Task Force on Kai Tak Harbourfront Development

For discussion
on 4 October 2016

TFKT/11/2016

Feasibility of Further Water Quality Improvement at Kai Tak Approach Channel and Kwun Tong Typhoon Shelter for Water Sports Activities

PURPOSE

This paper briefs Members on the findings of the study on the feasibility of further water quality improvement at Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS) for water sports activities.

BACKGROUND

2. KTAC / KTTS has a large catchment area, receiving discharges from Jordan Valley Box Culvert (JVBC) and Kai Tak Nullah (KTN), including treated effluent discharged through Tolo Harbour Effluent Export Scheme (THEES) [1], stormwater diverted from Waterloo Road culvert via Kai Tak Transfer Scheme[2], as well as stormwater and surface runoff from Kowloon City, San Po Kong, Kowloon Bay, Jordan Valley and part of Kwun Tong areas. In addition, the King Yip Street Nullah (KYSN) to be transformed into Tsui Ping River, with its outlet located close to the existing breakwater of KTTS, plays an influential role on the water quality of KTTS due to tidal effect. The catchment plan of KTAC / KTTS is shown in **Annex 1**.

3. As stipulated in the Environmental Impact Assessment (EIA) report for Kai Tak Development (KTD) approved in 2009 under the EIA Ordinance, a

[1] THEES solves the red-tide problem in Tolo Harbour and provides flushing to the KTN by exporting treated effluent from Tai Po and Shatin sewage treatment works to KTN via a tunnel.

[2] Kai Tak Transfer Scheme relieves flooding in Mong Kok by intercepting and conveying about two-thirds of the design flow from the Waterloo Road culvert via a drainage tunnel to KTN for discharge.

three-pronged approach was recommended to improve the water quality for general amenity at KTAC / KTTS as well as tackle the odour problem arising thereat, comprising the following :-

(a) measures at identified locations to rectify expedient connections (EC) and intercept polluted discharges from hinterland into KTAC / KTTS;
(b) localized maintenance dredging and in-situ bio-remediation treatment of sediments at KTAC / KTTS; and
(c) creation of a 600-metre (m) opening at the northern section of the former runway to improve water circulation in KTAC.

4. The various measures as mentioned under paragraphs 3(a) above were substantially completed in 2013 by Environmental Protection Department (EPD) and Drainage Services Department (DSD). The measures as mentioned under paragraph 3(b) above were substantially completed in mid 2014 by Civil Engineering and Development Department (CEDD). As a result, water and air quality at KTAC and KTTS is observed to have been substantially improved largely due to reduction of pollutants from being discharged into KTAC. Locations of the above mitigation measures are presented in **Annex 2**.

5. In view of the significant improvement in water and air quality, CEDD engaged consultants to conduct a comprehensive review on the effectiveness of the completed mitigation measures and formulated an Interception and Pumping Scheme (IP scheme), as an alternative to the originally proposed 600 m opening under paragraph 3(c) above. The IP scheme would be integrated partly with the Kai Tak District Cooling System (DCS) to achieve synergy and cost-effectiveness. In August 2015, we briefed Members on the IP Scheme (as detailed in **Annex 3**) aiming at improving the water quality at KTAC / KTTS, in particular bottom dissolved oxygen for odour mitigation as stipulated in the EIA Report for KTD.

6. With closure of the Kwun Tong public cargo working area in 2011 and the policy initiative for setting up a recreational landmark "Kai Tak Fantasy" at the former runway tip in KTD, there are rising public aspirations that KTAC / KTTS would have high potential to become a valuable water sports venue and leisure amenity area in the longer term.

FEASIBILITY OF FURTHER ENHANCEMENT OF WATER QUALITY FOR WATER SPORTS

7. CEDD has commissioned an additional consultancy study to investigate the feasibility of further improving the water quality at KTAC / KTTS for water sports activities. In this regard, *E.coli* in the water body, having a direct implication on the health of the water sports participants, is the most important water quality parameter to be considered. The study has examined whether the water quality requirement for water sports activities, which has made reference to the existing bacteriological Water Quality Objectives for the Secondary Contact Recreation Subzones (**annual geometric mean *E.coli* not exceeding 610 count / 100 ml**) as specified under the Water Pollution Control Ordinance, may be achieved at KTAC / KTTS.

