Civil Engineering and Development Department

Agreement No. CE 38/2010 (CE)

Liantang/Heung Yuen Wai Boundary Control Point and Associated Works (Site Formation and Infrastructure) – Design and Construction

Habitat Creation and Management Plan

November 2021

(Revision 4)

4th submission

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1 INTRODUCTION

Background

1.1 The "Liantang/Heung Yuen Wai Boundary Control Point and Associated Works Project" (hereinafter referred to as "the Project") comprises a new Boundary Control Point (BCP) proposed at Liantang/Heung Yuen Wai (LT/HYW), its connecting road and other associated works. The Layout of the Project is shown in Figure 1.1, comprising the following key components:

- Construction of BCP at the boundary with Shenzhen near the existing Chuk Yuen Village;
- Lin Ma Hang to Frontier Closed Area (FCA) Boundary – this section comprises at-grade and viaducts and includes the improvement works at Lin Ma Hang Road;
- Ping Yeung to Wo Keng Shan – this section stretches from the Frontier Closed Area Boundary to the tunnel portal at Cheung Shan and comprises at-grade and viaducts including an interchange at Ping Yeung;
- North Tunnel – this section comprises the tunnel segment at Cheung Shan and includes a ventilation building at the portals on either end of the tunnel;
- Sha Tau Kok Road – this section stretches from the tunnel portal at Wo Keng Shan to the tunnel portal south of Loi Tung and comprises at-grade and viaducts including an interchange at Sha Tau Kok and an administration building;
- South Tunnel – this section comprises a tunnel segment that stretches from Loi Tung to Fanling and includes a ventilation building at the portals on either end of the tunnel as well as a ventilation building in the middle of the tunnel near Lau Shui Heung; and
- Fanling – this section comprises the at-grade, viaducts and interchange connection to the existing Fanling Highway.

1.2 An Environmental Impact Assessment (EIA) study for the Project was conducted in accordance with EIA Study Brief No. ESB-199/2008. The EIA study concluded that the Project would be environmentally acceptable with the implementation of recommended mitigation measures.

1.3 The EIA Report (Register No.: AEIAR-161/2011) was approved on 24 March 2011 under the Environmental Impact Assessment Ordinance (EIAO). Following the approval of the EIA Report, an Environmental Permit (EP) was granted on 24 March 2011 (EP No.: EP-404/2011) for the construction and operation of the Project. Pursuant to Section 13 of the EIAO, the Director amended the EP (No. EP-404/2011/C) based on Application No. VEP-519/2016. The amendments were incorporated into the current EP (No. EP-404/2011/D).

1.4 The EIA identified 1.4ha of freshwater wetland habitat loss due to the proposed construction of the Project. On the basis of literature review and field surveys, these wetland habitats were considered of low (1.1 ha) or moderate (0.3ha) ecological value only. Nonetheless, given its ecological potential and the ecological significance of the cumulative loss of wetland, the EIA Report concluded that unavoidable freshwater wetland habitat required compensation by freshwater wetland habitat creation.

1.5 According to Condition 2.10 of the latest EP (No. EP-404/2011/D), the Permit Holder shall no later than three months before the commencement of construction of the Project, submit to the Director for approval 3 sets of Habitat Creation and Management Plan (HCMP) for the Wetland Compensation Area (WCA) of an area not less than 1.4 hectares (**Figure 1.2** refers). The submission shall take into account the recommendations of the EIA Report to set out details of the specifications for the habitats and ecological functions and to define the management and ecological monitoring and audit requirements of the WCA. Before submission to the Director, the

HCMP shall be certified by the ET Leader and verified by the IEC as conforming to the information and recommendations contained in the approved EIA Report.

Table 1-1 Compliance to EP Condition 2.10

No.	Key requirements as identified in EP Condition 2.10	Compliance made in this HCMP submission
1	*"The Permit Holder shall … submit to the Director for approval 3 sets of Habitat Creation and Management Plan (HCMP)"*	3 sets of hardcopies would be submitted to EPD for approval.
2	*"Wetland Compensation Area of an area not less than 1.4 hectares shown in Figure 2b of this Permit."*	WCA comprised of an area not less than 1.4 hectares as shown in **Figure 3.2**.
3	*"The submission shall take into account the recommendations of the EIA Report to set out details of the specifications for the habitats and ecological functions and to define the management and ecological monitoring and audit requirements of the Wetland Compensation Area."*	Section 3.23 tabulates the summary of the considerations of the EIA Report for setting out the details of the specifications for the habitats and ecological functions. The management and ecological monitoring and audit requirements of the Wetland Compensation Area have been elaborated in Section 4 of this report.
4	*"Before submission to the Director, the HCMP shall be certified by the ET Leader and verified by the IEC as confirming to the information and recommendations contained in the approved EIA Report."*	Certification by the ET Leader and Verification by the IEC as confirming to the information and recommendations contained in the approved EIA Report, have been incorporated in this HCMP submission.

1.6 AECOM Asia Co. Ltd (AECOM) has been commissioned by the Civil Engineering and Development Department (CEDD) to prepare and submit the Habitat Creation and Management Plan (HCMP).

1.7 This report is to provide the implementation and establishment details for the proposed Wetland Compensation Area (WCA).

Construction Contract Packaging

1.8 To facilitate project management and implementation, the Project will be implemented in the following contract packages:

- Contract 2 (CV/2012/08)
- Contract 3 (CV/2012/09)
- Contract 4 (TCSS/NE2014/02)
- Contract 5 (CV/2013/03)
- Contract 6 (CV/2013/08)
- Contract 7 (NE/2014/03)

1.9 The details of the contracts are summarized below:

Contract 2	
Contract No.:	CV/2012/08
Contract Name:	Liantang/ Heung Yuen Wai Boundary Control Point Site Formation and Infrastructure Works - Contract 2
Contract Period:	The works commenced in December 2013 and will take about 54 months to complete.
Major Scope of Works:	The works include construction of a dual two-lane trunk road (with about 0.4km of at-grade road and 4.8km of tunnel) connecting the Fanling Interchange with the proposed Sha Tau Kok Interchange, provision and installation of ventilation system, E&M works and building services works for Lung Shan tunnel and Cheung Shan tunnel and their portal buildings, Tunnel Administration Building adjacent to Wo Keng Shan Road and associated landscaping works, drainage / sewerage, waterworks, utilities and traffic engineering works.
Contractor:	Dragages Hong Kong Limited

Contract 3	
Contract No.:	CV/2012/09
Contract Name:	Liantang/ Heung Yuen Wai Boundary Control Point Site Formation and Infrastructure Works - Contract 3
Contract Period:	The works commenced in July 2013 and will take about 63 months to complete.
Major Scope of Works:	The works include construction of four link roads connecting the existing Fanling Highway with the south portal of the Lung Shan Tunnel, realignment of the existing Tai Wo Service Road West and Tai Wo Service Road East, widening portion of the existing Fanling Highway and the associated works, demolishment of the existing vehicular bridge and footbridge at Kiu Tau and reconstruction of the Kiu Tau Footbridge.
Contractor:	Chun Wo Construction and Engineering Company Limited

Contract 4	
Contract No.:	NE/2014/02
Contract Name:	Liantang/ Heung Yuen Wai Boundary Control Point Site Formation and Infrastructure Works - Contract 4
Contract Period:	The works are scheduled to commence in Q3 2015.
Major Scope of Works:	The works mainly include provision and installation of Traffic Control and Surveillance System for the connecting road.

Contract 5	
Contract No.:	CV/2013/03
Contract Name:	Liantang/ Heung Yuen Wai Boundary Control Point Site Formation and Infrastructure Works - Contract 5
Contract Period:	The works commenced in April 2013 and will take about 24 months to complete.
Major Scope of Works:	The works include site formation of about 23 hectares of land for the development of the new Boundary Control Point (BCP), diversion/modification of Lin Ma Hang Road, landscaping works, drainage/sewerage, waterworks, utilities and traffic engineering works.
Contractor:	Sang Hing Civil - Richwell Machinery JV

Contract 6	
Contract No.:	CV/2013/08
Contract Name:	Liantang/ Heung Yuen Wai Boundary Control Point Site Formation and Infrastructure Works - Contract 6
Contract Period:	The works commenced in June 2015 and will take about 40 months to complete.
Major Scope of Works:	The works include construction of a 4.6km long dual two-lane trunk road (with about 0.6km at grade roads, 3.3km viaducts and a 0.7km tunnel) connecting Sha Tau Kok Road Interchange to BCP, and the associated environmental mitigation measures, landscaping, drainage/sewerage, waterworks and utilities works.
Contractor:	CRBC-CEC-KADEN Joint Venture

Contract 7	
Contract No.:	NE/2014/03
Contract Name:	Liantang/ Heung Yuen Wai Boundary Control Point Site Formation and Infrastructure Works - Contract 7
Contract Period:	The works are scheduled to commence in Q3 2015.
Major Scope of Works:	The works include construction of the Hong Kong Special Administrative Region (HKSAR) portion of four vehicular bridges and one pedestrian bridge crossing Shenzhen (SZ) River (cross boundary bridges).

2 WETLAND COMPENSATION REQUIREMENTS IN THE EIA REPORT

Impacts on Freshwater Wetland Habitat

2.1 According to the EIA Report, Section 9.7.6, the 1.4ha freshwater wetland habitats directly impacted by the Project comprise mainly abandoned wet agricultural land. Section 9.8 of the EIA report states that loss of this type of habitat was identified in Loi Tung, Wo Keng Shan and Nga Yiu Ha area. All the potentially affected freshwater wetlands are dominated by thick herbaceous growth, predominantly *Hedychium coronarium*. The habitats are not actively managed, some are seasonally dry, and they are not regarded as optimal habitats for wetland-dependent birds. Freshwater wetlands directly affected by the Project are generally considered as having ecological value for sustaining aquatic communities such as amphibian and dragonfly species. On the basis of literature review and field surveys, the abandoned wet agricultural land found within the Assessment Area was found only in moderate to low ecological value.

Compensation on Wetland

2.2 Despite the relatively limited ecological value of affected wetlands, the EIA Report still considered that given its ecological potential and the ecological significance of cumulative loss of wetland, the loss of freshwater wetland should be compensated by habitat creation. Taking into consideration the existing situation of the habitats affected, the compensatory wetlands would target wetland communities in general (e.g., wetland-associated insects and amphibians) instead of wetland-dependent birds in particular.

2.3 The EIA Report identified that the WCA should be provided near affected habitats as far as possible for the purpose of on-site mitigation. The low-lying area contiguous with River Ganges near Ping Yeung Interchange was proposed as a potential location for the provision of compensation wetland (preliminary indicative boundary and conceptual layout plan of the WCA refer to **Figure 2.1** and **Figure 2.2** respectively). Details of the Wetland Compensation Plan (WCP) would be formulated and provided under an HCMP during the detailed design stage.

2.4 The Guiding Principles and Key Characters for wetland creation and management identified in the EIA Report are as follows:

Guiding Principles

- Recognition of the potential of the WCA to compensate for the loss of wetland function.
- Requirement that the wetland habitats should be largely self-sustaining – once the compensation wetlands are established, management should largely limit to maintenance works.
- Requirement that the wetland habitats should be provided with sustainable sources of water supply and amount of sunlight reaching the wetland habitats should be maximized as far as practicable.
- Requirement that hydrological changes as part of the compensation wetland creation must not increase the flood risk to other basin users.
- Understanding the feasibility of the provision of the required habitats and the habitat requirement of wetland communities.
- Recognition that monitoring is essential to assess the success or otherwise of the compensation wetland and to inform management decisions.

Key Characters

- The location of the WCA is contiguous with existing river channel which enables a potential ecological linkage between the river and the wetland.
- Rainfall and infiltration of groundwater are the main sources of water supply. Overflow of freshwater from contiguous River Ganges would provide a supplementary water source. The practicability and feasibility of using River Ganges as a supplementary water source would be further explored during the detailed design stage.
- The WCA will be re-profiled to a level comparable to the water table and the river-bed level of River Ganges. The WCA is self-sustainable in water management owing to the relative high-water table in the WCA.
- A total wetland area of at least 1.4 ha is proposed.
- The surplus of compensation area where possible, would be beneficial to mitigate the wetland loss during the time lag before the maturation of the WCA.

2.5 Implementation of the proposed WCA would involve the following fundamental steps:

- Identification of the exact profile of the wetland with more than 1.4 ha in area within the boundary of potential WCA. The amount of sunlight reaching the wetland should be considered during the wetland's detailed design stage and the road infrastructure. The decision would take into account the feasibility of the plan.
- To maintain the integrity of the proposed WCA and to avoid any trespass/unauthorised activities in the WCA, the WCA should be well demarcated and fenced off with appropriate hoarding and fencing during the construction and operation phases respectively. Maintenance parties of any hard landscape features including the fencing would be early identified.
- Site formation to re-profile the WCA to reach water table level; Site clearance, re-contour the wetland area, and connection with a sustainable source of water supply where appropriate.
- Planting of wetland vegetation. When preparing the Habitat Creation and Management Plan during the detailed design stage, shade-tolerant species of wetland plants should be considered to meet the site-specific condition of the proposed WCA.

3 HABITAT CREATION PLAN

WCA Location, Site Boundary and Baseline Condition

3.1 The proposed general location near the Ping Yeung Interchange adjacent to a section of Ping Yuen River was adopted for WCA. The WCA location is adjacent to the existing river channel to enable ecological linkage between the Ping Yuen River and the wetland.

3.2 The location and boundary of the WCA were slightly revised compared to that shown in EP-404/2011/D in response to a better understanding of site conditions (as detailed in **Figure 3.1** and **Table 3-1**). This change was approved by EPD on 26 November 2015.

Table 3-1 Change of WCA Site Boundary in Response to Site Conditions

No.	Items	Justifications for the change of Site Boundary
1	The actual landform in relation to the formation of the Created Wetland	The proposed wetland should be designed in a relatively “round” shape for better water retention. Those areas in narrow or odd shapes are not suitable to be converted as wetland.
2	Some existing site levels are higher than the designed pond level of the wetland	The area opposite the Ping Yuen River was much higher than the design level of the Created Wetland. Also, there was an existing hill at the western side of the Created Wetland, where had been determined as not suitable for Wetland's construction. Therefore, those areas were omitted from the approved HCMP rev. 2.
3	The 6m hard paved path confined the extent of wetland	After the commencement of the Contract, an additional 6m hard paved path was provisioned through the Created Wetland, and it physically divided the wetland into two parts. Further site analysis was conducted in later stage, and it determined that the wetland located at the northern side of the 6m hard paved path was not suitable to be converted as wetland, since it involved substantial construction cost and time implication, and it eventually weakens the cost-effectiveness of the wetland.
4	Actual alignment of Ping Yuen River was further verified on site	The actual alignment of the Ping Yuen River was verified on site after the commencement of the Contract, the works boundary of the Created Wetland was therefore slightly adjusted to tally with the actual site context.

3.3 The area of compensatory wetland was further enlarged from 1.42ha to 1.48ha due to revised road alignment bounding to the east of the site. This change also allows for a better arrangement of wetland areas within the WCA. A comparison of the original, Nov 2016 and final WCA is shown in **Figure 3.2.**

3.4 Existing habitat conditions at the WCA comprise abandoned agricultural land dominated by open grassy areas with occasional stands of common fruit trees (**Appendix 1** and **Appendix 2** refer) and some wetland associated species (**Table 3-2**). Wildlife at the WCA was surveyed on 25 August 2015 prior to commencement of construction, with a low diversity of common species recorded (**Table 3-3** to **Table 3-4**).

