Construction Phase

Temporary sewage treatment facility

Source ID	Description #			Total Surface Area (m^2)	Emission rates ($ou/m^2/s$)	Emission rats(ou/s)	Total original emission (ou/s)	97% removal efficiency (ou/s)	No. of emission points *	Emission rate for each emission points (ou/s) (without Deodorzation unit)	Emission rate for each emission points (ou/s) (with Deodorzation unit)
T1	Temporary sewage treatment facility						494.4375	14.833125	1 (i.e. SRC1_OC)	494.4375	14.833125
	L(m)	=	7.5								
	W(m)	=	7.5								
	No. of units	=	1								
				56.3	8.79	494.4375					

Notes:

* - The location of emission points are indicted in Figure 3.16.

Operational Phase

Room 1 - Preliminary Treatment Unit

Source ID	Description #			Total Surface Area (m^2)	Emission rates ($ou/m^2/s$))	Emission rats(ou/s)	Total original emission (ou/s)	97% removal efficiency (ou/s)	No. of emission points *	Emission rate for each emission points (ou/s) (without Deodorzation unit)	Emission rate for each emission points (ou/s) (with Deodorzation unit)
S1	Inlet Well and Flow Equalization Tank **(A)**										
	L(m)	=	21.3								
	W(m)	=	13.3								
	No. of units	=	1								
				283.3	8.79	2490.1191					
S2	6mm Screen Channel **(B)**										
	L(m)	=	7.26								
	W(m)	=	3.6								
	No. of units	=	1								
				26.1	8.79	229.7354					
S3	Grit Chambers **(C)**										
	L(m)	=	5								
	W(m)	=	7								
	No. of units	=	1								
				35.0	8.79	307.6500					
S4	Storm Tank **(D)**										
	L(m)	=	5								
	W(m)	=	13.3								
	No. of units	=	2								
				133.0	8.79	1169.0700					
							4600.9145	138.02744	4 (i.e. SRC1_O, SRC2_O, SRC3_O and SRC4_O)	1150.228635	34.50685905
S5	Flow Distribution Tank 1 **(W)**										
	L(m)	=	3								
	W(m)	=	5								
	No. of units	=	1								
				15.0	8.79	131.8500					
S6	1-2mm Fine Screen Channel **(X)**										
	L(m)	=	4.5								
	W(m)	=	3								
	No. of units	=	1								
				13.5	8.79	118.6650					
S7	Flow Distribution Tank 2 **(Y)**										
	L(m)	=	3.5								
	W(m)	=	5								
	No. of units	=	1								
				17.5	8.79	153.8250					
	V(ACPH)	=	15			(from engineer)					
	Total emission area (m^2)	=	10			(from engineer)					
	Exhaust exit velocity Velocity	=	2.5			(from engineer)					

Notes:

\# - The structure label in the bracket are correlated to the potential odour sources with the items in Figure 2.2.

* - The location of emission points are indicted in Figure 1 to Figure 4.

Room 2 - Treatment Unit

Source ID	Description #			Total Surface Area (m^2)	Emission rates ($ou/m^2/s$))	Emission rats(ou/s)	Total original emission (ou/s)	97% removal efficiency (ou/s)	No. of emission points *	Emission rate for each emission points (without Deodorzation unit)	Emission rate for each emission points (with Deodorzation unit)
S8	Wet Well Before MBR Tank **(Y1)**										
	L(m)	=	3.5								
	W(m)	=	13.6								
	No. of units	=	1								
				47.6	8.79	418.4040					
S9	Anoxic Tank **(E)**										
	L(m)	=	4.5								
	W(m)	=	4.2								
	No. of units	=	3								
				56.7	8.79	498.3930					
S10	Aerobic MBR Tank **(F)**										
	L(m)	=	9.2								
	W(m)	=	4.2								
	No. of units	=	3								
				115.9	0.10	12.0557	1589.8607	47.69582	4 (i.e. SRC5_O, SRC6_O, SRC7_O and SRC8_O)	397.46517	11.9239551
S11	Pump House and Header Tank **(Z)**										
	L(m)	=	6.2								
	W(m)	=	10								
	No. of units	=	1								
				62.0	8.79	544.9800					
S11	Effluent Reuse Building **(Z1)**										
	L(m)	=	4.4								
	W(m)	=	3								
	No. of units	=	1								
				13.2	8.79	116.0280					
	V(ACPH)	=	15			(from engineer)					
	Total emission area (m^2)	=	8.3			(from engineer)					
	Exhaust exit velocity Velocity	=	2.5			(from engineer)					

Notes: # - The structure label in the bracket are correlated to the potential odour sources with the items in Figure 2.2.
* - The location of emission points are indicted in Figure 1 to Figure 4.