SOURCES OF *E.COLI*

8. Based on the pollution loading surveys conducted by CEDD in 2014 and 2015, the percentage of *E.coli* loads discharged into KTAC / KTTS from KTN and JVBC is about 60% and 40% respectively.

9. The KTN flow comprises THEES effluent and the flow collected by the stormwater drainage system of KTN. CEDD's consultants have reviewed the data on effluent quality discharged from Tai Po and Shatin sewage treatment works, of which both are equipped with ultraviolet (UV) irradiation

disinfection facilities, and found that THEES effluent only accounts for less than 1% of the total *E.coli* load of KTN. The *E.coli* load in KTN is mainly attributed to ECs and mis-connections in their respective catchments of drainage system.

10. EPD has conducted monthly monitoring on the water quality along KTN. Based on the EPD's monitoring data, it is estimated that about 50% of *E.coli* load in KTN comes from two existing box culverts with outlets located between KN1 and KN2 while the remaining *E.coli* load comes from upstream of KTN section between Po Kong Village Road and Prince Edward Road East. In 2015, EPD's monitoring data on *E.coli* at KTN are shown in **Table 1** with monitoring points as shown in **Figure 1**.

KN1	KN2	KN3	KN4	KN5	KN7
310,000	150,000	120,000	94,000	48,000	4,800

Table 1: Annual Geometric Means of *E.coli* Level along KTN recorded by EPD in 2015 (Unit: cfu/100ml)

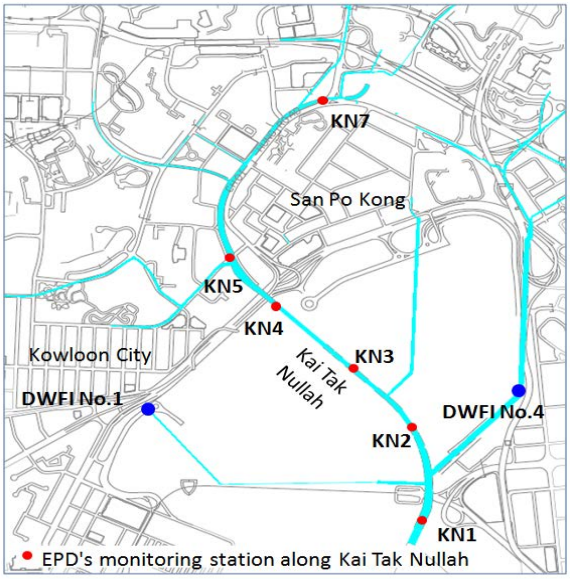


Figure 1: Sampling Locations along KTN by EPD

11. Apart from discharges from KTN and JVBC, the water

quality at KTTS is also influenced by the discharges from Tsui Ping River.

ON-GOING MITIGATION MEASURES TO REDUCE *E.COLI*

12. With the collaborative efforts of CEDD, DSD and EPD, mitigation measures including (a) identifying and rectifying pollution sources and (b) provision / enhancement of dry weather flow interceptors (DWFIs) to intercept pollutants have been / are being adopted with an aim to further reduce the *E.coli* level at KTAC / KTTS.

(a) Identifying and Rectifying Pollution Sources

13. Between 2014 and 2016, CEDD in consultation with EPD and DSD conducted three pollution loading surveys in the hinterland drainage system of KTAC / KTTS. According to the survey results, EPD and DSD identified a few major pollution sources contributing about 50% of *E.coli* load to KTAC. DSD and EPD are currently carrying out necessary rectification works as detailed in **Annex 4**.

