon Shelter had been included in the Public Works Programme.

- 20 For the remaining six potential locations for implementation of newly designed downstream DWFI, preliminary study on the relevant catchments have been conducted. The projects would be progressively planned, subject to further review on the land availability, technical feasibility, effectiveness of other measures, harbourfront development programme, etc.

3.3.1.3 Conventional Dry Weather Flow Interceptors (DWFI)

- 25 Conventional DWFI is a device to intercept the polluted DWF from the stormwater drainage system via the FID and divert it into sewerage system. There are a series of new and existing DWFI in the West Kowloon and Tsuen Wan which are being constructed and modified, and expected to be completed by 2022 tentatively. Subsequent to the completion of the planned DWFI works, the associated nearshore water quality should be monitored to evaluate the effectiveness on pollution reduction. To save the sewage conveyance and treatment infrastructure capacity,
- 30 further conventional DWFI were not recommended under this Assignment. However,



conventional DWFI may still be considered where necessary provided that other engineering solutions are not feasible and the sewerage capacities in the areas are available.

3.3.1.4 Gross Pollutant Trap (GPT)

GPT is hydrodynamic or vortex separator, that uses gravity and centrifugal force to separate out and collect rubbish, sediments, as well as oil & grease. The GPT could be deployed close to the non-point source black spots of stormwater pollution, such as food premises/food shop units, wet markets and back alleys, etc. Upon completion and achieving positive results from the GPT trial carried out at Lung Kong Road, Kowloon City, installation of GPTs should be further explored at other potential locations proposed in this Assignment.

3.3.1.5 Replacement and Rehabilitation of Drainage and Sewerage Systems

Replacement and rehabilitation (R&R) programme aims to rehabilitate the structural reliability and hydraulic performance of sewers and drains. Despite not its original intention to combat near shore pollution, it provides a good opportunity to reveal if there might be any expedient connections and cross connections for rectification during the condition surveys. Besides, it could prevent leakage from sewers affecting the water quality of Victoria Harbour. A territory-wide rehabilitation programme for aged stormwater drains and sewers using risk-based approach are being implemented in phases since 2017.

3.3.2 Odour Mitigation

3.3.2.1 Hydrogel

Deodorising hydrogel inhibits the growth of anaerobic bacteria to reduce Hydrogen Sulfide (H_2S) generated in stormwater drainage system, which in turn can control odour effectively. DSD's field study for hydrogel is on-going and it is anticipated to be completed by early 2021. Upon the successful trial of the hydrogel technology and achievement of positive results, further deployment of the hydrogel at the odour black spots identified in this Assignment should be considered to address the odour issues from drainage system.

3.3.2.2 Culvert Desilting

DSD monitors the hydraulic performance of its box culverts and carries out remedial works such as desilting when necessary in accordance with the preventative maintenance programme. DSD introduced a new remote-control submersible desilting machine that is controlled by an operator aboveground via video feed, to collect sediments and remove them via mechanical grabs and then dispose of them in dump trucks. As a result, the maintenance staff and machine operators do not need to enter box culverts physically, and the box culverts also do not need to be isolated during desilting works. The removal of sediment not only can assist in maintaining the drainage capacity and preventing blockage, but also, despite not its original intention, might indirectly assist in mitigating the odour problem which might potentially be due to any organic pollutants and odorous substance being trapped or contained in the sediment. Monitoring of the hydraulic performance at box culvert should remain as part of DSD's operation and maintenance strategy while desilting at persistent odour black spots should be reviewed as needed.

3.3.2.3 Outfall Curtain

The use of curtain to cover stormwater culvert openings at black spot locations can be an interim measure to reduce odour nuisance. In Tsuen Wan Bay, outfall curtains have been installed by DSD at the major box culverts. This measure is considered relatively low cost and without technical difficulties to reduce odour nuisance.

3.3.3 Implementation of In-system Measures

In-system measures are proposed to be implemented in on-going/ short-, medium- and long-term time frame:



- On-going / short term measures:
 - Public sewer cross connection and building expedient connection rectification
 - Refurbish / Construct conventional DWFIs where necessary
 - Territory-wide underground sewers and drains R&R programme³
- 5 - Hydrogel
- Culvert desilting (regular review of the desilting programme at persistent odour blackspots)⁴
- Outfall curtain
- Medium term measures:
- 10 - GPT
- Long term measures:
 - Newly designed downstream DWFI (or conventional DWFI where necessary)

Many measures mentioned above are being implemented or planned in parallel and the actual implementation programme should be further assessed and reviewed. Apart from continuing enforcement/rectification works on misconnections, [Exhibit 3-4](#) summarises the recommended measures for the polluted outfall locations identified in this Assignment.

Exhibit 3-4 Summary of Recommended Measures for the Polluted Stormwater Outfall Locations

DISTRICT	AREA	HYDROGEL*, DESILTING, OUTFALL CURTAIN	RECTIFICATION OF PUBLIC SEWER CROSS CONNECTION **	GPT*	NEWLY DESIGNED DOWNSTREAM DWFI
Sham Shui Po	Cheung Sha Wan near the embayment area of Stonecutter Island	√	√	√	√
Yau Tsim Mong	Tai Kok Tsui promenade	√	√	√	√
	New Yau Ma Tei Typhoon Shelter	√	√	√	√
	Tsim Sha Tsui promenade	√	√	√	
	Hung Hom promenade near Harbourfront Horizon	√	√		√
Kowloon City	Near Tai Wan Shan Park	√			
	To Kwa Wan coastal area	√		√	√
	To Kwa Wan Typhoon Shelter	√		√	

³ The territory-wide R&R programme is implemented in phases since 2017 using risk-based approach; it is not itself intended as an odour abatement measures.