Room 3 - Sludge Treatment Unit

Source ID	Description #			Total Surface Area (m^2)	Emission rates ($ou/m^2/s$))	Emission rats(ou/s)	Total original emission (ou/s)	97% removal efficiency (ou/s)	No. of emission points *	Emission rate for each emission points (without Deodorzation unit)	Emission rate for each emission points (with Deodorzation unit)
S12	Sludge Holding Tank (Pre-thickener)										
	Diameter(m)	=	4.4								
	No. of units	=	2								
	Area (m^2)	=	30.410617	30.4	26.42	803.4485					
S13	Sludge Digester										
	L(m)	=	6.1								
	W(m)	=	6.1								
	No. of units	=	2								
	Area (m^2)	=	74.42	74.4	26.42	1966.1764					
S14	Sludge Holding Tank (Post-digester)										
	Diameter(m)	=	3.2								
	No. of units	=	2								
	Area (m^2)	=	16.084954	16.1	26.42	424.9645	8003.0294	240.09088	6 (i.e. SRC9_O, SRC10_O, SRC11_O, SRC12_O, SRC13_O and SRC14_O)	1333.838232	40.01514697
S15	Sludge Dewatering Thickener and Units										
	L(m)	=	14								
	W(m)	=	13								
	No. of units	=	1								
	Area (m^2)	=	182	182.0	26.42	4808.4400					
	V(ACPH)	=	15			(from engineer)					
	Total emission area (m^2)	=	13.5			(from engineer)					
	Exhaust exit velocity Velocity	=	2.5			(from engineer)					

Notes: # - The structure label in the bracket are correlated to the potential odour sources with the items in Figure 2.2.
* - The location of emission points are indicted in Figure 1 to Figure 4.

Hang Mei Sewage Pumping Station

Source ID	Description #			Total Surface Area (m^2)	Emission rates ($ou/m^2/s$))	Emission rats(ou/s)	Total original emission (ou/s)	97% removal efficiency (ou/s)	No. of emission points *	Emission rate for each emission points (without Deodorzation unit)	Emission rate for each emission points (with Deodorzation unit)
S1	Inlet Chamber										
	L(m)	=	2								
	W(m)	=	4								
	No. of units	=	1								
	Area (m^2)	=	8	8.0	8.79	70.3200					
S2	Wet Well										
	L(m)	=	3				175.8000	5.274	1 (i.e. SRC15_O)	175.8	5.274
	W(m)	=	4								
	No. of units	=	1								
	Area (m^2)	=	12	12.0	8.79	105.4800					
	V(ACPH)	=	15			(from engineer)					
	Total emission area (m^2)	=	1			(from engineer)					
	Exhaust exit velocity Velocity	=	2.5			(from engineer)					

Notes: # - The location of potential odour sources are shown in Figure 2.4.
* - The location of emission points are indicted in Figure 1 to Figure 4.

Fan Kwai Tong Sewage Pumping Station

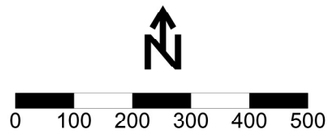
Source ID	Description #			Total Surface Area (m^2)	Emission rates ($ou/m^2/s$))	Emission rats(ou/s)	Total original emission (ou/s)	97% removal efficiency (ou/s)	No. of emission points *	Emission rate for each emission points (without Deodorzation unit)	Emission rate for each emission points (with Deodorzation unit)
S1	Inlet Chamber										
	L(m)	=	2								
	W(m)	=	4								
	No. of units	=	1								
	Area (m^2)	=	8	8.0	8.79	70.3200					
S2	Wet Well										
	L(m)	=	3				175.8000	5.274	1 (i.e. SRC16_O)	175.8	5.274
	W(m)	=	4								
	No. of units	=	1								
	Area (m^2)	=	12	12.0	8.79	105.4800					
	V(ACPH)	=	15			(from engineer)					
	Total emission area (m^2)	=	1			(from engineer)					
	Exhaust exit velocity Velocity	=	2.5			(from engineer)					

