Appendix 6: Sewerage Impact Assessment

Pine Garden Foundation Limited

Proposed Tai Po Kau Nature Academy

Sewerage Impact Assessment

June 2022

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1 Introduction

1.1 Background

1.1.1 This Sewerage Impact Assessment (SIA) has been prepared in support of a Planning Application to the Town Planning Board (TPB) for the proposed Tai Po Kau Nature Academy.

1.1.2 The Site is to be developed to a visitor centre, activity centre and plant nursery, with ancillary facilities including a camping ground for overnight educational activity. A Master Layout Plan (Application Site Boundary & Proposed Building GFA) is included in **Appendix A**.

1.1.3 This Report assesses the sewerage issues in the vicinity of the Site and the proposed arrangement for sewage treatment and disposal for the proposed development.

1.2 Information Available for the Study

1.2.1 Reference has been made to Environmental Protection Department's (EPD's) Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (GESF). For effluent quality standards, reference has been made to the Technical Memorandum on Effluent Standards (Cap 358AK, "the TM").

1.2.2 Reference has also been made to a topographic survey carried out for this Project.

2 Project Outline

2.1 Project Title

2.1.1 The project title is "Proposed Tai Po Kau Nature Academy". The location of the Site is shown on **Figure 1**.

2.2 Proponent

2.2.1 The proponent of the project is Pine Garden Foundation Limited.

2.3 Contact Person

2.3.1 For issues relating to this SIA Study, please contact Ir Colin Moreby of AIM Group Limited at 2572 6533.

2.4 Nature and Description of the Project

2.4.1 The Application Site has an area of about 0.9ha and is within an area currently zoned “Green Belt” under the Tai Po Outline Zoning Plan (OZP) (No. S/TP/29). The adjacent Tai Po Kau Nature Reserve is not covered by any OZP.

2.4.2 The Application Site is rural in nature, with a few old buildings and largely overgrown agricultural land. The Site is to the south of Tai Po Road – Tai Po Kau with a small access road running uphill to the Site from Tai Po Kau Garden.

2.4.3 Based on the current design scheme, there will be a visitor centre, an activity centre and a plant nursery. There will also be an area for overnight camping, as well as footpaths around the Site. The Master Layout Plan is included in **Appendix A**.

2.5 Planning Application

2.5.1 This SIA Report has been prepared in support of a S16 Submission to the TPB.

2.6 Location

2.6.1 The Application Site is located to the south of Tai Po Road – Tai Po Kau, approximately 400m uphill from Tai Po Kau Garden.

3 Planning and Implementation Programme

3.1 Planning and Implementation

3.1.1 The proposed development will be planned and implemented under the supervision of appropriately qualified and experienced professionals. The construction of any works for the proposed development will be carried out by a suitable Contractor.

3.2 Project Timetable

3.2.1 The Development is expected to be completed by 2024.

3.3 Interface with Other Projects

3.3.1 There is no foreseeable direct interaction with other development projects in the area, which should be considered at this time.

4 Existing Sewerage

4.1 Existing Sewerage

4.1.1 The Site is currently undeveloped/abandoned, so there are no existing sewage flows. The existing buildings appear to have been served by septic tanks.

4.1.2 The Site is remote and there is no existing public sewerage in the area, with the nearest sewer being in Tai Po Road – Tai Po Kau, approximately 170m to the west of Tai Po Kau Garden.

5 Sewerage Impact Assessment

5.1 Sewerage Impact Assessment

Sewage Generation

5.1.1 It is expected that there will be a total staff population of 10 persons (up to 8 staff members plus one gardener and one cleaner). In addition, there will be up to 400 day-visitors and up to 18 overnight campers. Based on Unit Flow Factors from GESF, the expected sewage generation is set out in **Appendix B**, with an overall total of 21.5m^3/day (N.B. as only simple toilet facilities are to be provided, it is expected that the actual flows will be less).

5.1.2 There will be no catering facilities at the Site (apart from the most basic facilities, such as kettle, microwave, etc.), so the sewage flow will only be from toilets and simple hand-washing facilities.

5.2 Sewage Collection, Treatment and Disposal Proposals

Sewage Disposal Arrangements

5.2.1 As the Site is not domestic, the effluent standards from the TM will apply. The Site is neither within a Water Gathering Ground or an official Country

Park and there no downstream irrigation or fish-pond uses, so the sewage will need to be treated for discharge to Group D Inland Waters. It will therefore be necessary to treat the sewage with on-Site treatment facilities, to enable local discharge to the nearby stream.

5.2.2 The most appropriate sewage treatment process for the Site flows and conditions is considered to be a Membrane Bio-Reactor (MBR) package sewage treatment plant (STP) and this will be the proposed treatment process for the development. Such facilities are fairly common in Hong Kong and are readily available. A description of an example project using MBR technology is included in **Appendix C**, with a brochure from a local supplier included in **Appendix D** (N.B. the brochure mentions reuse of treated effluent, but there is **no intention to reuse treated effluent for this Project**).

