CHAPTER 8

Environment Bureau
Environmental Protection Department
Drainage Services Department

Sewerage systems in rural areas

Audit Commission
Hong Kong
28 October 2016

This audit review was carried out under a set of guidelines tabled in the Provisional Legislative Council by the Chairman of the Public Accounts Committee on 11 February 1998. The guidelines were agreed between the Public Accounts Committee and the Director of Audit and accepted by the Government of the Hong Kong Special Administrative Region.

Report No. 67 of the Director of Audit contains 10 Chapters which are available on our website at http://www.aud.gov.hk

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SEWERAGE SYSTEMS IN RURAL AREAS

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SEWERAGE SYSTEMS IN RURAL AREAS

Executive Summary

1. According to the Environmental Protection Department (EPD), as of April 2016, about 510,000 population in Hong Kong were residing in village houses, squatters and private housing developments (mostly located in the New Territories) not being provided with public sewerage facilities. Of the 510,000 population, 115,000 (23%) were residing in areas being installed with private on-site sewage treatment plants and the remaining 395,000 (77%) population mainly relied on septic-tank-and-soakaway (STS) systems for treating their sewage or dry-weather-flow interceptors for reducing pollution caused by untreated sewage. Unsatisfactory installation and maintenance of STS systems would cause pollution to the environment and potential health hazards to people in the vicinity.

2. Under the Water Pollution Control Ordinance (Cap. 358 — WPC Ordinance), the EPD is responsible for monitoring the water quality of rivers and coastal areas and controlling pollution of these water bodies. Water Quality Objectives (WQOs) are established under the WPC Ordinance to lay down water quality requirements for a water body. Various WQOs expressed in numerical or narrative forms have been established, including the WQOs on *Escherichia coli (E. coli)*, which is used as an indicator of faecal contamination and pollution. The EPD has also formulated 16 Sewerage Master Plans (SMPs) which set out at regional/district level sewage collection, treatment and disposal programmes, including programmes for the provision of public sewerage systems for unsewered rural villages (hereinafter referred to as village sewerage programmes (VS programmes)).

3. Under the VS programmes, as of January 2015, of the 970 rural villages covered under the 16 SMP areas in Hong Kong, public sewerage works for 170 (17.5%) villages had been completed, 340 (35%) villages were under construction or included in the Public Works Programme, 170 (17.5%) villages were under planning and 290 (30%) villages would not be carried out due to their remoteness and difficult site topography. From 1989-90 to 2015-16, the Government's expenditures on implementation of the VS programmes and related works totalled $8.2 billion and the estimated expenditures from 2016-17 to 2025-26

totalled $2.7 billion. The Drainage Services Department is responsible for implementing works under the VS programmes. The Audit Commission (Audit) has recently conducted a review to examine the sewerage systems in rural areas.

Pollution control in unsewered areas

4. ***High E. coli levels at many water control subzones.*** *E. coli* is a bacterium that is commonly found in the intestine and faeces of humans and other warm-blooded animals, and the level of *E. coli* in a water body is used as an indicator of faecal contamination and pollution. According to the EPD, WQOs on *E. coli* were established to protect the public from the risk of exposure to disease-causing microorganisms, and could be used to assess and monitor the effectiveness of environmental improvement measures as well as to signal the need for further actions to improve water quality. Of the 71 river monitoring stations situated in water control subzones where WQOs on *E. coli* had been established, Audit examination revealed that the average levels of *E. coli* found at 63 (89%) stations had exceeded the corresponding statutory WQOs in 2015. For Yuen Long District and North District which had a large number of unsewered villages, in 2015, while the statutory WQOs established for the water control subzones located in the two districts ranged from 0 to 1,000 *E. coli* per 100 millilitres (mL) of water, the average levels of *E. coli* at 14 (58%) of the pertinent 24 river monitoring stations exceeded 10,000 *E. coli* per 100 mL of water, indicating that sewage discharged from unsewered villages in these areas could have caused faecal contamination and pollution to rivers in the areas (paras. 1.6, 1.9, 2.5 and 2.7(a)).

5. ***Lack of effective means to prevent STS systems from causing pollution.*** According to the EPD, many village sites located in flood plains (e.g. in Yuen Long, Kam Tin, North District and Tai Po areas) were not suitable for the operation of STS systems, the systems installed in some unsewered areas were generally ineffective and sewage from these areas was a source of pollution to nearby watercourses and marine waters. For the purpose of ameliorating the problems, the EPD has implemented works projects under the VS programmes to install public sewerage systems for unsewered villages. In the meantime, many of the 70,000 unsewered village houses rely on STS systems for treating their sewage, and some of the 84,000 unsewered residential squatters rely on dry-weather-flow interceptors for reducing pollution caused by the untreated sewage (paras. 1.2, 1.4, 1.10, 2.19 and 2.22(a)).

6. According to the then Planning, Environment and Lands Branch of the Government Secretariat, a licensing scheme for STS systems would be the best and the only way through which the Government and the community could make real progress in improving the environment of the New Territories. From 1993, an owner of an STS system might apply to the EPD for issuance of a perpetual licence under the WPC Ordinance for his STS system, which specified the related operational and maintenance requirements. However, Audit examination revealed that, as of August 2016, of the 70,000 village houses and 84,000 residential squatters, only 1,912 had been issued with licences for STS systems. According to the EPD, licensing of STS systems was not mandatory under the WPC Ordinance. Moreover, the EPD did not conduct periodic inspections of STS systems installed for unsewered houses, nor maintain a database for such systems, adversely affecting the effectiveness of its monitoring and enforcement actions on these systems (paras. 2.16 and 2.21 to 2.30).

7. ***Requirements for some STS systems not on par with EPD practice note.*** According to the EPD, an STS system having been designed, constructed and maintained in accordance with a practice note issued by it in 1993 would help achieve the intended sewage treatment function of the system and prevent related sewage discharge from polluting the environment. EPD practice note specified that an STS system should be located at least 100 metres from the boundaries of gazetted beaches, and percolation tests should be carried out for the system irrespective of the number of houses to be served and the distance of the system from sensitive water bodies. However, the certificate of exemption issued by the Lands Department for pertinent drainage works in the New Territories specified differently, by stating that an STS system should only be located beyond 30 metres from beaches, and percolation tests need not be carried out if an STS system served a single village house and was located beyond 30 metres from streams, springs, wells and beaches (paras. 2.36 and 2.37).

8. ***No licences issued for desludging of septic tanks and disposal of excretal matter.*** Under the Waste Disposal Ordinance (Cap. 354 — WD Ordinance), on the condition that the EPD and the Food and Environmental Hygiene Department (FEHD) provide any services for desludging of septic tanks and disposal of excretal matter from such tanks, or any person is permitted to provide such services under a licence issued by the EPD and the FEHD, any person who provides such services without obtaining a licence from the EPD and the FEHD commits an offence. As of

April 2016, 78 private desludging operators (having a total of 317 desludging vehicles) were involved in the provision of related services. Audit noted that, as of October 2016, none of the 78 desludging operators had been issued licences under the WD Ordinance from the EPD or the FEHD for provision of the desludging and related disposal services (paras. 2.45 to 2.47).

Planning and implementation of village sewerage programmes

9. ***Need to prevent uncontrolled discharge of untreated sewage from residential squatters.*** As of December 2015, 84,000 residential squatters were located in 791 areas. According to the EPD: (a) STS systems were generally not installed for squatter areas and untreated sewage generated from the squatters was mostly directly discharged into the nearby rivers or other water bodies, causing water pollution and environmental problems; and (b) dry-weather-flow interceptors had been installed for some squatter areas to help ameliorate the pollution problem. However, the EPD did not have readily available information on the squatter areas having been installed with dry-weather-flow interceptors. Furthermore, Audit noted that, for a project having an Approved Project Estimate (APE) of $33 million for installing public sewers for a squatter area in Tuen Mun completed in May 2011, up to June 2016, only 112 (41%) of the 270 squatters in the area had been connected to public sewers (paras. 3.4 to 3.9).

10. ***Delays in implementing the VS programmes.*** In May 2001, the EPD informed the Legislative Council (LegCo) that village sewerage works for 8 of the 16 SMP areas were targeted for completion between 2004 and 2009. Moreover, in May 2009, the EPD informed LegCo that the target completion dates had been extended to between 2013-14 and 2017-18. However, Audit examination revealed that these time targets could not be met. As of June 2016, of the total 662 villages covered under the VS programmes for the eight SMP areas, public sewerage works for 178 (27%) villages had been completed, 10 sewerage projects involving 77 (12%) villages were in progress, 24 sewerage projects involving 238 (36%) villages were under planning and sewerage projects under the Public Works Programme had not been created for the remaining 169 (25%) villages (paras. 3.15 and 3.16).

11. ***Slippages in implementing village sewerage projects.*** For a village sewerage project in Sha Tin and Tai Po having an APE of $381.4 million, mainly owing to objections on private land resumption, there was a slippage of 25 months in completing the works. In another project in Tuen Mun having an APE of $1,340 million, mainly due to the need to divert unrecorded underground utilities and a delay to seek legal advice on adopting appropriate procedures for road closure related to the works, the project was delayed by 17 months (paras. 3.23 to 3.28 and 3.31).

Sewer connection of village houses

12. Under the Government's policy, public sewers would only be constructed up to the lot boundaries of private land as far as practicable, and village-house owners need to carry out works at their own cost to connect their sewerage systems with public sewers. According to the EPD, as of June 2016, 14,710 village houses located at 178 villages in the eight SMP areas were covered by public sewers. However, 4,531 (31%) houses had not been connected to the public sewers, which comprised: (a) 3,168 houses not being ready for sewer connection or having technical problems for the connection; and (b) 1,363 houses where the house owners did not take required sewer-connection actions (paras. 4.2 and 4.6).

13. ***Inadequate actions taken to cause house owners to carry out sewer-connection works.*** According to the EPD, the majority of sewer-connection works would be completed by village-house owners between 2 and 5 years after completion of public-sewer works. However, Audit examination of the progress of sewer connections at 5 villages and 1 squatter area (having a total of 385 houses suitable for sewer connection) revealed that, as of June 2016, while the related public sewerage works had been completed 5 to 15 years ago, only 144 (37%) houses had been connected to public sewers. In one case involving public sewerage works having an APE of $2.7 million being carried out for 2 elderly homes and a village comprising 56 houses in Yuen Long, owing to objections of village representatives of 49 houses, public sewerage works for these 49 houses were not carried out. Public sewerage works for the remaining 7 houses were completed in December 2000. However, up to June 2016, none of the 7 houses had been connected to public sewers. In another case involving public sewerage works having an APE of $125.1 million for 8 unsewered areas, which included a village comprising 62 houses in North District where the works were completed in June 2006, up to June 2016, only 12 (19%) houses had been connected to public sewers (paras. 4.7 and 4.11).

Audit recommendations

14. **Audit recommendations are made in the respective sections of this Audit Report. Only the key ones are highlighted in this Executive Summary. Audit has *recommended* that the Government should:**

Pollution control in unsewered areas

(a) **consider periodically conducting assessments of the extent of pollution of major rivers caused by village sewage discharge, and publishing the results of assessments (para. 2.12);**

(b) **explore ways and means to strengthen control over high-risk STS systems (para. 2.40);**

(c) **review and revise the Lands Department's requirements for STS systems specified in the certificate of exemption such that they are in line with the EPD's practice note as far as practicable (para. 2.41);**

(d) **explore ways and means to strengthen controls over desludging operations (para. 2.54(a));**

Planning and implementation of village sewerage programmes

(e) **take measures to ascertain the extent and effectiveness of dry-weather-flow interceptors in reducing pollution caused by untreated sewage generated from unsewered residential squatters (para. 3.13(c));**

(f) **periodically inform LegCo of the progress of implementing the VS programmes, with comparisons with the time targets set for implementing the programmes (para. 3.39(a));**

Sewer connection of village houses

(g) **take effective measures to ensure that houses suitable for sewer connection are connected to public sewers within a reasonable time after completion of public sewer works (para. 4.19(a)); and**

(h) **periodically publish the progress of sewer-connection works of individual villages (para. 4.19(g)).**

Response from the Government

15. The Government agrees with the audit recommendations.

PART 1: INTRODUCTION

1.1 This PART describes the background to the audit and outlines the audit objectives and scope.

Background

1.2 According to the Environmental Protection Department (EPD), as of April 2016, about 93% of the 7.3-million population in Hong Kong were residing in areas being provided with public sewerage facilities. For the remaining 7% (510,000) population, they were residing in unsewered premises, comprising 70,000 village houses, 84,000 residential squatters and some private housing developments (mostly located in the New Territories). The EPD had estimated that 115,000 (23%) of the 510,000 population were residing in areas being provided with private on-site sewage treatment plants, and the remaining 395,000 (77%) population mainly relied on septic-tank-and-soakaway (STS) systems (Note 1) for treating their sewage or dry-weather-flow interceptors (DWFIs — Note 2) for reducing pollution caused by untreated sewage.

1.3 As of June 2016, 189 on-site sewage treatment plants had been installed at residential developments. According to the EPD:

(a) all the 189 treatment plants had been issued with five-year renewable licences under the Water Pollution Control Ordinance (Cap. 358 — WPC Ordinance); and

(b) the EPD conducted inspections of these plants four times a year to ensure compliance with the licence conditions.

Note 1: *A septic tank is a device used for the collection, storage and treatment of sewage, in which the sewage is partially decomposed. Furthermore, under a soakaway system, effluent from the septic tank would filter through gravel and the pollutants would be decomposed by bacteria in the surrounding soil.*

Note 2: *According to the EPD, DWFIs are short-term measures installed in stormwater drains to intercept pollutants contained in the water flow in dry seasons to minimise the pollutants flowing into nearby rivers and streams. The intercepted pollutants would be conveyed through public sewers to the nearby sewage treatment plants for proper treatment.*

1.4 STS systems are normally installed in unsewered rural areas for treating sewage before it is discharged into the surrounding areas. According to the EPD:

(a) an STS system is an internationally acceptable system for treating sewage. The performance of an STS system would be affected by factors such as local conditions, development density, and its design, operation and maintenance;

(b) under normal circumstances, sewage flow from village houses is small, and as long as STS systems are properly designed and operated with its effluent being soaked into the ground, individual STS systems would not become a significant pollution source to water bodies; and

(c) unsatisfactory installation and maintenance of STS systems would at times lead to overflow of effluent, causing pollution to the environment and water bodies, as well as potential health hazards to people in the vicinity.

1.5 According to the WPC Ordinance, the EPD shall exercise and perform its powers, functions and duties under the Ordinance with the aim of achieving the relevant Water Quality Objectives (WQOs) as soon as is reasonably practicable and thereafter maintaining the quality so achieved. Various WQOs in numerical or narrative form have been established under the WPC Ordinance to describe the water quality that should be achieved and maintained in order to promote the conservation and best use of Hong Kong waters. Compliance with WQOs is based on the attainment of certain levels of parameters, including dissolved oxygen, suspended solids, pH values (Note 3), 5-day biochemical oxygen demand (Note 4), chemical oxygen demand (Note 5) and *Escherichia coli* (*E. coli*).

Note 3: *The pH is an expression of concentration of hydrogen ions present in water and is used to indicate the degree of alkalinity or acidity of a solution.*

Note 4: *The 5-day biochemical oxygen demand is a measure of the amount of oxygen consumed by microorganisms in the process of decomposing organic matter in 5 days. A high value of the parameter indicates that a water body has been polluted by a large quantity of organic matter.*

Note 5: *The chemical oxygen demand value indicates the amount of oxygen which is needed for the oxidation of organic substances in water. It is often used as a measurement of the strength of pollutants (mainly organic matter) in natural water and waste water.*

1.6 *E. coli* is one of the WQOs set under the WPC Ordinance for 62 of the 90 water control subzones in Hong Kong. According to the World Health Organisation (WHO — Note 6):

(a) *E. coli* is a bacterium that is commonly found in the intestine and faeces of humans and other warm-blooded animals, and the level of *E. coli* in a water body is used as an indicator of faecal contamination and pollution; and

(b) while most of the *E. coli* bacteria are harmless, the presence of *E. coli* in water bodies indicates that the water may contain other disease-causing microorganisms.

1.7 In 2015, the average levels of *E. coli* at 63 (89%) of the 71 EPD river monitoring stations having WQOs on *E. coli* exceeded the WQO levels established under the WPC Ordinance (see Appendices A and B for details). According to the EPD, the level of *E. coli* at a river monitoring station exceeding 10,000 *E. coli* per 100 millilitres (mL) of water is most likely attributed to the following sources:

(a) unsatisfactory STS systems installed for unsewered village houses;

(b) illegal connections to stormwater drains by house owners for discharge of sewage into nearby rivers and streams; and

(c) illegal discharge from livestock farms into nearby rivers and streams. As of June 2016, there were 72 livestock farms in Hong Kong.