⁴ Culvert desilting is carried out when necessary in accordance with the Drainage Services Department's preventive maintenance programmes. It is not itself intended as odour abatement measures.



DISTRICT	AREA	HYDROGEL*, DESILTING, OUTFALL CURTAIN	RECTIFICATION OF PUBLIC SEWER CROSS CONNECTION **	GPT*	NEWLY DESIGNED DOWNSTREAM DWFI
Kwun Tong	Lei Yue Mun Typhoon Shelter	✓		✓	
Tsuen Wan	Tsuen Wan Bay Promenade	✓	✓	✓	✓
Kwai Tsing	Near Kwai Chung Preliminary Treatment Works (PTW)	✓			
Central and Western	Western District Public Cargo Handling Area	✓			
	Near Shun Tak Center	✓	✓	✓	
	Central Pier				✓
	Tamar Park & Central Harbourfront	✓	✓		✓
Wan Chai	East of Hong Kong Convention and Exhibition Centre	✓	✓	✓	✓
	Causeway Bay Typhoon Shelter	✓	✓	✓	✓
Eastern	Hoi Yu Street under Island Eastern Corridor	✓			
	Shau Kei Wan Typhoon Shelter	✓		✓	✓
	Near Chai Wan PTW	✓			
Remarks: * measures to be considered further upon successful trials **cross connections identified under this Assignment					

3.4 POLICY, PLANNING AND DESIGN

The Government has a vision to enhance Victoria Harbour and its harbourfront areas to become an attractive, vibrant, accessible and sustainable world-class asset: a harbour for the people, a harbour of life. There are existing harbourfront parks, promenades, residential development and typhoon shelters. Besides, there are new projects implemented to help improve the leisure and amenity value of the Victoria Harbour. It is important to early liaise with stakeholders of new and re-development projects to raise their awareness of the nearshore pollution and to collaborate to implement the solutions at early stage.

The concepts and principles similar to WSUD can be considered to be adopted in new development, re-development and improvement projects, whenever feasible, to implement total water management to ensure rational utilization, protection and management of water resources in the water cycle in a holistic manner. The potential approaches include development of bioswale, green roof, green wall, perforated pipe, permeable pavement, rain garden, bioretention and rain harvesting.

Examples of WSUD have been locally adopted, such as the Kowloon City Sewage Pumping Station project which adopts several stormwater management measures including green roofs, porous pavements, rain gardens and water harvesting systems; the Anderson Road Quarry Development includes the first flood retention lake in Hong Kong, which will become an open space with landscape feature for public enjoyment, and operate as the function of flood attenuation during



the wet season. Further investigation studies should be undertaken to investigate and confirm the WSUD approach for more catchments of Hong Kong.

- 5 Early liaison with stakeholders of new and re-development projects to raise their awareness of the nearshore pollution and to collaborate on the planning and implementation of solutions are needed. For the ultimate WSUD, continuous liaison, planning, development, promotion, manuals and guidelines publication for implementation are required.

3.5 MASTER IMPLEMENTATION PROGRAMME

The proposed implementation timeframe of the programme is presented in [Exhibit 3-5](#).



Exhibit 3-5 Proposed Implementation Timeframe of the Programme

Short term (Year 1 to Year 2)		Medium term (Year 3 to Year 5)		Long term (beyond Year 5)
Source Control				
Improvements to administrative and regulatory arrangement *	Review existing programmes and confirm initiatives	Enhance existing programmes and arrange resources to implement new programmes	Continue to enhance existing programmes and roll out new programmes	Conduct on-going evaluation on effectiveness and realign the objective if needed
Education*	Review recommendations on publicity proposal and allocate resources to implement public awareness plan	Improve existing education programmes and publicity materials and prepare new programmes	Implement new programmes	Conduct on-going evaluation on effectiveness and realign thete objective if needed
In-system Measures				
Investigation and Rectification of Public Sewer Cross Connection and Building Expedient Connections	Investigation and rectification			
Newly designed downstream Dry Weather Flow Interceptor (DWFI)	Conduct investigation, design and construction study			Implement measures
Refurbish / construct conventional DWFI	Refurbish / construct conventional DWFIs where necessary			
Gross pollution trap	Feasibility and trial		Implement upon successful trial	
Replacement and rehabilitation (R&R) for drainage and sewerage system#	Implement territory-wide R&R for sewers and drains			
Hydrogel	Implement measures upon successful trial			
Culvert Desilting^	Regular review the desilting programme at persistent odour blackspots			
Outfall Curtain	Implement upon successful trial			
Policy, Planning and Design				
Coastal land and water use planning	Liaise with stakeholders of new development or re-development projects to collaborate on the planning and implementation of nearshore pollution abatement measures			
Water Sensitive Urban Development (WSUD)*	<ul style="list-style-type: none">Liaise with stakeholdersInvestigate WSUD approach	Plan, develop and implement WSUD for specific development sites		Develop and publish WSUD manuals and guidelines

Note:

* The timeframe to implement the proposed steps shall be further studied by individual B/Ds taking into account departmental service and resource allocation priority

The territory-wide R&R programme is implemented in phases since 2017 using risk-based approach. It is not itself intended as odour abatement measures.

^ Culvert desilting is carried out when necessary in accordance with the Drainage Services Department's preventive maintenance programmes. It is not itself intended as odour abatement measures.