Table 3-2 Summary of Baseline Monitoring – Wetland Dependent Plant Species

Common Name	Common Name	中文名	Abundance
Water Hyssop [(1)]	*Bacopa monnieri*	假馬齒莧	++
Blunt Signal-grass [(1)]	*Brachiaria mutica*	巴拉草，爬拉草	+++
Taro [(1)]	*Colocasia esculenta*	芋	++
Diffuse Day-flower [(1)]	*Commelina diffusa*	節節草	+++
Laxspiculate Galingale [(1)]	*Cyperus distans*	疏穗莎草，疏穎莎草	+
Umbrella Plant [(1)]	*Cyperus involucratus*	風車草	++
Short-leaved Kyllinga [(1)]	*Kyllinga brevifolia*	短葉水蜈蚣	++
Hairy Knotweed [(1)]	*Polygonum barbatum*	毛蓼	++

Notes:
- [(1)]Wetland dependent species.
- A full list of flora species recorded in the area is shown in **Appendix 2.**
- Code for Abundance: +++++=dominant; ++++=abundant; +++=frequent; ++=occasional; +=scarce

Table 3-3 Summary of Baseline Monitoring – Dragonfly

Common Name	Scientific Name	中文名稱	Abundance
Blue Dasher	*Brachydiplax chalybea flavovittata*	藍額疏脈蜻	+
Common Red Skimmer	*Orthetrum pruinosum neglectum*	赤褐灰蜻	+
Wandering Glider	*Pantala flavescens*	黃蜻	+++++
Pied Skimmer	*Pseudothemis zonata*	玉帶蜻	+
Crimson Dropwing	*Trithemis aurora*	曉褐蜻	++

Note:
Code for Abundance: +++++=dominant; ++++=abundant; +++=frequent; ++=occasional; +=scarce

Table 3-4 Summary of Baseline Monitoring – Butterfly

Common Name	Scientific Name	中文名稱	Abundance
Common Mormon	*Papilio polytes polytes*	玉帶鳳蝶	+
Common Grass Yellow	*Eurema hecabe hecabe*	寬邊黃粉蝶	+
Angled Castor	*Ariadne 10riadne alterna*	波蛺蝶	+
Great Egg-fly	*Hypolimnas bolina kezia*	幻紫斑蛺蝶	+
Common Sailer	*Neptis hylas hylas*	中環蛺蝶	+
Common Sergeant	*Athyma perius perius*	玄珠帶蛺蝶	+
Red Ring Skirt	*Hestina assimilis assimilis*	黑脈蛺蝶	+

Note:
Code for Abundance: +++++=dominant; ++++=abundant; +++=frequent; ++=occasional; +=scarce

General Arrangement

3.5 The WCA area will be reprofiled to create a series of seven interconnected wetland ponds between the bridge viaduct columns. The wetland ponds will be graded to provide areas of open water along with areas of suitable depth for different types of wetland planting. A layer of 'sodium bentonite waterproofing composite' will be laid at the bottom of the ponds to minimize water leakage. Suitable growing medium such as imported soil mix or sandy clay loam will be provided for wetland vegetation cultivation. The general layout plan for the WCA is provided in **Figure 3.3**, and typical sections in **Figure 3.4**.

3.6 The wetland pools are designed to have a shallow water covering most of the area during the wet season, while during the dry months (usually occurs from November to March of the following year) water can still be retained at the deeper area of the ponds to sustain long-lived aquatic macroinvertebrates such as dragonfly larvae. The shallow, densely planted margins of the pools will provide suitable habitat for amphibians to breed, and the surrounding areas will provide additional habitat and refuge for adults.

Water Management

3.7 As shown in the drainage layout plan of the wetland ponds (Figure 3.9), hillside runoff is intercepted by the DN300 U-channel along the northern periphery of the WCA and collected by catch-pits connecting to the rock channel inlets for each wetland pond.

3.8 The seven wetland ponds will be hydrologically linked with DN300 balancing pipes and gate valves (Figure 3.5 and Figure 3.6 refer). Gate valves provide an option to isolate each pond for maintenance of one pond separately.

3.9 The EIA Report notes that rainfall and groundwater infiltration should be the main sources of water supply for the WCA. The overflow of freshwater from the Ping Yuen River is considered a supplementary source. Under the proposed design, the wetland's primary water supply will be rainfall runoff from the natural hillside north of the WCA. This catchment area is approximately 60,000m2.Details of catchment area is shown in **Figure 3.20**.

3.10 A separated water balancing analysis report has demonstrated the rainfall runoff can maintain the wetland water level between +9.5mPD (i.e. approximate 2m depth in dry season) and +11.5mPD (i.e. 4m depth in wet season) or above (water level of +10.5mpd or above could only be achieved by closing the water balancing pipes / during typical high flow event in Ping Yuen River). It also provides adequate water exchange and water quality. For emergency supply in extreme drought cases, a manual potable water inlet is also provided (**Figure 3.7 refers**). Stormwater harvested from the vehicular bridge will be discharged to the drainage system and combine flow from the wetland and overflow to the Ping Yuen River **(Figure 3.8 and Figure 3.9).**

3.11 Overflow from the wetland ponds will be discharged to the Ping Yuen River via DN300 outlet pipes **(Figure 3.9).** The compensation wetland creation will not increase the flood risk to other basin users due to water retaining capacity of the wetland ponds.

Vegetation Planting

3.12 A mixture of native/exotic wetland planting is proposed to suit the site context. Concerning the relative slow-growing habit of most native plants and the shady environment; a series of shade tolerant native and exotic wetland plants in the form of 6 types of plant matrix will be planted. The planting schedule is shown in **Figure 3.10**.

3.13 The fast growth exotic wetland plant may speed up the greening effect and provide a shelter to protect the slow-growing native wetland plant and control weed growth to a certain extent. The majority of wetland dependent species identified in the survey conducted on 25 August 2015 as shown in **Table 3-2** will be included in the species mix, along with notable species recorded from freshwater wetlands in the Project EIA (i.e., Hedychium coronarium), subject to the market availability. In case the wetland vegetation is not growing satisfactorily, species selection will be further reviewed in the later monitoring stage and replanting with alternative wetland species as required.

3.14 To enhance wetland biodiversity, the seven wetland pools will be carefully graded from 5° to 25° to create a variety of planting zones, as described in Table 3-5 and shown **in Figures 3.11 and 3.12:**

Table 3-5 Description of Planting Zones

The entrance	The entrance of wetland is open to the sky in the south-west and covered by the viaduct with an average 10.8m (H) headroom in north-east. It will be fully vegetated with the shade tolerant flowering shrubs to echo the existing environment. Loading and unloading bay paved with grasscrete will be provided for the maintenance vehicular parking. Surface U-channel will be provided along the perimeter of the wetland entrance. Thus, no surface water from the wetland will be drained out and the risk of flooding will be minimized.
Dry Zone	Dry Zone is proposed at above the estmitaed highest water level in wet season (+mPD11.5 or above) , planting will be relatively tall and no need to be immersed in water. Shade-tolerant flowering shrubs and broad leaved shrubs in the Plant Matrix 1 and 2 will be planted at Dry Zone. Some patches of bare ground will be reserved in the Dry Zone.
Semi Dry and Wet Zone	Semi Dry and Wet Zone is proposed at the water level in between dry and wet season (+mPD 10.5 to +mPD 11.5), planting will be able to tolerate flood and drought condition and their root system will be relative pliable but strong. Aquatic plants in the Matrix 3 and 4 are to be planted at Semi-Dry and Wet Zone. Some patches of bare ground may be reserved in the Semi Dry and Wet Zone. It encourages to sustain the aquatic communities such as amphibian and dragonfly species in year-round allow their migration within the whole wetland.
Wet Zone	Wet Zone is proposed at the water level at/below the water level at dry season (+mPD 10.5), planting will be floating on water and their root system shall be immersed in water at all time. Aquatic plants with floating habitat as identified in the Plant Matrix 5 and 6 are to be planted by the water edge at +mPD 10.5.

3.15 Patches of bare ground with boulders in various sizes will be maintained between planted areas (**Figure 3.13**). The soil in these open areas may facilitate the germination of self-seeded vegetation, while the boulders and stones act as a refuge for wetland fauna (particularly herpetofauna).

Other Works

3.16 To facilitate the departmental maintenance and inspections to the bridge piers, continuous hard-paved maintenance access at min. 1000mm wide is reserved. Multiple gates will be installed at the front of each maintenance path along the public footpath. Details of vehicular access gate and pedestrian access gates are shown in **Figures 3.14** and **Figure 3.15**.

3.17 Thematic plantings will be provided along the 6m footpath of the wetland to enhance visual interest, and sitting-out area will be provided near the entrance of wetland to encourage public enjoyment. The thematic planting within the wetland will be maintained by AFCD, while the street furniture will be maintained by other Department**. (Figure 3.16).**

3.18 Water level ruler will be provided for monitoring purpose. Details of water level ruler are shown in **Figure 3.17**.

3.19 Life Buoy will be provided as safety measures. Details of life buoy are shown in **Figure 3.18**.

3.20 Maintain the integrity of the wetland and to avoid any trespass/unauthorized activates, 1.2m railing will be constructed along the footpath of wetland. Details of the railing are shown in **Figure 3.19**.

3.21 For identification purpose, each pond will be annotated with a signage, Details of the signage are shown in **Figure 3.21.**

3.22 For demarcation of maintenance responsibilty between different departments, continuious kerbs will be installed along the edge of wetland adjencent to the 6m footpath. Details of kerbs are shown in **Figure 3.22.**

Summary

3.23 Summary of the considerations of the EIA Report for setting out the details of the specifications for the habitats and ecological functions are elaborated in **Table 3-6, 3-7** and **3-8.**

Table 3-6 Summary of Details of the Specifications for the Habitats & Ecological Functions (Guiding Principles)

Guiding Principles as identified in EIA Report Section 9.8.1	Design consideration in this HCMP submission
Recognition of the potential of the WCA to compensate the loss of wetland function.	The WCA is 1.48ha, larger than the 1.4 ha of freshwater wetland impacted by the project; and it conforms to the principles of "No-Net-Loss in Wetland function".
Requirement that the wetland habitats should be largely self-sustaining – once the compensation wetlands are established, management should largely limit to maintenance works.	A mix of native, shade-tolerant, drought-tolerant or aquatic species is carefully selected for the compensation wetlands. All of them are self-sustaining once the compensation wetlands are established.
Requirement that the wetland habitats should be provided with sustainable sources of water supply and amount of sunlight reaching the wetland habitats should be maximized as far as practicable.	A separated water balance analysis report conducted for the WCA demonstrates that rainfall collected from the adjacent catchment can sustain water levels throughout the year. Shadowing effect is unavoidable since 60% of at-grade area is covered by the viaduct structure, and it constrained the availability of direct sunlight to penetrate through the compensation wetlands. However, the amount of sunlight is maximized by enlarging the area at the entrance of the compensation wetlands.
Requirement that hydrological changes as part of the compensation wetland creation must not increase the flood risk to other basin users.	The wetland pools will collect and store run-off from the adjacent catchment: no increased flood risk to other basin users is therefore anticipated.
Understanding the feasibility of the provision of the required habitats and the habitat requirement of wetland communities.	Considering the existing situation of the habitats affected, the wetland created would be targeted for wetland communities in general (e.g., wetland associated insects and amphibians).

Guiding Principles as identified in EIA Report Section 9.8.1	Design consideration in this HCMP submission
Recognition that monitoring is essential to assess the success or otherwise of the compensation wetland and to inform management decisions.	Adaptive management and monitoring will be the main guiding principle. The compensation wetlands have been designed with the best available ecological information, including data on local species of conservation significance and general ecological design principles, as well as market availability of materials for construction. Ecological monitoring is required to evaluate the efficacy of wetland and acts as a source of empirical data to allow for adaptive management in the future. Active management of the subclimax community in the long-run will be the secondary guiding principle. Regarding community succession effects, continuous and active management is required to prevent the newly established subclimax community from being lost through minimum maintenance shall be aimed at.

Table 3-7 Summary of Details of the Specifications for the Habitats & Ecological Functions (Key Characters)

Key Characters as identified in EIA Section 9.8.1	Design consideration in this HCMP submission
The location of the WCA is contiguous with existing river channels which enables a potential ecological linkage between the river and the wetland.	Ecological linkage of existing river channels and the wetland ponds is enhanced. The physical connection between the Ping Yuen River and the wetland compensation wetland is enabled by the provision of balancing pipes that control the intake/ discharge of water resources. Selection of plant species has made reference to the Wetland Dependent Species identified in the baseline monitoring, which resembles the habitat requirement of existing insects and amphibians and enhances the ecological linkage with other habitats in the vicinity. Waterproofing Composite will be laid to seal up the pond base, which ensures no leakage of water from the wetland to the surrounding.
Rainfall and infiltration of groundwater are the main sources of water supply. Overflow of freshwater from contiguous River Ganges would provide a supplementary water source. The practicability and feasibility of using River Ganges as supplementary water source would be further explored during the detailed design stage.	A separate water balance analysis report conducted for the WCA demonstrates that rainfall collected from the adjacent catchment can sustain water levels throughout the year. River Ganges does not overflow due to the river bed's lower elevation relative to the WCA wetland bund during normal conditions.
The WCA will be re-profiled to a level comparable to the water table and the riverbed level of River Ganges. The WCA is self-sustainable in water management owing to the relatively highwater table in the WCA.	A separate water balance analysis conducted for the WCA demonstrates that rainfall collected from the adjacent catchment can sustain water levels throughout the year. There is no need to rely on groundwater, which can fluctuate in level through the year and as such is relatively unreliable water source. Details to refer to **Appendix 3.**
A total wetland area of at least 1.4 ha is proposed.	The wetland area has been maximized to 1.48 ha.
The surplus of compensation area where possible, would be beneficial to mitigate the wetland loss during the time lag before the maturation of the WCA.	A surplus of 0.08 ha wetland area has been provided to mitigate the ecological loss as far as practicable.