1.8 Under the Public Health (Animals and Birds) Ordinance (Cap. 139), a livestock farm operator needs to apply and obtain a licence from the Agriculture, Fisheries and Conservation Department. Moreover, under the Waste Disposal Ordinance (Cap. 354 — WD Ordinance), the operator is required to install a waste water treatment system acceptable to the EPD. In 1987, the EPD implemented a Livestock Waste Control Scheme, under which the EPD would carry out inspections of each licensed farm at least twice a year to ensure that sewage treated by the waste water treatment system could achieve the minimum statutory effluent standard.

Note 6: *WHO is the directing and coordinating authority for health in the United Nations.*

In addition, to assist livestock farmers in disposing of the livestock waste in an environmentally acceptable manner, the EPD has offered a capital grant and low-interest loan to assist farmers for installation of waste treatment facilities, and provided free collection services for livestock waste.

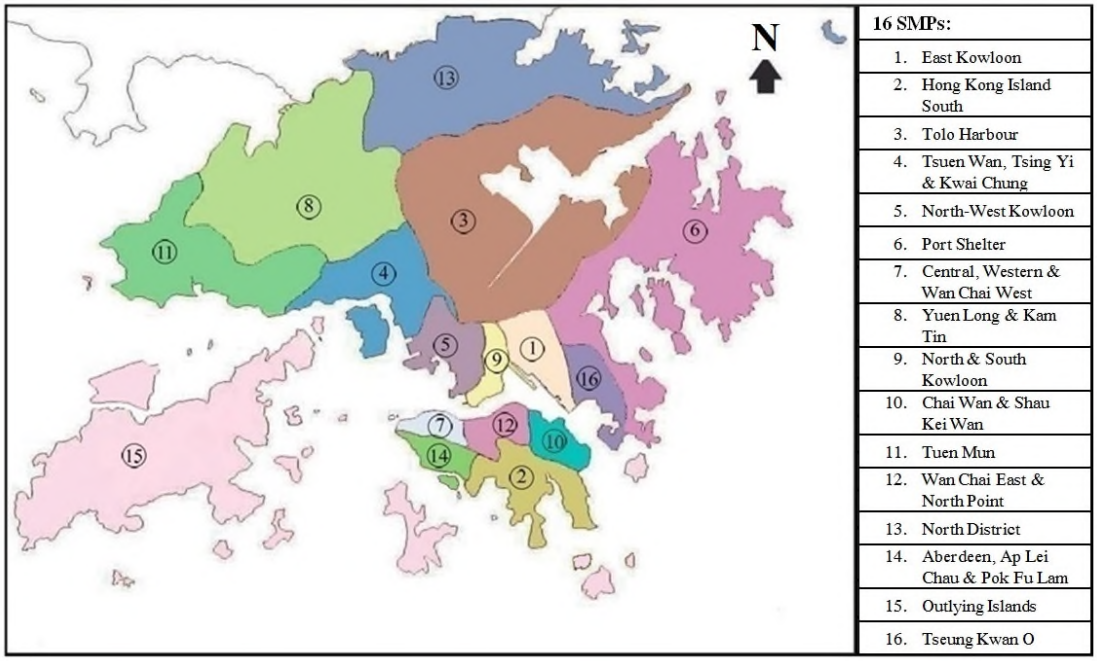
1.9 As revealed in Appendices A and B, of the 24 river monitoring stations situated in Yuen Long District and North District which have a large number of unsewered villages, in 2015, the average levels of *E. coli* at 14 (58% of 24) stations still exceeded 10,000 *E. coli* per 100 mL of water, indicating that sewage discharge from villages in these areas might be a source causing the high levels of *E. coli* in the pertinent rivers.

Village sewerage programmes

1.10 According to the EPD and the Drainage Services Department (DSD), a proper sewerage network for collecting sewage from village houses for suitable treatment is the long-term solution to the water pollution problems in related areas. From 1989 to 1996, the EPD had formulated 16 Sewerage Master Plans (SMPs) for Hong Kong, which set out at the regional/district level sewage collection, treatment and disposal programmes on a catchment basis (see Figure 1) to meet the present and future development needs. The key objectives of the SMP studies were to assess the appropriateness of the prevailing sewerage networks, sewage pumping stations and sewage treatment facilities, and to make recommendations on measures to mitigate pollution problems or shortfalls in the sewerage systems. The SMPs included programmes of rehabilitation and construction of sewers, provision, expansion and upgrading of sewage treatment plants, construction of DWFIs, and provision of public sewerage systems for unsewered rural villages (hereinafter referred to as village sewerage programmes (VS programmes)).

Figure 1

Sewage catchment areas under 16 SMPs



Source: EPD records

1.11 According to the EPD, the pollution load in most major river catchments had been reduced by up to 96% resulting from the provision of a comprehensive sewage catchment system under the SMPs over the past decades and enforcement actions taken against unlawful acts causing water pollution. From 1999 to 2010, the EPD also completed reviews of the SMPs by taking into account the updated population and development parameters. According to the EPD, its actions in recent years have led to the significant improvement in the overall water quality of Hong Kong. Details are shown in Appendix C.

1.12 The objectives of the VS programmes included:

(a) facilitating achievement of the statutory WQOs;

(b) protecting public health, the ecosystem, rivers and coastal waters; and

(c) reducing nuisance associated with deposition of unsightly food residues and toiletries contained in waste water, and spread of insects and malodour.

1.13 In March 2015, in response to the Legislative Council (LegCo) Members' requests, the EPD informed LegCo Public Works Subcommittee (PWSC) that, as of January 2015, of the 970 rural villages covered under the 16 SMP areas in Hong Kong, public sewerage works for:

(a) 170 (17.5%) villages had been completed;

(b) 340 (35%) villages were under construction or included in the Public Works Programme (PWP);

(c) 170 (17.5%) villages had been planned for inclusion under the VS programmes in a later stage; and

(d) 290 (30%) villages had not been included in the VS programmes due to reasons such as their remoteness and difficult site topography.

1.14 From 1989-90 to 2015-16, the Government's expenditure on the implementation of VS programmes and related works was $8.2 billion, and the estimated expenditure from 2016-17 to 2025-26 is $2.7 billion.

Responsible government bureaux and departments

1.15 The Environment Bureau (ENB — Note 7) is responsible for policy matters on improving the water quality of rivers and coastal areas. As the executive arm of the ENB, the EPD, through its Water Policy Division, is responsible for monitoring the water quality of rivers and coastal areas and planning the VS programmes and, through its Environmental Compliance Division, for enforcing compliance with the WPC Ordinance. Appendix D shows an extract of the organisation chart of the EPD. As the EPD's works agent, the DSD is responsible for implementing works under the VS programmes and for operating and maintaining public sewage treatment plants in Hong Kong.

1.16 Under the Public Health and Municipal Services Ordinance (Cap. 132 — PHMS Ordinance), the Food and Environmental Hygiene Department (FEHD) is vested with the authority to take enforcement actions on nuisances arising from STS systems in private premises. It also provides desludging services for STS systems and, under the WD Ordinance, may issue licences to operators for them to provide services for desludging and disposal of excretal matter.

Audit review

1.17 In 2010, the Audit Commission (Audit) conducted a review of the Government's planning and administration of the VS programmes, focusing on the implementation of VS programmes in Yuen Long District and North District and the sewer connection of village houses. The results of the review were included in Chapter 9 of the Director of Audit's Report No. 55 of October 2010.

Note 7: *In July 2007, the ENB was formed to take over the policy issues on environmental matters. Before July 2007, the policy responsibility had been taken up by the then Environment, Transport and Works Bureau (July 2002 to June 2007), the then Environment and Food Bureau (January 2000 to June 2002), the then Planning, Environment and Lands Bureau (July 1997 to December 1999) and the then Planning, Environment and Lands Branch (before July 1997).*

1.18 In May 2016, Audit commenced a review to examine sewerage systems in rural areas. The review focuses on the following areas:

(a) pollution control in unsewered areas (PART 2);

(b) planning and implementation of village sewerage programmes (PART 3); and

(c) sewer connection of village houses (PART 4).

Audit has found room for improvements in the above areas, and has made a number of recommendations to address the issues.

Acknowledgement

1.19 Audit would like to acknowledge with gratitude the full cooperation of the staff of the ENB, the EPD, the DSD, the FEHD, the Lands Department (Lands D) and the Home Affairs Department (HAD) during the course of the audit review.

PART 2: POLLUTION CONTROL IN UNSEWERED AREAS

2.1 This PART examines actions taken by the EPD to control pollution caused by unsewered villages and squatters, focusing on:

(a) control and monitoring of compliance with WQOs on *E. coli* (see paras. 2.2 to 2.13);

(b) control and monitoring of STS systems (see paras. 2.14 to 2.43); and

(c) control and monitoring of desludging operations (see paras. 2.44 to 2.56).

Control and monitoring of compliance with Water Quality Objectives on *E. coli*

2.2 Under the WPC Ordinance:

(a) the marine and inland waters (including rivers, lakes, and ponds) in Hong Kong are designated into 10 water control zones and 4 supplementary water control zones (see Figure 2). These water control zones comprise 48 subzones for inland waters and 42 subzones for marine waters (totalling 90 water control subzones);

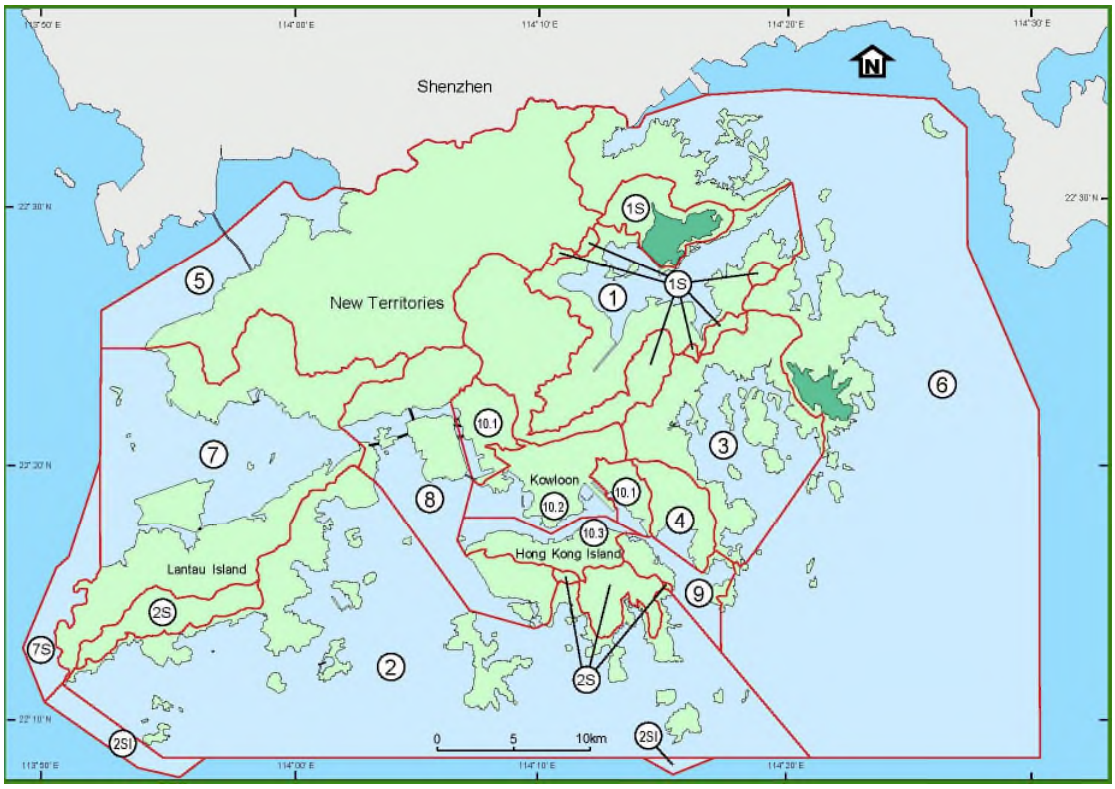
(b) different levels of WQO parameters, such as *E. coli* (see para. 1.6), pH value, suspended solids, dissolved oxygen, 5-day biochemical oxygen demand and chemical oxygen demand, have been established for different water control subzones; and

(c) the EPD shall take actions with a view to achieving the relevant WQOs established for each water control subzone as soon as is reasonably practicable and thereafter maintaining the quality so achieved.

The objectives of the above statutory requirements are to promote the conservation and best use of marine and inland waters in the public interest.

Figure 2

Water control zones in Hong Kong



Legend:

1.	Tolo Harbour and Channel	2.	Southern
3.	Port Shelter	4.	Junk Bay
5.	Deep Bay	6.	Mirs Bay
7.	North Western	8.	Western Buffer
9.	Eastern Buffer	10.	Victoria Harbour (in 3 phases)
1S.	Tolo Harbour Supplementary	2S.	Southern Supplementary
2SI.	Second Southern Supplementary	7S.	North Western Supplementary

Source: *EPD records*

2.3 In order to assess the water quality of a river and its changes over time, the EPD has established 82 river monitoring stations along 30 major rivers in Hong Kong to collect water samples on a monthly basis. The EPD has published in its annual river-water quality reports details of the monitoring results obtained from its river monitoring programme, including summary statistics of water quality data, compliance rates of five WQO parameters (namely pH value, suspended solids, dissolved oxygen, 5-day biochemical oxygen demand and chemical oxygen demand) and Water Quality Index (WQI), whereas the WQI is not stipulated under the WPC Ordinance.

2.4 In September and October 2016, the EPD informed Audit that:

(a) the WQI had been used since 1986 to indicate the general health of a river, which was based on assessment of 3 parameters, namely dissolved oxygen, 5-day biochemical oxygen demand and ammonia-nitrogen (Note 8), and similar indices were also used overseas. These parameters were relevant to conserving the primary beneficial use on maintenance of the aquatic life, and were collectively used to gauge the extent of organic pollution in a river. The WQI classified river-water quality into 5 gradings (namely "Excellent", "Good", "Fair", "Bad" and "Very Bad"). A river having a WQI grading of "Good" or "Excellent" meant that it did not suffer from organic pollution and the water quality was good or excellent in terms of conserving the primary beneficial use on maintenance of the aquatic life. A river having a WQI grading of "Very Bad" meant that it was seriously polluted by organic waste and the water quality failed to support a healthy aquatic life;

(b) while the WQI was not stipulated under the WPC Ordinance, based on the EPD's 30 years of river-monitoring experience and professional judgement, the EPD considered the WQI as the most important and relevant index for assessing the river quality in Hong Kong;

(c) in 2015, the overall compliance rate of Hong Kong's rivers with the five WQOs on pH value, suspended solids, dissolved oxygen, 5-day biochemical oxygen demand and chemical oxygen demand was 89%, as compared with 49% in 1986. All beaches gazetted under the PHMS Ordinance had complied with the WQO on *E. coli* for six consecutive years from 2010 to 2015;

(d) in 2015, based on the 3 WQI parameters (see (a) above), 48% of the river monitoring stations were graded "Excellent" and 34% were graded "Good", as compared with only 8.5% being graded "Excellent" and 25.5% being graded "Good" in 1986. No stations were graded "Very Bad" in 2015, as compared with 26% in 1986. 82% of water samples

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Note 8: *Ammonia-nitrogen is a pollutant in water that mainly arises from decomposition of nitrogen-containing organic chemical matter by microorganisms. A high level of ammonia, if present in unionised form, may be harmful to human beings and aquatic lives such as fish.*

collected at river monitoring stations had achieved the grading of "Good" or above. The number of gazetted beaches being graded "Good" increased from 9 in 1986 to 25 in 2015; and

(e) the above improvements were the results of the implementation of various pollution control measures, including provision of village sewerage facilities.

High E. coli levels at many water control subzones

2.5 According to the WHO, the level of *E. coli* in a water body is used as an indicator of faecal contamination and pollution, and the presence of *E. coli* indicates that the water may be contaminated by sewage which may contain other disease-causing microorganisms. According to the WPC Ordinance, after consultation with the Advisory Council on the Environment (Note 9), the ENB shall establish different levels of WQO parameters for different water control zones and subzones, and may amend any WQO from time to time. As of October 2016, for 39 (81%) of 48 inland water control subzones, WQOs on *E. coli* had been established as subsidiary legislations under the Ordinance. Water samples collected from river water monitoring stations should be representative of the inland water quality of the corresponding water control subzones. Of the 71 monitoring stations situating in water control subzones where WQOs on *E. coli* had been established, Audit examination revealed that the average levels of *E. coli* found at 63 (89%) of the 71 monitoring stations had exceeded the corresponding statutory WQOs in 2015. Details are shown in Appendices A and B.