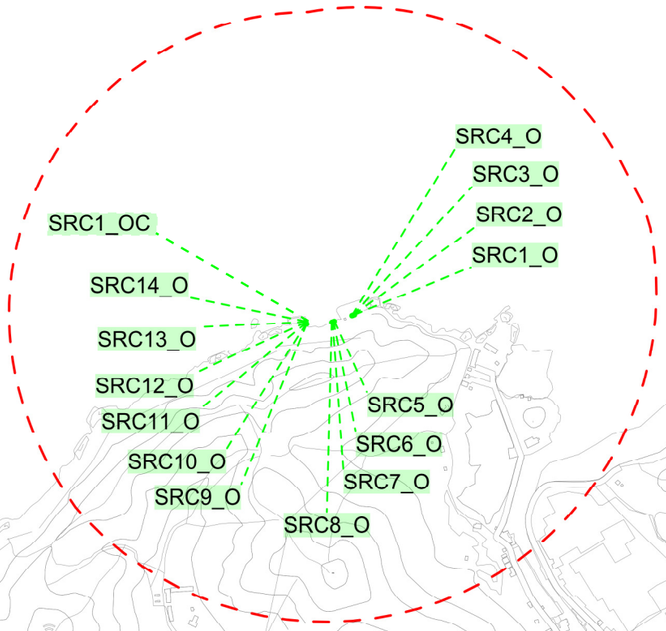
Notes: # - The location of potential odour sources are shown in Figure 2.5.
* - The location of emission points are indicted in Figure 1 to Figure 4.