14. To reduce pollution from Tsui Ping River, EPD has employed a term contractor in mid 2014 to carry out field surveys to identify ECs and mis-connections in the catchment of Tsui Ping River. A total of 30 ECs / mis-connections have been identified and rectified. The *E.coli* loading at Tsui Ping River has been substantially reduced and has helped improve the water quality of KTTS.

(b) Provision / Enhancement of DWFIs to Intercept Pollutants

15. DWFIs have been installed in the drainage system to intercept pollutants from being discharged into the downstream water body during dry days. Locations of the major DWFIs within the catchment of KTAC / KTTS are shown in **Annex 5**.

16. Rectification works to DWFI No. 4 near Kowloon Bay were completed in 2015 to ensure its proper functioning. The successful implementation of JVBC DWFI in July 2013 have intercepted most of the polluted flow from JVBC in dry days.

CURRENT WATER QUALITY SITUATION AT KTAC AND KTTS

17. The benefit of rectification of ECs and provision / enhancement of DWFIs at the upstream of KTAC as mentioned above was found obvious. As revealed from the monitoring data on *E.coli* in the past few years, the water quality at KTAC / KTTS has indicated substantial improvement. In particular, the *E.coli* levels at the southern part of KTAC have been significantly reduced following the successful implementation of JVBC DWFI in July 2013. The rectification of pollution sources at catchment areas of KTN and JVBC and the restoration of DWFI No. 4 have led to a notable improvement of water quality at KTAC in 2015. For KTTS, the rectification of pollution sources in Tsui Ping River in early 2015 also resulted in a reduction of the *E.coli* level. The summary of annual *E.coli* data in KTAC / KTTS in recent years is presented in **Table 2** with sampling locations shown in **Figure 2**.

Year	KTAC							KTTS
	AC1	AC2	AC3	AC4	AC5	AC6	AC7	KT1
2013	7,800	7,200	5,100	9,700	4,800	5,900	2,700	700
2014	7,900	6,600	4,200	4,500	2,800	2,600	1,800	600
2015	5,500	2,200	2,500	1,500	1,200	1,000	610	<600

Table 2: Annual Geometric Means of *E.coli* Level in KTAC/KTTS From 2013 to 2015 (Unit: cfu/100ml)

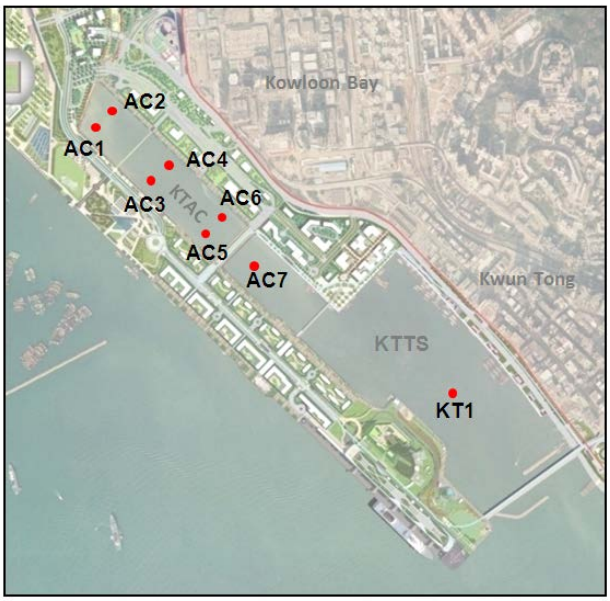


Figure 2: Sampling Locations in KTAC/ KTTS

18. Referring to the water quality requirement for water sports activities as mentioned in paragraph 7 (i.e. annual geometric mean *E.coli* not exceeding 610 count / 100 ml), the water quality of KTAC has been improving but is still below standard, whereas a sign of compliance has been observed at KTTS based on recent though limited data.

19. However, as revealed from the monitoring data, the water quality in respect of the *E.coli* level at KTAC / KTTS would become significantly worse in rainy days when there was overflow of rainwater at DWFIs. On the other hand, better water quality has been observed in the dry season due to interception of most of the pollutants by DWFIs.