2.6 In this connection, the EPD published the level of *E. coli* obtained from water samples collected from related river monitoring stations in the following five levels:

(a) "very high" (100,001 or more *E. coli* per 100 mL of water);

Note 9: *The Advisory Council on the Environment is the Government's principal advisory body on matters relating to pollution control, environmental protection and nature conservation. It is chaired by an academic with members comprising academics, businessmen, professionals and representatives from major green groups, and trade and industrial associations.*

(b) "high" (10,001 to 100,000 *E. coli* per 100 mL of water);

(c) "moderate" (1,001 to 10,000 *E. coli* per 100 mL of water);

(d) "moderately low" (611 to 1,000 *E. coli* per 100 mL of water); and

(e) "low" (610 or less *E. coli* per 100 mL of water).

2.7 The EPD had expressed views on the following occasions related to *E. coli*:

(a) in March 1995, the EPD informed LegCo Panel on Environmental Affairs that beneficial uses of inland waters (including rivers, lakes and ponds) included abstraction for potable-water supply, irrigation, pond fish culture, secondary-contact recreation activities, general amenity and provision of a habitat for marine life, and WQOs in line with those used in many other countries had been developed for the various water control zones in Hong Kong to protect the beneficial uses in these zones. WQOs on *E. coli* were established to protect the public from the risk of exposure to disease-causing microorganisms. WQOs could be used to indicate prevailing water quality and long-term water-quality trends, to assess and monitor the effectiveness of environmental improvement measures, and to signal the need for further actions to improve water quality;

(b) in May 2003, the EPD informed the then Environment, Transport and Works Bureau (ETWB — see Note 7 to para.1.15) that sewage pollution from unsewered developments was the main source of water quality deterioration at rivers in the territory, and all major rivers in the New Territories failed to meet the WQOs on *E. coli*; and

(c) from 2008 to 2015, the EPD stated in its annual river water quality reports that sewage discharge from unsewered village houses was one of the sources contributing to the high *E. coli* levels at many rivers in the New Territories.

2.8 In October 2016, the EPD informed Audit that:

(a) WQOs on *E. coli* should only be established for water bodies having beneficial uses of potable-water abstraction, primary-contact (i.e. whole-body contact with water), secondary-contact recreational uses, aquaculture and mariculture purposes. The objective was to safeguard public health from infection risk due to human contact with contaminated water, and a higher *E. coli* count in the water bodies would indicate greater faecal contamination of the water and a higher health risk. Therefore, for inland water control subzones (e.g. watercourses in urban and semi-rural areas) not having the above beneficial uses, *E. coli* level was no longer a significant parameter and some of the existing WQOs on *E. coli* should be removed from the WPC Ordinance (details of the EPD's views are shown in Appendix E); and

(b) the EPD would conduct a review of the WQOs for inland waters, which would cover the WQOs on *E. coli* and the need for monitoring compliance with related WQOs.

2.9 In Audit's view, the EPD needs to closely monitor the levels of *E. coli* of water control zones as high *E. coli* levels in the water would indicate a high level of faecal contamination.

2.10 Audit noted that, while the EPD published in the annual river-water quality reports the level (in terms of "low" to "very high") of *E. coli* obtained at related river monitoring stations, the EPD did not publish the actual values of *E. coli* in comparison with the related statutory WQO value for each water control subzone.

Need to ascertain the extent of river pollution caused by village sewage discharge

2.11 Audit noted that the EPD did not conduct periodic assessments of the extent of pollution of major rivers caused by village sewage discharge. In Audit's view, the EPD needs to consider periodically conducting such assessments and publishing the results of the assessments. These assessments would help the EPD

monitor and evaluate the effectiveness of its actions on village sewerage, and to focus its actions on areas having high water pollution caused by village sewage discharge.

Audit recommendation

2.12 **Audit has *recommended* that the Director of Environmental Protection should consider periodically conducting assessments of the extent of pollution of major rivers caused by village sewage discharge, and publishing the results of the assessments.**

Response from the Government

2.13 The Director of Environmental Protection agrees with the audit recommendation.

Control and monitoring of septic-tank-and-soakaway systems

2.14 In areas where public sewerage is not provided, house owners normally install STS systems for treating sewage. An STS system (see Figure 3 for a typical layout) comprises the following three elements:

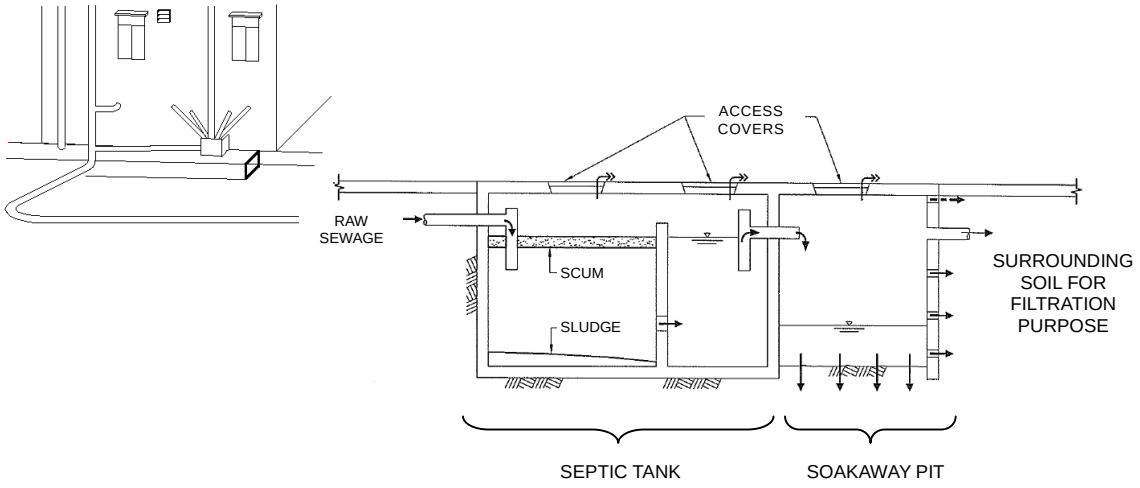
(a) ***Septic tank.*** In a septic tank (usually composing of two compartments), waste water is segregated into three layers (scum on the top, sludge at the bottom and effluent in the middle of the tank);

(b) ***Soakaway pit.*** Effluent discharged from a septic tank flows into a soakaway pit and then soaks into the surrounding soil; and

(c) ***Surrounding soil.*** Bacteria in the surrounding soil would decompose the polluting materials contained in the effluent.

Figure 3

A typical STS system



Source: EPD records

2.15 According to the EPD, satisfactory operation of an STS system requires:

(a) sufficient space for installing the system of an adequate size to handle sewage being discharged from an unsewered house;

(b) suitable ground conditions for the effluent to filter into the ground and adequate underground distance for the effluent to travel for satisfactory decomposition of the polluting materials; and

(c) regular maintenance of the septic tank to prevent blockage and effluent overflow.

Failure to meet the above requirements may lead to the effluent being discharged from the house causing pollution to the nearby rivers and environment.

Mechanisms to control STS systems

2.16 Under the WPC Ordinance, since 1993, the EPD may issue a perpetual licence for an STS system requiring the pertinent owner to meet certain operational and maintenance conditions. The licence conditions include:

(a) ***Regular maintenance.*** The septic tank shall be desludged regularly, the clogged soakaway pit shall be cleaned immediately and damage to the STS system shall be repaired promptly;

(b) ***Proper sludge disposal.*** Sludge removed in the desludging process shall be handled and disposed of properly (e.g. disposal of at DSD sewage treatment plants by specialist desludging operators); and

(c) ***Proper record keeping.*** Records of the desludging and disposal operations shall be maintained and made available for inspection by EPD officers.

Any person contravening the licence conditions commits an offence, and is liable on conviction to a fine of $200,000 and to imprisonment of six months.

2.17 The EPD and the FEHD adopt a complaint-driven approach to tackle pollution problems and nuisances arising from STS systems. Upon receiving a pollution complaint by the EPD, its staff would conduct an inspection of the related STS systems and associated stormwater drains, and request the responsible persons to make improvements in accordance with the Guidance Notes on Discharges from Village Houses issued by the EPD in 1992 (hereinafter referred to as the 1992 Guidance Notes — Note 10). If the responsible persons do not carry out any improvement work, the EPD will consider taking prosecution actions against them. Moreover, upon receiving a pollution complaint by the FEHD, its staff would also conduct an inspection of the related STS systems and request the responsible person to abate the nuisances caused by the STS systems. The FEHD will consider taking enforcement actions if the responsible person fails to abate the nuisances.

Note 10: *The 1992 Guidance Notes emphasised the principle of "Prevention is better than cure" and advised villagers of practical guidelines on the operation and maintenance of an STS system.*

2.18 Under the Buildings Ordinance (Application to the New Territories) Ordinance (Cap. 121), the Lands D may issue a Certificate of Exemption (CoE) for drainage works to an owner of a new or redeveloped village house in the New Territories meeting specified criteria (Note 11) to exempt him from complying with the drainage requirements under the Buildings Ordinance (Cap. 123) in carrying out drainage works for his house. A CoE for drainage works lays down some conditions for compliance, such as the minimum distance between the STS system and sensitive water bodies and the size and type of an allowable septic tank. The Lands D would check compliance with the CoE conditions before granting a certificate of compliance for the occupation of a village house, including the operation of an STS system.

Problems of STS systems

2.19 The Government had identified various problems related to STS systems on the following occasions:

(a) in July 1991, in a press release, the then Planning, Environment and Lands Branch (PEL Branch — see Note 7 to para. 1.15) of the Government Secretariat said that septic tanks were one of the major pollution sources in the New Territories;

(b) the EPD informed the then ETWB in May 2003 that:

(i) many village sites located in flood plains (e.g. in Yuen Long, Kam Tin, North District and Tai Po areas) were not suitable for the operation of STS systems, as soakaway pits would not function properly in soil having high groundwater levels or a high clay content;

(ii) regular maintenance of septic tanks (e.g. desludging of the tanks) was not commonly practised;

Note 11: *The specified criteria include a requirement that the pertinent building should not consist of more than three storeys and it:*

(a) has a roof area of not exceeding 65.03 square metres and a height of not exceeding 8.23 metres; or

(b) has a roof area of not exceeding 92.90 square metres and a height of not exceeding 7.62 metres.

(iii) while the environmental impacts of septic tanks of individual village houses were small, the cumulative impacts arising from large village population, high density of village house developments and reliance on ineffective STS systems were a major concern; and

(iv) sewage pollution from unsewered developments was the main source of water quality deterioration at rivers in the territory, and all major rivers in the New Territories failed to meet the WQOs on *E. coli*;

(c) from 2005 to 2015, when seeking funding approvals for 24 projects relating to the VS programmes (involving 172 villages with total Approved Project Estimates (APEs) of $8 billion — Note 12), the then ETWB and the ENB informed LegCo Finance Committee (FC) that STS systems installed in the related unsewered areas were generally ineffective in removing pollutants due to their close proximity to watercourses and inadequate maintenance, and sewage from these unsewered areas was identified as a source of water pollution to nearby watercourses and the related marine waters; and

(d) from 2008 to 2015, the EPD stated in its annual river water quality reports that sewage discharge from unsewered village houses was one of the sources contributing to the high *E. coli* levels at many rivers in the New Territories.

2.20 An EPD consultancy study in October 2001 (2001 Consultancy Study) had identified the following problems related to STS systems:

(a) based on observations of the consultant and staff of the EPD's Regional Offices, the favourable site characteristics and proper design, operation and maintenance for the appropriate functioning of STS systems were found not being commonly met in practice;

Note 12: *According to the DSD, the total APEs of $8 billion also covered costs of works on trunk sewers, sewage pumping stations and sewage treatment plants, and it was not practicable for the DSD to provide the APE solely related to village sewerage works.*

(b) a septic tank for an 8-person village house having a volume of 2.3 cubic metres (m^3) as required under a CoE issued by the Lands D did not have sufficient capacity to receive the full sewage flow, when compared with the size of 3 m^3 adopted in the Australia and New Zealand standards and that of 3.8 m^3 in the United States of America standards, representing under-capacity of 23% and 39% respectively (Note 13);

(c) the soakaway capacity of STS systems of some village houses was uncertain because percolation tests were not normally performed;

(d) the expected effective life of an STS system would be 10 to 20 years depending on the pollution loading of the surrounding soil;

(e) site investigation, detailed monitoring and laboratory tests carried out on STS systems installed in two villages (located in Tai Po and Lantau Island respectively) revealed that there were problems associated with the operations of the related STS systems, where soakaway pits were connected to surface water drains and waste water from baths, showers and sinks was discharged into stormwater drains, causing pollution to the nearby environment and downstream rivers; and

(f) although the study found little or nominal groundwater contamination that could be attributed to sewage discharge at the two villages, the study indicated that, if effluent discharged from village houses was not properly treated, it would lead to contamination of groundwater and nearby rivers.

2.21 With a view to tackling environmental problems arising from STS systems, the 2001 Consultancy Study, inter alia, made the following recommendations:

Short-term measures

(a) investigating the feasibility of installing DWFI at villages located near sensitive receivers;

Note 13: *In October 2016, the EPD informed Audit that the volume of septic tanks was not considered a key issue of pollution caused by STS systems, and there was a practicality issue in the design of sewage treatment facilities in Hong Kong in view of space constraints.*

(b) establishing a register of village premises and associated sewerage facilities at all villages in Hong Kong, and a map of villages showing areas associated with high risk of pollution caused by unsewered villages;

(c) undertaking periodic inspections, and formulating monitoring and audit requirements for villages;

Long-term measures

(d) providing sewerage infrastructure for village houses (see paras. 3.16 to 3.18); and

(e) investigating the adoption of small sewage treatment plants for individual village houses (see paras. 3.36 to 3.38).

2.22 Regarding the recommendations of the 2001 Consultancy Study, Audit examination and enquiries revealed that:

(a) for paragraph 2.21(a), the EPD did not have readily available information on the number and conditions of all DWFIs being installed for unsewered village houses and squatters. Moreover, although the EPD had taken actions to assess the effectiveness of some DWFIs (e.g. those installed near Kai Tak River, Shing Mun River and Tuen Mun River), the EPD had not taken actions to comprehensively ascertain the extent and effectiveness of all DWFIs in controlling pollution caused by unsewered residential squatters (see para. 3.6);

(b) for paragraph 2.21(b), the EPD had not taken action on this recommendation. In August and September 2016, the Lands D and the EPD informed Audit that they did not maintain statistics on the total number of village houses in Hong Kong that were installed with STS systems, nor the types and sizes of septic tanks installed for the houses (see paras. 2.29(e) and 2.30(d));

(c) for paragraph 2.21(c), the EPD had not taken action on this issue (see paras. 2.32 to 2.35);

(d) for paragraph 2.21(d), the EPD had implemented the VS programmes to address this issue. However, Audit noted that there had been long delays in implementing the VS programmes and there was no timeframe for completing the whole programmes (see paras. 3.16 to 3.18), and 290 villages were not included in the VS programmes due to their remoteness and difficult site topography (see para. 1.13(d)); and

(e) for paragraph 2.21(e), the EPD had not taken action on this issue (see paras. 3.36 to 3.38).

Lack of effective means to prevent STS systems from causing pollution

2.23 According to the EPD, the WPC Ordinance was implemented in phases starting from 1987 and pre-existing discharges (i.e. sewerage facilities installed before 1987) were exempted from control under the Ordinance. From 1990 to 1993, an owner of an STS system might apply to the EPD for issuance of a renewable two-year licence for the system under the WPC Ordinance. In July 1991, the then PEL Branch informed the public that:

(a) to avoid becoming a pollution source, septic tanks had to be constructed and maintained properly, and therefore a CoE issued by the Lands D (see para. 2.18) for regulating the construction of a septic tank did not on its own ensure that the effluent discharged by that septic tank was acceptable;

(b) the maintenance of septic tanks would be a continuous responsibility and could not be dealt with by periodic publicity campaigns, and therefore there had to be some means of legal enforcement; and

(c) for village houses in the New Territories, a licensing scheme for septic tanks would be the most suitable form of enforcement, as it defined the responsibilities of licensees and enforcement would be based on these responsibilities. The licensing scheme would be the best and the only way through which the Government and the community could make real progress in improving the environment of the New Territories.