5.2.3 The MBR STP will be provided as a package unit and housed within a simple structure adjacent to the Plant Nursery, with appropriate odour control facilities. There will also be a holding tank for raw sewage, to enable peak discharges to be retained and the MBR unit to run at a fairly consistent flow rate. Emergency (back-up) power supply will be provided for the STP.

5.2.4 Flows from the toilets at the Activity Centre and the Visitor Centre will be conveyed to the STP via gravity sewers (probably uPVC), as indicated on **Figure 2**. The STP will discharge via a dedicated pipe to the main streamcourse.

5.2.5 As the STP and sewerage facilities will be entirely within the Application Site, the Project Proponent will be responsible for the on-going operation and maintenance.

5.2.6 A Discharge Licence will be required for the STP and this will be applied for at later stages of implementation, at which time further details and specifications will be submitted for approval.

6 Conclusions

6.1.1 The proposed development will generate new sewage flows in the order of 21.5m^3/day.

6.1.2 There are no existing public sewerage or sewage treatment facilities in the vicinity of the Site and the flows will therefore need to be treated on-Site.

6.1.3 It is proposed to adopt the MBR treatment process to treat the flows, with the MBR STP to be provided as a package unit.

6.1.4 The effluent will need to be treated to a standard suitable for discharge to the local streamcourse (Group D Inland Waters).

6.1.5 The Project Proponent will be responsible for the on-going operation and maintenance of the sewerage and sewage treatment facilities.

6.1.6 The Project Proponent will be responsible for applying for a Discharge Licence for the STP.

6.1.7 There will be no unacceptable sewerage impacts as a result of the proposed development.

Appendix A

Master Layout Plan

LEGEND:

APPLICATION SITE BOUNDARY	=	9,054	M² APPROX
PROPOSED ACTIVITY CENTRE	=	146	M²
PROPOSED VISITOR CENTRE	=	220	M²
PROPOSED PLANT NURSERY	=	194	M²
TOTAL BUILDING G.F.A.	=	560	M²

N

THE SITE

ACCESS FOR PLANT NURSERY STAFF

PLANT NURSERY

ACCESS FOR VISITOR (MAIN ENTRANCE)

VISITOR CENTRE

ACTIVITY CENTRE

ACCESS ROAD

FOOT PATH

MASTER LAYOUT PLAN

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PROJECT MANAGER: SMILEY PLANET

LANDSCAPE ARCHITECT: SQUARE METRES DESIGN

Check all measurements on site.
Do not scale off drawings.

This drawing is to be read in conjunction with the specification and any discrepancies are to be immediately reported to the Architect.

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REV.	DESCRIPTION	DATE

PROJECT TITLE: TAI PO KAU NATURE ACADEMY

DRAWING TITLE: MASTER LAYOUT PLAN

PROJECT NO. 21004SD	DRAWN BY WH
SCALE 1 : 600 @ A3	CHECKED BY AK
DATE 16/05/2022	APPROVED BY TI
DRAWING NO. PLN001	REV. NO.

DRAWING PURPOSE: Indicative Only

Appendix B

Sewage Flow Calculations

C197 - Proposed Tai Po Kau Nature Academy
Sewage Flows for Treatment

Category	**Population** (Person)	**Assumed Population Category**[1]	**Unit Flow Factor** (m^3/person/day)	**Sewage Flow** (m^3/day)		**Population Equivalent** 0.27 (m^3/person/day)
Day Visitors	400	Student	0.04	16		
Overnight Visitors	18	Temporary	0.15	2.7		
Staff - General	10	J11	0.28	2.8		
Total	428			**21.5**	**m^3/day**	80

[1] Refer to EPD "Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning"

Appendix C

Example Project for MBR Technology

Design and Operation of MBR Type Sewage Treatment Plant at Lo Wu Correctional Institution, Hong Kong

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Abstract:
Lo Wu Correctional Institution (LWCI) is one of the female penal institutions managed by the Correctional Services Department (CSD) of the Government of the Hong Kong Special Administrative Region (HK Government of SAR). It comprises three prison facilities with two of them at medium security level and one at minimum security level respectively. The institution's accommodation capacity is 1,400 female adult prisoners. Having no public sewer available, a sewage treatment plant adopting Membrane Bioreactor (MBR) technology was built inside LWCI to handle sewage at designed average flow of 775 m^3/d. The MBR plant was designed with nitrification and denitrification process. It exhibits good performance in removal of organics, solids, nutrients, micro-organisms, etc. and operates satisfactorily in meeting stringent discharge license requirements stipulated by the Environmental Protection Department (EPD) of HK Government of SAR. This paper presents the experience in design and operation of this MBR plant.

Keywords: MBR, Lo Wu Correctional Institution

1. INTRODUCTION

LWCI is one of the female penal institutions managed by the Correctional Services Department of the HK Government of SAR. Its design accommodation capacity is 1,400 female adult prisoners. Having no public sewer available, a sewage treatment plant adopting MBR technology was built inside LWCI to handle the wastewater generated. Part of the treated effluent is recycled for toilet flushing within LWCI with the excess being discharged to the inland watercourse.