Table 3-8 Summary of Details of the Specifications for the Habitats & Ecological Functions (Implementation)

Implementation as identified in EIA Report Section 9.8.1	Design consideration in this HCMP submission
Identification of the exact profile of the wetland with more than 1.4ha in area within the boundary of potential WCA. Amount of sunlight reaching the wetland should be considered during the detailed design stage of the wetland and the road infrastructure. The decision would take into account the feasibility of the plan.	1.48 ha of wetland has been identified within the boundary of potential WCA. Amount of sunlight is considered, area with direct sunlight has been maximized and variety of shade tolerant species has been proposed as appropriate. Sufficient road infrastructure has been providing to connect with the local villages, and to serve for maintenance purpose.
To maintain the integrity of the proposed WCA and to avoid any trespass/ unauthorized activities in the WCA, the WCA should be well demarcated and fenced off with appropriate hoarding and fencing during the construction and operation phases respectively. Maintenance parties of any hard landscape features including the fencing would be early identified.	The wetland will be fenced off with 1.2m (H)railing whilst the overall development of Liantang/Heung Yuen Wai Boundary Control Point will be fenced off with chain-link fence to avoid any trespass/unauthorized activities. AFCD will be the maintenance agent of all hard landscape features within the wetland, which includes the railing along the site perimeter.
Site formation to re-profile the WCA to reach water table level; Site clearance, re-contour the wetland area and connection with a sustainable source of water supply where appropriate.	The compensation wetlands are carefully re-profiled with comprehensive consideration of water table levels, site clearance, re-contour and connected to a sustainable source of rainwater run-off supply from the adjacent catchment.
Planting of wetland vegetation. When preparing the Habitat Creation and Management Plan during the detailed design stage, shade-tolerant species of wetland plants should be considered to meet the site-specific condition.	A mix of native, shade-tolerant, drought-tolerant or aquatic species is carefully selected for the compensation wetlands. All of them are able to meet the site-specific condition of the proposed WCA. Provisions of change to as-planted species are allowed when necessary.
The implementation of the proposed WCA would commence within the construction phase after completion of the construction works at Ping Yeung Section. The implementation stage would firstly include about two years for construction of the wetland site and the following planting works. After implementation stage, the wetland is self-sustainable. The practicability and feasibility of using water from River Ganges, such as lowering of riverbank to allow overflow of freshwater in wet season and extraction of water from River Ganges before an inflatable dam nearby the WCA, should be further explored during the subsequent detailed design stage. Connection details between the wetland and the riverbank shall be submitted to DSD for approval prior to the WCP implementation. After construction, about 12 months would be required for the	The project proponent will implement the proposed WCA in accordance with the EIA, followed by the handover of works to AFCD for further maintenance.

Implementation as identified in EIA Report Section 9.8.1	Design consideration in this HCMP submission
establishment of the created wetland site. After the mitigation plantings are properly grown and established, AFCD would take over the maintenance and management of the ecological plantings.	
On-the-basis of similar freshwater wetland setting in Wo Keng Shan and Nga Yiu Ha (upstream direction of the WCA) where direct inflow of river water is not required, it is predicted that the WCA can be self-sustained. The water source can be supplemented with inflow of freshwater from contiguous River Ganges in wet season. Supplementary water source by extraction of water from River Ganges before an inflatable dam nearby the WCA would be considered during the detailed design stage upon liaison with the relevant government departments (e.g., Drainage Services Department, AFCD and Lands Department).	A separate water balance analysis conducted for the WCA demonstrates that rainfall collected from the adjacent catchment can sustain water levels throughout the year. Therefore, it is considered that the provision of "Supplementary water source by extraction of water from River Ganges before an inflatable dam nearby the WCA" is not necessary. If we install a gravity/balancing pipe at the riverbed connecting to Pond A, we have discussed with the Contractor and concluded that it was feasible to do it during a dry season in PY River. However, the water level of Pond A would be definitely lowered from the current +10.5mPD to +10mPD. It would reduce the pond water and also violate the intent to secure the pond water-retaining capacity. The water balancing analysis indicated that surface runoff from the hillside could maintain the water demand most of the time. PY River water levels are low in the dry season. The PY River's flow is quite low during the dry season (only 0.054 m3/s). The amount of low water flow during the dry season needs to sustain the diversity of aquatic life and the PY River's functioning ecosystem. We will treat this low flow as ecological flow. If we set a dam near pond A or use pumping facilities to abstract water to supply the wetlands in the dry season, this could have a secondary impact on river ecology itself. The water abstraction will affect the existing flow regime that protects river ecological integrity in PY River. All relevant governments, including AFCD and DSD had offered "no further comment" on this submission.
Since the WCA is self-sustainable in long term, it is expected the affected invertebrate species such as dragonfly nymph will recolonize the created wetland and develop a stable population in the WCA. Therefore, the loss of ecological function due to the loss of freshwater wetland can be fully mitigated with the proposed WCA. A Habitat Creation and Management Plan including detailed layout, monitoring and management would be finalized and submitted in the detailed design stage before commencement of works under the Project.	A Habitat Creation and Management Plan is herewith submitted for EPD's review. Designed wetland features resemble those has been lost, in order to retain ecological value in the vicinity. Habitat heterogeneity and diversity of micro habitats shall be enhanced by creating various wetland types, different vegetation composition and aerial coverage, so as to be made available to various wetland wildlife. Also, areas of open water optimize ecocline in designed irregularities whilst patches of bare zones create islands for greater niche capacity.

4 MONITORING PLAN

4.1 Ecological monitoring at implementation and establishment periods will be conducted to cover the ecological attributes. Implementation of the wetland will commence within the construction phase after completion of the construction works at Ping Yeung Section. According to Section 5.3.2.4 of the latest EM&A Program (Revision 7), monitoring on the WCA will be conducted in the implementation and establishment stages. The monitoring would be conducted by the Environmental Team (ET) and supervised by a qualified ecologist (Project Ecologist) who will be formed as a member of the ET.AFCD will be responsible of the maintenance and the monitoring works which is not covered in this manual after the handover of the wetland.

Table 4-1 Compliance to Section 5.3.2.4 of the latest EM&A Program (Revision 7)

	Key requirements as identified in Section 5.3.2.4 of the latest EM&A Program (Revision 7)	Compliance made in this HCMP submission
1	*"In order to mitigate the ecological impact o floss of 1.4 ha freshwater wetland, more than 1.4 ha Wetland Compensation Area (WCA) will be created near Nga Yiu Ha."*	Wetland Compensation Area comprised of an area not less than 1.4 hectares as shown in Figure 3.2.
2	*"According to the proposed plan, theprogramme will comprise implementation, establishment and maintenance stages."*	Section 5.1 described the general programme of implementation, establishment and maintenance for the Wetland Compensation Area.
3	*"Ecological monitoring at implementation and establishment periods will be conducted to cover the ecological ttributes. Implementation of the wetland will commence within the construction phase after completion of the construction works at Ping Yeung Section."*	Section 4.2 – 4.9 detailed the monitoring requirement of the Wetland Compensation Area at implementation and establishment periods.
4	*"Monitoring on the WCA will be conducted in implementation and establishment stages.The monitoring shall be conducted by the Environmental Team (ET) and supervised by a qualified ecologist (Project Ecologist) who will be formed as a member of the ET.After establishment stage, AFCD will beresponsible of the maintenance and the monitoring works, which is not covered in this Program."*	The monitoring would be conducted by the Environmental Team (ET) and supervised by a qualified ecologist (Project Ecologist) who will be formed as a member of the ET. After establishment stage, AFCD will be responsible of the maintenance and the monitoring works, which is not covered in this manual after the handover of WCA.

Monitoring in Implementation and Establishment Stage

4.2 Monitoring in implementation and establishment stage is summarized in the **Table 4-2** and findings of the monitoring would be reported in the Monthly and Quarterly EM&A Reports.

Table 4-2 Summary of Monitoring in Implementation and Establishment Stage

Monitoring Parameters	Frequency
Site Inspection	Weekly
Monitoring of Water level in the ponds	Monthly
Monitoring of Water Quality	Monthly (for in-situ parameters)
	Every six months (for laboratory testing)
Monitoring of Vegetation Cover	Every six months
Monitoring of Dragonflies	Twice per month (April to August) Monthly (September to March)
Monitoring of Butterflies	Monthly
Monitoring of Amphibians	Monthly (March to October) Every two months (November to February)

Water Level

4.3 Monitoring of water level at the centre of each pool will be conducted on a monthly basis.

Water Quality

4.4 *In-situ* water quality will be measured in each pool once per month. The following parameters will be monitored:

- Temperature
- pH
- Dissolved Oxygen
- Turbidity

4.5 In addition, every six months (end of the wet season, in September, and end of the dry season, in March) water samples will be collected at each pool and the following parameters will be tested by a HOKLAS laboratory:

- Ammoniacal nitrogen
- Biochemical oxygen demand
- Total oxidized nitrogen
- Total phosphorus
- Total reactive phosphorus (orthophosphate)

Monitoring of Vegetation Cover

4.6 Detailed floristic surveys will be conducted at six monthly intervals at the end of the wet season (September) and the end of the dry season (March). A number of 2mx2m quadrats will be used for the survey. Within each quadrat all plant species and their densities will be identified to species-level and estimated respectively. The percentage cover of bare ground, leaf litter cover and coverage by each species will be measured. The tallest height of each plant species will be measured in nearest cm. Any rare or protected species will also be identified.

Monitoring of Dragonflies and Buffterflies

4.7 Dragonfly and butterfly utilization of the site will reflect the effectiveness of the compensatory wetland . Surveys for dragonflies will be undertaken twice per monthly during the peak period of dragonfly emergence (April to August). Monthly monitoring will be conducted during other months. Surveys for butterflies will be conducted monthly. Survey will be conducted during the middle of the day to coincide with the peak flight time for these species.

4.8 During the surveys a fixed survey route will be followed. All dragonfly and butterfly species observed will be identified and counted. Dragonfly exuviae will be recorded qualitatively to monitoring breeding success.

Monitoring of Amphibians

4.9 Amphibians colonising the WCA will be surveyed. Survey will be conducted monthly (March to October) and bi-monthly (November to February). Species and abundance of amphibian adults and juveniles should be recorded by direct visual and aural observation and active searching of potential micro-habitats. Surveys should be undertaken during the day and night.

Performance Limits and Action Plans

4.10 It is recognised that during the implementation and establishment periods, ecological functionality of the WCA will still be developing, and it will take time for wetland-associated fauna to colonise the newly created habitats. Performance limits and action planning will therefore focus on assuring the correct environmental conditions have been established (with regard to water management and vegetation communities) to establish sustainable wetland ecosystem in the medium- to long-term.

4.11 **Table 4-3** shows the proposed Wetland Quality Performance Limits and the corresponding Contingency Plans. The proposed plans will be reviewed and updated on a quarterly basis by the ER based on the monitoring results and situation of the site in future. Any proposed changes, if necessary, would be agreed with ET, Ecologist and IEC and submitted to relevant Authority for approval.

Table 4-3 Wetland Quality Performance Limits and Contingency Plan

Monitoring Parameters	Action Level	Limit Level	Action
Flooding/storm damage	NA	NA	Discuss among ETL, Ecologist, IEC, ER and the Contractor to review and determine damage. If necessary, ER to review design and agree mitigation measures with ETL, Ecologist and IEC, and the Contractor to undertake repairs/modifications.
Area of water coverage in wet season	<50%	Water in one of the ponds is isolated	**AL:** Double the monitoring frequency. Discuss among ETL, Ecologist, IEC, ER and the Contractor to Identify and review the problem. If the water coverage (in m2) decrease by 50%, to increase the monitoring frequency from monthly basis to bi-weekly basis. **LL:** Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. Consider providing supplementary water (from potable source)

Monitoring Parameters	Action Level	Limit Level	Action
Area of water coverage in dry season	<10%	Water level below +9.5mPD for more than 2 weeks.	**AL:** Discuss among ETL, Ecologist, IEC, ER and the Contractor to Identify and review the problem. If the water coverage (in m2) decrease by 10%, but the water level is still higher than +9.5mPD, to increase the monitoring frequency from monthly basis to bi-weekly basis. **LL:** Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. Add the water in all ponds and maintain the water level at the acceptance level in dry season (i.e., not lower than +9.5mPD).
Monitoring of Water Quality	AL and LL will be established after the wetland formed.		AL:Double the monitoring frequency. Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. Action plan for the limit level exceedance should be implemented in case further deterioration is expected. LL: Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem and if necessary agree on mitigation measures. The Contractor will be responsible to undertake repairs/modifications to resume the water quality.
Vegetation in permanent open water designed last during dry season	Area >10%	Area >20%	AL: Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. Action plan for the limit level exceedance should be implemented in case further deterioration is expected. LL: The Contractor will be responsible to remove the vegetation.
Vegetation cover on the seasonal water level fluctuation area	Area <60%	Area <40%	AL: Double the monitoring frequency. Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. Action plan for the limit level exceedance should be implemented in case further deterioration is expected. LL: Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem, in particular the species of planting. The Contractor will be responsible to undertake supplemental planting.

Monitoring Parameters	Action Level	Limit Level	Action
Monitoring of Dragonflies	Species identified in the baseline monitoring cannot be found in two successive monitoring periods	Species identified in the baseline monitoring cannot be found in four successive monitoring periods	**AL**: Double the monitoring frequency. Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. Action plan for the limit level exceedance should be implemented in case the problem is likely due to the Project works or the design. **LL**: Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. ER/The Contractor to provide feasible mitigation measures in case the problem was due to the Project works. If necessary, ER to review the design and the Contractor to provide necessary modification.
Monitoring of Butterflies	Species identified in the baseline monitoring cannot be found in two successive monitoring periods	Species identified in the baseline monitoring cannot be found in four successive monitoring periods	**AL**: Double the monitoring frequency. Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. Action plan for the limit level exceedance should be implemented in case the problem is likely due to the Project works or the design. **LL**: Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. ER/The Contractor to provide feasible mitigation measures in case the problem was due to the Project works. If necessary, ER to review the design and the Contractor to provide necessary modification.
Amphibians	Not observed	Not observed in two successive monitoring periods	**AL**: Double the monitoring frequency. Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. Action plan for the limit level exceedance should be implemented in case the problem is likely due to the Project works or the design. **LL**: Discuss among ETL, Ecologist, IEC, ER and the Contractor to identify and review the problem. ER/The Contractor to provide feasible mitigation measures in case the problem was due to the Project works. If necessary, ER to review the design and the Contractor to provide necessary modification.

5 IMPLEMENTATION PROGRAMME

5.1 The wetland would be constructed after completion of the construction works at Ping Yeung Section. The implementation stage would firstly include about two years for the construction of the wetland. After construction, about twelve months would be required for the establishment of wetland habitats.

5.2 The management details of the WCA depends on the ecological monitoring and audit results and will be provided at the later stage of the establishment period.

5.3 After establishment stage, AFCD will be responsible of the maintenance and the monitoring works which is not covered in this manual after the handover of the Wetland.

5.4 Connection details between the wetland and the river bank would be submitted to DSD for approval prior the construction.

5.5 According to EP Condition 3.6, all measures recommended in the HCMP approved under Condition 2.10 of this Permit respectively shall be fully implemented and thereafter maintained.

5.6 The Permit Holder shall ensure the ecological mitigation measures stated in HCMP are properly implemented, maintained and monitored during the entire period of the life of the Project.

5.7 This submission has taken into account the recommendations of the EIA Report to set out details of the specifications for the habitats and ecological functions and to define the management and ecological monitoring and audit requirements of the WCA.

5.8 This HCMP had been certified by the ET Leader and verified by the IEC as confirming to the information and recommendations contained in the approved EIA Report.