2.24 In December 1990, the WPC Ordinance was amended where the control exemptions for pre-existing discharges (see para. 2.23) were discontinued. In 1990, when the Deep Bay and Mirs Bay Water Control Zones (covering the North and

Yuen Long Districts) were declared to be included under the Ordinance, all discharges from industrial, commercial, construction and institutional activities and discharges of domestic sewage in unsewered areas were brought into the licensing control regime. According to the EPD, the implementation of WPC Ordinance in the two Water Control Zones had encountered strong opposition from village representatives and they argued that the licensing system under the Ordinance should not be applicable to discharges of domestic sewage from village houses. In this connection, the then PEL Branch sought legal advice in December 1991 and subsequently informed village representatives in the New Territories in January 1992 that:

(a) licensing under the WPC Ordinance was not a mandatory requirement and failure to obtain a licence was not an offence;

(b) it was an offence under the WPC Ordinance to discharge any waste or polluting matter into any water control zone, and a licence issued under the Ordinance would provide a complete defence to the dischargers as long as the discharge was made in accordance with the licence conditions. Dischargers were therefore advised to obtain a licence under the Ordinance and comply with the licence conditions as this was the only certain way of avoiding conviction for causing pollution to the environment;

(c) the EPD would initially concentrate its enforcement efforts on the potentially most harmful discharges, including septic tank discharges found to be particularly polluting in some environmentally sensitive areas, such as those locating near beaches and water gathering ground; and

(d) the EPD would prepare and distribute guidance notes to the rural community on proper maintenance of septic tanks.

2.25 In 1992, the EPD published the 1992 Guidance Notes (see para. 2.17) to educate owners on how to properly operate and maintain STS systems. According to the EPD, the 1992 Guidance Notes covered all the operational and maintenance requirements that were included in a septic-tank licence, and inspections of STS systems installed at private premises might cause disturbance to the owners and a court warrant might be required for gaining entry to premises for conducting inspections.

Pollution control in unsewered areas

2.26 In 1993, amendments were made to the WPC Ordinance under which the EPD might issue a perpetual licence for an STS system. According to the EPD, this arrangement would reduce the administrative work and cost burden on villagers if they choose to apply for a licence for their STS systems.

2.27 In response to LegCo Members' enquiries, the then ETWB said in June 2003 that:

(a) many septic tanks installed at village houses could not function properly and the pollution problem associated with village houses was long-standing;

(b) of the 100,000 village houses in Hong Kong (Note 14), only 8,000 septic tanks had been licensed; and

(c) the then ETWB hoped that village house owners could apply for licences for their septic tanks with a view to ameliorating the water pollution problem more effectively.

2.28 However, as of August 2016, of the about 70,000 village houses and 84,000 residential squatters, only 1,912 had been issued with valid licences for STS systems. According to EPD records:

(a) of the 8,000 septic tanks that had been licensed (see para. 2.27(b)), the licences of 6,098 septic tanks had in fact expired and had not been renewed. Hence, only 1,902 (8,000 less 6,098) licences were in force as of June 2003;

(b) from July 2003 to August 2008, only 10 STS-system owners had applied for and had been granted the licences;

Note 14: *According to the EPD, of the 100,300 village houses as of June 2003, STS systems were adopted for 80,000 houses, private sewage treatment plants for 17,000 houses, and public sewers were connected for 3,300 houses.*

(c) from September 2008 to August 2016, none of the STS-system owners had applied for the licences; and

(d) as of August 2016, 1,912 (1,902 + 10) licences for STS systems were in force.

2.29 From August to October 2016, the EPD informed Audit that:

(a) although owners of STS systems might choose not to apply for licences for their septic tanks (as licensing of septic tanks under the WPC Ordinance was not mandatory), the owners might run the risk of being prosecuted because they would have no defence for discharging any waste or polluting matter;

(b) although sewage discharges from STS systems would soak into the ground and would not be visible under normal circumstances, problematic systems with overflow or leakage would affect the hygiene conditions of the owners' premises and they would have an incentive to rectify the problems in their own interests. The EPD would also take actions against the owners if they caused pollution to the water environment;

(c) licensing for STS systems was not regarded as the only way of improving water quality in the New Territories over the years. In light of the legal constraints on implementing the licensing scheme for STS systems, cost-effectiveness consideration and the need to provide village sewerage as a long-term solution, the EPD would focus actions on the installation of DWFIs for village houses (see para. 2.22(a)) and planning and provision of sewerage infrastructure (see para. 2.22(d)). As a result, water pollutants had been substantially removed and sewage discharges from STS systems were only one of the pollution sources. There had been significant improvement in the river-water quality as compared with that in 1991;

(d) there were practical difficulties in gaining access to private premises to ascertain the extent of compliance with the 1992 Guidance Notes for each STS system; and

(e) regarding the lack of a database on STS systems installed for unsewered village houses (see para. 2.22(b)), the EPD's enforcement experience had indicated that STS systems should have been installed for the vast majority (if not all) of village houses located in unsewered areas. On the other hand, the EPD had maintained records of village houses for planning VS programmes and taking enforcement actions against house owners. Each complaint on water pollution would be investigated and tackled individually, and there was no strong operational need to establish a database for such systems. The setting up of a database for STS systems of about 80,000 village houses would also involve very significant additional resources in collection, management and updating of data from time to time.

2.30 Audit considers it unsatisfactory that:

(a) only a small percentage (Note 15) of STS systems were subject to licensing control and that licensing of the systems was not mandatory under the WPC Ordinance;

(b) owing to the lack of survey and inspection of STS systems, there is no assurance that the 1992 Guidance Notes have been commonly complied with in STS system maintenance;

(c) there is no indication that DWFIs have been effectively installed and operated to minimise pollution caused by unsewered villages because the EPD has not taken action to comprehensively ascertain the extent and effectiveness of all the DWFIs installed; and

(d) the EPD and the Lands D have not maintained a database for STS systems installed for unsewered village houses, which may render it difficult for the two departments to carry out effective monitoring and enforcement actions on these systems.

Note 15: *The EPD did not have the up-to-date number of STS systems. Based on the 80,000 STS systems as of June 2003, the 1,912 licences only accounted for 2% of the 80,000 STS systems.*

2.31 In Audit's view, the EPD needs to explore ways and means to strengthen control over high-risk STS systems to ensure that the operations would not cause pollution to the environment. The EPD also needs to consider implementing the recommendation of the 2001 Consultancy Study on establishing a register or a database for STS systems, particularly for the high-risk ones, installed for unsewered village houses (see para. 2.21(b)). The database could be used for:

(a) keeping details of all STS systems highlighting the high-risk ones for monitoring and conducting inspections;

(b) maintaining records of complaints, follow-up actions taken and rectification works carried out; and

(c) registering details of inspections carried out and results of inspections.

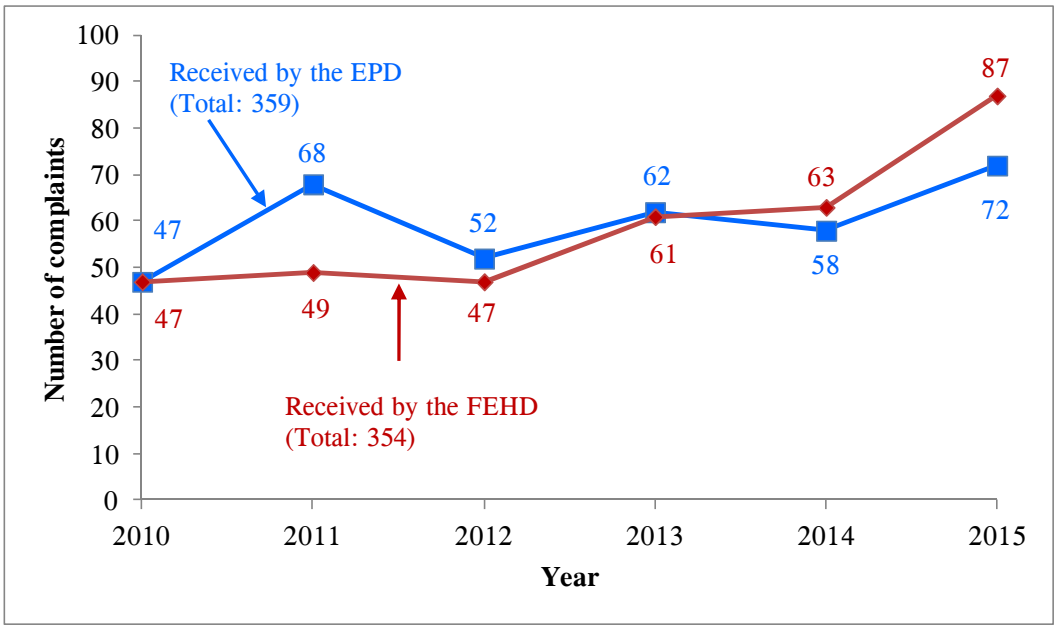
Need to strengthen inspections of high-risk STS systems

2.32 Before August 2002, the FEHD had conducted inspections of septic tanks installed for use by residents of unsewered houses at least once every three months. Since August 2002, the FEHD has ceased the regular-inspection arrangement. According to the FEHD, owing to rapidly increasing workload in terms of volume, complexity and variety of its district offices, a review conducted by the FEHD in 2002 concluded that other competing duties should take priority over regular inspections of septic tanks.

2.33 At present, the EPD and the FEHD adopt a complaint-driven approach to handle pollution problems and nuisances arising from STS systems (see para. 2.17). Figure 4 shows the number of complaints received on STS systems by the EPD and the FEHD from 2010 to 2015. As shown in Figure 4, the number of complaints on STS systems received by the EPD and the FEHD had increased from 94 (47 + 47) in 2010 to 159 (72 + 87) in 2015, representing a 69% increase. Regarding the total 713 (359 + 354) complaints received from 2010 to 2015, the EPD had issued 301 warning letters and the FEHD had issued 3 warning letters and 1 nuisance notice under the PHMS Ordinance to the STS-system owners concerned.

Figure 4

Number of complaints on STS systems received by EPD and FEHD (2010 to 2015)



Source: EPD and FEHD records

2.34 From August to October 2016, the EPD and the FEHD informed Audit that:

EPD

(a) in view of the EPD's available manpower resources, it had accorded a lower priority to taking surveillance or monitoring actions on STS systems of village houses and a higher priority on industrial and commercial premises, because discharges from the latter premises were potentially more polluting than those from village houses;

(b) the pollution problem of discharges from village houses would be resolved most effectively through the progressive implementation of the VS programmes;

FEHD

(c) the number of complaints on STS systems (see para. 2.33) only represented a very small fraction of the complaints related to environmental hygiene matters received by FEHD in the same period. For instance, in 2015, the FEHD received over 46,000 complaints relating to environmental hygiene matters, including complaints on STS systems. Only 3 warning letters and 1 nuisance notice were issued under the PHMS Ordinance for the 354 complaints on STS systems received from 2010 to 2015. The reasons of taking relatively small number of enforcement actions by the FEHD included: (i) nuisances arising from STS systems could be abated easily without enforcement actions, (ii) complaints on some STS systems received were unjustified, or (iii) complaints being outside the FEHD's jurisdiction had been referred to other relevant government departments for follow-up action; and

(d) in view of priorities of other competing duties, manpower deployment and the very small number of complaint cases warranting the FEHD's enforcement actions, the FEHD considered it more cost-effective to continue with the complaint-driven approach in handling nuisances related to STS systems.

2.35 Audit noted that effluent discharged from STS systems may be soaked into the ground and nearby rivers which could not be detected and observed except by conducting a detailed monitoring and laboratory test (see para. 2.20(e)). In Audit's view, given the many problems associated with STS systems installed at unsewered village houses (see paras. 2.19 and 2.20), the EPD needs to strengthen actions in identifying and monitoring STS systems that pose a high risk of causing pollution to the environment, particularly those located close to streams and rivers.

Requirements for some STS systems not on par with EPD practice note

2.36 Under the Buildings Ordinance (Application to the New Territories) Ordinance, the Lands D may impose conditions relating to safety and health standards when issuing a CoE for drainage works. The CoE conditions related to STS systems included the minimum distances of the systems from various sensitive water bodies (e.g. streams, springs, wells and beaches) and the conduct of percolation tests. In 1993, the EPD issued a practice note entitled "Drainage Plans subject to comment by the EPD" (hereinafter referred to as the 1993 Practice Note) for reference by Authorised Persons for preparing drainage-plan submissions under the Buildings Ordinance. The 1993 Practice Note stipulated various technical requirements for an STS system, including the minimum distances of the system from various sensitive water bodies and the need for conducting percolation tests in all cases. According to the EPD, an STS system having been designed, constructed and maintained in accordance with the requirements of the 1993 Practice Note would help achieve the intended sewage treatment function and prevent sewage discharge from polluting the environment.

2.37 Audit examination revealed that some of the village-house sewerage requirements stipulated under a CoE issued by the Lands D were not on par with those stipulated under the EPD's 1993 Practice Note. Details are shown in Table 1.

Table 1

Key variances between EPD and Lands D requirements on STS systems

Aspect	EPD's 1993 Practice Note	Lands D's CoE conditions
(a) Minimum horizontal distance from beaches and wells	An STS system should be located at least: (i) 100 metres from the boundaries of beaches gazetted under the PHMS Ordinance; and (ii) 50 metres from wells.	An STS system should be located beyond 30 metres from wells (used for drinking or domestic purposes) and beaches.
(b) Minimum vertical distance from underground water level	An STS system should be located at least 0.6 metres from underground water level.	There is no minimum distance requirement between an STS system and underground water level, if the system is located beyond 30 metres from streams, springs, wells and beaches.
(c) Conduct of percolation tests	Percolation tests should be carried out to determine the absorption capacity of the soil surrounding an STS system, irrespective of the number of houses to be served and the distance of the system from sensitive water bodies.	Percolation tests need not be carried out, if an STS system serves a single village house and is located beyond 30 metres from streams, springs, wells and beaches.

Source: EPD and Lands D records

2.38 In September and October 2016, the Lands D informed Audit that:

(a) owing to site constraints, in most of the applications for redevelopment of village houses, the applicants had encountered practical difficulties to find suitable locations for construction of STS systems in line with the EPD's 1993 Practice Note; and

(b) in an attempt to achieve better control over the provision of sewerage systems for village houses in the New Territories, the Lands D and the EPD agreed that, starting from December 2014:

(i) the design and construction of STS systems for village houses located within country-park enclaves in three areas (namely Hoi Ha and Pak Lap in Sai Kung area, and So Lo Pun in North District) should be in line with the EPD's 1993 Practice Note irrespective of the distance from sensitive water bodies. Applicants for development/redevelopment of village houses in these three locations should submit percolation test results certified by building professionals to the Lands D for scrutiny at the application stage, which would circulate the related information to the EPD, the DSD, the Planning Department and the Agriculture, Fisheries and Conservation Department for comments; and

(ii) the EPD's 1993 Practice Note was applicable to village-house sites located outside existing "V" zones requiring planning approvals under the Town Planning Ordinance (Cap. 131) or located in new/newly enlarged "V" zone areas (Note 16).

2.39 As the adoption of the 1993 Practice Note would help prevent sewage discharge from polluting the environment (see para. 2.36), and given the variances between the requirements of the EPD and the Lands D on installation and monitoring of STS systems, the Lands D, in collaboration with the EPD, needs to review and revise the CoE conditions such that they are in line with the EPD's 1993 Practice Note as far as practicable.

Note 16: *According to the Lands D:*

(a) a "V" zone is an area of land having been zoned for village-type developments on a statutory plan under the Town Planning Ordinance before 30 December 2014;

(b) a new "V" zone is an area of land that has been zoned for village-type developments on a statutory plan under the Town Planning Ordinance since 30 December 2014; and

(c) a newly enlarged "V" zone is an area of land that has been extended from the existing "V" zone since 30 December 2014.