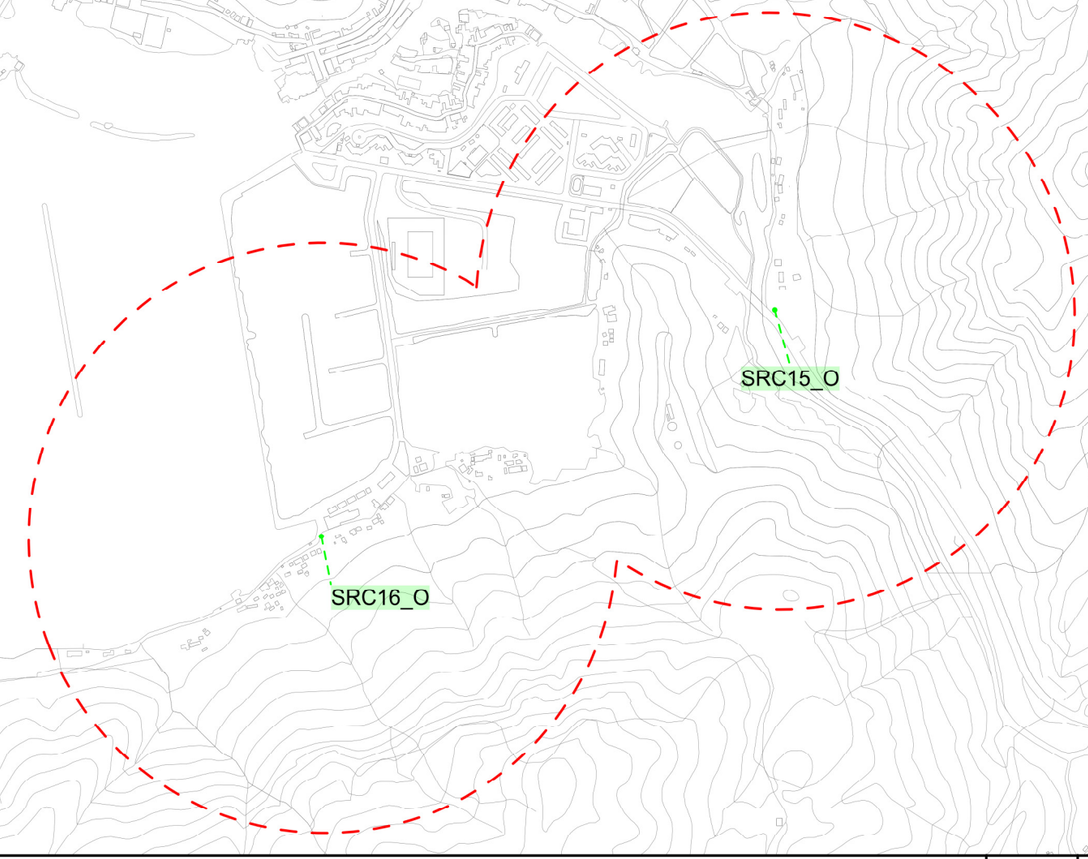
Information of odour emission sources

Emission Point ID	Description	X-Coordinate	Y-Coordinate	Elevation (meters)	Working Hour		Release Height (m)	Temperature (K)	Exit Velocity (m/s)
					Emission Rate (Unmitigated Scenario)	Emission Rate (Mitigated Scenario)			
SRC1_O	Rm1_1	803585.4	813618.1	3.0	1150.229	34.507	2.5	303	2.5
SRC2_O	Rm1_2	803583.9	813617.6	3.0	1150.229	34.507	2.5	303	2.5
SRC3_O	Rm1_3	803582.4	813617.0	3.0	1150.229	34.507	2.5	303	2.5
SRC4_O	Rm1_4	803581.0	813616.6	3.0	1150.229	34.507	2.5	303	2.5
SRC5_O	Rm2_1	803550.9	813606.8	3.0	397.465	11.924	2.5	303	2.5
SRC6_O	Rm2_2	803549.4	813606.3	3.0	397.465	11.924	2.5	303	2.5
SRC7_O	Rm2_3	803547.9	813605.7	3.0	397.465	11.924	2.5	303	2.5
SRC8_O	Rm2_4	803546.5	813605.3	3.0	397.465	11.924	2.5	303	2.5
SRC9_O	Rm3_1	803503.6	813602.0	3.0	1333.838	40.015	2.5	303	2.5
SRC10_O	Rm3_2	803503.2	813603.0	3.0	1333.838	40.015	2.5	303	2.5
SRC11_O	Rm3_3	803502.9	813603.9	3.0	1333.838	40.015	2.5	303	2.5
SRC12_O	Rm3_4	803502.4	813605.0	3.0	1333.838	40.015	2.5	303	2.5
SRC13_O	Rm3_5	803502.1	813606.0	3.0	1333.838	40.015	2.5	303	2.5
SRC14_O	Rm3_6	803501.7	813607.0	3.0	1333.838	40.015	2.5	303	2.5
SRC15_O	HM_PS	804595.9	812450.4	3.4	175.800	5.274	2.5	303	2.5
SRC16_O	FKT PS	803821.0	812063.5	3.9	175.800	5.274	2.5	303	2.5
SRC1_OC	Temporary sewage treatment facility	803502.0	813625.0	3.0	494.438	14.833	2.5	303	2.5

Note: Emission Points correspond to ventilated air exit locations.







Assessment Area

Odour Emission Point

Odour Emission Point ID

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DRAINAGE SERVICES DEPARTMENT

ATKINS

Agreement No. CE 15/2010 (DS)
Upgrading of Cheung Chau and Tai O Sewerage Collection, Treatment and Disposal Facilities - Design and Construction

Outlying Islands Sewerage Stage 2 -
Upgrading of Tai O Sewage Collection, Treatment and Disposal Facilities

Title : Location of Odour Emission Points

Date : MAY 2015

Figure : 1

PROPOSED STRUCTURE
(A') WET WELL BEFORE 6mm SCREEN CHANNEL
(B) 6mm SCREEN CHANNEL
(C) GRIT CHAMBER
(D') STORM TANK (UNDERGROUND)
(D1) ODOUR CONTROL ROOM (ABOVE GROUND)
(E) ANOXIC TANK
(F) AEROBIC MBR TANK
(G) MBR SYSTEM EQUIPMENTS AREA
(H) FIRE PUMP ROOM (ABOVE R)
(J) SLUDGE DEWATERING BUILDING
(K) ODOUR CONTROL ROOM
(L) SLUDGE HOLDING TANK (PRE-THICKENER)
(M) AIR BLOWER ROOM (ABOVE M1)
(M1) SLUDGE PUMP HOUSE
(N) SLUDGE HOLDING TANK (POST-DIGESTER)
(P) SLUDGE DIGESTER
(R) WORKSHOP
(S) TRANSFORMER ROOM AND SWITCH ROOM
(T) ADMINISTRATION BUILDING (ABOVE D1)
(U) DANGEROUS GOODS HOUSE
(V) STANDBY GENERATOR ROOM (ABOVE S)
(W) FLOW DISTRIBUTION ROOM
(X) 1-2mm FINE SCREEN CHANNEL
(Y) FLOW DISTRIBUTION CHAMBER
(Y1) WET WELL BEFORE MBR TANK
(Z) PUMP HOUSE AND HEADER TANK
(Z1) CHEMICAL DOSING AREAS FOR EFFLUENT REUSE
(Z2) CHLORINE CONTACT TANK

PROPOSED TWIN 300mm DIAMETER OUTFALLS

PROPOSED MARINE BERTHING AREA

Temporary Sewage Treatment Facilities (construction Phase only)