ATAL Engineering Limited (hereafter called ATAL) is the specialist sub-contractor responsible for the design and construction of the electrical and mechanical engineering works of the plant while the Drainage Services Department (DSD) of the HK Government of SAR is responsible for its operation and maintenance.

2. DESIGN CRITERIA AND CONSIDERATIONS

According to the "Design and Construction of the Redevelopment of LWCI - Second Stage Sewerage Impact Assessment Report" (hereafter called the SIA Report) issued in October 2007, the design population and the design flow for the plant are shown in Table 1 below:

Type	Design Population	Unit Flow Factors (m^3/person/d)	Sub-total Flow (m^3/d)
Inmates	1,680*	0.440	739.20
Prison Staff	506	0.060	30.36
Civilian Staff	48	0.060	2.88
Visitors	85	0.025	2.13
Average Dry Weather Flow (ADWF) (m^3/d)			**775**

** Population of Inmate should be 1,400 plus 20% design allowance*

Table 1 – Design Population and Design Flow

According to the SIA Report, the design loadings for the plant are shown in Table 2 below:

Type	Unit	Design Loading
Suspended Solids (SS)	kg/d	88.926
Biochemical Oxygen Demand (BOD_5)	kg/d	92.286
Chemical Oxygen Demand (COD)	kg/d	195.930
Total Kjeldahl Nitrogen (TKN)	kg/d	18.561
Ammonia Nitrogen (NH_3-N)	kg/d	10.956
Escherichia Coli (E. Coli)	count/d	9.6×10^{13}

Table 2 – Design Loadings

Based on the design flow and the design loadings in the SIA Report, the influent characteristics and the treated effluent quality for recycling are listed in Table 3 below:

	Flow (m^3/d)	BOD_5 (mg/L)	SS (mg/L)	TKN (mg/L)	NH_3-N (mg/L)	E. Coli (count/100mL)	TRC (mg/L)
Influent	775	119.1	114.7	23.9	14.1	1.22×10^7	N/A
Effluent	775	5.839	3.273	3.071	3.071	Non-Detected	1 - 2

Table 3 – Influent Characteristics and Effluent Quality

As the treated effluent may not be fully recycled, the excess effluent will be discharged to the local drainage system. In this case, the effluent must comply with the discharge standards at Deep Bay area, which require that the Total Residual Chlorine (TRC) level in the excess effluent should not be larger than 0.4 mg/L.

Wastewater from laundry and kitchen are assumed entering the plant on intermittent basis. After mixing with the wastewater from other sources at the equalization tank, the temperature of the wastewater will be less than 35℃. Also, the grease trap is designed to remove the majority of oil and grease in the wastewater generated from the kitchen.

A diurnal flow pattern is developed based on the activity schedule shown in Table 4 below:

Time	Activity
7:00 a.m.	Wake Up
8:00 a.m.	Breakfast
9:00 a.m. – 4:00 p.m.	Activities at Workshop including Lunch from 1:00 p.m. to 2:00 p.m.
5:00 p.m.	Dinner
8:00 p.m. – 10:00 p.m.	Shower at Dormitory

Table 4 – Activity Schedule

According to the "Guidelines for Design of Small Sewage Treatment Plants" published by the EPD and the diurnal flow pattern, the design peak flow is assumed to be four times of the ADWF. With the aid of the equalization tank, the MBR plant is therefore designed to handle three times of ADWF, that is 775 x 3 = 2,325 m^3/d.

3. TREATMENT PROCESS DESIGN

Coarse Screening

Wastewater from various buildings in LWCI will flow by gravity to the plant at a level of approximately +6.00 mPD. Solids of size larger than 20 mm will be screened out by the automatic raked coarse screens installed upstream of the equalization tank. The coarse screening is designed to protect the downstream mechanical equipment in the equalization tank.

Equalization Tank

The equalization tank is designed to smooth out peak flow and meet the design flow for two hours in accordance with the "Guidelines for Design of Small Sewage Treatment Plants" published by the EPD.

Fine Screening

The equalized wastewater is then further screened by the automatic fine screens. Solids of size over 2 mm will be screened out prior to the anoxic tank. The fine screening is designed to protect the downstream membrane module and aeration equipment.

Anoxic Tank

Screened wastewater flows to the anoxic tank and is mixed with the nitrate recycled from MBR tank and pre-aeration tank for denitrification. The design denitrification rate is 0.02 kg-N/kg-MLSS/d at 18℃.

Membrane Bioreactor

Mixed Liquor Suspended Solids (MLSS) from the anoxic tank is evenly distributed to two MBR tanks in which biological oxidation and nitrification takes place. Each MBR tank contains seven sets of fully submerged flat sheet type membrane modules and each membrane module has 200 nos. of membrane panels. The membrane modules comprises two sections – the top section containing membrane cartridges fixed into a stainless steel housing constructed with the lower section containing coarse bubble diffusers. The bubbles released by the lower diffuser section generate

an upward sludge bubble flow over the membrane surface at a velocity of approximately 0.5 m/s. This bubble flow is able to minimize fouling and allow low pressure suction filtration of the treated effluent into the inner compartment of membrane cartridge and thence to the collecting manifold. The membrane nominal (maximum) and average pore sizes are approximate 0.4 microns and 0.2 microns respectively.