Audit recommendations

2.40 **Audit has *recommended* that, in controlling and monitoring STS systems, the Director of Environmental Protection should explore ways and means to strengthen control over high-risk STS systems, particularly those located close to streams and rivers, to ensure that the operations would not cause pollution to the environment.**

2.41 **Audit has also *recommended* that the Director of Lands, in collaboration with the Director of Environmental Protection, should review and revise the CoE conditions for STS systems such that they are in line with the EPD's 1993 Practice Note as far as practicable.**

Response from the Government

2.42 The Director of Environmental Protection agrees with the audit recommendations in paragraphs 2.40 and 2.41. He has said that:

(a) the EPD will strengthen control over village-house developments with a high risk of pollution (i.e. those located in environmentally sensitive areas or next to rivers) to improve water quality and provide greater protection to the water environment;

(b) starting from 2014, the EPD has required developers of new village houses located in environmentally sensitive areas (e.g. country-park enclaves) to carry out percolation tests for STS systems during the planning stage. In collaboration with the relevant government departments, the EPD will consider extending the percolation-test requirement to new village houses located in areas other than country-park enclaves (see para. 2.38(b)(i)) as far as practicable; and

(c) the EPD and Lands D are exploring possible enhancements to the standard conditions issued under a CoE.

2.43 The Director of Lands agrees with the audit recommendation in paragraph 2.41. She has said that the Lands D welcomes the EPD's advice on the ways in which the CoE conditions for STS systems of village houses would further align with the EPD's 1993 Practice Note as far as practicable.

Control and monitoring of desludging operations

2.44 According to the EPD guidelines, to ensure the proper functioning of an STS system, it should be desludged every six months and the sludge removed from the system should be transported by desludging operators to sewage treatment plants for proper disposal.

No licences issued for desludging of septic tanks and disposal of excretal matter

2.45 Under the WD Ordinance:

(a) the EPD and the FEHD (Note 17) may provide services for desludging of septic tanks and disposal of excretal matter from such tanks;

(b) the EPD and the FEHD may issue a licence to permit any person to provide the services in (a) above. A licensee may be required to:

(i) comply with stipulated standards for the design, construction, labelling, maintenance, operation, cleansing and disinfection of any containers, equipment and vehicles used for waste collection and transportation;

(ii) produce and comply with an operation plan to provide assurance on the quality of operation and a satisfactory level of environmental hygiene and pollution control;

Note 17: *Under the WD Ordinance, the EPD and the FEHD are designated as the "collection authority" for desludging of septic tanks and disposal of excretal matter.*

(iii) formulate and implement pollution control precautions for preventing and mitigating any nuisance arising from waste collection and transportation;

(iv) draw up an emergency plan for dealing with emergency situations and reporting incidents to the EPD and the FEHD; and

(v) keep records for each consignment of waste and submit related trip tickets (Note 18) to the EPD and the FEHD; and

(c) any person who provides services for desludging of septic tanks or disposal of excretal matter from such tanks without obtaining a licence from the EPD and the FEHD commits an offence and is, on conviction, liable to a fine of $100,000, where:

(i) the EPD and the FEHD provide any services for desludging of septic tanks and disposal of excretal matter from such tanks; or

(ii) any person is permitted to provide such services under a licence issued by the EPD and the FEHD.

2.46 Audit noted that, since 2000, the FEHD had advertised on its website the provision of desludging services. From 2000 to 2002, as requested by members of the public, the FEHD had provided desludging services on 34 occasions. The FEHD had not provided desludging services during the 13 years from January 2003 to August 2016 (Note 19). In September 2016, the FEHD informed Audit that it

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Note 18: *As an administrative arrangement, a trip ticket recording the details of a desludging operator and the date of each sludge disposal is collected at a sewage treatment plant by the DSD for charging purposes. The charge rate is $11.7 per m^3 of sludge being disposed of at the plant.*

Note 19: *According to the FEHD, from 2003 to 2014, it had not received any request for desludging services from members of the general public. Two desludging service requests were received in October 2015 and January 2016 respectively. However, the desludging services were not provided due to the lack of parking space and working area at the desludging locations.*

had not conducted a review of the reasons why the public had not requested desludging services of the FEHD in the past 13 years. As of August 2016, the FEHD managed five desludging vehicles (see Photograph 1) which provided desludging services mainly for public toilets under its management.

Photograph 1

A desludging vehicle

Source: FEHD records

2.47 The DSD has designated three sewage treatment plants (Note 20) for receiving excretal matter from private desludging operators. According to DSD records, as of April 2016, 78 private desludging operators (having a total of 317 desludging vehicles) were involved in the provision of related services. However, Audit noted that, as of October 2016, these 78 operators had not been issued with licences under the WD Ordinance from the EPD or the FEHD for provision of desludging and excretal-matter disposal services.

2.48 Audit noted that, when introducing the WD Ordinance in 1979, the Government informed LegCo that one of the objectives of the Ordinance was to ensure that the public would be adequately protected against any harmful effects of pollution caused by disposal of solid wastes.

Note 20: *The three sewage treatment plants are the Ap Lei Chau Preliminary Treatment Works, the Pillar Point Sewage Treatment Works and the Sai Kung Sewage Treatment Works.*

2.49 In September and October 2016, the EPD and the FEHD informed Audit that:

EPD

(a) under the WD Ordinance, chemical-waste and clinical-waste collection operators were required to obtain licences because they would impose immediate health hazards and significant impacts on the environment if their operations were not properly managed. To introduce a licensing scheme over a non-hazardous waste such as sludge from septic tanks, the EPD needed to have a firm basis and full justifications, and it would consult the related trade in this regard. The EPD would carefully review the above factors before deciding the way forward on whether a licensing scheme on the collection and disposal of septic-tank sludge should be introduced;

FEHD

(b) in the past when limited desludging services were available in the private market, the FEHD had received requests from members of the public and provided the services to private premises subject to payment of the service cost and when its desludging team had spare capacity. With increasing supply of such services in the private market, the demand for the FEHD's desludging services had decreased, and the services were provided primarily to government venues as of October 2016; and

(c) as a collection authority under the WD Ordinance, the FEHD would work with the EPD to review whether licensing control should be introduced on the collection of septic-tank sludge.

2.50 In Audit's view, owing to the potential impacts caused to the environment by improper provision of desludging and excretal-matter disposal services, the EPD and the FEHD need to take measures to ascertain whether or not desludging operators are statutorily required to obtain a licence for providing the related services (see para. 2.45(c)) and, if in the affirmative, take necessary actions to

ensure compliance with the WD Ordinance on this issue. In the event that private operators are not required to obtain a licence for providing desludging services, the EPD and the FEHD need to explore ways and means to strengthen controls over desludging operations. These measures would help minimise pollution caused by desludging operations.

Ineffective action taken to prevent illegal dumping of excretal matter

2.51 From 2010 to 2015, the EPD and the FEHD had received a total of 55 complaints on environmental problems related to desludging operations, of which 23 (42%) related to improper disposal of excretal matter at unauthorised locations and 32 (58%) related to the odour or noise emitted by desludging vehicles during their operations. Audit examination revealed that repeated complaints had been received on improper disposal of excretal matter at an illegal dumping blackspot in the North District.

2.52 From October 2013 to October 2014, in response to 14 complaints, the EPD and the FEHD found excretal matter having been illegally disposed of at a hill top in the North District on 8 occasions. However, their staff could not find any person related to the illegal waste disposal. In November 2014, as a preventive measure to avoid further illegal disposal of waste at the site, the EPD requested the Lands D to take action to block the access road leading to the blackspot location. In May 2015, in response to another complaint, the EPD found excretal matter being illegally disposed of at the same location but EPD staff again could not find any person related to the waste disposal.

2.53 In this connection, Audit noted that, from August 2015 to February 2016, the EPD had implemented a trial scheme on installing surveillance camera systems at blackspots for detecting illegal dumping of construction waste, and the systems captured images of 170 cases involving illegal dumping of construction waste by vehicles. The EPD subsequently took prosecution actions on 46 cases. As a result, the responsible persons of 11 cases had been issued with fixed penalty notices (each with a fine of $1,500) and of 35 cases had been convicted with fines ranging from $2,000 to $15,000. Audit considers that the EPD and the FEHD need to consider installing surveillance camera systems at blackspots of illegal dumping of waste, including excretal matter.

Audit recommendations

2.54 **Audit has *recommended* that, in controlling and monitoring desludging operations, the Director of Environmental Protection and the Director of Food and Environmental Hygiene should:**

(a) **explore ways and means to strengthen controls over desludging operations; and**

(b) **consider installing surveillance camera systems at blackspots of illegal dumping of waste, including excretal matter.**

Response from the Government

2.55 The Director of Environmental Protection agrees with the audit recommendations.

2.56 The Director of Food and Environmental Hygiene agrees with the audit recommendations. She has said that:

(a) to tackle the problem of illegal dumping of bagged refuse, the FEHD will implement a pilot scheme by the end of 2016 or early 2017 to install internet-protocol cameras at some hygiene blackspots so that effective enforcement action can be taken to catch culprits red-handed; and

(b) depending on the effectiveness of the pilot scheme, consideration may be given to extending the scheme to cover more hygiene blackspots, and the relevant District Councils will be consulted on whether some blackspots involving illegal disposal of excretal matter should be selected for installation of surveillance cameras.

PART 3: PLANNING AND IMPLEMENTATION OF VILLAGE SEWERAGE PROGRAMMES

3.1 This PART examines actions taken by the EPD and the DSD in planning and implementing the VS programmes, focusing on:

(a) control of sewage discharge from unsewered squatters (see paras. 3.2 to 3.14); and

(b) implementation of village sewerage programmes (see paras. 3.15 to 3.42).

Control of sewage discharge from unsewered squatters

3.2 According to the EPD and the DSD, a proper sewerage infrastructure for collecting and treating sewage from village houses is the long-term solution to the water pollution problems. The DSD is the EPD's works agent for implementing VS programmes, which also cover residential squatters.

3.3 In 1982, the Government conducted a squatter control survey to record the locations, dimensions, height, building materials and usage of squatter structures. Under the Government's squatter control policy, these surveyed squatter structures are unauthorised and tolerated to remain on government land and private agricultural land on a temporary basis until they cease to exist or are involved in a clearance programme for development, environmental improvement or safety reasons. They are tolerated on the condition that their locations, dimensions, height, building materials and usage remain unchanged as compared with the 1982 survey records maintained by the Lands D. Most of the squatter areas are not provided with public sewerage systems. Since April 2006, the Lands D has taken over the squatter control responsibilities from the Housing Department.

Need to prevent uncontrolled discharge of untreated sewage from residential squatters

3.4 Audit noted that the EPD's SMPs (completed from 1989 to 1996) and its subsequent reviews (completed from 1999 to 2010) had conducted sewerage planning for some 100,000 village houses, including surveyed squatter structures.

According to Lands D records, as of December 2015, 84,000 residential squatters were located in 791 areas. However, Audit noted that the EPD had not taken action to ascertain the progress of implementing sewerage works for residential squatters in these 791 areas similar to that for rural villages (see para. 1.13). In Audit's view, the EPD needs to take measures to address this issue and inform LegCo of the progress of the related sewerage works.

3.5 According to the EPD's study reports on SMPs and the subsequent reviews, STS systems were generally not installed in squatter areas and untreated sewage generated from the squatters was mostly directly discharged into the nearby rivers or water bodies, causing water pollution and environmental problems. In Audit's view, the EPD needs to take measures to prevent untreated sewage generated from residential squatters from being directly discharged into nearby rivers or water bodies.

3.6 According to the EPD, many squatter areas were situated within existing villages or sewered areas, and DWFIs had been installed at pollution blackspots as first-aid measures under the SMPs to help intercept and convey sewage discharge from the squatters to public sewers. However, Audit noted that the EPD did not have readily available information on the squatter areas having been installed with DWFIs. In Audit's view, the EPD needs to take measures to ascertain the extent and effectiveness of DWFIs in reducing pollution caused by untreated sewage generated from unsewered residential squatters.

Low sewer-connection rate in a squatter area

3.7 Under the arrangement of VS programmes, the Government would generally install public sewers for selected unsewered areas up to the boundaries of private land, and house owners need to complete, at their own cost, works for connecting their sewerage systems to the public sewers (hereinafter referred to as sewer-connection works).

3.8 In November 2007, when seeking the FC's funding approval of $33 million for implementing a sewerage project for a squatter area near the midstream of Tuen Mun River (Squatter Area A), the ENB said that:

(a) domestic sewage from Squatter Area A was mostly discharged directly into the open drainage channels without any treatment or having been treated by ineffective private treatment facilities (e.g. STS systems), causing hygiene problems and water pollution to nearby water bodies; and

(b) the ENB expected that the sewerage works would be able to alleviate the water pollution problem in Tuen Mun and improve the hygiene condition in Squatter Area A.

3.9 According to EPD records, the public sewerage works were planned to cover 278 squatters (involving 1,100 residents) at Squatter Area A. Based on the experience gained in previous village sewerage projects, the EPD estimated that 80% of the squatters would be connected to the new sewerage system. In May 2011, public sewerage works at Squatter Area A were completed. However, up to June 2016, Audit noted that, of the 278 squatters, apart from 8 squatters which did not have any resident, only 112 (41%) of the remaining 270 squatters had been connected to public sewers.

3.10 Audit considers it unsatisfactory that, more than five years after completion of public sewerage works, only 41% of squatters in Squatter Area A had been connected to public sewers, which was much lower than the target connection rate of 80%.

3.11 According to the EPD:

(a) the low sewer connection rate at Squatter Area A was attributed to the following:

(i) although the EPD might issue statutory notices under the WPC Ordinance to require the squatter residents to carry out sewer-connection works, after seeking legal advice and considering the temporary nature of squatter areas, the EPD had not issued any notice to residents of Squatter Area A requiring them to carry out the works; and

(ii) residents of Squatter Area A had expressed that they were very poor and they needed a longer time to complete the sewer connection works;

(b) the EPD had taken continuous actions to persuade the residents of Squatter Area A to carry out sewer-connection works by organising briefing sessions, sending reminder letters, providing technical assistance and erecting promotion banners with a view to improving the sewer-connection rate; and

(c) in order to control the pollution caused by waste water being discharged to the river near Squatter Area A, public toilets had been provided for use by squatter occupants and regular cleansing of the related surface stormwater drains had been conducted.

3.12 In Audit's view, the EPD needs to draw lessons from the sewerage project for Squatter Area A in implementing similar projects in future. The EPD also needs to take measures with a view to ensuring that sewage discharge from unsewered squatters in Squatter Area A would not cause pollution to the environment.

Audit recommendations

3.13 **Audit has *recommended* that, in controlling sewage discharge from residential squatters, the Director of Environmental Protection should:**

(a) **take measures to ascertain the progress of implementing sewerage works for residential squatters and inform LegCo of the progress;**

(b) **take measures to prevent untreated sewage generated from residential squatters (including Squatter Area A) from being directly discharged into nearby rivers or water bodies;**

(c) **take measures to ascertain the extent and effectiveness of DWFIs in reducing pollution caused by untreated sewage generated from unsewered residential squatters; and**

(d) **draw lessons from the sewerage project for Squatter Area A in implementing similar projects in future.**

Response from the Government

3.14 The Director of Environmental Protection agrees with the audit recommendations. He has said that, for paragraph 3.13(a), the EPD has requested the Lands D to provide information on the exact locations of squatter areas, and the Lands D is checking its records in this regard.

Implementation of village sewerage programmes

3.15 In May 2001, November 2006 and May 2009, the then Environment and Food Bureau (EFB — see Note 7 to para.1.15) and the EPD informed LegCo of the indicative target completion dates of village sewerage works under 8 of the 16 SMPs. Details are shown in Table 2.

Table 2

Target completion dates of implementing VS programmes (May 2001 to May 2009)

	Indicative target completion date		
SMP area covered by VS programme (see Figure 1 in para. 1.10)	**As of May 2001**	**As of November 2006**	**As of May 2009**
(a) Tuen Mun	2004 (Note)	2012 to 2013	2017-18
(b) Tsuen Wan, Tsing Yi and Kwai Chung	2005	2009	2013-14
(c) Tseung Kwan O	2006	Not mentioned	Not mentioned
(d) Outlying Islands	2007 (Note)	2010 to 2013	2017-18
(e) Port Shelter	2008	Not mentioned	2016-17
(f) Yuen Long and Kam Tin	2008	2012 to 2014	2016-17
(g) North District	2009	2012 to 2015	2016-17
(h) Tolo Harbour	2009	2010 to 2014 (for Sha Tin) 2011 to 2014 (for Tai Po)	2017-18

Source: EFB and EPD records

Note: VS programmes in Tuen Mun and Outlying Islands each comprised 2 stages of works. According to the EPD, since Stage 2 works for each area were under review as of May 2001, LegCo was only informed of the target completion dates of Stage 1 works of the two programmes.