FURTHER MITIGATION MEASURES TO REDUCE *E.COLI* OF KTAC / KTTS

20. Apart from continued collaboration with EPD and DSD to further rectify pollution sources and upgrade DWFIs to intercept pollutants, CEDD had also examined the feasibility of applying disinfection technologies to reduce *E.coli* level at KTAC/

KTTS.

Further Rectification of Pollution Sources

21. DSD and EPD will continue to follow up on the pollution sources identified in CEDD's pollution load surveys as discussed in paragraph 13 and detailed in **Annex 4**. It is anticipated that most of the identified pollution sources could be removed after completion of the rectification and improvement works by end 2016/ early 2017 as scheduled by DSD / EPD.

22. Part of the *E.coli* load at KTN is contributed through the drainage system at Wong Tai Sin, Kowloon City and San Po Kong for discharge into the KTN section between Po Kong Village Road and Prince Edward Road East. EPD has awarded a new 2-year term contract commencing from November 2015 covering the Wong Tai Sin, Kowloon City and San Po Kong catchment areas with a view to identifying ECs and mis-connections in the areas. EPD / DSD will take follow-up actions to rectify the ECs and mis-connections identified.

Further Upgrading of DWFIs to Intercept Pollutants

23. While DSD had rectified the DWFI No. 4 in 2015, seepage of dry weather flow from the drainage outlets for the upstream section of KTN, i.e. section between Po Kong Village Road and Prince Edward Road East, has been observed due to insufficient capacity of existing DWFIs installed alongside this section of KTN, the locations of which are shown in **Annex 5**. This section of KTN is currently under reconstruction and rehabilitation by DSD for completion in end 2017. The improvement works include upgrading of the DWFIs through enlargement, and hence the capacity, of its connection pipes. Meanwhile, temporary improvement works at the existing collection pits of these DWFIs have been implemented to reduce the occurrence of overflow to KTN.

Disinfection Technologies

24. Disinfection technologies, including chlorination, ozonation and UV irradiation, have been examined to reduce *E.coli*. To ascertain their feasibility, the consultants conducted water sampling at the outlet of JVBC DWFI during a rainstorm event in September 2015 with necessary laboratory testing, including chlorination test. Laboratory test results have revealed that stormwater contains up to about 600 mg/l of suspended solids. Under such a high suspended solid content level, disinfection using chlorination technology will become inapplicable. According to the test results, removal of *E.coli* may only be effective when the chlorine concentration reaches about 650 to 900 mg/l. This high chlorine dosage coupled with large stormwater flow discharged during a rainstorm event would render chlorination disinfection impractical. It is estimated that a substantial amount of concentrated sodium hypochlorite solution (NaOCl) is required to generate sufficient chlorine for disinfection. Apart from the above, high residual chlorine level and associated chlorination by-products will have direct impacts on marine ecology and human health.

25. Disinfection using ozonation technology is also considered infeasible due to low solubility of ozone in water. It is estimated that a substantial amount of ozone dosage is required for a similar storm event mentioned in paragraph 24 above. However, the solubility of ozone in pure water is far below the required dosage.

26. As regards UV irradiation disinfection technology, the high level of suspended solid content in stormwater as mentioned in paragraph 24 renders it impractical due to poor UV irradiation transmittance through this level of suspended solid.

27. In summary, disinfection using chlorination, ozonation and UV irradiation technologies are considered technically not effective as a key measure to reduce

E.coli level for stormwater discharge at DWFIs due to the substantial quantity of flow. During dry days, however, most of the pollutants have been intercepted by DWFIs and the effect of disinfection is considered not significant.

PREDICTION OF WATER QUALITY AT KTAC / KTTS

28. It is expected that, with further rectification of pollution sources by DSD / EPD as mentioned in paragraphs 21 and 22 and improvement of the DWFIs by DSD as mentioned in paragraph 23, the water quality at KTAC / KTTS would be progressively improved.

29. To evaluate the water quality at KTAC / KTTS after completion of the above rectification works and the implementation of IP scheme, an assessment using numerical water quality modelling techniques to predict the future water quality.