PROPOSED EMERGENCY OUTFLOW

EXISTING TWIN 225mm DIAMETER OUTFALLS

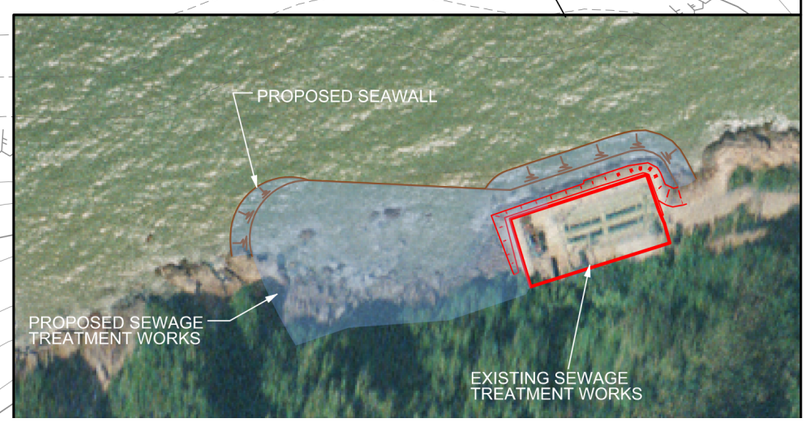
SRC1_OC
SRC14_O
SRC13_O
SRC12_O
SRC11_O
SRC10_O
SRC9_O
SRC5_O
SRC8_O
SRC7_O
SRC6_O
SRC4_O
SRC3_O
SRC1_O
SRC2_O

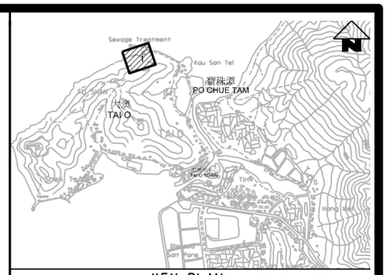
INCOMING 450Ø SEWER FROM TAI O PS 2

BOUNDARY OF 'OU (SEWAGE TREATMENT WORKS)' UNDER DRAFT OZP NO. S/I-TOF/1

EXISTING SLOPE TOE

STW SITE BOUNDARY / BOULDER ENTRAINMENT FENCE





KEY PLAN SCALE : N.T.S.

LEGEND:

- (A) STRUCTURE LOCATED AT GROUND LEVEL
- (A') STRUCTURE LOCATED UNDERGROUND
- (A) STRUCTURE LOCATED AT UPPER GROUND LEVEL
- FLOW DIRECTION
- ODOUR EMISSION POINT

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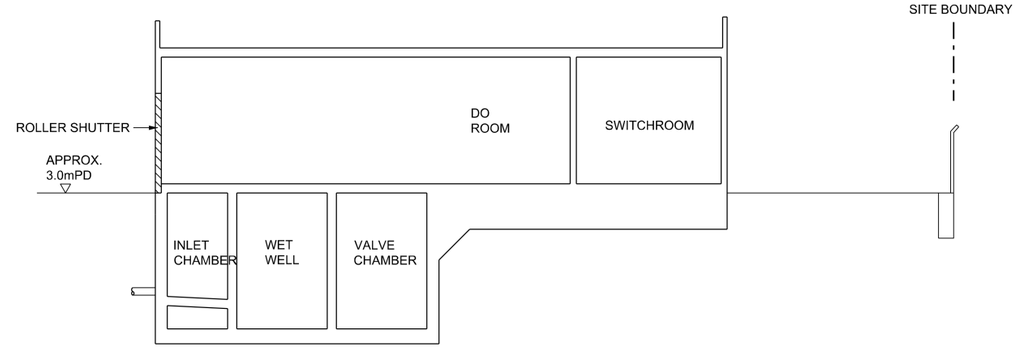
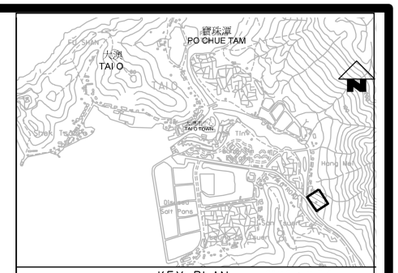
Outlying Islands Sewerage Stage 2 -
Upgrading of Tai O Sewage Collection, Treatment and Disposal Facilities

Title :	Location of Odour Emission Points at Tai O Sewage Treatment Works		
Date :	MAY 2015	Figure :	2