Delays in implementing VS programmes

3.16 As shown in Table 2, from May 2001 to May 2009, the target time of completing VS programmes for eight SMP areas had been extended twice for a total of 8 to 9 years. Furthermore, for the up-to-date time targets set in May 2009 for completing the VS programmes from 2013-14 to 2017-18, Audit examination revealed that these time targets could not be met. As of June 2016, of the total 662 villages covered under the VS programmes for the eight SMP areas, public sewerage works for 178 (27%) villages had been completed, 10 sewerage projects involving 77 (12%) villages were in progress, 24 sewerage projects involving 238 (36%) villages were under planning and sewerage projects under the PWP had not been created for the remaining 169 (25%) villages. The progress of implementing works for 484 (77 + 238 + 169) villages is shown in Table 3.

Table 3

Works progress of 484 villages under VS programmes (June 2016)

SMP area covered by VS programme (involving 484 villages)	Target completion date set in May 2009	Position as of June 2016
(a) Tuen Mun (involving 36 villages)	2017-18	– 1 project (involving 7 villages) was scheduled for completion in April 2019 – 2 projects (involving 7 villages) were in Category B stage of the PWP (Note 1) – 4 projects (involving 22 villages) were in Category C stage of the PWP (Note 2)
(b) Tsuen Wan, Tsing Yi and Kwai Chung (involving 26 villages)	2013-14	– 2 projects (involving 26 villages) were in Category B stage of the PWP
(c) Tseung Kwan O (involving 11 villages)	Not mentioned (2006 as set in May 2001)	– 2 projects (involving 11 villages) were in Category B stage of the PWP
(d) Outlying Islands (involving 65 villages)	2017-18	– 2 projects (involving 15 villages) were scheduled for completion in August 2017 and July 2018 respectively – 5 projects (involving 42 villages) were in Category B stage of the PWP – 1 project (involving 8 villages) was in Category C stage of the PWP

Table 3 (Cont'd)

SMP area covered by VS programme (involving 484 villages)	Target completion date set in May 2009	Position as of June 2016
(e) Port Shelter (involving 36 villages)	2016-17	– 1 project (involving 11 villages) was scheduled for completion in January 2017 – 2 projects (involving 25 villages) were in Category B stage of the PWP
(f) Yuen Long and Kam Tin (involving 166 villages)	2016-17	– 1 project (involving 6 villages) was scheduled for completion in August 2016 – 2 projects (involving 27 villages) were in Category C stage of the PWP – PWP projects were not created for 133 villages
(g) North District (involving 88 villages)	2016-17	– 3 projects (involving 14 villages) were scheduled for completion from December 2015 to September 2017 – 3 projects (involving 38 villages) were in Category B stage of the PWP – PWP projects were not created for 36 villages
(h) Tolo Harbour (involving 56 villages)	2017-18	– 2 projects (involving 24 villages) were scheduled for completion from December 2016 to September 2017 – 1 project (involving 32 villages) was in Category B stage of the PWP

Source: EPD and DSD records

Note 1: For a Category B project under the PWP, the responsible works department has established the project's technical feasibility and it may undertake the necessary pre-construction work including planning, investigation and design to render the project ready in all aspects. Subject to resource availability, the responsible bureau and works department may proceed to seek the FC's funding approval for the project. When funding approval is granted by the FC, the project is upgraded to a Category A project. According to the Financial Services and the Treasury Bureau, whether a works project is ready for upgrading to Category A will depend on various factors including readiness, relative merits and urgency of the project versus other competing projects.

Note 2: For a Category C project under the PWP, the responsible works department may provide a conceptual design and a broad order of cost of the project.

3.17 According to the EPD:

(a) the main constraints for implementing the VS programmes included objections from the local communities, competition for resources among various environmental programmes, availability of funding for public works projects, as well as site constraints and technical issues identified during the works-implementation stage; and

(b) most of the constraints in (a) above were beyond the control of the EPD and the DSD.

3.18 In Audit's view, the long delays in completing the VS programmes are undesirable which would defer improvements to village sewerage in rural areas and perpetuate the hygiene and environment problems caused by the less-than-satisfactory sewerage systems in these areas (see paras. 2.19 and 2.20). The EPD needs to periodically inform LegCo of the progress of implementing the VS programmes, with comparisons with the time targets set for implementing the programmes.

Incomplete records for planning public sewerage works

3.19 In March 2015, the EPD informed LegCo PWSC of the progress of implementing public sewerage works for 970 rural villages (see para. 1.13). However, Audit examination of records of the EPD, the DSD and the HAD revealed that, as of October 2016, 158 unsewered areas not being installed with approved on-site sewage treatment plants were not included in the 970 villages. The 158 unsewered areas comprised:

(a) 151 unsewered areas (comprising 5,408 premises) based on the DSD's "List of sewered and unsewered areas" for billing of sewage charges (SC) under the Sewage Services Ordinance (Cap. 463); and

(b) 7 unsewered areas (having 501 registered voters) based on the HAD's list of rural committees and villages under the Rural Representative Election Ordinance (Cap. 576). According to the HAD, the list of rural committees and villages may not include all the rural villages/areas in the New Territories.

3.20 In August and October 2016, the EPD informed Audit that:

(a) some of the unsewered areas only contained scattered structures and houses that should not be classified as "villages" under the VS programmes, which had been prepared and prioritised focusing on the sensitivity and value of the affected water bodies and extent of pollution. Hence, the HAD's list of rural committees and villages was not considered when planning the VS programmes. The EPD did not have readily available information indicating whether the VS programmes had covered all the areas related to the HAD's list of rural committees and villages; and

(b) for some unsewered areas, no sewerage works were recommended under the SMPs (completed from 1989 to 1996) and their subsequent reviews (completed from 1999 to 2010) as the EPD did not identify pollution in these areas.

3.21 Audit considers that, with a view to ensuring that major unsewered areas are covered in the planning for implementing public sewerage works, the EPD needs to make reference to the DSD's list of sewered and unsewered areas and the HAD's list of rural committees and villages in determining the total number of unsewered areas, and to formulate an appropriate strategy to address the sewage problems in each area.

Delay in completing a project due to objections on land resumption

3.22 From January 2011 to June 2016, works for 10 village sewerage projects had been substantially completed. Of these 10 projects, Audit found that the actual works completion dates of 2 projects were respectively 25 months (for Project A) and 17 months (for Project B) later than their scheduled completion dates.

3.23 Sewerage works under Project A having an APE of $381.4 million mainly involved the construction of 31.2 kilometres (km) of sewers for 17 unsewered areas in Sha Tin and Tai Po. According to the paper submitted to the FC for funding approval in November 2008, the sewerage works would commence in January 2009 and were scheduled for completion in December 2012 (i.e. involving a works

duration of 47 months). However, the works were only substantially completed in January 2015, 25 months later than the target completion date.

3.24 For the purpose of laying sewers and related facilities for Project A, the DSD sought assistance from the Lands D to take actions under the Roads (Works, Use and Compensation) Ordinance (Cap. 370) to resume some private land lots for use as the works areas. The sewerage works were authorised by the EPD in June 2008, under which 208 private land lots were required to be resumed for carrying out sewerage works for four unsewered areas in Tai Po.

3.25 In July 2008, the DSD received objections to the resumption of 17 land lots. In February 2009, the works contract for the sewerage works was awarded. In July 2012, 41 months after award of the works contract, the DSD reached consensus with the concerned land-lot owners and village representatives to make changes to the sewer alignments such that land resumption of the 17 land lots was not required. The changes entailed resumption of another 5 land lots, which were subsequently resumed after obtaining consent from the concerned land-lot owners.

3.26 In Audit's view, the DSD needs to draw lessons from Project A on the need to expedite actions to resolve objections received after commencement of a works project.

Slippage in completing a works project due to unrecorded underground utilities and delay in gazetting the works

3.27 Sewerage works under Project B (see para. 3.22) having an APE of $1,340 million mainly involved the construction of 7 km of sewers for two unsewered areas in Tuen Mun, 7 km of trunk sewers along Lung Mun Road and a new sewage pumping station. According to the paper submitted to the FC for funding approval in July 2009, the sewerage works would commence in December 2009 and were scheduled for completion in June 2014 (i.e. involving a works duration of 54 months). In December 2009, the DSD awarded a works contract (Contract A) under Project B at an estimated cost of $711 million for constructing the trunk sewers and the new sewage pumping station. In September 2011, the DSD awarded another works contract (Contract B) for the sewerage and related works at the two unsewered areas under Project B at an estimated cost of $49 million (Contract B also included works under other works projects).

3.28 According to the paper submitted to the FC for funding approval, the objective of Contract A was to improve the sewerage capacity in Tuen Mun to handle the sewage diverted from unsewered areas and the forecast sewage flow generated in the area. Works under Contract A commenced in December 2009 and were scheduled for completion in June 2014. However, works under Contract A were only substantially completed in November 2015, 17 months later than the target completion time. Audit noted that, apart from the extension of time of about 200 days being granted to the works contractor due to inclement weather during the construction period, the slippage was mainly due to the presence of unrecorded underground utilities (e.g. water pipes and electricity cables) and the need for diversion of the affected utilities. As of September 2016, the works contractor had submitted claims for extension of time for the affected works items. According to the works contractor, works to deal with the unrecorded underground utilities had caused delays to the works.

3.29 In October 2016, the DSD informed Audit that the DSD was aware of the need to identify existing underground utilities within works areas during the planning and design stages of a works project through carrying out site investigations as far as possible, but it was not uncommon for village sewerage works to encounter unrecorded underground utilities during works excavation, rendering more time being required for the construction works.

3.30 In Audit's view, in implementing a works project in future, the DSD needs to take measures to identify underground utilities in works areas for works planning purposes before award of a related works contract.

3.31 Regarding Contract B, the village sewerage works commenced in September 2011 and were scheduled for completion in June 2014. However, works under Contract B were only substantially completed in July 2015, 13 months later than the target completion time. Audit noted that, after funding being approved by the FC in July 2009, the DSD identified the need for temporary closure of parts of a narrow footpath and a single-lane carriageway during non-peak hours for implementing the village sewerage works. In June 2010, when preparing the tender documents for Contract B, the DSD, as the EPD's works agent, sought legal advice on whether it needed to adopt the formal gazettal procedures for carrying out the

proposed works. In November 2010, after considering legal advice and with a view to minimising public disputes after the commencement of Contract B, the EPD gazetted the proposed village sewerage works. As it transpired, the DSD only awarded Contract B for implementing the village sewerage works in September 2011, 26 months after the FC's funding approval in July 2009.

3.32 In Audit's view, for works involving temporary closure of roads in future, the DSD needs to draw lessons from Project B on the need to seek legal advice on adopting necessary procedures for the road closure in a timely manner.

Significant cost under-estimation of works

3.33 Of the 10 village sewerage projects having been substantially completed from January 2011 to June 2016, Audit noted that the original APEs of two projects on Lamma Island (Projects C and D) had been significantly under-estimated.

3.34 In April 2010, the EPD informed the FC that there was a need to increase the APE of Project C from $288.3 million to $347.5 million (an increase of $59.2 million, or 21%), and that of Project D from $256.4 million to $353.7 million (an increase of $97.3 million, or 38%). According to the paper submitted to the FC in April 2010, apart from the increases in price-adjustment provisions of $51 million and $52.9 million for Projects C and D respectively, the increases in the APEs were mainly due to the higher-than-expected tender prices received. For example, the successful tender price for sewerage works under Projects C and D (covered under one works contract) totalled $100 million, which was $29.7 million higher than the sum of the original estimates of $70.3 million (representing a 42% increase). According to the EPD, the increases in prices were likely due to greater risk allowances made by the tenderers due to perceived difficulties involved in engaging labour, construction plants and materials for carrying out this type of village sewerage works on an outlying island, and the difficulties in laying sewers in congested and constrained village areas.

3.35 In Audit's view, the DSD needs to draw lessons from Projects C and D on the need to prevent as far as possible significant cost under-estimation when seeking funding approval from the FC for implementing works projects on outlying islands.

Need to explore measures to reduce pollution caused by village houses located in remote areas

3.36 In March 2009, an EPD consultancy study found that it was technically feasible for installing a small localised sewage treatment plant for treatment of sewage discharged from village houses located in a remote area, and the study recommended that the provision of such a plant for use by a group of village houses should be further investigated.

3.37 In February 2015, in response to a LegCo Member's enquiry, the EPD informed LegCo PWSC that it would study the feasibility to provide alternative sewerage facilities (e.g. small localised sewage treatment plants) for remote villages with small populations, and would report the study results to LegCo Panel on Environmental Affairs. In March 2015, the EPD informed LegCo that 290 villages had not been included in the VS programmes due to their remoteness and difficult site topography (see para. 1.13(d)).

3.38 In Audit's view, given the potential pollution caused by unsewered houses located in areas where public sewerage works would not be carried out in the near future, the EPD needs to take necessary actions and inform LegCo of the EPD's actions plans for these areas in a timely manner.

Audit recommendations

3.39 **Audit has *recommended* that, in implementing the VS programmes in future, the Director of Environmental Protection should:**

(a) **periodically inform LegCo of the progress of implementing the VS programmes, with comparisons with the time targets set for implementing the programmes;**

(b) **make reference to the DSD's list of sewered and unsewered areas and the HAD's list of rural committees and villages in determining the total number of unsewered areas, and to formulate an appropriate strategy to address the sewage problems in each area; and**

(c) **conduct a review of the environmental conditions and the need for provision of sewerage facilities for unsewered areas where public sewerage works would not be carried out in the near future, and inform LegCo of the EPD's action plans for these areas in a timely manner.**

3.40 **Audit has also *recommended* that, in implementing the VS programmes in future, the Director of Drainage Services should:**

(a) **draw lessons from Project A on the need to expedite actions to resolve objections received after commencement of a works project;**

(b) **take measures to identify underground utilities in works areas for works planning purposes before award of a related works contract;**

(c) **for works involving temporary closure of roads, draw lessons from Project B on the need to seek legal advice on adopting necessary procedures for the road closure in a timely manner; and**

(d) **draw lessons from Projects C and D on the need to prevent as far as possible significant cost under-estimation when seeking funding approval from the FC for implementing works projects on outlying islands.**

Response from the Government

3.41 The Director of Environmental Protection agrees with the audit recommendations in paragraph 3.39. He has said that the EPD will collaborate with the DSD to expedite actions to complete the VS programmes.

3.42 The Director of Drainage Services agrees with the audit recommendations in paragraph 3.40. He has said that:

(a) the DSD will collaborate with the EPD to expedite actions to complete the VS programmes;

(b) in 2010, the DSD set up an internal Village Sewerage Support Group (VSS Group) comprising professional officers from relevant project offices in the DSD to discuss common issues and share experiences on the problems, difficulties and lessons learnt in respect of implementing village sewerage projects on a quarterly basis. The DSD will draw lessons from Projects A and B for sharing in the VSS Group;

(c) upon obtaining legal advice in the course of implementing Project B concerning clearer definition on road closure, the DSD has a better grasp of adopting appropriate legal procedures when implementing similar works projects in future. Moreover, the DSD will seek necessary legal advice in a timely manner in future; and

(d) the DSD has reminded its project offices of the need to prepare pre-tender estimates based on the best and latest available information, particularly for implementing village sewerage works on outlying islands to account for the extra costs of labour, construction plants and materials. The DSD will also arrange to share the lessons learnt from Projects C and D in the VSS Group.

PART 4: SEWER CONNECTION OF VILLAGE HOUSES

4.1 This PART examines actions taken by the EPD to cause village-house owners to carry out works to connect their sewerage systems with public sewers.

Connection of village houses to public sewers

4.2 The objective of provision of sewerage infrastructure for unsewered villages could only be achieved after the target village houses have been properly connected to the public sewerage system. Under the Government's policy, public sewers would only be constructed up to the lot boundaries of private land as far as practicable. Village house owners need to carry out works (including construction of a terminal manhole and connecting sewers) at their own cost to connect their sewerage systems with public sewers.

4.3 According to DSD Technical Circular No. 2/2015 "Reporting New Sewer Connections and the Related Procedures" issued in May 2015:

(a) after completion of sewer connection works, a village-house owner is required to return a duly completed form to the EPD confirming that his house has been connected to a public sewer; and

(b) the EPD will forward the completed form to the DSD for verification of the village-house address, the water-meter number and the progress of connecting sewers to the terminal manhole of the village house, and for collection of the SC under the Sewage Services Ordinance (Note 21).