30. Based on the water quality modelling results, the predicted water quality at KTAC to the east of existing Taxiway Bridge and KTTS (Zones 3 and 4 as referred in **Figure 3**) would be able to meet the requirement of *E.coli,* i.e. annual geometric mean *E.coli* not exceeding 610 count / 100 ml, for water sports activities, whilst that at KTAC to the west of Taxiway Bridge (Zones 1 and 2 as referred in **Figure 3**) is still unable to meet the *E.coli* requirements for water sports activities. A summary of predicted *E.coli* level at different Zones of KTAC / KTTS is shown in **Table 3**.

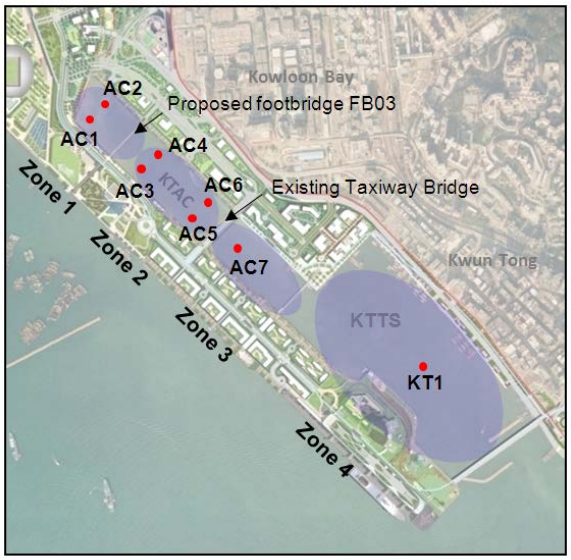


Figure 3: Water Zones at KTAC/ KTTS

KTAC							KTTS
Zone 1		Zone 2				Zone 3	Zone 4
AC1	AC2	AC3	AC4	AC5	AC6	AC7	KT1
1,500 - 2,000		About 800				<600	<400

Note: Figures round to the nearest hundred

Table 3: Summary of Predicted *E.coli* Level at KTAC/ KTTS (Annual Geometric Mean)

31. Upon implementation of on-going and further mitigation measures by EPD / DSD to reduce *E.coli*, the water quality of KTAC / KTTS is anticipated to be further improved in the longer term.

WAY FORWARD

32. To facilitate more beneficial use of KTAC / KTTS for water sports activities, CEDD, EPD and DSD would :-

(i) further rectify identified pollution sources as far as practicable and upgrade DWFIs to intercept pollutants,

so as to achieve the water quality requirement for water sports activities, initially at KTTS and then the southern part of KTAC; and

(ii) continue to monitor the water quality in KTAC / KTTS.