The MBR tank performs both functions of aerobic treatment and solids / liquid separation. The complete MBR system is able to operate at high MLSS concentration in the range 6,000 - 20,000 mg/L which features compact design and small footprint area, low sludge production rate due to long sludge age and strong resistance to shock pollutant loads. The micro-filtration performance of the flat sheet type membrane also produces permeate to disinfected quality. Sometimes pre-aeration is required if the air supply for air scouring is insufficient for biological treatment. As discussed above, the denitrification is performed in a separate anoxic compartment. Sludge is drawn off at a constant volume rate to maintain the MLSS at the optimum level according to the operational needs.

Design flux rates of 0.35 and 1.2 $m^3/m^2/d$ are used for sizing the average flow and design peak flow of the MBR system respectively.

Disinfection

In order to ensure pathogen-free for the recycled water, chlorination using sodium hypochlorite is adopted for disinfection followed by the de-chlorination.

4. PERFORMANCE OF THE PLANT

Compliance of EPD's Discharge License

Since taking-over of the plant from ATAL by DSD for operation in August 2011, the treated effluent quality has fully complied with EPD's Discharge License and the plant could demonstrate good performance in terms of effluent quality. The summary of the actual performance is listed in Table 5 below:

	SS (mg/L)	BOD_5 (mg/L)	Oil & Grease (mg/L)	Nitrate + Nitrite Nitrogen (mg/L)	NH_3-N (mg/L)	Surfactants (mg/L)	E. Coli (count/ 100mL)	TRC (mg/L)
Design (Influent)	114.7	119.1	-	-	14.1	-	1.22×10^7	-
Actual (Influent)	320	340	43	-	16	-	-	-
EPD's Requirements	60	40	20	40	10	10	100	0.4
Actual (Effluent)	<5	<5	<5	<2.5	<0.5	<2	40	<0.2

Table 5 – Influent Characteristics and Effluent Quality

Treatment Capacity

The average daily flow of the plant was about 64% of the design flow while the number of inmates was about 1,100 in September 2012. However, it is noticed that the BOD_5 strength was about three times of the design BOD_5 strength assumed for the influent, therefore the treatment capacity in term of kg-BOD_5 removed per day was 159 in average, which was approximate 1.79 times of the design treatment capacity.

5. OPERATION AND MAINTENANCE ISSUES

Concentration of MLSS

The concentration of MLSS in the MBR tanks is monitored by the MLSS sensors and controlled by the automatic desludge valves regularly. The concentration of MLSS can be maintained at about 10,000 to 12,000 mg/L and the average desludge rate is about 9 m^3/d which is corresponding to a sludge yield rate of 0.587 kg-SS/kg-BOD_5 removed.

Permeate Flux

The permeate pumps are controlled by variable speed drive to adjust the permeate flux to meet the demand. Based on the operation records, the flow of permeate pumps are always operated between 18 and 23 m^3/hr which are corresponding to flux rate at 0.192 to 0.246 m^3/m^2/d, lower than the design flux at 0.35 m^3/m^2/d.

Staffing Requirements

The plant is designed for unmanned operation. The plant incorporates the supervisory control and data acquisition (SCADA) system and the online sensors/instruments for the automatic control and remote monitoring of the plant. All signals and alarms are transmitted to the Regional Control Centre at Shek Wu Hui Sewage Treatment Works. However, appropriate level of manning is required for the satisfactorily operation and maintenance of the plant. In general, the overall staffing requirements of the plant are about 10 man-day per week.

Operation Activities

As the plant is almost fully automated, the on-site operation activities involving staffing requirements are minimal. The major manual operation activities of the plant are the waste disposal, sample collection as well as routine inspections. The general requirements of these operation activities are shown in Table 6 below:

Major Operation Activity	Frequency of Activity
Waste Disposal	6 times per week
Routine Inspection	6 times per week
Sample Collection	3 times per week

Table 6 – Operation Schedule

Maintenance Activities

One of the major maintenance activities is to clean the membranes as well as the effluent discharge pipelines with sight-glasses. Furthermore, the diffusers are required to clean for satisfactorily operation. The membranes are cleaned offline using sodium hypochlorite. The general requirements of these maintenance activities are shown in Table 7 below:

Major Maintenance Activity	Frequency of Activity
Membrane Cleansing	Once every 3 months
Discharge Pipeline Cleansing	Once every 1 month
Diffuser Cleansing	Once every 2 weeks

Table 7 – Maintenance Schedule

Major Breakdown

During the past 15 months of operation, no major breakdown was occurred. The system is very reliable.