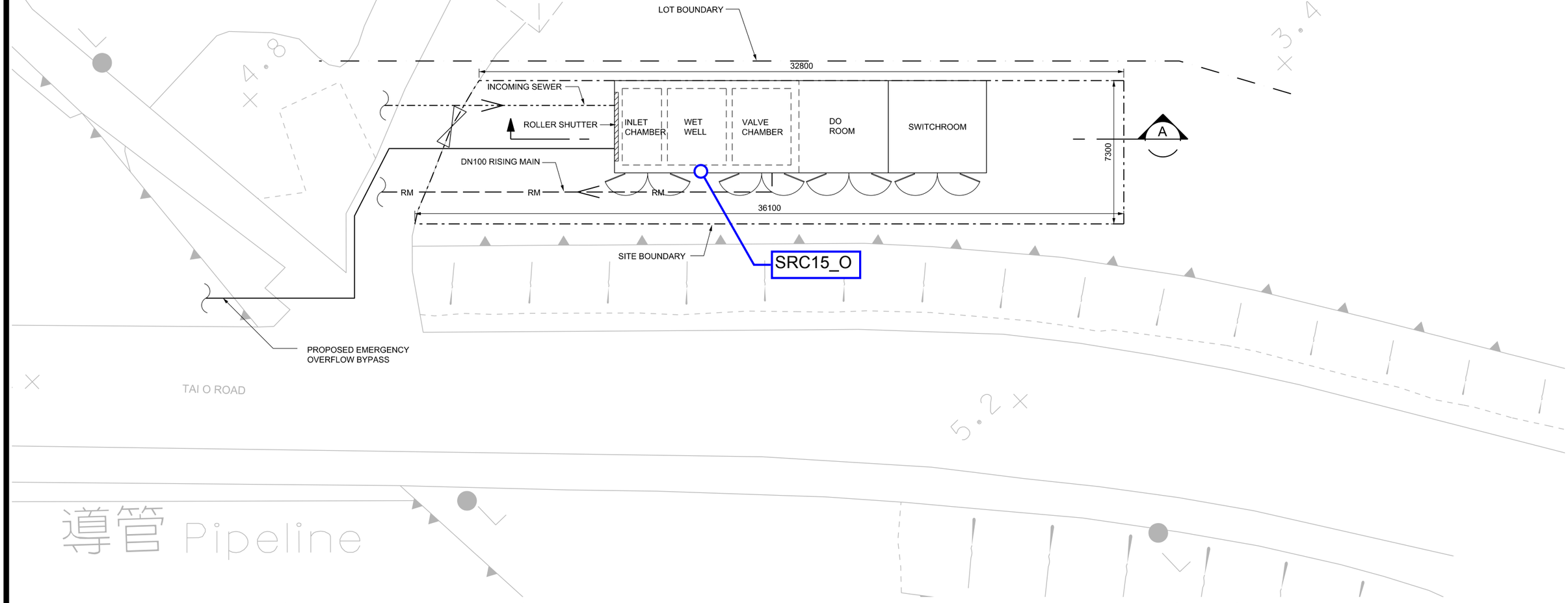


SECTION A



LEGEND:

ODOUR EMISSION POINT



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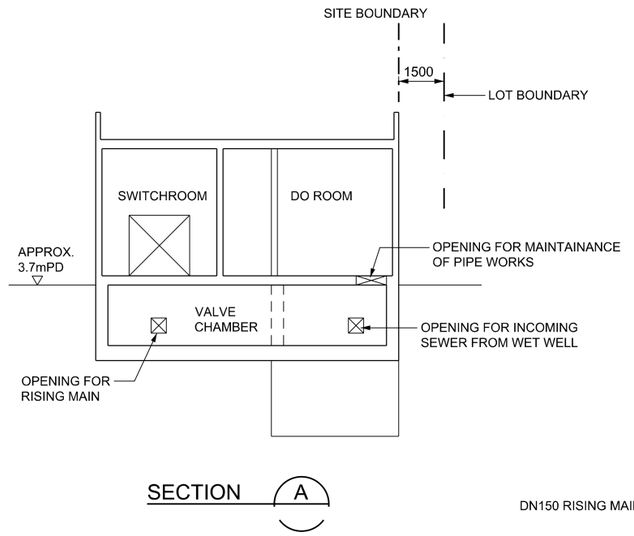
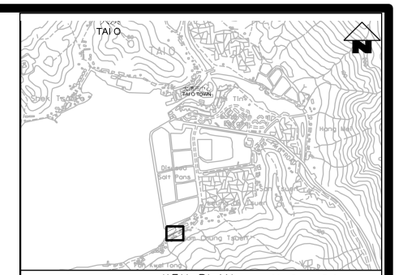
Outlying Islands Sewerage Stage 2 -
Upgrading of Tai O Sewage Collection, Treatment and Disposal Facilities