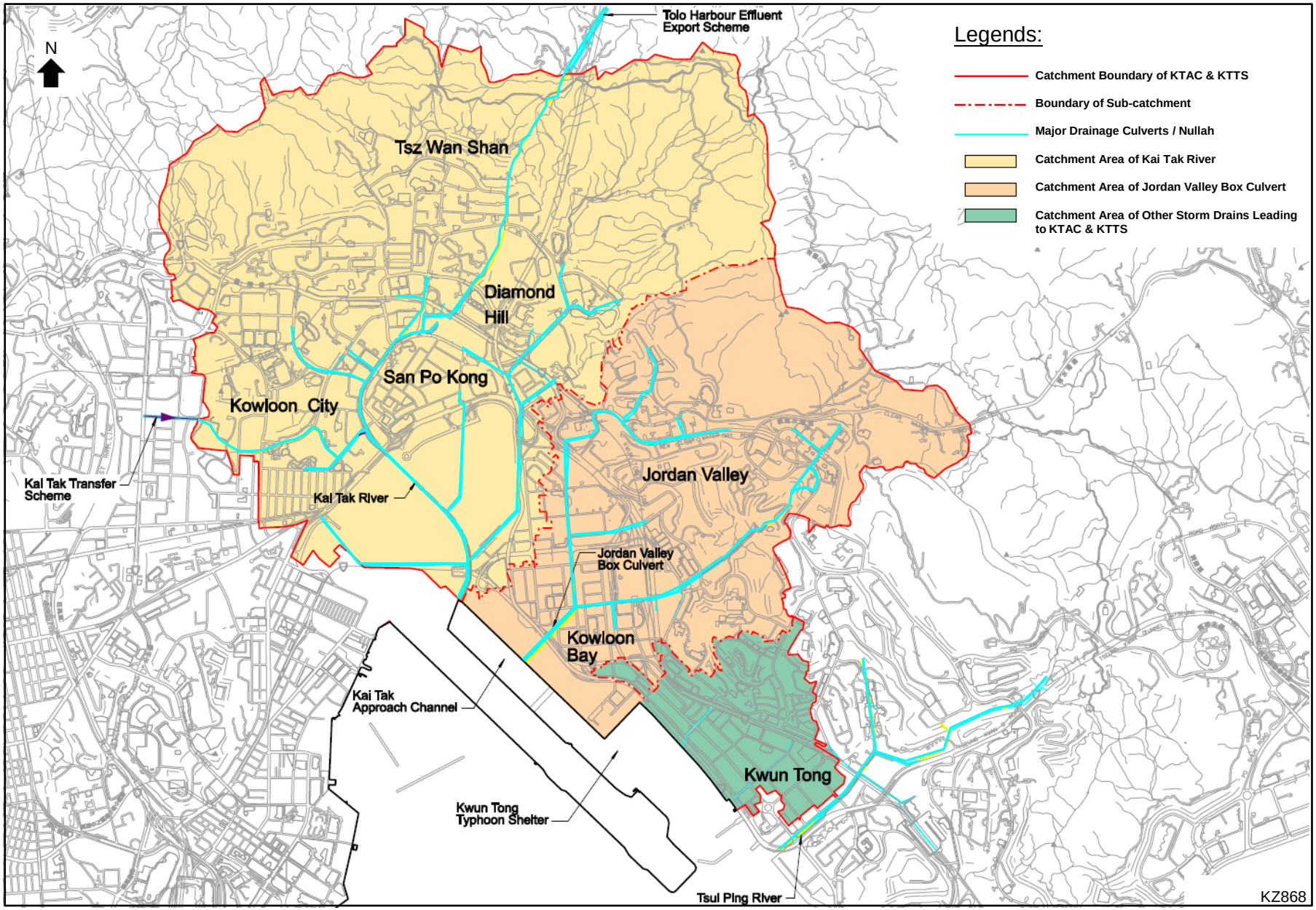
Civil Engineering and Development Department
Drainage Services Department
Environmental Protection Department
September 2016

ATTACHMENTS

Annex 1 Catchment Area of KTAC and KTTS
Annex 2 Completed Mitigation Measures
Annex 3 Interception and Pumping (IP) Scheme
Annex 4 Rectification Works by DSD/EPD
Annex 5 Major DWFIs at Upstream of KTAC/KTTS