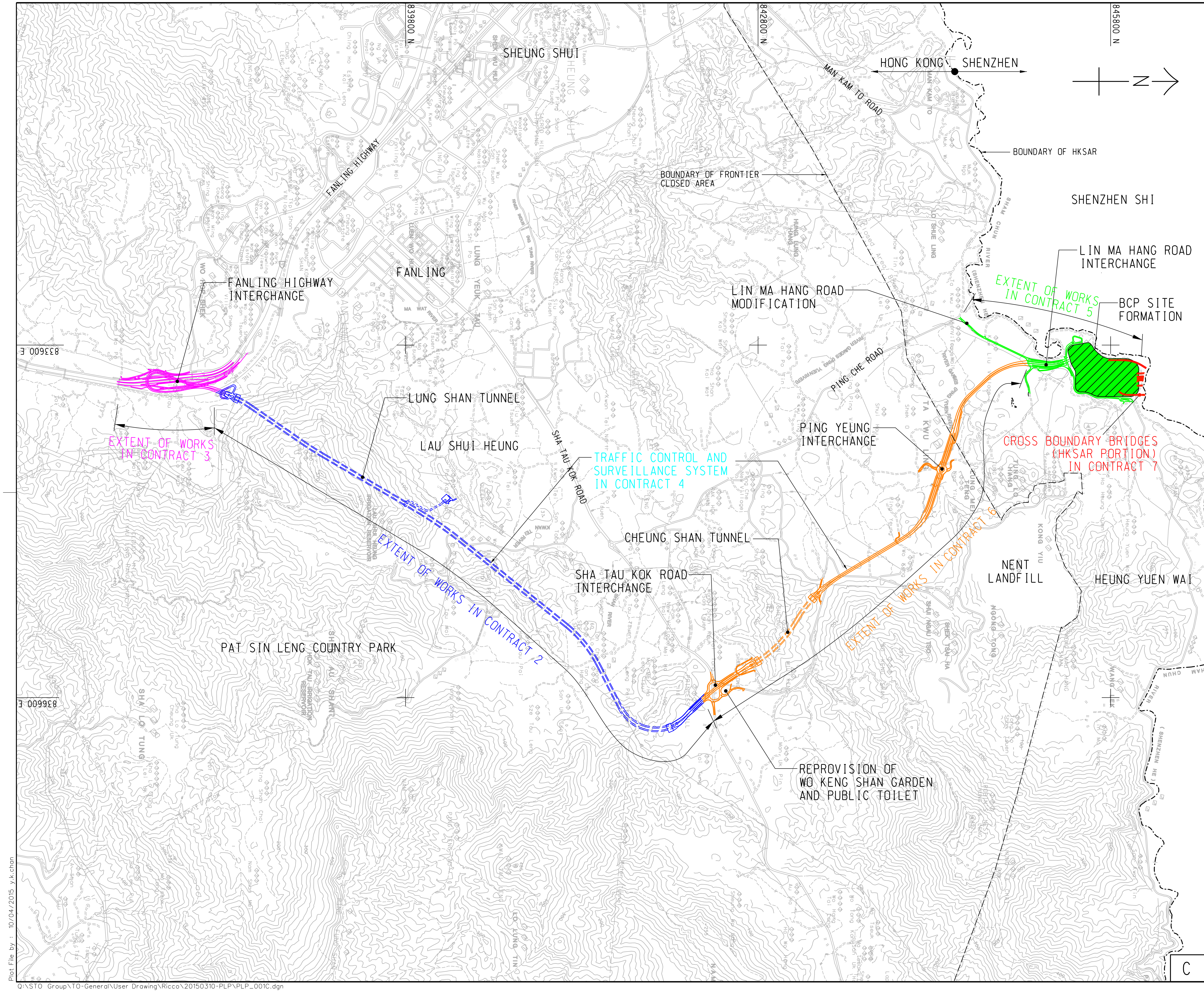
6 CONCLUSION

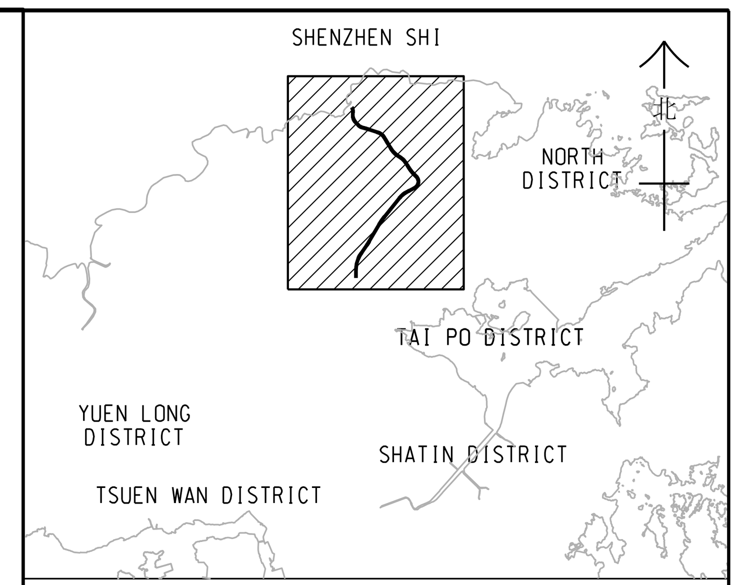
6.1 1.4ha of freshwater wetland habitat loss was identified in the EIA Report. On the basis of literature review and field surveys, the abandoned freshwater wetlands impacted by the Project were found to be of low or moderate ecological value only. Nonetheless, in view of its ecological potential and the ecological significance of cumulative loss of wetland, the loss of freshwater wetland is proposed to be compensated by creation of a freshwater wetland.

6.2 The Permit Holder is therefore required to compensate a freshwater wetland area not less than 1.4 hectares and provide a HCMP.

6.3 This HCMP provides detailed information for the implementation and establishment of a **1.48ha** in area of freshwater wetland.

Figures





LOCATION PLAN
SCALE 1 : 30000

LEGEND:

– – – – – – UNDERGROUND WORKS

土木工程拓展署
Civil Engineering and Development Department

LIANTANG/HEUNG YUEN WAI BOUNDARY CONTROL POINT AND ASSOCIATED WORKS (SITE FORMATION AND INFRASTRUCTURES) - DESIGN AND CONSTRUCTION

PROJECT LAYOUT PLAN

AECOM

DRG.NO. 圖紙編號 Figure 1.1

DRAWN BY ZJ
SCALE A1 1 : 15000 A3 1 : 30000
DIMENSIONS ARE IN METRES

C

Figure 1.2 Location of Wetland Compensation Area Identified In EP-404/2011/D

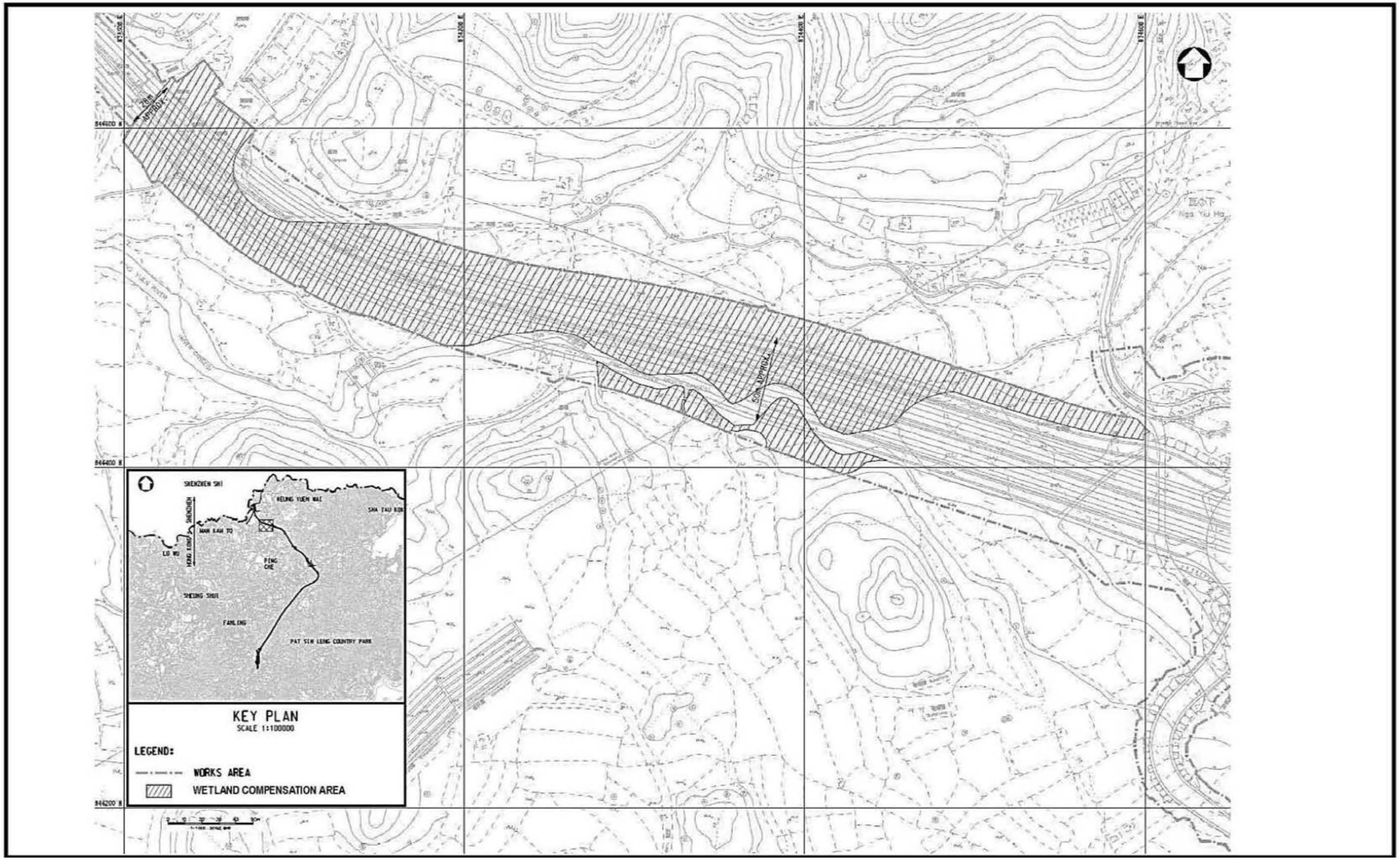


Figure 2b **圖二 b**	**Liangtang / Heung Yuen Wai Boundary Control Point and Associated Works 蓮塘/香園圍口岸與相關工程** **Location of Wetland Compensation Area 濕地補償地區位置** **The figure was prepared based on Figure 2 b of Application for Variation of Environmental Permits (No. VEP466/2015)** **本圖是根據更改環境許可證申請(編號:VEP466/2015)的圖二 b 編制**	**Environmental Permit No.:EP-404/2011/D** **環境許可證編號:EP-404/2011/D**

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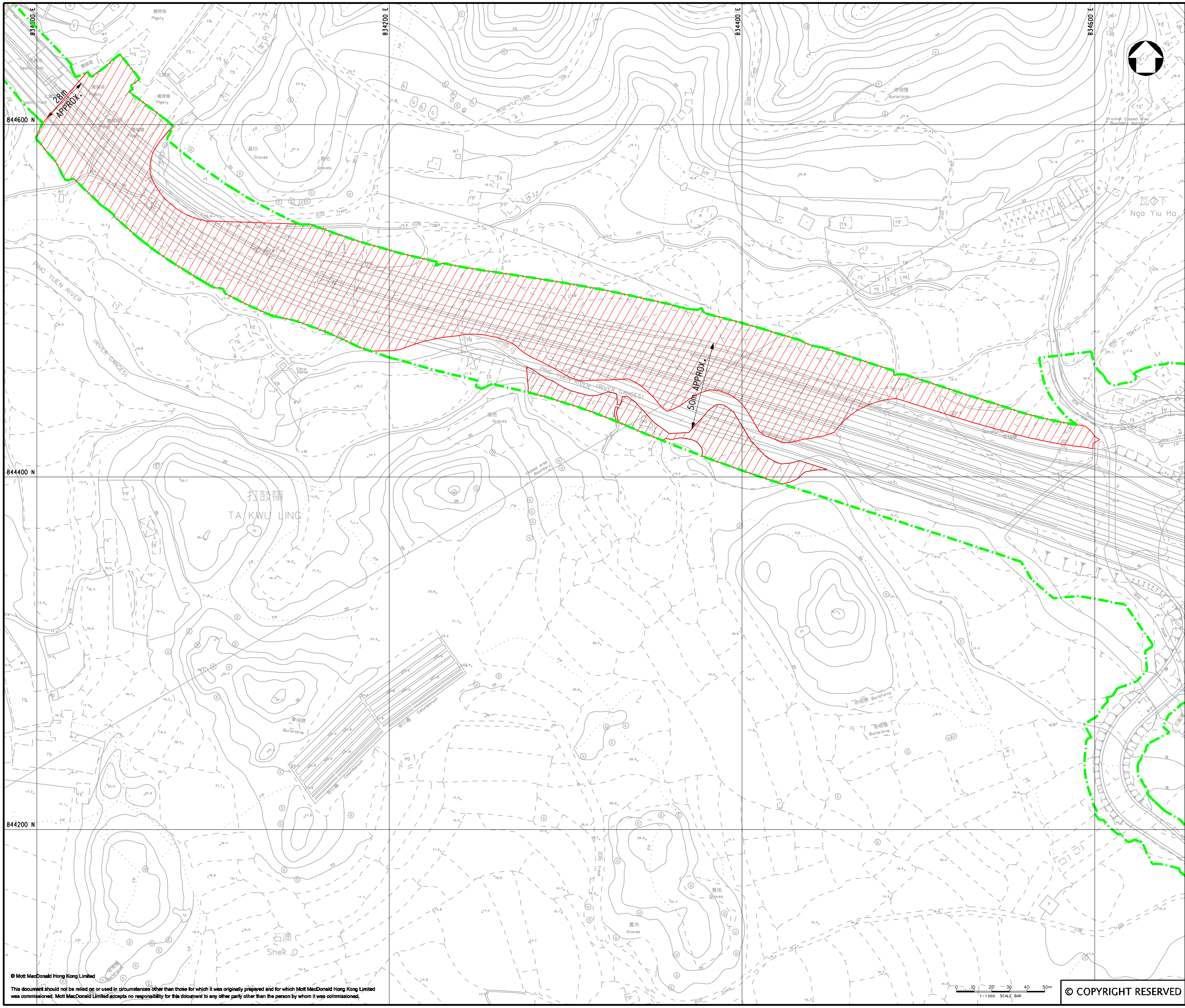

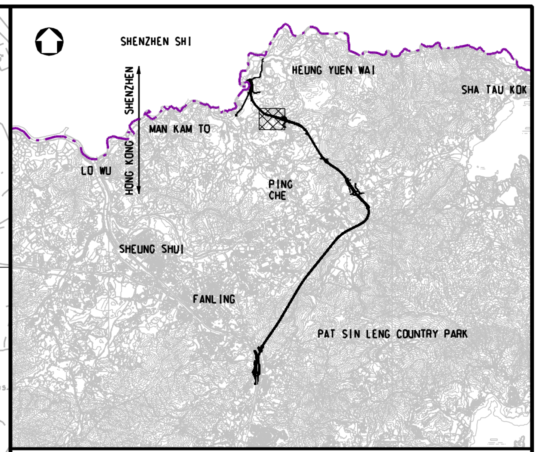

KEY PLAN
SCALE 1:100000

LEGEND:

- WORKS AREA
- PROPOSED WCA

Rev	Date	Drawn	Description	Ch'k'd	App'd
P2	NOV 10	MING	GENERAL REVISION	PW	HT
P1	OCT 10	MING	FIRST ISSUE	PW	HT

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CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT

Project

AGREEMENT NO. CE45/2008(CE)
LIANTANG/HEUNG YUEN WAI BOUNDARY CONTROL POINT AND ASSOCIATED WORKS

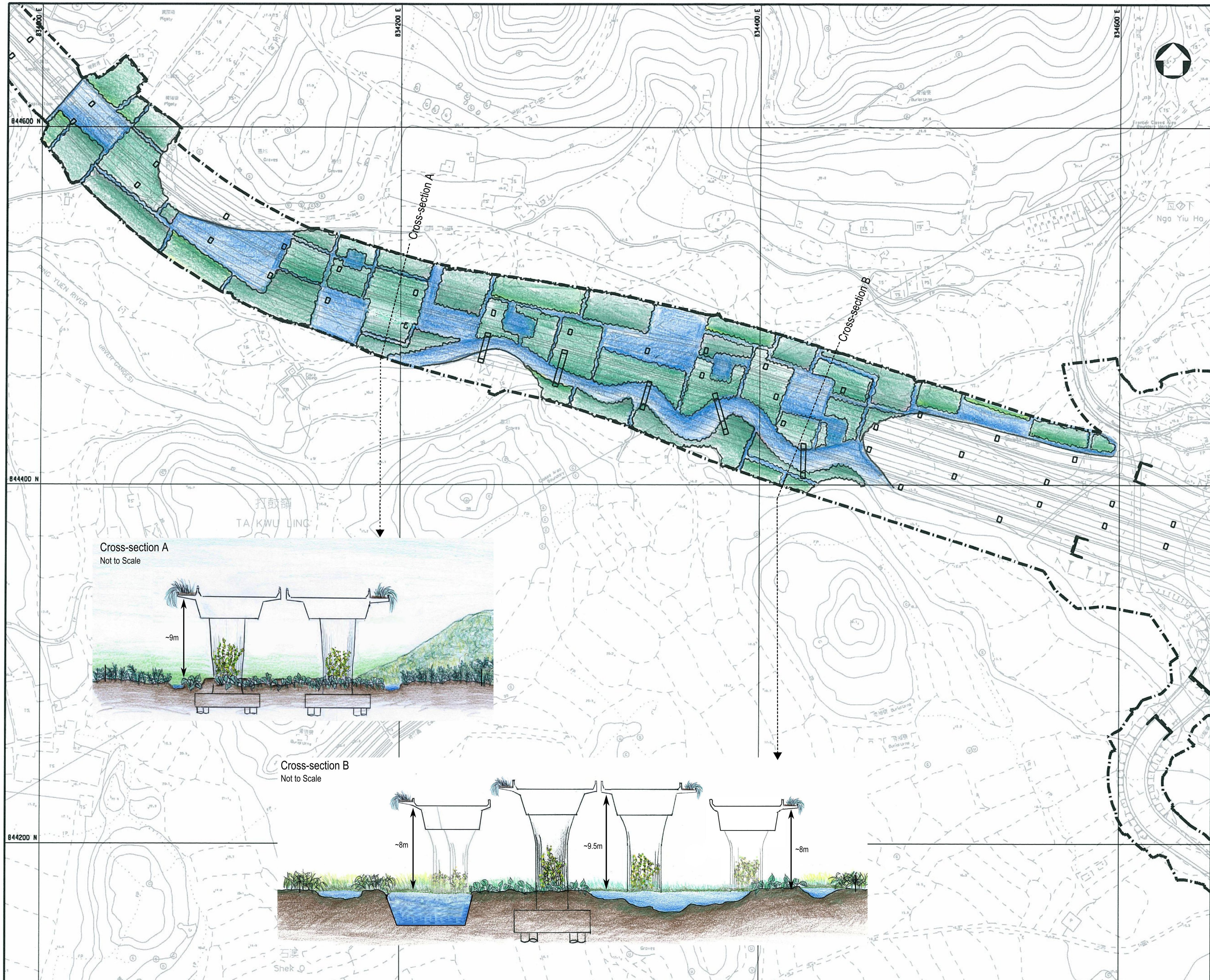
Title

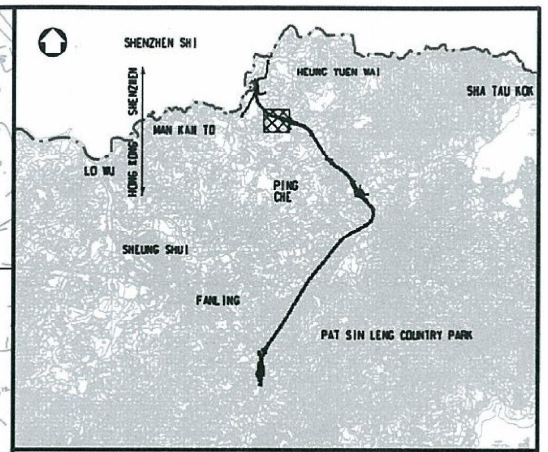
INDICATIVE BOUNDARY OF THE POTENTIAL WETLAND COMPENSATION AREA

Designed	HY	Eng.Chk.	EC
Drawn	MING	Coordination	EC
Dwg.Chk.	HY	Approved	HT

Scale at A1	Project	Status
1:1000	255228 CAD file J:\255228\REPORT\ENV\EIA\IOHS\FIG 9-27.dgn	PRE

Drawing No		Rev
	Figure 2.1	P2





KEY PLAN
SCALE 1:100000

LEGEND:

WORKS AREA

OPEN WATER

INDICATIVE WETLAND PLANTING

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	OCT 10	MING	FIRST ISSUE	GC	HT

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CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT

Project

AGREEMENT NO. CE45/2008(CE)
LIANTANG/HEUNG YUEN WAI BOUNDARY CONTROL POINT AND ASSOCIATED WORKS

Title

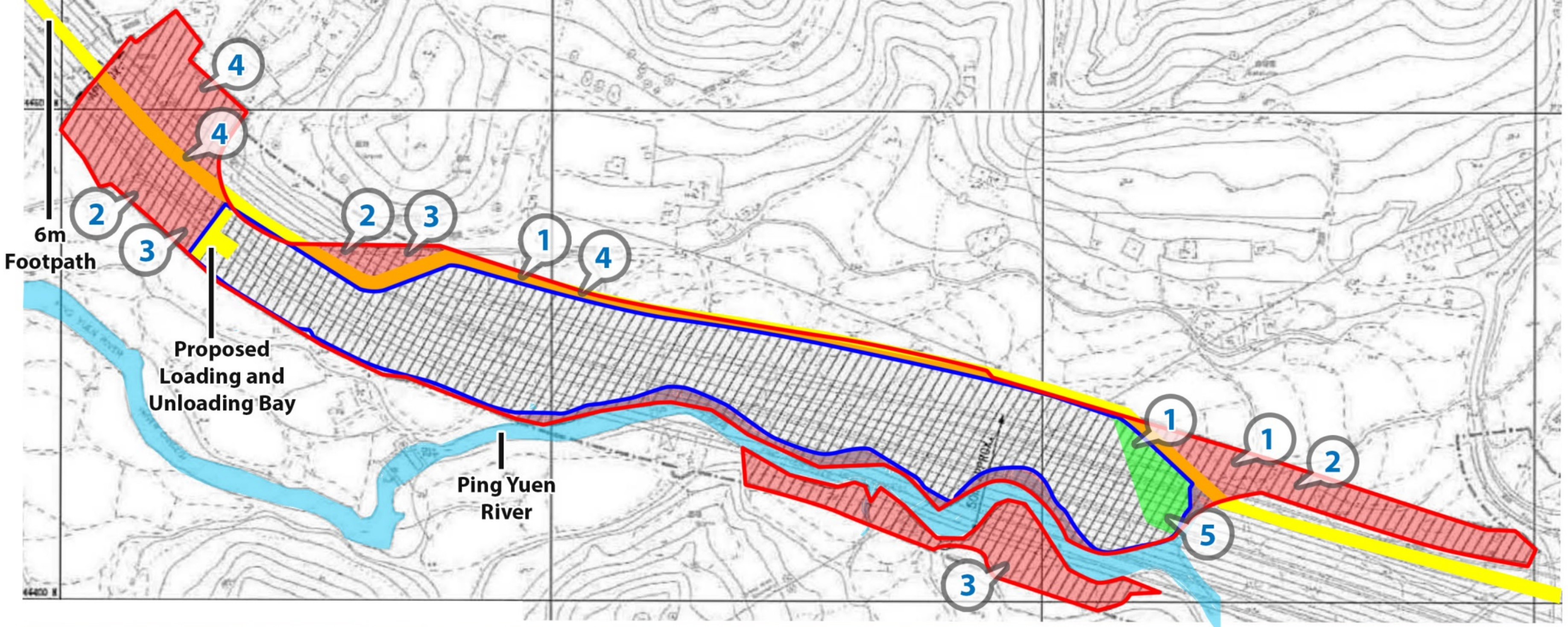
CONCEPTUAL PLAN AND TYPICAL CROSS-SECTION VIEWS OF THE PROPOSED WETLAND COMPENSATION AREA

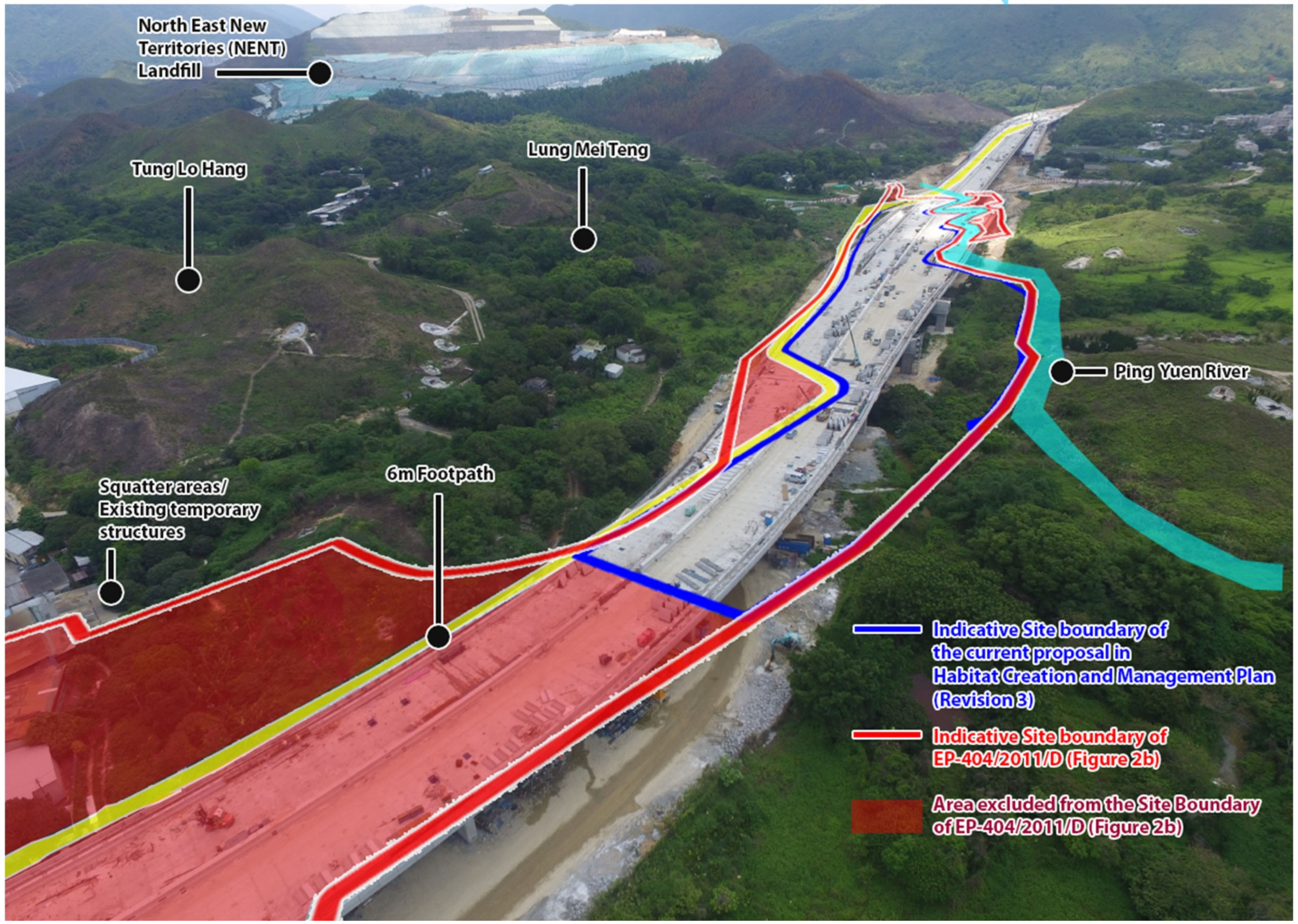
Designed	HY	Eng.Chk.	EC
Drawn	MING	Coordination	EC
Dwg.Chk.	HY	Approved	HT

Scale at A1	Project	Status
Not to Scale	255228	PRE
	CAD file	

Drawing No: **Figure 2.2**

Rev: P1





Justifications for the change of Site boundary

Figure 3.1

AECOM

1 The actual landform in relation to the formation of the Created Wetland

The proposed wetland should be designed in relatively "round" shape for better water retention, those areas in narrow or odd shape are not suitable to be converted as wetland.

2 The distance of water supply from the Ping Yeung River

According to the approved HCMP, Ping Yuen River serves as the main water supply source for the Created Wetland, area located far from Ping Yuen River was actually not feasible to be converted as wetland since there was technical constraint to discharge water from the Ping Yuen River to the area which was not directly attached to the river.

3 Some existing site levels are higher than the designed pond level of the wetland

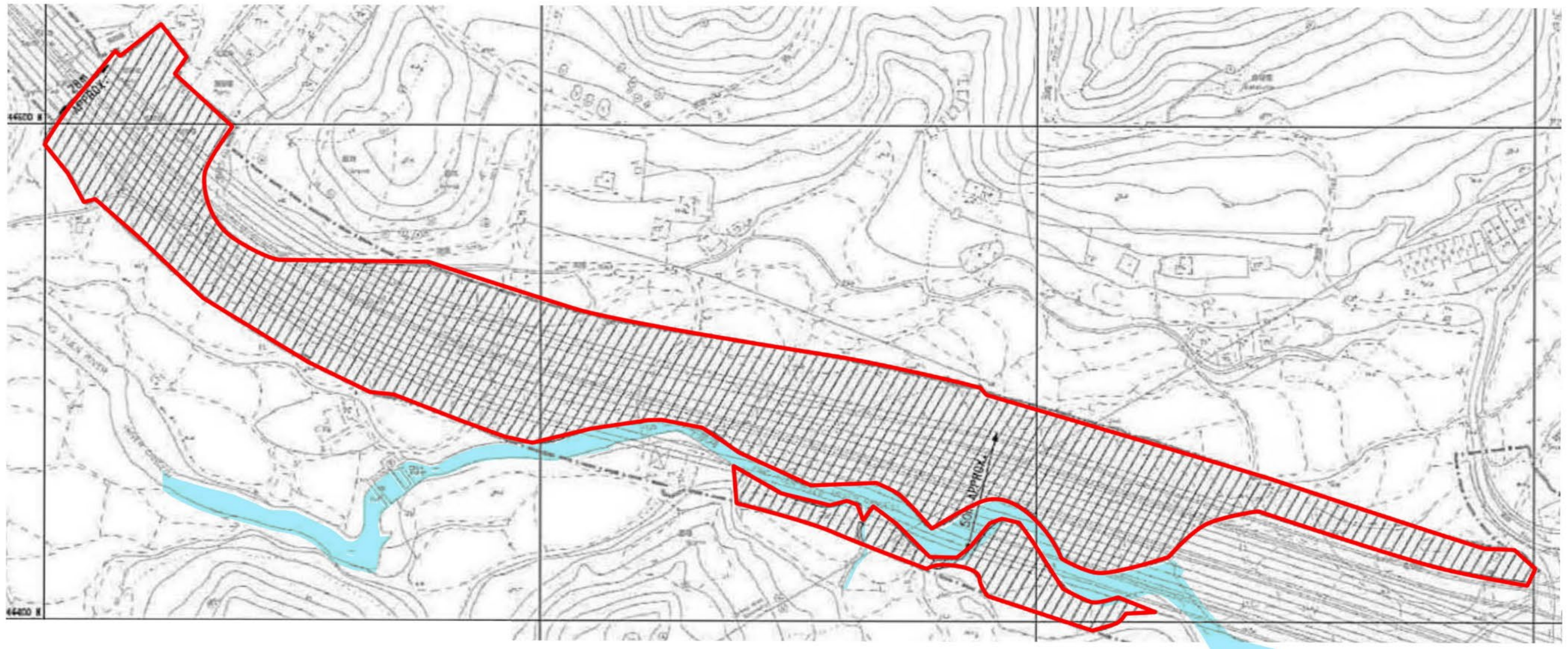
The area opposite the Ping Yuen River was actually much higher than the design level of the Created Wetland and also there was an existing hill at the western side of the Created Wetland, where had been determined as not suitable for the construction of Wetland. Therefore, those area were omitted from the approved HCMP rev. 2.