Title :	Location of Odour Emission Point at (Hang Mei Sewage Pumping Station		
Date :	MAY 2015	Figure :	3



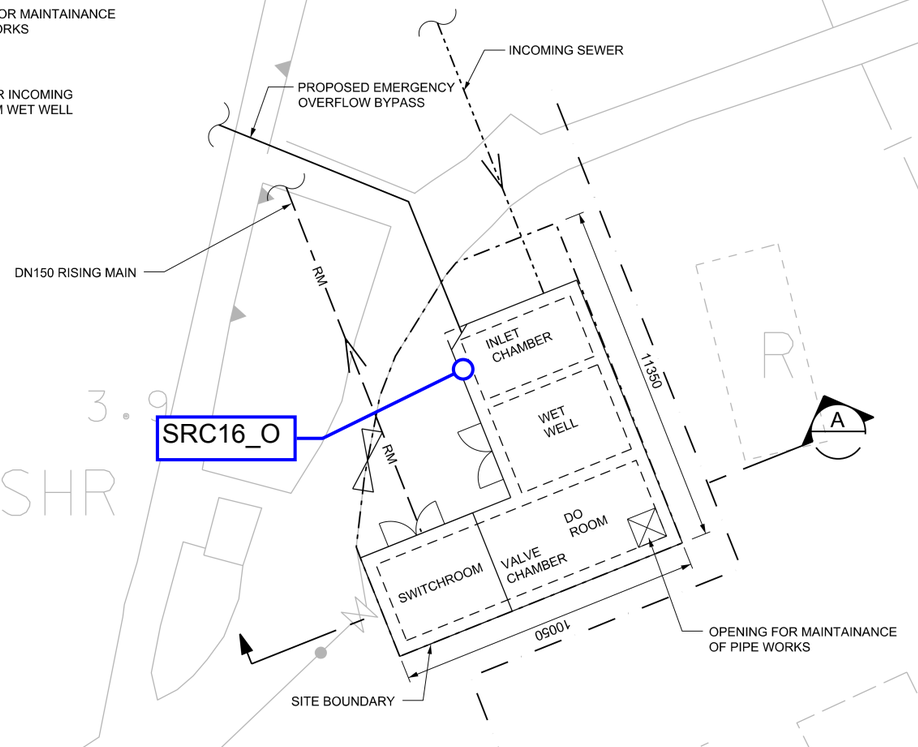
SECTION A



KEY PLAN SCALE : N.T.S.

LEGEND:

ODOUR EMISSION POINT



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Outlying Islands Sewerage Stage 2 -
Upgrading of Tai O Sewage Collection, Treatment and Disposal Facilities

Title :	Location of Odour Emission Point at Fan Kwai Tong Sewage Pumping Station		
Date :	MAY 2015	Figure :	4

THE HONG KONG
POLYTECHNIC UNIVERSITY
香港理工大學
土木及結構工程學系
Department of Civil and Structural Engineering
Tel (852) 2766 6011 Fax (852) 2334 6389

Re: Report for odour emission Factor at STW (Law Wu)

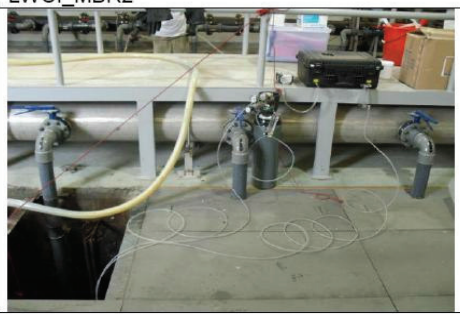
The gas sampling and Odour/ H2S analysis provided by the Odour and Air Laboratories of PolyU as follows:

The service includes on-site gas sampling, sample transport, and odour/H2S analysis in PolyU with an analytical report. To determine an odour emission rate from an area surface source, air sampling can use a "hood" method as shown below, whereby either a dynamic flux hood is placed on the odour emission surface of selected locations, and odour-free air either from a gas cylinder or by passing through an activated carbon filter is blown through it. The emission rate is then determined by the air flow through the hood and the odour concentration of the exit air.