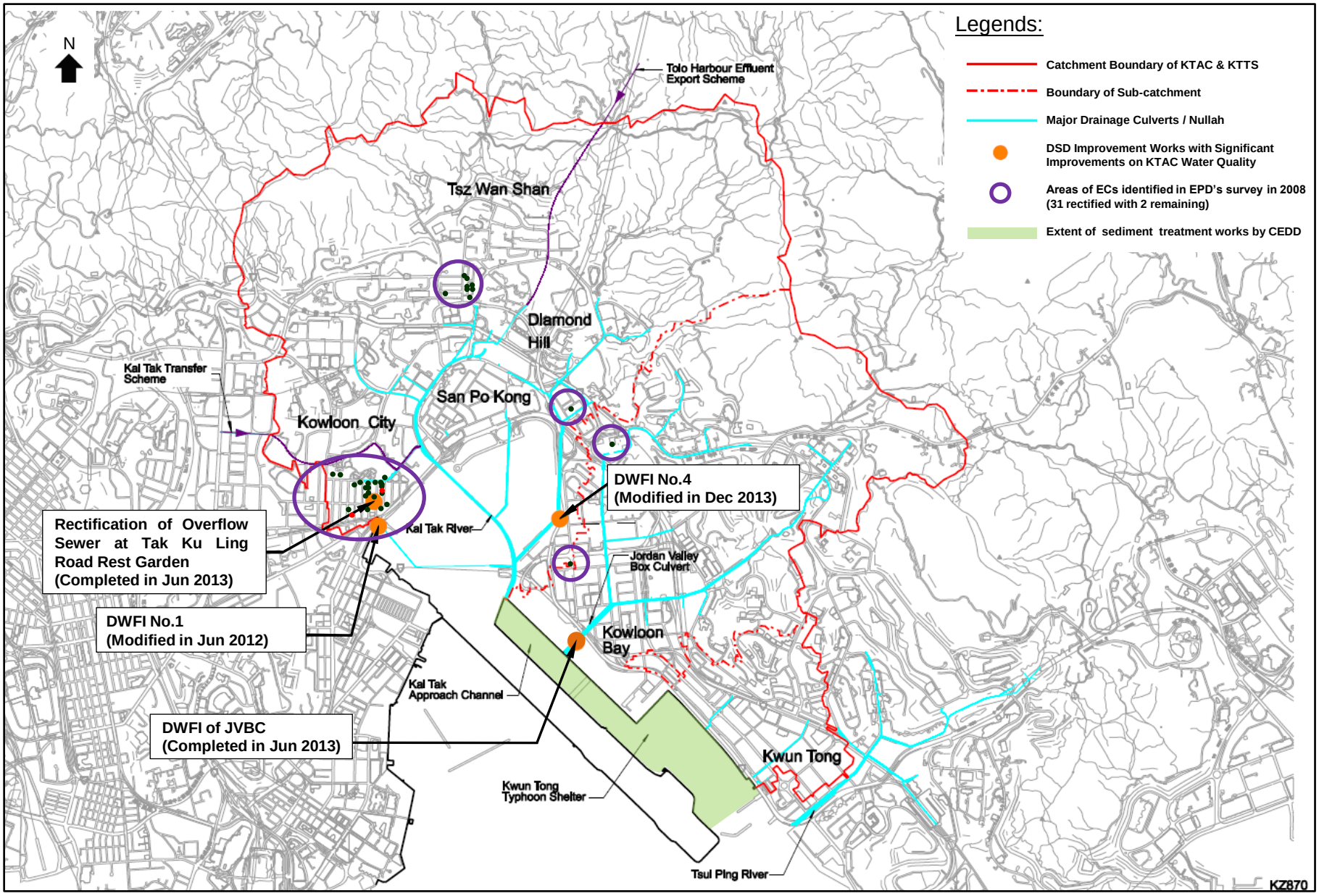
Catchment Area of KTAC and KTTS

Annex 1



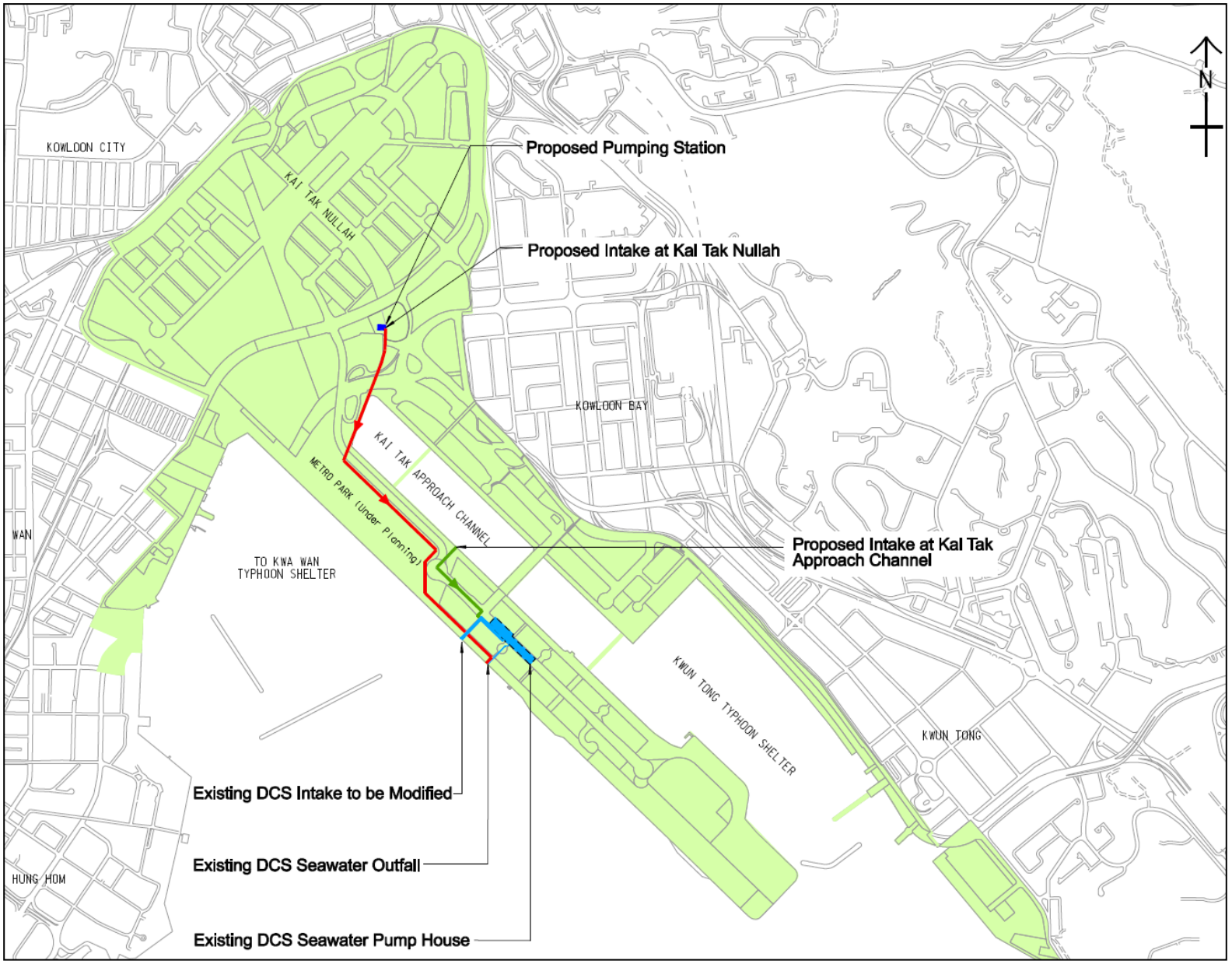
Completed Mitigation Measures

Annex 2



Interception and Pumping (IP) Scheme

Annex 3



Rectification Works by DSD/EPD

Annex 4

Catchment	Survey Points and Pollution Sources	Actions
KTN	A misconnection to a defective sewer at Lung Cheung Road	DSD is carrying out the repairing works
	Unsewered area at Ngau Chi Wan Village	Potential sewerage provision is being explored by EPD and DSD
	EC/misconnections from residential blocks/ factories / restaurants	EPD awarded a 2-year term contract in Nov 2015 to identify pollution sources in Wong Tai Sin, Kowloon City and San Po Kong
JVBC	Misconnections at Lung Cheung Road near Ngau Chi Wan Market	DSD is carrying out the repairing works
	Misconnection at Siu Yip Street	Rectification works completed
	Misconnection near Maryknoll Secondary School	Rectification works completed
	Misconnection from Amoycan Industrial Centre	Rectification works completed
	Suspected EC from an existing cooked food stall at Kai Yip Estate	Rectification works completed

Major DWFIs at Upstream of KTAC/KTTS

Annex 5