4 The 6m hard paved path confined the extent of wetland

After the commencement of the Contract, an additional 6m hard paved path was provisioned through the Created Wetland and it physically divided the wetland in 2 parts. Further site analysis was conducted in later stage and it determined that the wetland located at northern side of the 6m hard paved path was not suitable to be converted as wetland, since it involved substantial construction cost and time implication, and it eventually weaken the cost effectiveness of the wetland.

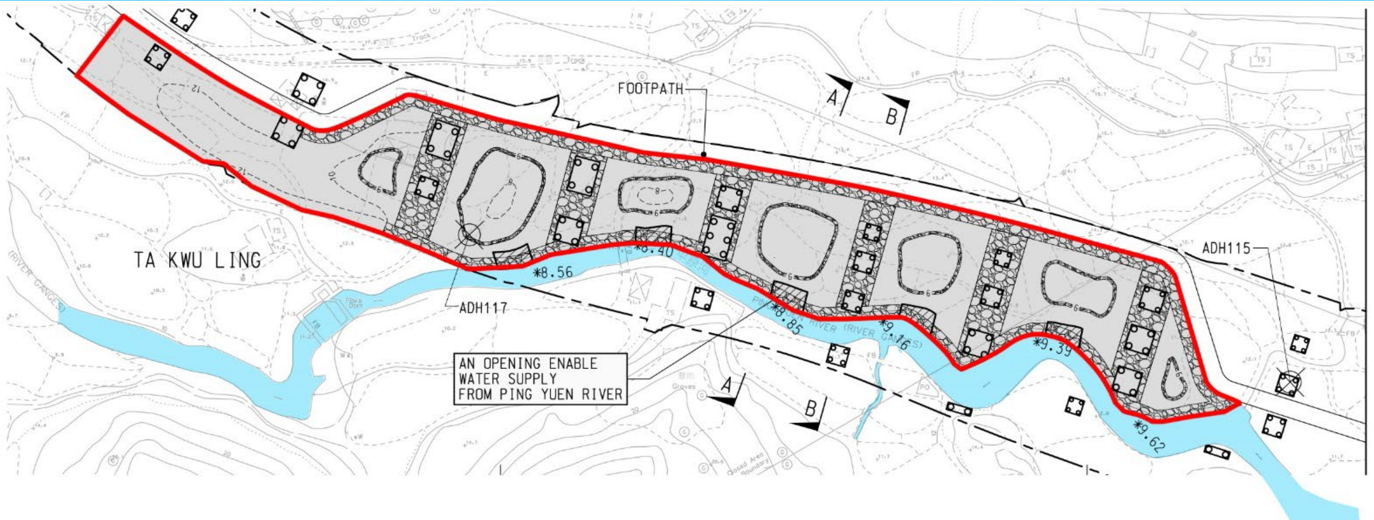
5 Actual alignment of Ping Yuen River was further verified on site

The actual alignment of the Ping Yuen River was verified on site after the commencement of the Contract, the works boundary of the Created Wetland was therefore slightly adjusted to tally with the actual site context.



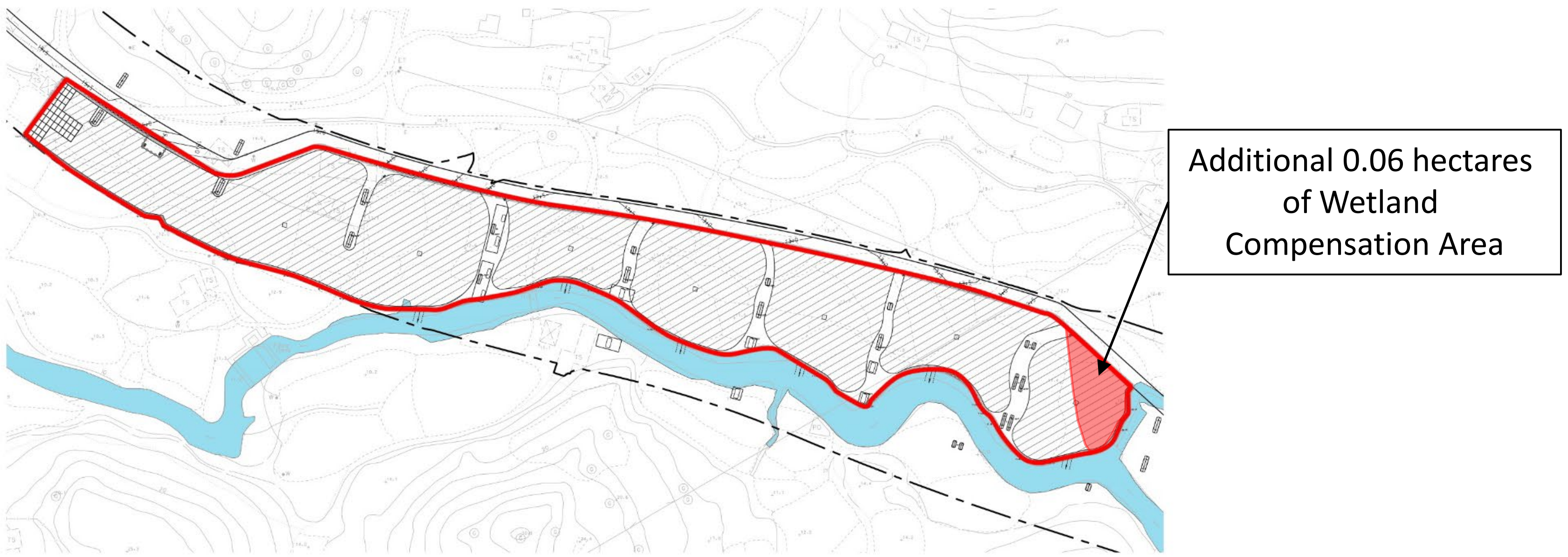
Site boundary of EP-404/2011/D (Figure 2b).

Area is not less than 1.4 hectares.



Site boundary of Habitat Creation and Management Plan (Revision 2) – approved by EPD on 26 November 2015.

Area is approximately 1.42 hectares.

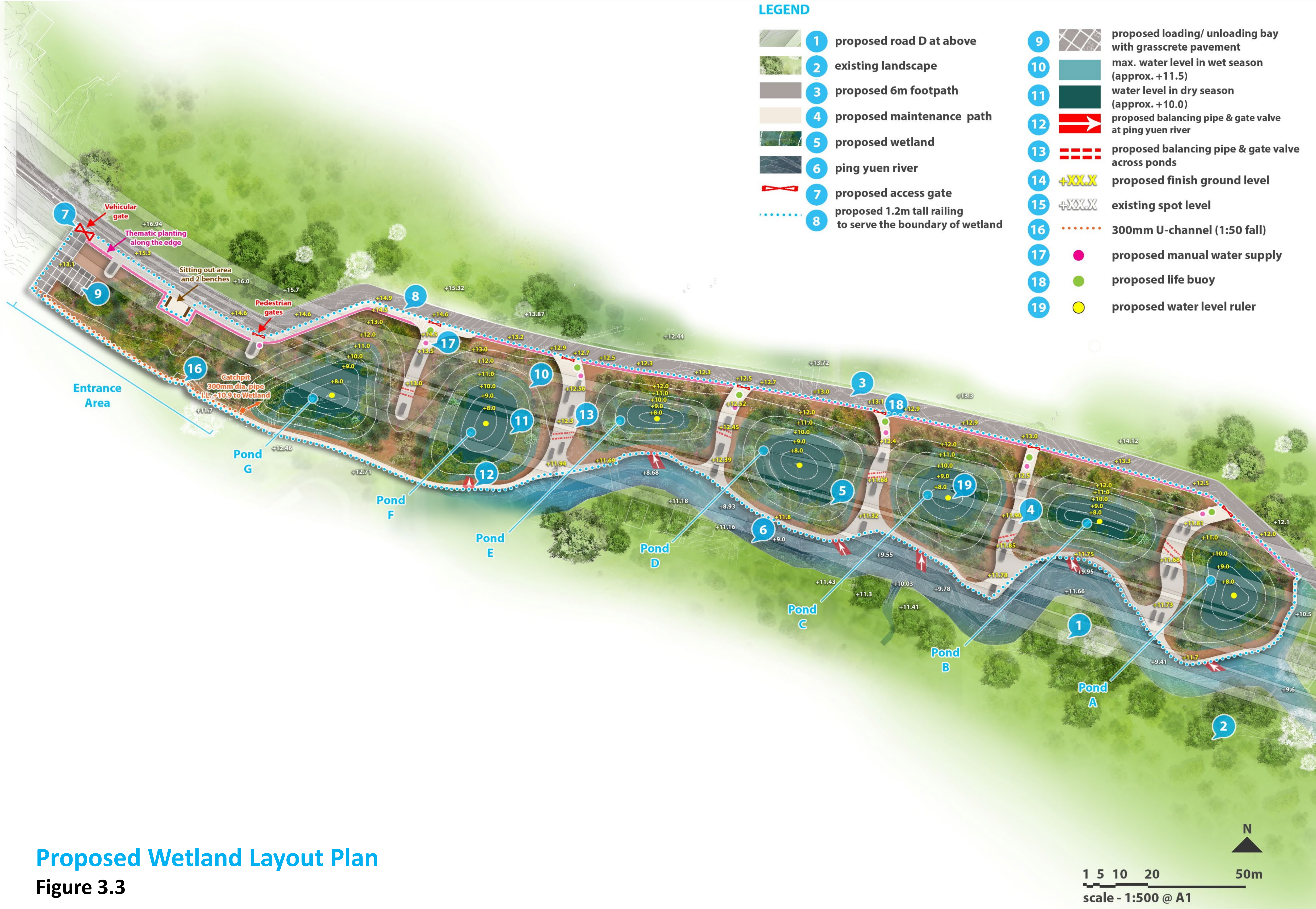


Site boundary of Habitat Creation and Management Plan (Revision 3) – approved by EPD on 17 October 2019.

Area is approximately 1.48 hectares.