Replacement of Membrane Panels

During the past 15 months of operation (by DSD) plus 15 months of process commissioning and trial run (by ATAL), 50 nos. of membrane panels were found damaged. The damage rate was approximate 0.7% per year. Investigation and consultation with the membrane supplier were conducted. It was believed that damages of the membranes were due to wear and tear arising from inflow of certain amount of food wastes to the sewage treatment plant with the influent during the process commissioning period.

6. TREATMENT COST

Electricity Cost

The electricity loading of the plant includes the aeration and the pumping systems. The electricity cost per unit flow was about 2.7 kWh/m^3. This comparatively high electricity consumption is mainly due to the additional electricity consumption for treating the excessive high BOD_5 concentration, which was three times higher than the design BOD_5 strength of the influent.

Chemical Cost

The membranes are cleaned offline using sodium hypochlorite. The annual consumption is about 3,300 kg. The chemical cost per unit flow is about HK$0.02/$m^3$.

Other Operation Costs

The other operation costs include the labour cost and the waste disposal cost. The cost per unit flow is about HK$2.6/$m^3$.

Replacement and Repair Cost

No major replacement or upgrading works has been carried out since the operation of the plant. In short, 50 nos. of membrane panels (out of 2,800) were replaced in 2012. The overall replacement and repair cost per unit flow is about HK$1.8/$m^3$.

Total Treatment Cost

The above breakdown of the operation and maintenance costs may not fully represent the actual treatment cost of the plant as the years of operation of the plant is relatively short. In addition, the generated sludge is not dewatered or treated locally. For initial reference, the estimated total treatment cost per unit flow of the plant in the first year of operation is between HK$6/$m^3$ and HK$8/$m^3$.

7. CONCLUSIONS

The wastewater generated from LWCI is currently treated by a flat sheet type MBR sewage treatment plant. MBR technology is the combination of activated sludge treatment technology and microfiltration/ultrafiltration technology for biological treatment of wastewater and separating the bio-solids from the effluent. The experience gained from the design and operation of this plant in LWCI indicates that MBR type sewage treatment plant performs well with regard to BOD_5 and SS removal, nutrients removal and effluent disinfection in reliable manner. Its effluent quality meets the design requirements reliably and is unaffected by operational problem, like sludge bulking or foaming commonly in existence in conventional type secondary sewage treatment plants. It is considered that the performance of MBR plants is reliable.

ACKNOWLEDGEMENTS

We would like to thank the Correctional Services Department and the Drainage Services Department for their permission to publish this paper.

We are also deeply indebted to our colleagues who support, provide suggestions and help us for writing this paper.

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Appendix D

Brochure for MBR Technology

Job references 過往項目

Lung Kwu Tan Public Toilet – 28m³/day
龍鼓灘公共廁所 – 28立方米/天

Toyokawa shi, Japan - 10m³/day
日本豐川市 - 10立方米/天

Qingdao Laoshan Tourist Area, China – 20m³/day
中國青島嶗山旅遊景區 - 20立方米/天

CIC Zero Carbon Building – 5m³/day
零碳天地 - 5立方米/天

DECL_BT_201910

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Dunwell Bio Toilet
正昌膜生化廁所

Compact Sewage Recycling Treatment Plant
小型生活污水處理及回用系統

- Eliminates public sewage pipes
毋需排污渠
- 100% Water Reuse On Site
100%水循環再用
- Remote Monitoring System
在線監控
- Reliable solution for small scale applications
適合低污水量的用途

DUNWELL GROUP

Introduction 介紹

With the increasing demand of sanitary facilities in remote locations with limited space, a cost effective solution was called for to meet the needs. Dunwell Bio-Toilet is an advanced wastewater treatment process which combines membrane separation, biological treatment and aeration technologies. It is specially designed for toilets with daily maximum flow capacity of less than 40m³. The system treats the wastewater on site with the effluent reused directly for toilet flushing, eliminating the need for sewage piping.

隨着空間有限而且在偏遠地區衛生設施需求不斷增加，需要一種具有成本效益而且能有效解決以滿足需求。正昌膜生化廁所系統是先進的廢水處理技術，結合了膜分離，生物處理和曝氣技術。系統針對生活廢水處理而設計，日處理水量可小於40立方米。當沒有排污管道，膜生物系統現場處理廢水，廢水直接回用於冲洗馬桶。