Dynamic Flux Hood

During collection of odorous gas, the air velocity inside wind tunnel shall match with the actual wind speed at the water surface. The wind speed, temperature and humidity shall be recorded during sampling. Method by using "Hood" Method with Flux Hood) per Location (If the area of the odour source is known, the odour emission rate can be calculated accordingly based on your measured/ calculated SOER (ou/m2/s)).

Site photos

LWCI_MBR1	LWCI_MBR2
	

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香港理工大學
土木及結構工程學系
Department of Civil and Structural Engineering
Tel (852) 2766 6011 Fax (852) 2334 6389

Results:

General Information				
Date	8/6/2012	(dd/mm/yy)		
Ambient Temp.	30.8 ~ 33.0 °C		Humidity:	65 ~ 78 %
Weather:	Fine		Wind Direction:	S-SE

Sample Name	Time	Sampling Method	Ambient Temp. °C	Humidity %	H2S (ppb) In Lab.	OC OUE/m³	SOER OU/m².s
1-butanol-352						1489.0	
LWCI_MBR2-080612	10:05	FH	31.5	74.4	0.3	37.0	0.0245
LWCI_MBR1-1-080612	11:00	FH	32.3	68.0	0.6	46.0	0.0304
LWCI_MBR1-2-080612	11:55	FH	32.8	68.9	0.5	40.0	0.0264

Professor S.C. Lee
Odour Research Laboratory at PolyU

Variation of Odour Emission from MBR tank with Different Surface Flow Rate

The measured odour emission rate collected from the existing Lo Wu Correctional Institution Sewage Treatment Plant (LWCISTP) will need to be corrected for estimating rate of the future upgraded Tai O Sewage Treatment Works (Tai O STW) to be adopted in the odour impact prediction. The correction factor for the difference in surface flow rate under operation of LWCISTP and Tai O STW was calculated by the following equation (Design Manual: Odor and Corrosion Control in Sanitary Sewerage and Treatment Plants (1985), USEPA).

$$F = 0.7\,(n^2V^3 / R^{4/3})^{3/8}\,[H_2S]$$
$$F = V^{9/8}\,K$$

Where K = $0.7\,(n^2 / R^{4/3})^{3/8}\,[H_2S]$
F = odour flux (g/m^2-hr)
n = Mannings' Coefficient (0.014 was assumed)
V = velocity of sewage (m/s)
R = hydraulic radius (m)
$[H_2S]$ = H_2S molecule concentration in sewage

Summary of Odour flux under different surface flow rates during operation at LWCISTP and Tai O STW

	Existing Operation at LWCISTP	Proposed Operation at Tai O STW
Average flow rate (m^3/day)	775	2750
Effective surface area of MBR tank, m^2	96	108
Surface flow rate(m/hr) under normal operation	0.336	1.061
Percentage change of odour flux compare with LWCISTP	--	365%

Correction Factor for Ambient Temperature

To determine the worst case scenario for odour impact assessment, temperature adjustments on the measured odour emission rates at LWCISTP were required. The odour surveys at LWCISTP were carried out on 8-June-2012 and the averaged daytime temperature was 32.2˚C. Based on Year 2011to 2015 meteorological data from the Hong Kong Observatory, the mean daily maximum ambient temperature in the summer (June – September) were in the range of 30 to 33˚C. With reference to the Hydrogen Sulphide Control Manual (Technological Standing Committee on Hydrogen Sulphide Corrosion in Sewage Works, 1989), the equation below presented by Pomeroy and Parkurst was taken to estimate the variation of odour emissions due to temperature changes:

$$G = M[BOD_5]1.07^{T-20}$$

where G sulphide flux from wall slimes, g/m^2h
$[BOD_5]$ 5-day biochemical oxygen demand
T temperature, °C
M coefficient, m/h

Based on the above equation, the sulphide flux increased by about 5.6% (i.e. $[1.07^{(33-20)} - 1.07^{(32.2-20)}]/[\,1.07^{(32.2-20)}] \times 100\% = 5.6\%$) when temperature increased from 32.2˚C to 33˚C. Therefore, 5.6% increase or a 1.056 correction factor was applied in the measured odour emission rate at LWCISTP to estimate the odour emission in Tai O STW.

Average measured SOER = (0.0245+0.0304+0.0264)/3 (Collected from the existing LWCISTP.)
=0.0271 ($OU/m^2.s$)

Therefore, the odour emission rate of MBR in proposed Tai O STW is calculated to be:

Average measured SOER x 365% x 1.056
= 0.0271 x 365% x 1.056
=0.10 $OU/m^2/s$