Note 21: *In 2013, Audit conducted a review of the Sewage Services Charging Scheme, the results of which were included in Chapter 8 of the Director of Audit's Report No. 61 of October 2013. Under the Scheme, a person whose premises is connected to a public sewer needs to pay the SC.*

Sewer connection of village houses

4.4 Under the WPC Ordinance, in an area having been provided with public sewers, the EPD may serve a statutory notice to a related village-house owner requiring him to carry out works for conveying his waste water to public sewers before a deadline specified in the notice. A house owner who fails to comply with the notice may be subject to prosecution by the EPD, and is liable on conviction to a fine of $100,000 and an additional daily fine of $5,000. The EPD may also carry out the required works on the owner's behalf and recover the works costs from him.

4.5 According to the EPD, the following types of village houses may not be connected to public sewers after completion of public sewerage works:

(a) ***Village houses not ready for sewer connection.*** These houses include those which are under planning or construction, and existing houses not having sewage discharge (e.g. derelict properties and houses having no resident); and

(b) ***Village houses having technical problems for sewer connection.*** In carrying out the sewer connection works, house owners may encounter problems such as space constraints, costly pumping requirements, obstruction from underground utilities and works involving encroachment on other private land.

4.6 According to the EPD, as of June 2016, 14,710 village houses located at 178 villages in the eight SMP areas (see para. 3.16) were covered by public sewers. Table 4 shows the progress of sewer connections of these 14,710 village houses as of June 2016.

Table 4

Sewer connections of 14,710 village houses at 178 villages
(June 2016)

Sewer-connection progress	Village houses (No.)	Percentage
(a) Houses covered by public sewers	14,710	100%
(b) Houses not ready for sewer connection (see para. 4.5(a))	1,490	10%
(c) Houses having technical problems for connection (see para. 4.5(b))	1,678	12%
(d) Houses suitable for sewer connection [(d) = (a) – (b) – (c)]	11,542	78%
(e) Houses connected to public sewers	10,179	69%
(f) Houses not yet connected to public sewers [(f) = (d) – (e)]	1,363	9%

Source: Audit analysis of EPD records

Inadequate actions taken to cause house owners to carry out sewer-connection works

4.7 According to the EPD, the majority of sewer-connection works would be completed by village-house owners between 2 and 5 years after completion of public-sewer works. However, Audit examination of the progress of sewer connections at 6 locations revealed that, as of June 2016, while the related public-sewer works had been completed 5 to 15 years ago, the average sewer-connection rate was only 37% (ranging from 0% to 62%). Details are shown in Table 5.

Table 5

Sewer connections at 6 locations
(June 2016)

Location	Date of completing works for public sewers (a)	Houses suitable for sewer connection (b) (No.)	Houses connected to public sewers (c) (No.)	Connection rate of suitable houses (d) = (c) ÷ (b) ×100% (%)
Village A	Dec. 2000	7	0 (Note 1)	0% (see Case 1)
Village B	Jun. 2006	62	12 (Note 2)	19% (see Case 2)
Village C	Jan. 2011	25	7	28%
Squatter Area A	May 2011	270	112	41% (see para. 3.9)
Villages D and E	Feb. 2009	21 (Note 3)	13	62%
Overall		385	144	37%

Source: Audit analysis of EPD records

Note 1: According to the EPD, in addition to unsewered houses, public sewers at Village A also served two elderly homes (which accounted for the majority of sewage pollution in the concerned sewage catchment area), and the sewer connection works for the two homes were completed in 2006 and 2011 respectively.

Note 2: According to the EPD, as of August 2016, 28 (45%) of 62 houses at Village B had been connected to public sewers.

Note 3: According to the EPD, all premises suitable for connection to public sewers in Villages D and E were squatters.

4.8 According to the EPD's "Enforcement Guidelines on Sewer Connection" issued in November 2007:

(a) the EPD's ultimate goal is to connect as many premises as possible within the coverage of new public sewerage facilities for the purpose of achieving early improvement of the environment and full utilisation of the constructed public sewers;

(b) after completion of public sewer works, administrative advisory letters would be issued to related house owners advising them to complete sewer-connection works normally within 6 months;

(c) if a house owner fails to commence connection works by the deadline stipulated in an advisory letter, a statutory notice would be served under the WPC Ordinance requiring him to complete the sewer-connection works within 3 months; and

(d) if the owner fails to observe the statutory notice, the EPD would consider taking prosecution action according to the following priorities:

(i) ***Top priority.*** There is no works progress and the owner has not shown intention to carry out the required works, or serious pollution has been caused;

(ii) ***Medium priority.*** There is no works progress due to certain reasons, but the owner has shown intention to carry out the required works; and

(iii) ***Low priority.*** The required deadline has lapsed, but the house owner has made some works progress.

4.9 In June 2014, with a view to expediting the sewer-connection works by house owners and facilitating the early collection of the SC, the EPD and the DSD jointly implemented an enhanced workflow for village-house sewer connection. Under the enhanced workflow, for house owners who have not notified the EPD of the completion of sewer-connection works after expiry of the time stated in advisory letters, EPD staff should contact them to ascertain the progress of the connection works.

4.10 In October 2016, the EPD informed Audit that:

(a) the EPD's experience since the 1990's had proven that proactive liaison and continued dialogue with house owners/occupiers, village representatives and related stakeholders to resolve practical difficulties on sewer-connection works, as well as their commitment and cooperation, were essential for the smooth completion of connection works to public sewers in the New Territories; and

(b) given the wide coverage of village areas in the New Territories and the issues raised by the rural community against the VS programmes in the past two decades, the EPD and the DSD would make every reasonable effort to secure the voluntary efforts of house owners for timely and successful completion of sewer-connection works.

4.11 Audit examination of EPD Regional Offices' records on individual villages revealed that the EPD's enforcement guidelines (see para. 4.8) had not been fully complied with in some cases (see Cases 1 and 2 for examples).

Case 1

None of the 7 village houses had carried out sewer connection works (Village A in Yuen Long District)

1. In May 1999, under delegated authority, the DSD approved funding of $2.7 million for carrying out public sewerage works for 56 village houses and 2 elderly homes located in a village in Yuen Long (Village A) for the purpose of resolving the pollution problem caused by discharge of sewage which had not been adequately treated by septic tanks. According to the information provided to LegCo PWSC in June 2002, the public sewerage works at Village A were completed in December 2000. According to the EPD, owing to objections raised by village representatives of 49 houses, public sewerage works for these houses were not carried out. Therefore, public sewers were only provided for 7 (56 less 49) houses.

2. From February 2001 to April 2002, the EPD issued advisory letters to owners of 6 village houses and the 2 elderly homes requesting them to complete the sewer connection works within six months.

3. In February 2004, the EPD served statutory notices to the owners of the 6 village houses requiring them to complete the sewer connection works by August 2004. In May 2010, the EPD further served statutory notices to the owners of 7 village houses (including the 6 owners to whom statutory notices were served in 2004) requiring them to complete the sewer connection works by November 2010.

Case 1 (Cont'd)

4. In August 2010, in the course of audit review of the Government's planning and administration of the VS programmes (see para. 1.17), the EPD informed Audit that, as the Government had made considerable efforts to provide assistance to the villagers in Village A, the EPD would consider taking prosecution actions if the house owners still refused to make sewer connection by the deadline of November 2010.

5. As of June 2016, none of the 7 village houses at Village A were connected to public sewers, and the EPD had not served further statutory notices nor taken prosecution actions against the related village-house owners from June 2010 to June 2016.

EPD response

6. From July to October 2016, the EPD informed Audit that:

(a) the public sewers at Village A also served two elderly homes, which accounted for the majority of sewage pollution in the concerned sewage catchment area and had completed the required sewer-connection works; and

(b) no discharge of waste water from the remaining 7 village houses and no pollution to the environment had been observed.

Audit comments

7. Audit considers it unsatisfactory that:

(a) due to objections from owners of 49 village houses, public sewers were not provided for them even though public sewerage works costing $2.7 million had been approved for providing sewerage facilities for 56 houses (including these 49 houses) and 2 elderly homes; and

(b) more than 15 years after completion of public sewerage works in December 2000, none of the 7 village houses in Village A were connected to public sewers.

Source: DSD and EPD records

Case 2

Statutory notice not served on house owners
(Village B in North District)

1. In February 2002, when seeking the FC's funding approval of $125.1 million for public sewerage works at 8 unsewered areas (including Village B) in North District, the then EFB said that sewage discharged from these unsewered areas was a source of pollution in Deep Bay, and the EPD would serve statutory notices to request villagers to carry out the sewer-connection works.

2. In June 2006, the sewerage works at Village B were completed and 62 village houses could carry out sewer connection works.

3. Since the completion of sewerage works in June 2006, the EPD has held briefing sessions to encourage the villagers to commence sewer connection works. In June 2011, 5 years after completion of public-sewer works, the EPD issued 80 advisory letters to owners of 54 houses requesting them to complete the sewer connection works by December 2011. In December 2011 and June 2016, the EPD respectively issued 6 and 16 advisory letters to the concerned house owners. Up to June 2016, owners of only 12 (19%) of the 62 houses in Village B had completed the sewer-connection works but the EPD had not served any statutory notice on the remaining 50 house owners to require them to carry out sewer-connection works.

EPD response

4. From July to October 2016, the EPD informed Audit that:

(a) as some of the house owners in Village B were usually residing overseas (Note) and they returned to Hong Kong very occasionally, it had taken a longer time to contact them for verifying the progress of sewer connection works; and

(b) as of August 2016, 28 (45%) of the 62 houses at Village B had been connected to public sewers.

Audit comments

5. Audit considers it unsatisfactory that, as of June 2016, 10 years after completion of the public sewerage works, only 12 (19%) of 62 village houses in Village B were connected to public sewers. Moreover, although the Government informed the FC in February 2002 that the EPD would serve statutory notices to require villagers to carry out the sewer connection works, up to June 2016, the EPD had not served any statutory notice on related house owners in Village B. In Audit's view, the EPD needs to make improvement in this area.

Source: EPD and DSD records

Note: As of September 2016, the EPD had only provided Audit with the addresses of three village houses the owners of which were usually residing overseas.

4.12 As illustrated in Cases 1 and 2 in paragraph 4.11, for full utilisation of the constructed public sewers, Audit considers that the EPD needs to take effective measures to ensure that houses suitable for sewer connection are connected to public sewers within a reasonable time after completion of public-sewer works. The EPD also needs to remind its staff of the need to comply with EPD guidelines on serving statutory notices on house owners not carrying out sewer-connection works in a timely manner.

Incomplete database on sewer-connection information

4.13 According to the EPD:

(a) for village sewerage works having been completed before mid-2004, the sewer connection information of individual villages are kept in the paper files for the villages maintained by the EPD's Regional Offices;

(b) for village sewerage works having been completed from mid-2004, the following information is maintained in a computerised database:

  (i) the village-house addresses;

  (ii) details of advisory letters issued and statutory notices served; and

  (iii) progress of sewer connection and date of completing sewer connection works of each village house; and

(c) in 2013, the EPD worked with the DSD to make enhancements to the computerised database under which the data would be updated on a monthly basis. The enhancement would facilitate reporting and monitoring the progress of sewer-connection works by the two departments.

Sewer connection of village houses

4.14 In September 2016, the EPD provided Audit with village house addresses and sewer connection information (see para. 4.13(b)) maintained in the computerised database of 10,427 (71%) of the total 14,710 village houses located in areas which were covered by public sewers. According to the EPD, the information related to the remaining 4,283 (14,710 less 10,427) houses was not recorded in the database and was kept in paper files on individual villages maintained by the EPD's Regional Offices. In addition, Audit found the following inadequacies in the EPD's database:

(a) only 27 (2%) of the 1,678 village houses (see item (c) in Table 4 of para. 4.6) having technical problems for sewer connection had records showing their sewer-connection progress in the database;

(b) only 6,553 (64%) of the 10,179 village houses (see item (e) in Table 4 of para. 4.6) having been connected to public sewers had records in the database showing the progress of their sewer-connection works;

(c) information on 1,363 village houses (see item (f) in Table 4 of para. 4.6) not having been connected to public sewers and the actions taken by the EPD to cause sewer connection by the related house owners were not maintained in the database;

(d) the dates of completing public-sewer works by the DSD were not recorded in the database, rendering it difficult for the EPD to monitor the progress of the sewer connection works; and

(e) in response to Audit's request for information in June 2016, the EPD informed Audit that, of the 334 houses at a village in Sha Tin, 255 (76%) houses were not ready for sewer connection (see para. 4.5(a)). However, in October 2016, the EPD informed Audit that only 22 instead of 255 houses were not ready for sewer connection.

4.15 In Audit's view, to facilitate effective monitoring of progress of sewer-connection works and timely retrieval of accurate sewer-connection information, the EPD needs to take measures to ensure that the pertinent information related to sewer-connection works is accurately and timely input into the computerised database. The EPD also needs to take measures to cause the database to generate periodic exception reports highlighting significant slippages in sewer-connection works to facilitate effective monitoring by the EPD's senior management.

Need to issue guidelines on monitoring sewer-connection works

4.16 Audit noted that the EPD had not issued guidelines on determining houses not ready for sewer connection (see para. 4.5(a)) and houses having technical problems for sewer connection (see para. 4.5(b)). In Audit's view, the EPD needs to issue such guidelines and to remind its officers of the need to clearly document justifications for not taking actions against related house owners who do not carry out sewer-connection works. These measures will help ensure that EPD officers would adopt a transparent and consistent approach in taking enforcement actions in this area.

Need to periodically publish progress of sewer-connection works

4.17 In June 2015, in response to a LegCo Member's enquiry, the EPD provided the FC with the sewer-connection information of 164 villages where sewerage works had been completed by December 2014.

4.18 For public accountability and effective monitoring of the effectiveness of the VS programmes, Audit considers that the EPD needs to periodically publish the progress of sewer-connection works of individual villages.

Audit recommendations

4.19 **Audit *has recommended* that the Director of Environmental Protection should:**

(a) **take effective measures to ensure that houses suitable for sewer connection are connected to public sewers within a reasonable time after completion of public sewer works;**

(b) **take measures to ensure that pertinent information related to sewer-connection works is accurately and timely input into the EPD computerised database;**

(c) **take measures to input into EPD computerised database information kept in paper files related to village sewerage works completed before mid-2004;**

(d) **take measures to cause the database to generate periodic exception reports highlighting significant slippages in sewer-connection works;**

(e) **issue guidelines on determining houses not being ready for sewer connection and houses having technical problems for sewer connection;**

(f) **remind EPD staff of the need to clearly document the justifications for not taking actions against related house owners who do not carry out sewer-connection works; and**

(g) **periodically publish the progress of sewer-connection works of individual villages.**

Response from the Government

4.20 The Director of Environmental Protection agrees with the audit recommendations. He has said that:

(a) the EPD has circulated proposed actions to relevant government departments with a view to expediting sewer-connection works in Village A. The HAD's Yuen Long District Office is arranging a briefing section in end October 2016 for the EPD to introduce the relevant policy and current situation to the concerned village representatives and villagers. The EPD and the DSD will continue to be prudent and ensure proper use of public money by controlling the capital cost of works projects;

(b) where technical issues and difficulties hindering sewer-connection works have been resolved, the EPD will consider the circumstances of each outstanding case on individual merits in order to expedite the works completion, including taking enforcement action as necessary. The EPD is drawing up a proposal of criteria for issuing statutory notices and taking subsequent prosecution action for cases involving non-compliance with the notices. When the proposal is finalised, the "Enforcement Guidelines on Sewer Connection" will be updated accordingly. The EPD will also update the enforcement guidelines for implementing the audit recommendations in paragraph 4.19(b), (e) and (f). The EPD will remind its staff to comply with the updated enforcement guidelines;

(c) the EPD will work jointly with the DSD to convert the available paper-file records on village sewerage works projects completed before mid-2004 into digital data in the computerised database, and will examine the feasibility of modifying its computerised database for generating periodic exception reports; and

(d) the EPD will conduct a review of the most suitable means to periodically publish the progress of sewer-connection works of individual villages.