香港工商業獎 2017 HONG KONG AWARDS FOR INDUSTRIES 設備及機器設計大獎 EQUIPMENT AND MACHINERY DESIGN GRAND AWARD

2017 香港工商業獎 HONG KONG AWARDS FOR INDUSTRIES 創意獎 INNOVATION AND CREATIVITY AWARD

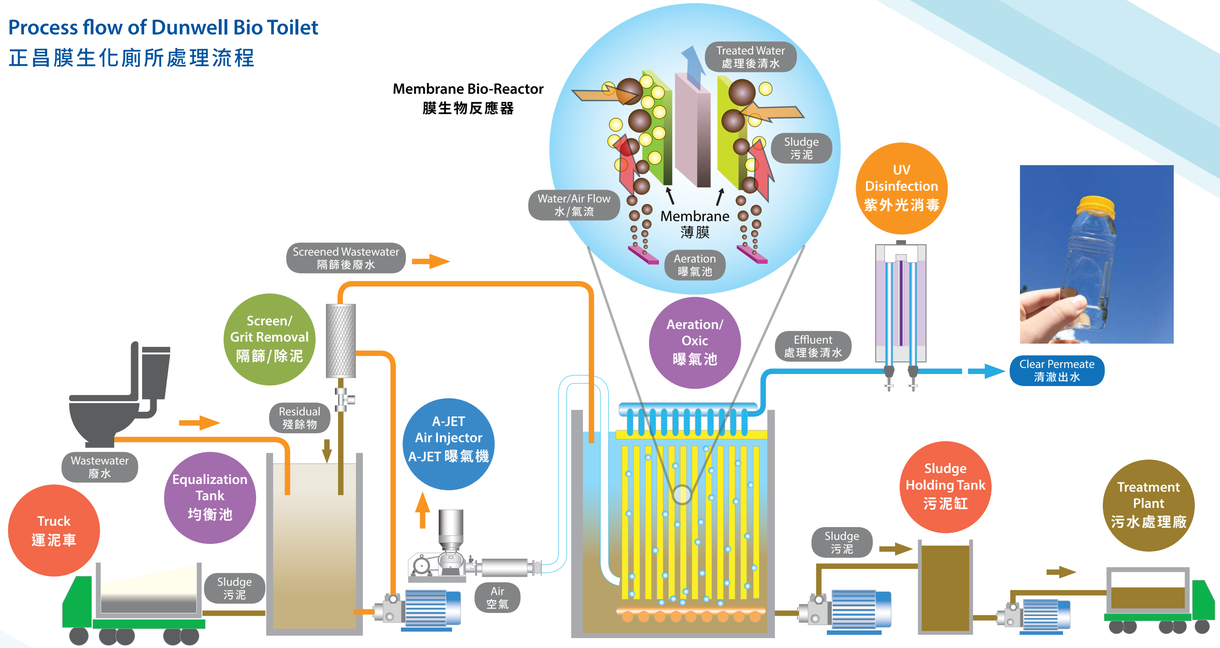
2017 香港工商業獎 HONG KONG AWARDS FOR INDUSTRIES 科技成就獎 TECHNOLOGICAL ACHIEVEMENT AWARD

24-hour Remote monitoring system
24小時在線監控

Dunwell Bio Toilet Sizing Chart 正昌生化廁所體積表

Model 型号	Design Flow (m³/day) 設計流量 (立方米/天)	Overall Dimension (Including Maintenance Space) 外形尺寸(包括維修空間)				
		Length (mm) 長度 (毫米)	Width (mm) 度 (毫米)	Height (mm) 高度 (毫米)	Necessary headroom (mm) 房間淨高 (毫米)	Membrane Area (m²) 膜面積 (平方米)
DBT-5	5	3,000	2,000	3,000	4,000	20
DBT-10	10	4,000	2,200	3,000	4,000	50
DBT-20	20	6,000	2,200	3,000	4,000	100
DBT-40	40	10,000	2,200	3,000	4,000	200

Process flow of Dunwell Bio Toilet
正昌膜生化廁所處理流程

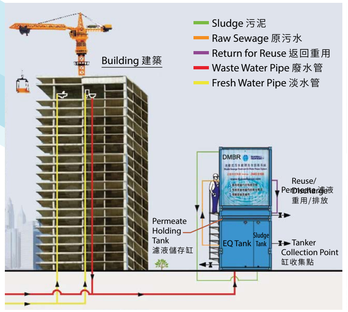


Advantages 優點

- On site reuse of treated water
  處理後出水現場回用
- Automated control by Programmable Logic Controller (PLC)
  全自動編程邏輯控制
- 24-hour Remote monitoring system
  24小時在線監控
- Eliminates sewage piping
  毋需排污渠
- High concentration of Mixed Liquor Suspended Solid (MLSS) (10,000-20,000mg/L) greatly improves efficiency
  混合中懸浮固體提濃(MLSS) (10,000-20,000毫克/升) 提升污水處理效率
- Completely removes suspended solids from effluent
  完全去除出水的懸浮固體
- Membranes have excellent durability and chemical resistance
  膜組性能優异,耐久性高和耐化学性
- Can easily add UV disinfection or Reverse Osmosis to further enhance effluent quality
  可以加裝紫外光消毒或加裝反滲透,進一步提高出水水質

Optional Features – Containerized Plant 可選設計 – 集裝箱裝置

Designed for construction sites and remote areas with limited space
專為建築工地和空間有限的偏遠地區而設計



Containerized plant installed
集裝箱式系統安裝

To cope with temporary demands, phased construction sites or extremely remote areas, Dunwell takes a step further and introduces a containerized version of Bio-Toilet. The entire treatment plant is fitted into a customized container which is compact and portable. It is designed to provide reliable and efficient sewage treatment for small scale applications.