Site Boundary Comparison of Compensation Wetland

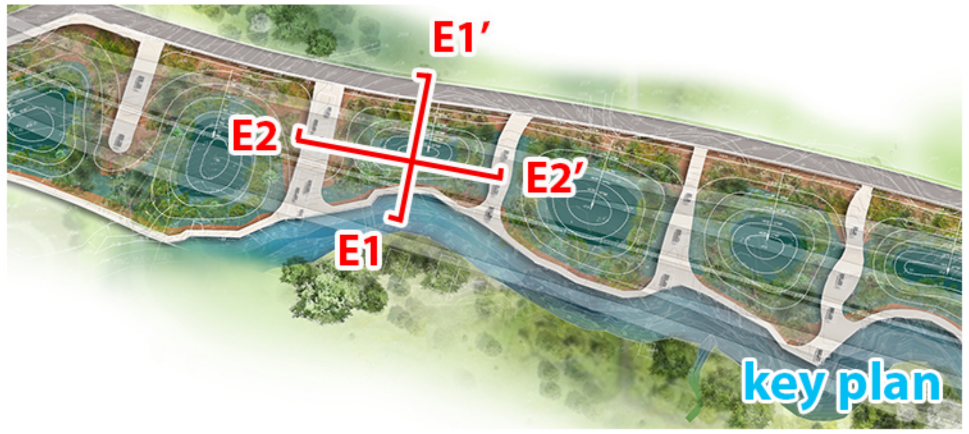
Figure 3.2

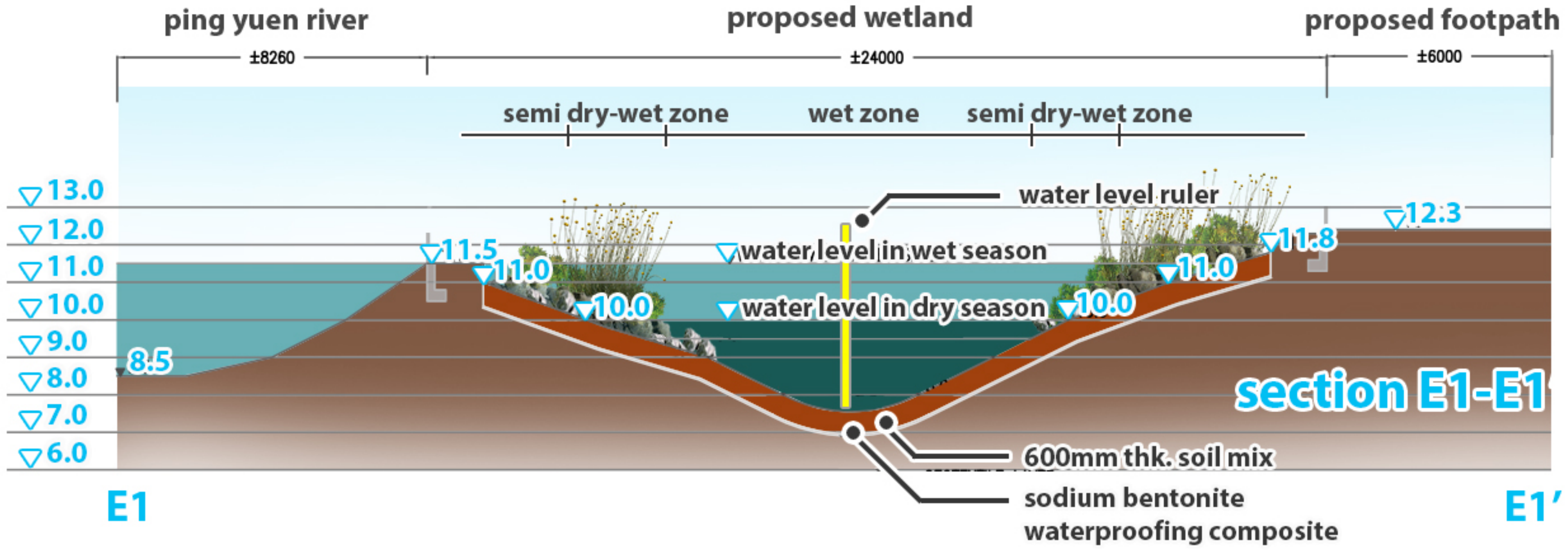


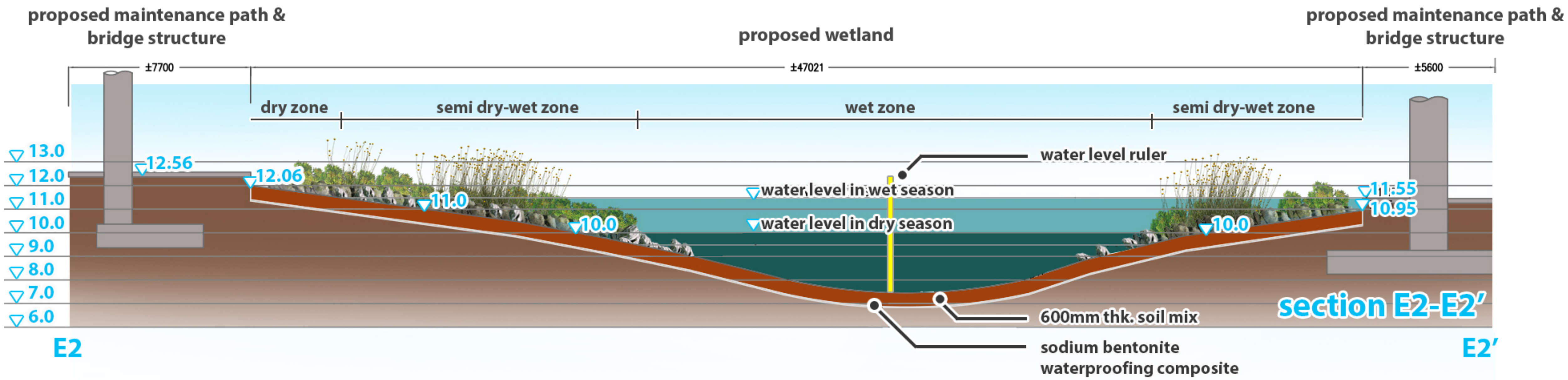
Proposed Wetland Layout Plan

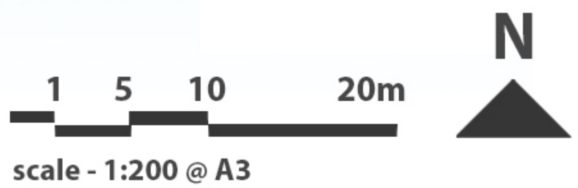
Figure 3.3

- Estimated Water level
    - wet season = approx. +11.5
    - dry season = approx. +10.0
- Aquatic plants with boulders to be planted above +9.5
- Provision of 600mm thick Clear soil depth
- Provision of maintenance access and footpath
- Proposed wetland to be surrounded with railing