Appendix A
(paras. 1.7, 1.9 and 2.5 refer)

E. coli levels of 63 river monitoring stations exceeding WQOs (2015)

Monitoring station	River	District	Number of *E. coli* (per 100 mL of water)				WQI (Note 2)
			WQO	Lowest (Note 1)	Highest (Note 1)	Annual geometric mean	
(A) Calculation method: Running median of the most recent five consecutive water samples							
1	River Beas (Sheung Yue River)	North	0	7,900	56,000	18,517	Fair
2			0	5,500	35,000	12,332	Good
3			0	1,200	3,000	2,016	Good
4	River Ganges (Ping Yuen River)		0	8,500	110,000	35,185	Fair
5			0	1,700	11,000	4,266	Good
6			0	320	1,300	572	Excellent
7	River Indus (Ng Tung River)		0	34,000	350,000	113,106	Fair
8			0	740	2,000	1,400	Good
9			0	330	1,900	739	Excellent
10	Fairview Park Nullah	Yuen Long	1,000	9,000	45,000	28,672	Fair
11	Kam Tin River		0	160,000	450,000	299,709	Bad
12			0	40,000	100,000	77,535	Bad
13	Ngau Hom Sha Stream		1,000	290	2,200	704	Excellent
14	Sheung Pak Nai Stream		1,000	9,000	58,000	14,707	Good
15	Tin Shui Wai Nullah		1,000	150,000	1,400,000	299,807	Fair
16			1,000	6,400	88,000	23,790	Good
17	Yuen Long Creek		1,000	800,000	4,000,000	2,040,507	Bad
18			1,000	640,000	1,200,000	995,006	Bad
19			0	120,000	300,000	175,935	Bad
20			0	23,000	100,000	46,615	Fair
21	Tung Chung River	Islands	1,000	16,000	41,000	23,241	Good
22	Tseng Lan Shue Stream	Sai Kung	1,000	36,000	110,000	60,335	Fair
23			1,000	29,000	80,000	44,844	Good
24			1,000	440	2,400	882	Excellent
25	Shing Mun River	Sha Tin	1,000	5,800	66,000	13,638	Good
26			1,000	1,900	5,100	4,537	Good
27			1,000	1,600	23,000	11,175	Good
28			1,000	520	14,000	4,251	Good
29			0	520	7,400	3,414	Good
30			1,000	460	3,400	1,262	Excellent
31			0	380	3,100	1,773	Excellent
32			1,000	130	19,000	2,713	Excellent
33	Lam Tsuen River	Tai Po	1,000	30,000	90,000	45,450	Good
34			0	1,700	2,900	2,424	Excellent
35			0	900	3,900	1,853	Good

Appendix A
(Cont'd)
(paras. 1.7, 1.9 and 2.5 refer)

Monitoring station	River	District	Number of *E. coli* (per 100 mL of water)				WQI (Note 2)
			WQO	Lowest (Note 1)	Highest (Note 1)	Annual geometric mean	
(A) Calculation method: Running median of the most recent five consecutive water samples (Cont'd)							
36	Shan Liu Stream	Tai Po	1,000	1,300	3,300	1,623	Excellent
37	Tai Po River		1,000	5,000	21,000	9,552	Excellent
38	Tung Tze Stream		1,000	2,400	7,300	2,895	Excellent
39	Tuen Mun River	Tuen Mun	1,000	100,000	170,000	135,709	Bad
40			1,000	40,000	67,000	58,503	Fair
41			1,000	2,000	11,000	8,132	Good
42			1,000	1,400	13,000	2,939	Good
43			1,000	900	10,000	3,589	Excellent
44			1,000	800	9,000	3,987	Good
(B) Calculation method: Geometric mean of the most recent five consecutive water samples							
45	Kai Tak River	Kowloon City	1,000	184,209	498,556	309,879	Fair
46			1,000	99,716	277,932	152,549	Good
47			1,000	87,969	236,574	123,426	Good
48			1,000	68,380	182,687	93,620	Good
49			1,000	35,518	99,577	47,608	Good
50			1,000	2,163	11,147	4,760	Good
51	Kau Wa Keng Stream	Kwai Tsing	1,000	18,553	101,015	67,602	Good
52	Shing Mun River	Sha Tin	1	306	2,383	699	Excellent
53	Lam Tsuen River	Tai Po	1	20,887	27,693	23,544	Good
54			1	653	1,758	1,291	Excellent
55			1	360	778	646	Excellent
56			1	268	1,444	484	Excellent
57			1	90	348	216	Excellent
58			1	32	475	136	Excellent
59	Pai Min Kok Stream	Tsuen Wan	1,000	4,578	20,894	6,981	Excellent
60			1,000	3,058	12,156	5,364	Excellent
61	Sam Dip Tam Stream		1,000	4,780	21,510	7,256	Excellent
62			1,000	1,243	9,203	3,410	Excellent
63			1,000	569	3,205	1,364	Excellent

Source: Audit analysis of EPD records

Note 1: These refer to the lowest and highest running medians (or geometric means as appropriate) of E. coli among the 12 values calculated for 2015.

Note 2: WQI is based on the assessment of 3 parameters, namely dissolved oxygen, 5-day biochemical oxygen demand and ammonia-nitrogen.

Appendix B
(paras. 1.7, 1.9 and 2.5 refer)

E. coli levels of 8 river monitoring stations complying with WQOs (2015)

Monitoring station	River	District	Number of *E. coli* (per 100 mL of water)				WQI (Note)
			WQO	Lowest (Note)	Highest (Note)	Annual geometric mean	
Calculation method: Geometric mean of the most recent five consecutive water samples							
64	Pak Nai Stream	Yuen Long	1,000	310	800	417	Excellent
65	Tsang Kok Stream		1,000	120	290	239	Good
66	Ha Pak Nai Stream		1,000	49	230	77	Excellent
67	Tai Shui Hang Stream		1,000	40	580	199	Excellent
68	Tung Chung River	Islands	1,000	21	310	114	Excellent
69			1,000	18	340	64	Excellent
70	Shing Mun River	Sha Tin	1,000	1	1	4	Excellent
71	Tai Po Kau Stream	Tai Po	1,000	81	710	260	Excellent

Source: Audit analysis of EPD records

Note: See Notes 1 and 2 to Appendix A.

Appendix C
(para. 1.11 refers)

Actions taken by the EPD to improve water quality

District	River water quality and/or EPD actions
(a) Islands	• The *E. coli* levels of Mui Wo River had reduced by 97% in 2015 as compared with 1988. • The WQIs of Mui Wo River and Tung Chung River have been "Good" or better throughout the years.
(b) Kowloon City	• The *E. coli* levels of Kai Tak River had reduced by over 75% in 2015 as compared with 1999. The polluted discharges were mainly originated from non-point sources (e.g. sewage from surface channels) in old developed areas. • The WQI of the above river improved from "Very Bad" in 1986 to "Fair" or better in 2015. • To improve water quality, the EPD has pursued the upgrading of DWFIs installed alongside Kai Tak River, as well as conducting a detailed survey to identify expedient connections for rectification.
(c) Kwai Tsing	• The *E. coli* levels of Kau Wa Keng Stream had reduced by 40% in 2015 as compared with 1998. • The WQI of the above stream improved from "Bad" in 1991 to "Good" in 2015.
(d) North	• The *E. coli* levels of River Indus, River Beas and River Ganges had reduced by over 90% in 2015 as compared with 1990. *E. coli* found in the rivers might be caused by treated waste water discharge from livestock farms and sewage discharge from unsewered houses, as well as sewage from surface channels and expedient connections. • The WQIs of downstream monitoring stations of the above rivers improved from "Very Bad" in 1986 to "Fair" in 2015. • To improve river water quality, the EPD has conducted surveys on expedient connections for rectification, and sewer-connection works for villages have been on-going. The EPD and the Agriculture, Fisheries and Conservation Department have undertaken enforcement actions and education programmes on livestock waste treatment facilities for farms.

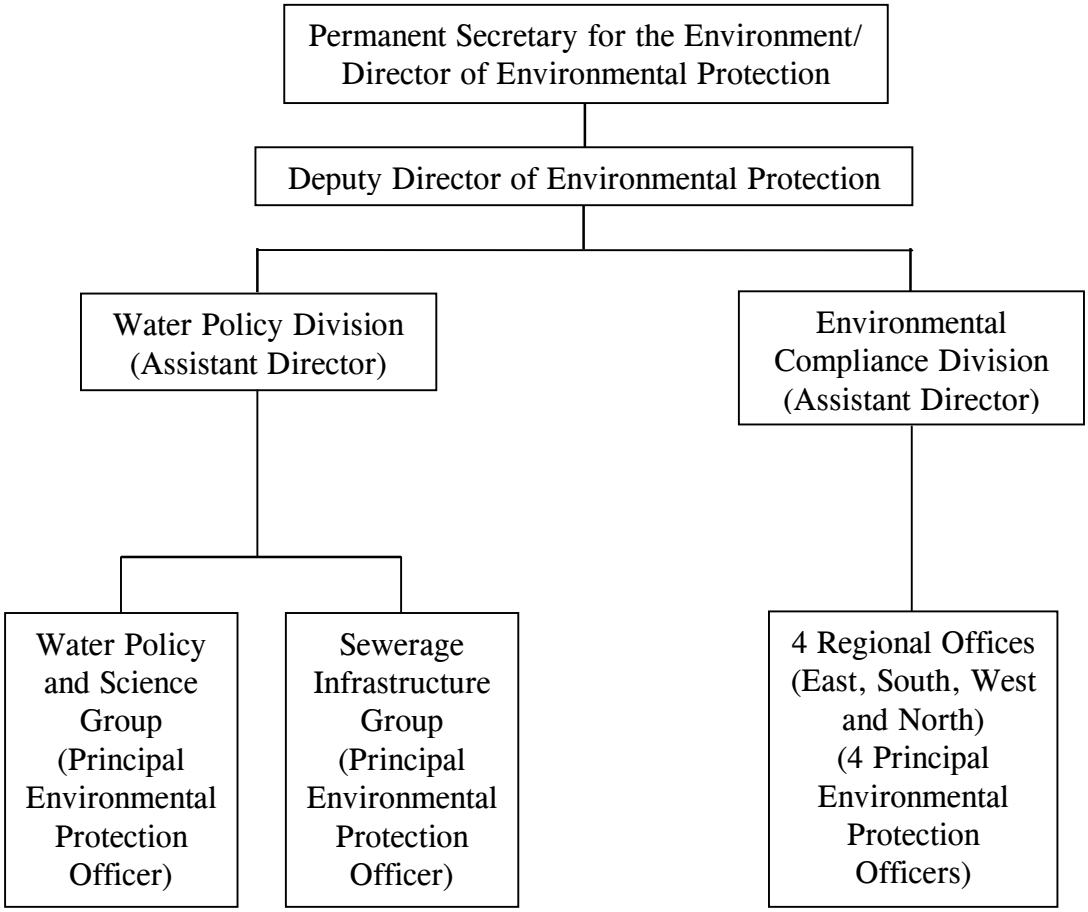
District	River water quality and/or EPD actions
(e) Sai Kung	• The *E. coli* levels of rivers in the district had reduced by over 65% in 2015 as compared with 1997. • The WQIs of these rivers improved from "Bad" in 1991 to "Fair" or better in 2015. • As of October 2016, sewer-construction works for 13 villages, and sewer-connection works for other villages, were in progress.
(f) Sha Tin	• The *E. coli* levels of Shing Mun River had reduced by 85% in 2015 as compared with 1988. • The WQI of the main channel of Shing Mun River improved from "Fair" in 1986 to "Excellent" in 2015. • To further improve water quality, the EPD has conducted surveys to identify expedient connections for rectification.
(g) Tai Po	• The *E. coli* levels of rivers in the district had reduced by over 70% in 2015 as compared with 1999. • The WQIs of downstream monitoring stations of these rivers improved from "Very Bad" in 1986 to "Good" or better in 2015.
(h) Tsuen Wan	• The *E. coli* levels of Pai Min Kok Stream had reduced by over 90% in 2015 as compared with 1989. • The *E. coli* levels of Sam Dip Tam Stream had reduced by 90% in 2015 as compared with 1999. • The WQIs of the above rivers in the district improved from "Bad" in 1988 to "Excellent" in 2015.
(i) Tuen Mun	• The *E. coli* levels of Tuen Mun River had reduced by 90% or more in 2015 as compared with 1988. • The WQI of upstream section of Tuen Mun River improved from "Very Bad" in 1988 to "Bad" in 2015, and the WQIs of midstream and downstream sections of Tuen Mun River improved from "Bad" in 1988 to "Good" in 2015. • Village sewerage works at the upstream section of Tuen Mun River are ongoing. Sewage at upstream section of the river has been diverted by a DWFI to a nearby sewage treatment plant for proper treatment, without affecting the main river sections of Tuen Mun River.

District	River water quality and/or EPD actions
(j) Yuen Long	• The *E. coli* levels of Yuen Long Creek and Kam Tin River had reduced by over 70% in 2015 as compared with 1998, and those of Tin Shui Wai Nullah had decreased by 94% compared with 1992. *E. coli* found in the rivers might be caused by treated waste water discharge from livestock farms and sewage discharge from unsewered houses, as well as sewage from surface channels and expedient connections. • The WQIs of Yuen Long Creek and Kam Tin River improved from "Very Bad" in 1986 to "Bad" ("Fair" for one monitoring station in Yuen Long Creek) in 2015. The WQI of Tin Shui Wai Nullah improved from "Bad" in 1993 to "Fair" or better in 2015. • To improve river water quality, sewer construction works for 6 villages, and sewer connection works for other 11 villages, were in progress. As trunk sewers and sewerage network for many other unsewered villages would take some time for completion, a DWFI was installed in Kam Tin in 2016 to intercept polluted surface water from Kam Tin areas. • The EPD has planned to intercept polluted surface water along the most densely populated areas of Yuen Long Creek and to upgrade the capacity and treatment level of Yuen Long Sewage Treatment Works. The EPD has carried out surveys on expedient connections for rectification, and undertaken enforcement actions and education programmes in collaboration with the Agriculture, Fisheries and Conservation Department to tackle the pollution problems arising from livestock waste.

Source: EPD records

Appendix D
(para. 1.15 refers)

Environmental Protection Department: Organisation chart (extract) (30 June 2016)



Source: EPD records

Appendix E
(para. 2.8(a) refers)

EPD views regarding WQOs on *E. coli* (October 2016)

(a) For water bodies having beneficial uses of pond fish culture, agriculture and irrigation, the mainstream overseas practices generally did not stipulate bacteriological standards. For jurisdictions having bacteriological water quality standards for aquaculture, they were mainly established specifically for culture of shellfish for raw consumption. To address the human-health risk associated with consumption of aquacultural products, it was a common practice for the food-safety authority to establish bacteriological standards for aquacultural food rather than for the culturing water.

(b) For water bodies where the major beneficial use was for the maintenance of aquatic life, overseas practices included a wide range of physical and chemical parameters (similar to the parameters reported in the EPD's annual river-water quality reports — see para. 2.3) and no bacteriological criteria had been established. Compliance check with WQOs based on five key indicators, namely pH value, suspended solids, dissolved oxygen, 5-day biochemical oxygen demand and chemical oxygen demand were most relevant for reflecting the related water quality.

(c) The beneficial use of general amenity was generally applicable to all water control zones including marine and inland waters. Numerical WQOs (including WQO on *E. coli*) were irrelevant to such a beneficial use, and only the narrative WQO, namely "aesthetic appearance", was relevant and had been established to protect such a generic use.

(d) The EPD had been taking actions (including pollution and planning control, and the provision of sewerage infrastructures) so as to achieve the various WQOs stipulated under the WPC Ordinance as far as practicable. Regarding the achievement of the WQOs on *E. coli*, other factors, such as deposit of faeces from warm-blooded animals (e.g. birds and dogs), could also affect the *E. coli* levels.

(e) Some of the WQOs on *E. coli* for inland water control subzones were outdated as they were established 20 to 30 years ago when there was a lack of microbiological data. Based on current overseas practices, WQOs on *E. coli* would need to be established for a very few number of such subzones.

Source: EPD records

Appendix F

Acronyms and abbreviations

APE	Approved project estimate
Audit	Audit Commission
CoE	Certificate of Exemption
DSD	Drainage Services Department
DWFI	Dry-weather-flow interceptor
E. coli	*Escherichia coli*
EFB	Environment and Food Bureau
ENB	Environment Bureau
EPD	Environmental Protection Department
ETWB	Environment, Transport and Works Bureau
FC	Finance Committee
FEHD	Food and Environmental Hygiene Department
HAD	Home Affairs Department
km	Kilometres
Lands D	Lands Department
LegCo	Legislative Council
m^3	Cubic metre
mL	Millilitres
PEL Branch	Planning, Environment and Lands Branch
PHMS Ordinance	Public Health and Municipal Services Ordinance
PWP	Public Works Programme
PWSC	Public Works Subcommittee
SC	Sewage charges
SMPs	Sewerage Master Plans
STS system	Septic-tank-and-soakaway system
VS programme	Village sewerage programme
VSS Group	Village Sewerage Support Group
WD Ordinance	Waste Disposal Ordinance
WHO	World Health Organisation
WPC Ordinance	Water Pollution Control Ordinance
WQI	Water Quality Index
WQO	Water Quality Objective