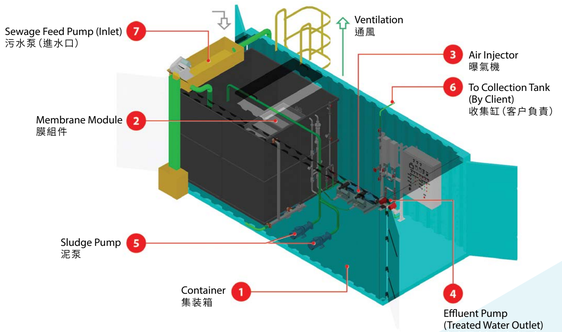
為了應對分階段建築工地或極為偏遠地區的臨時需求,正昌更進一步設計集裝箱式生化廁所。整個處理廠安裝在一個小型及可移動的集裝箱內。它旨在提供可靠和有效的小規模污水處理方案。

- Factory installed and tested, hence no construction works on site 於工廠進行出廠前安裝和測試,毋需現場施工
- Short delivery period 交貨期短
- Easy to relocate 易於搬運
- Minimal operation and maintenance attention needed 簡易操作和維護

Dunwell Bio Toilet Containerized Plant Sizing Chart 正昌集裝箱式生化廁所系統尺寸表

Model 型号	Design Flow (m^3/day) 設計流量 (立方米/天)	Overall Dimension (Including Maintenance Space) 外形尺寸(包括維修空間)			
		Length (mm) 長度 (毫米)	Width (mm) 寬度 (毫米)	Height (mm) 高度(毫米)	Membrance Area (m^2) 膜面積 (平方米)
DBT-C5	5	3,000	2,100	2,100	20
DBT-C10	10	3,000	2,100	2,100	50
DBT-C20	20	6,000	2,100	2,100	100
DBT-C40	40	12,000	2,100	2,100	200

Compact and modular design
預製式的設計



"Plug and Play" Design
「一駁即用」一體化設計

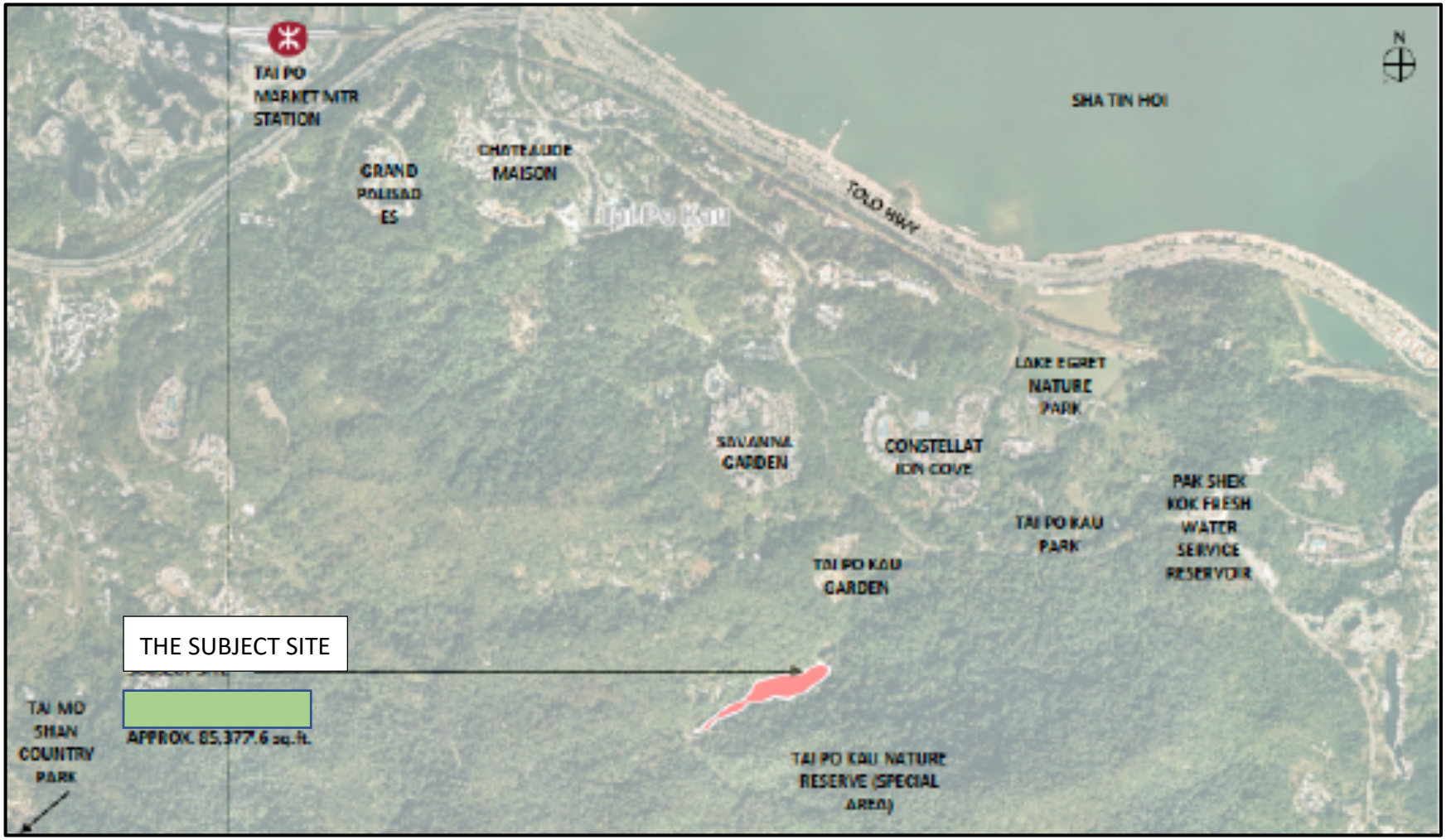
In the manufacturing factory
於廠房內準備搬運

Moving the packaged plant into the site
吊裝入場

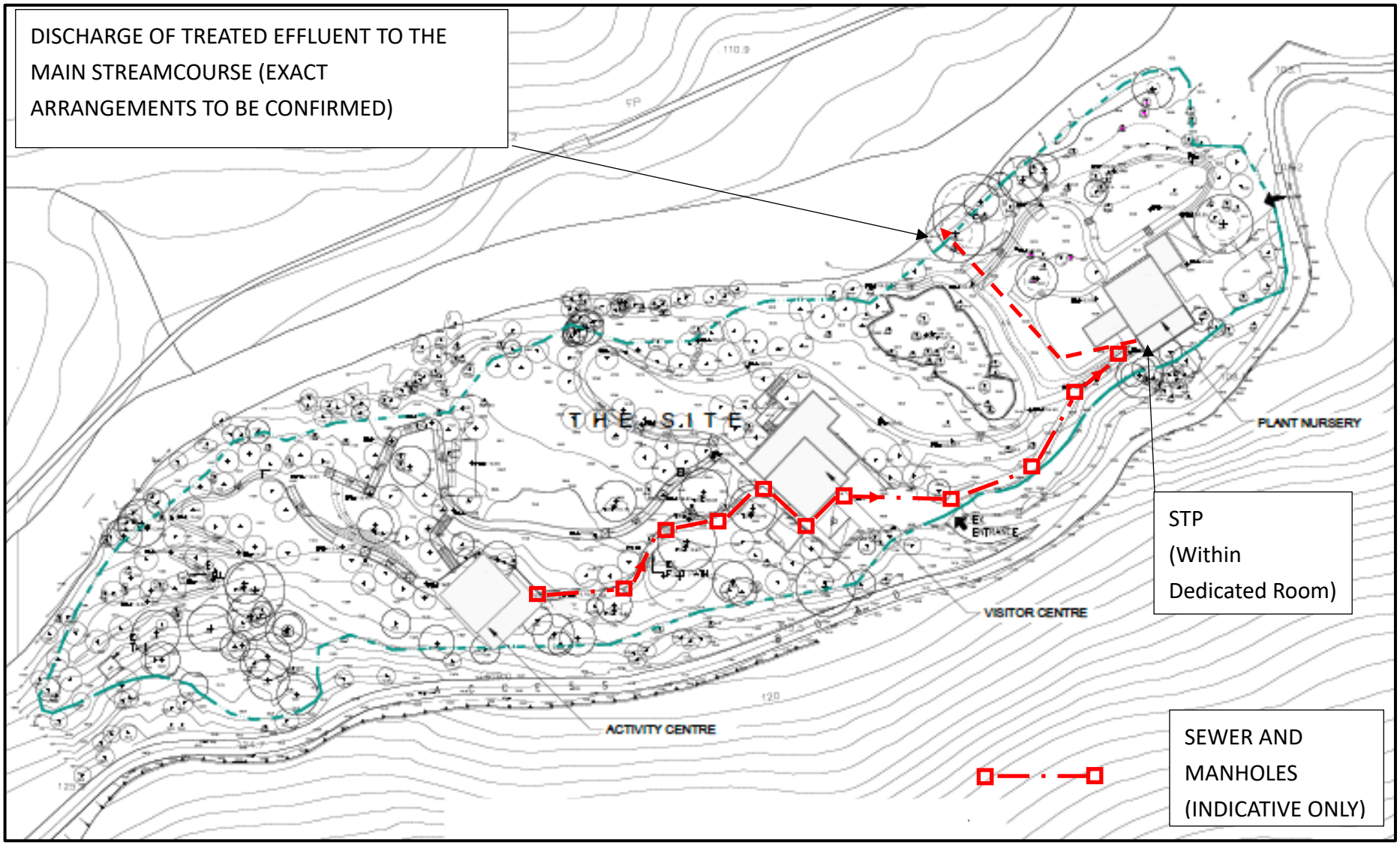
Installed into the site
安裝後的系統

Appendix E

Figures



Proposed Tai Po Kau Nature Academy	Site Location Plan
	Figure 1



Proposed Tai Po Kau Nature Academy	Proposed Sewage Collection, Treatment and Disposal Arrangement
	Figure 2