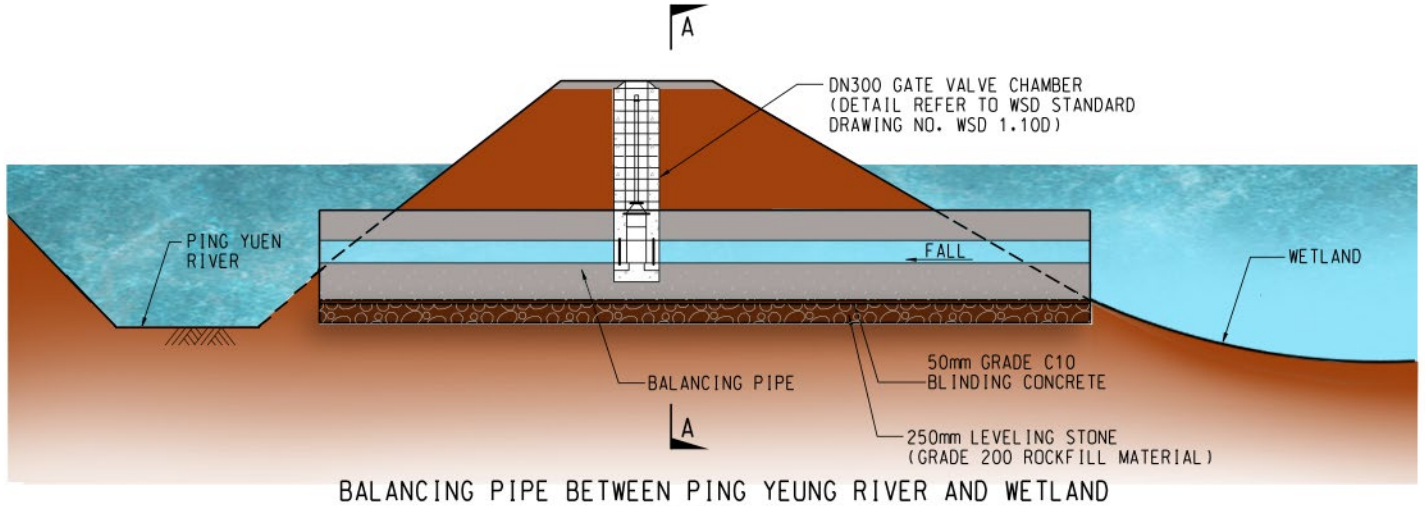




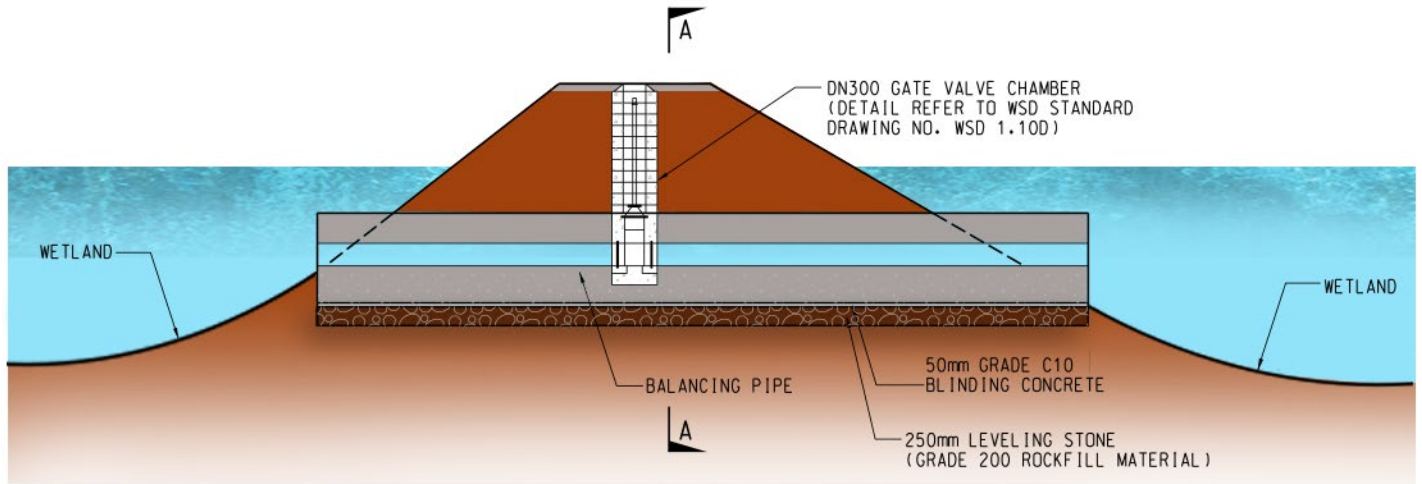


Typical Section of Proposed Wetland Pond

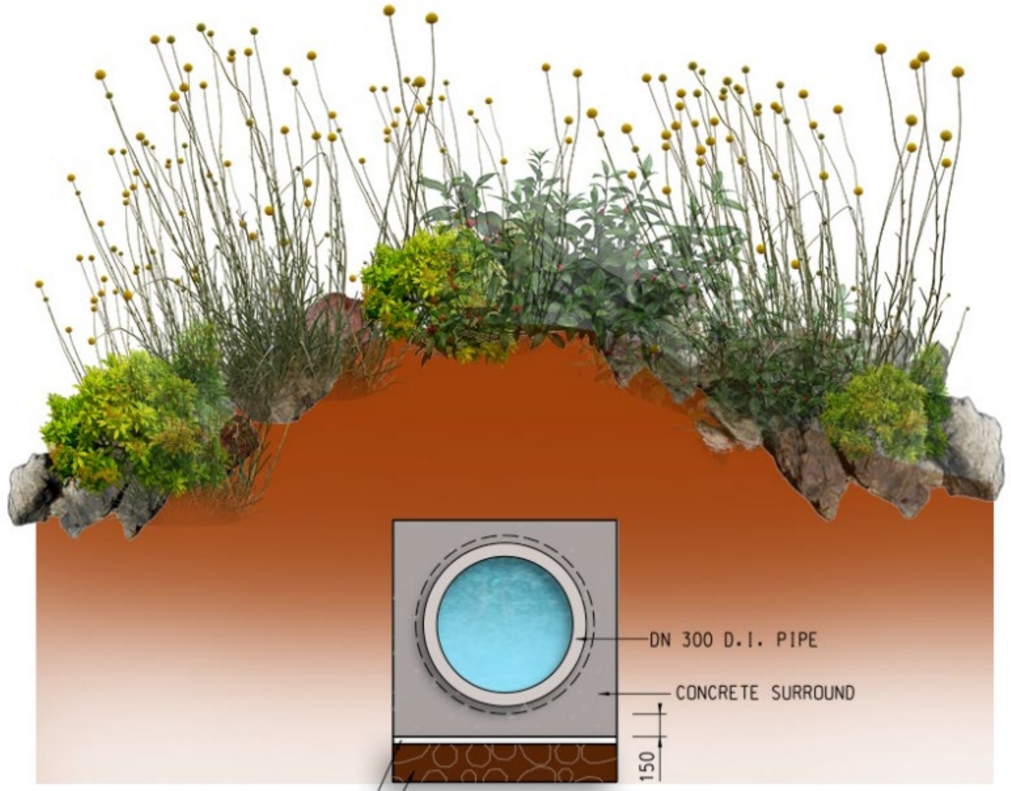
Figure 3.4



BALANCING PIPE BETWEEN PING YEUNG RIVER AND WETLAND
SCALE 1 : 100



BALANCING PIPE BETWEEN WETLAND PONDS
SCALE 1 : 100

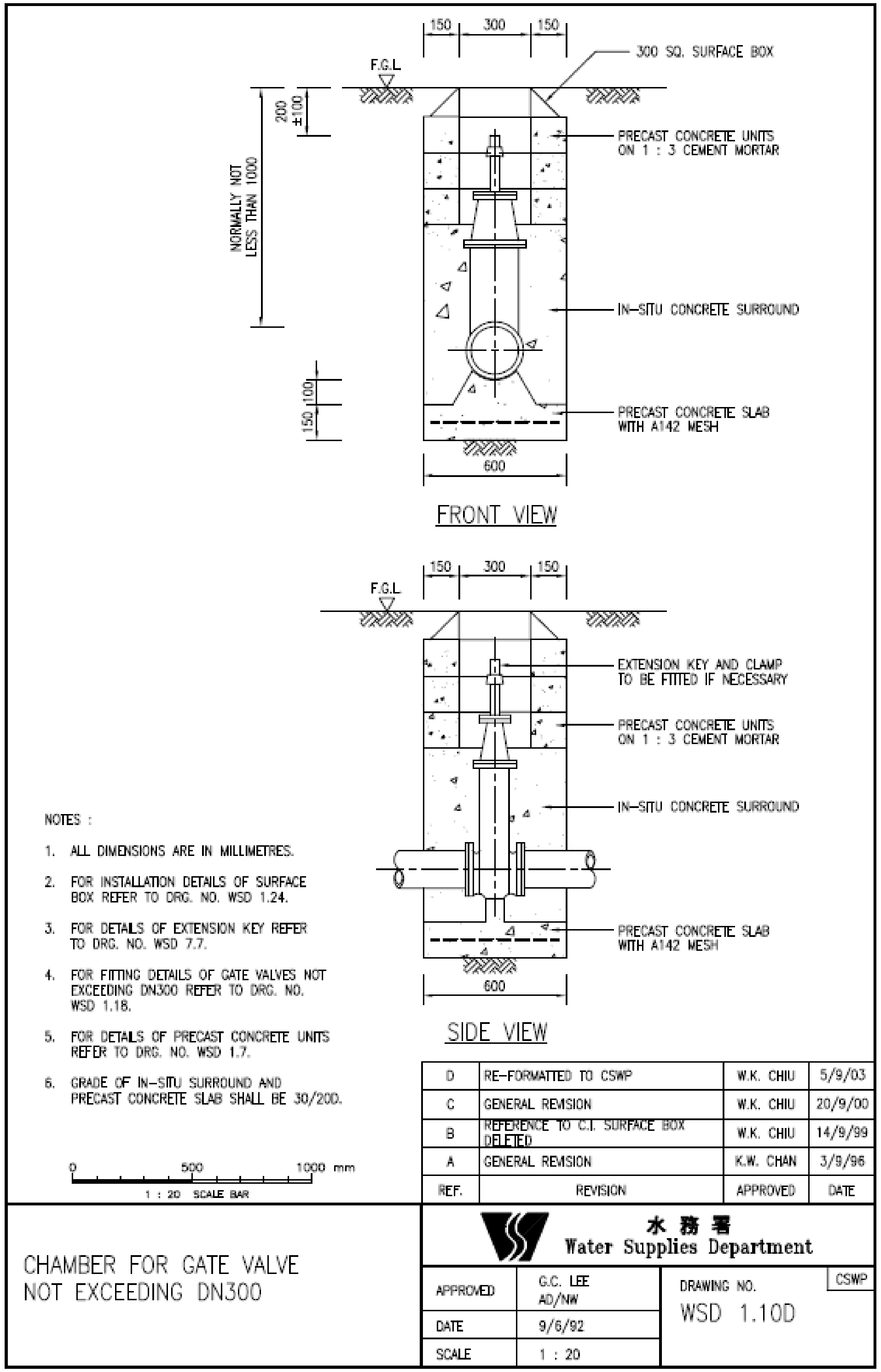


SECTION A - A
SCALE 1 : 50

*** Please note that all dimensions to be confirmed on site.**

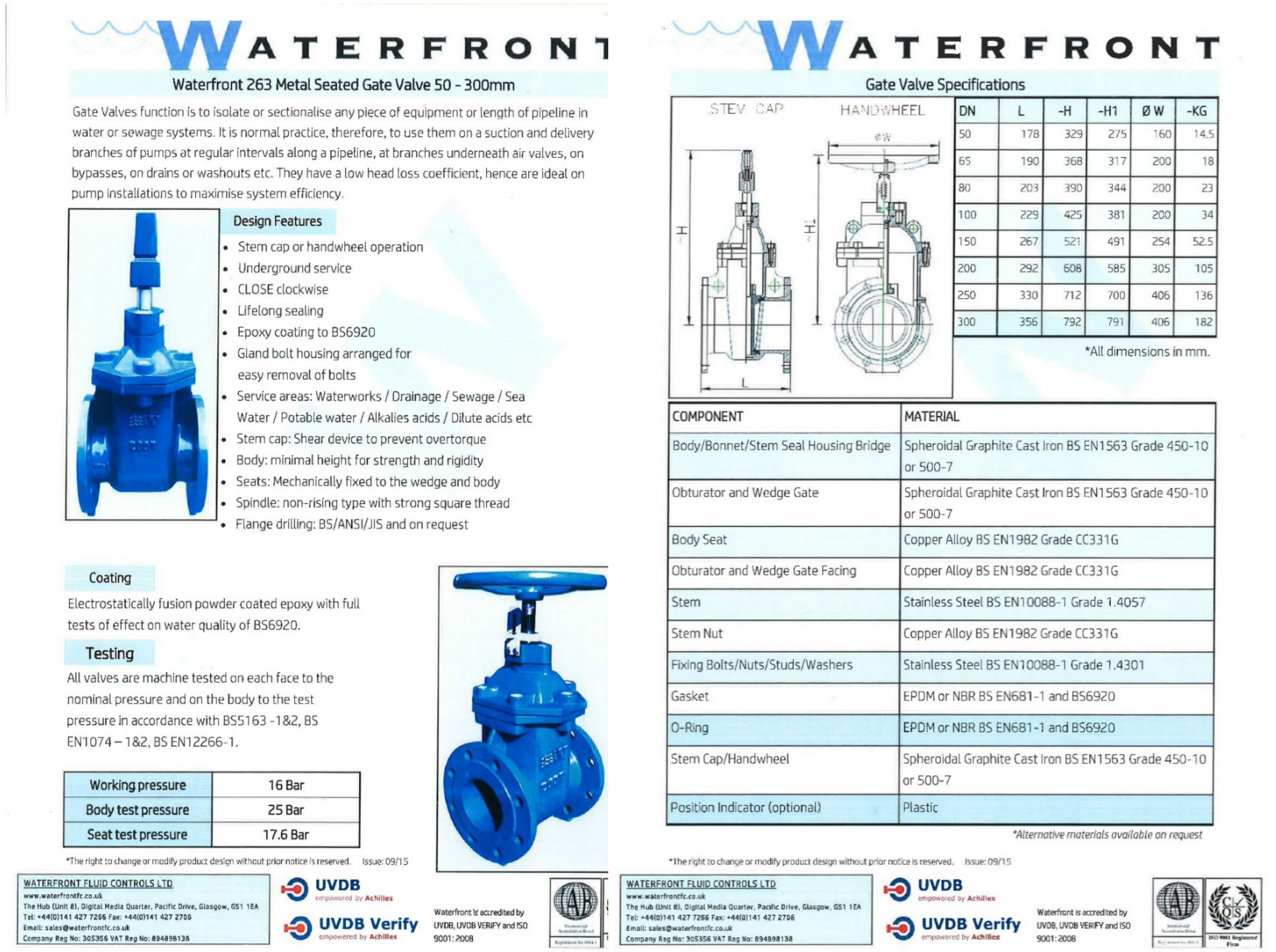
Typical Details of Balancing Pipe and Gate Valve

Figure 3.5



Typical Details of Gate Valve

Figure 3.6



WATERFRONT

Waterfront 263 Metal Seated Gate Valve 50 - 300mm

Gate Valves function is to isolate or sectionalise any piece of equipment or length of pipeline in water or sewage systems. It is normal practice, therefore, to use them on a suction and delivery branches of pumps at regular intervals along a pipeline, at branches underneath air valves, on bypasses, on drains or washouts etc. They have a low head loss coefficient, hence are ideal on pump installations to maximise system efficiency.

Design Features

- Stem cap or handwheel operation
- Underground service
- CLOSE clockwise
- Lifelong sealing
- Epoxy coating to BS6920
- Gland bolt housing arranged for easy removal of bolts
- Service areas: Waterworks / Drainage / Sewage / Sea Water / Potable water / Alkalies acids / Dilute acids etc
- Stem cap: Shear device to prevent overtorque
- Body: minimal height for strength and rigidity
- Seats: Mechanically fixed to the wedge and body
- Spindle: non-rising type with strong square thread
- Flange drilling: BS/ANSI/JIS and on request

Coating

Electrostatically fusion powder coated epoxy with full tests of effect on water quality of BS6920.

Testing

All valves are machine tested on each face to the nominal pressure and on the body to the test pressure in accordance with BS5163 -1&2, BS EN1074 – 1&2, BS EN12266-1.

Working pressure	16 Bar
Body test pressure	25 Bar
Seat test pressure	17.6 Bar

*The right to change or modify product design without prior notice is reserved. Issue: 09/15

WATERFRONT FLUID CONTROLS LTD
www.waterfrontfc.co.uk
The Hub (Unit 8), Digital Media Quarter, Pacific Drive, Glasgow, G51 1EA
Tel: +44(0)141 427 7266 Fax: +44(0)141 427 2706
Email: sales@waterfrontfc.co.uk
Company Reg No: 305356 VAT Reg No: 894898138

UVDB empowered by Achilles
UVDB Verify empowered by Achilles

Waterfront is accredited by UVDB, UVDB VERIFY and ISO 9001: 2008

WATERFRONT

Gate Valve Specifications

STEM CAP
HANDWHEEL

DN	L	-H	-H1	Ø W	-KG
50	178	329	275	160	14.5
65	190	368	317	200	18
80	203	390	344	200	23
100	229	425	381	200	34
150	267	521	491	254	52.5
200	292	608	585	305	105
250	330	712	700	406	136
300	356	792	791	406	182

*All dimensions in mm.

COMPONENT	MATERIAL
Body/Bonnet/Stem Seal Housing Bridge	Spheroidal Graphite Cast Iron BS EN1563 Grade 450-10 or 500-7
Obturator and Wedge Gate	Spheroidal Graphite Cast Iron BS EN1563 Grade 450-10 or 500-7
Body Seat	Copper Alloy BS EN1982 Grade CC331G
Obturator and Wedge Gate Facing	Copper Alloy BS EN1982 Grade CC331G
Stem	Stainless Steel BS EN10088-1 Grade 1.4057
Stem Nut	Copper Alloy BS EN1982 Grade CC331G
Fixing Bolts/Nuts/Studs/Washers	Stainless Steel BS EN10088-1 Grade 1.4301
Gasket	EPDM or NBR BS EN681-1 and BS6920
O-Ring	EPDM or NBR BS EN681-1 and BS6920
Stem Cap/Handwheel	Spheroidal Graphite Cast Iron BS EN1563 Grade 450-10 or 500-7
Position Indicator (optional)	Plastic

*Alternative materials available on request

*The right to change or modify product design without prior notice is reserved. Issue: 09/15

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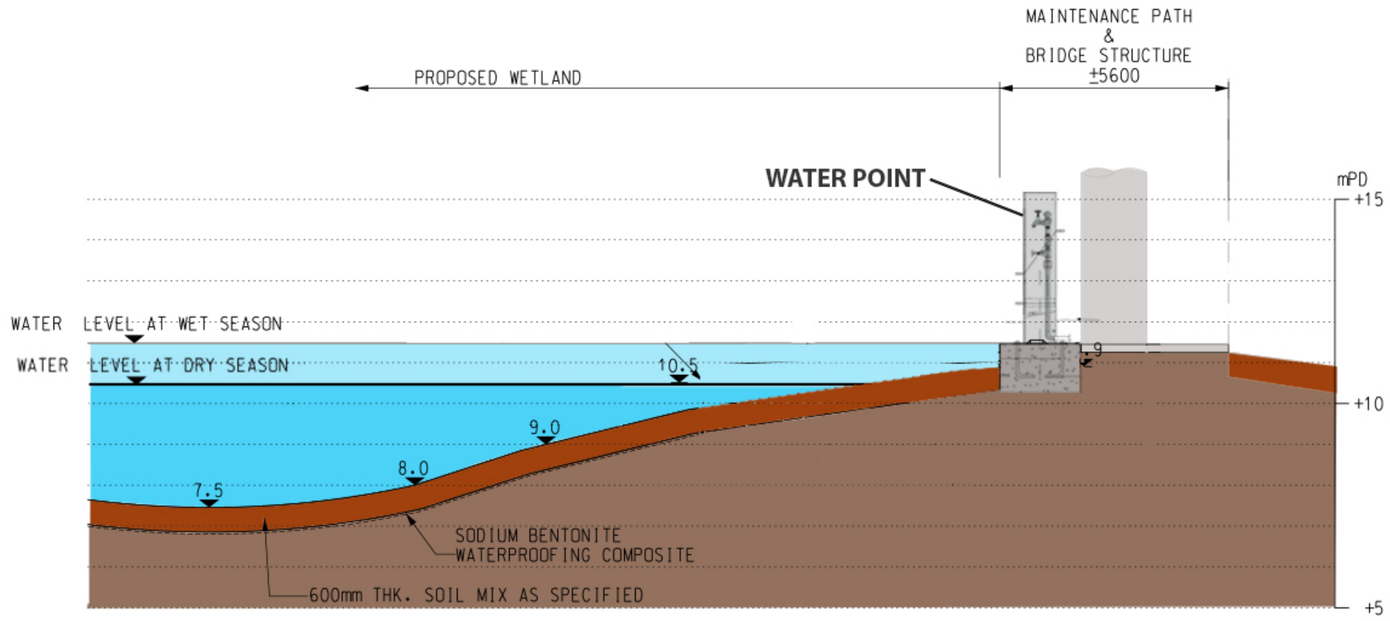
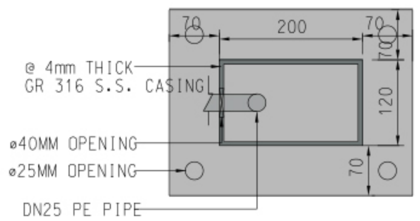
ISO 9001 Registered Firm

Gate valve for controlling the change of water level

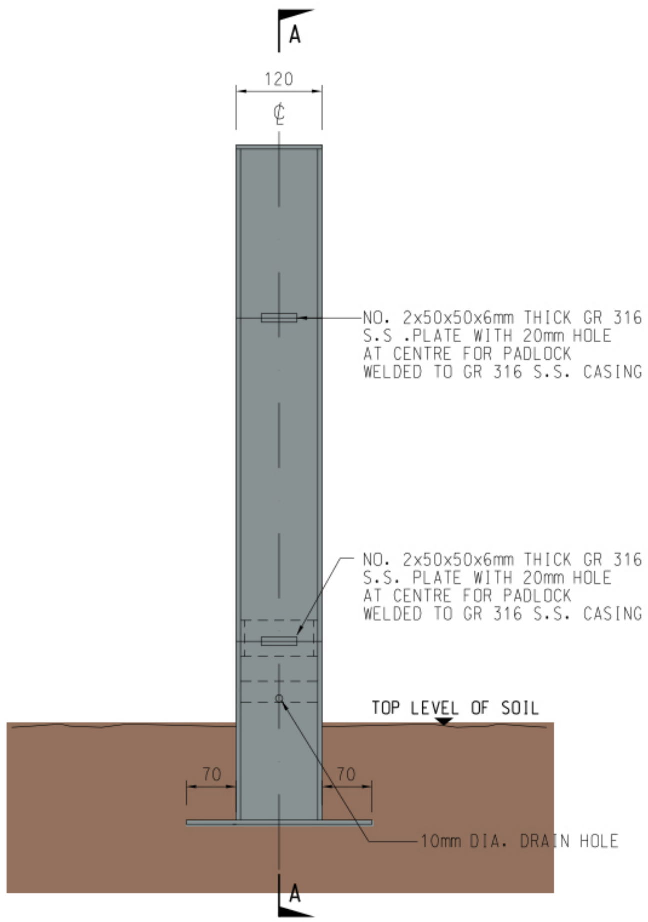


TYPICAL DETAILS FOR FRESH WATER SUPPLY TO WETLAND

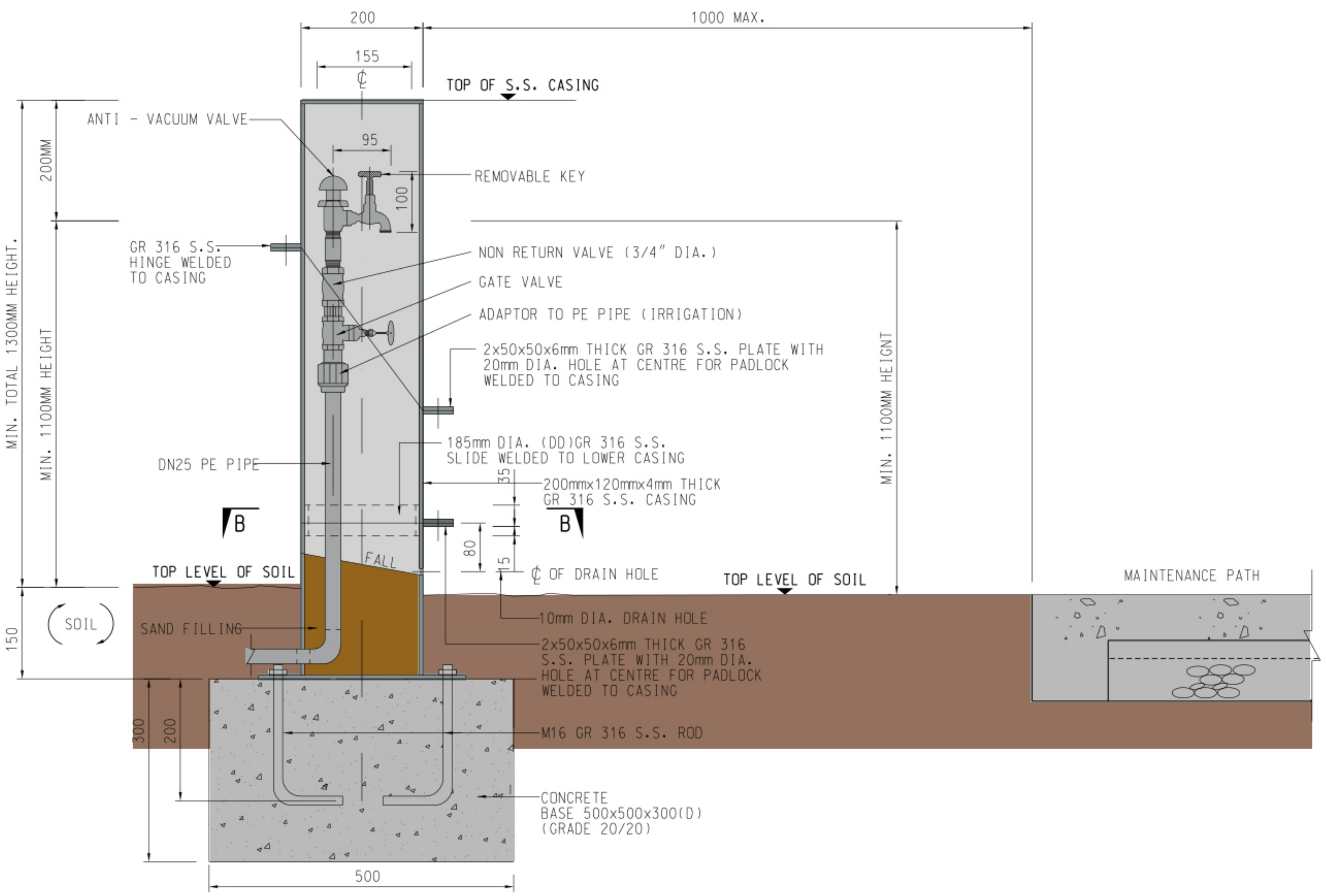


SECTION B – B
IRRIGATION WATER POINT

Manual water supply will be available during dry season to prevent the wetland ponds from drying out.



FRONT VIEW
IRRIGATION WATER POINT

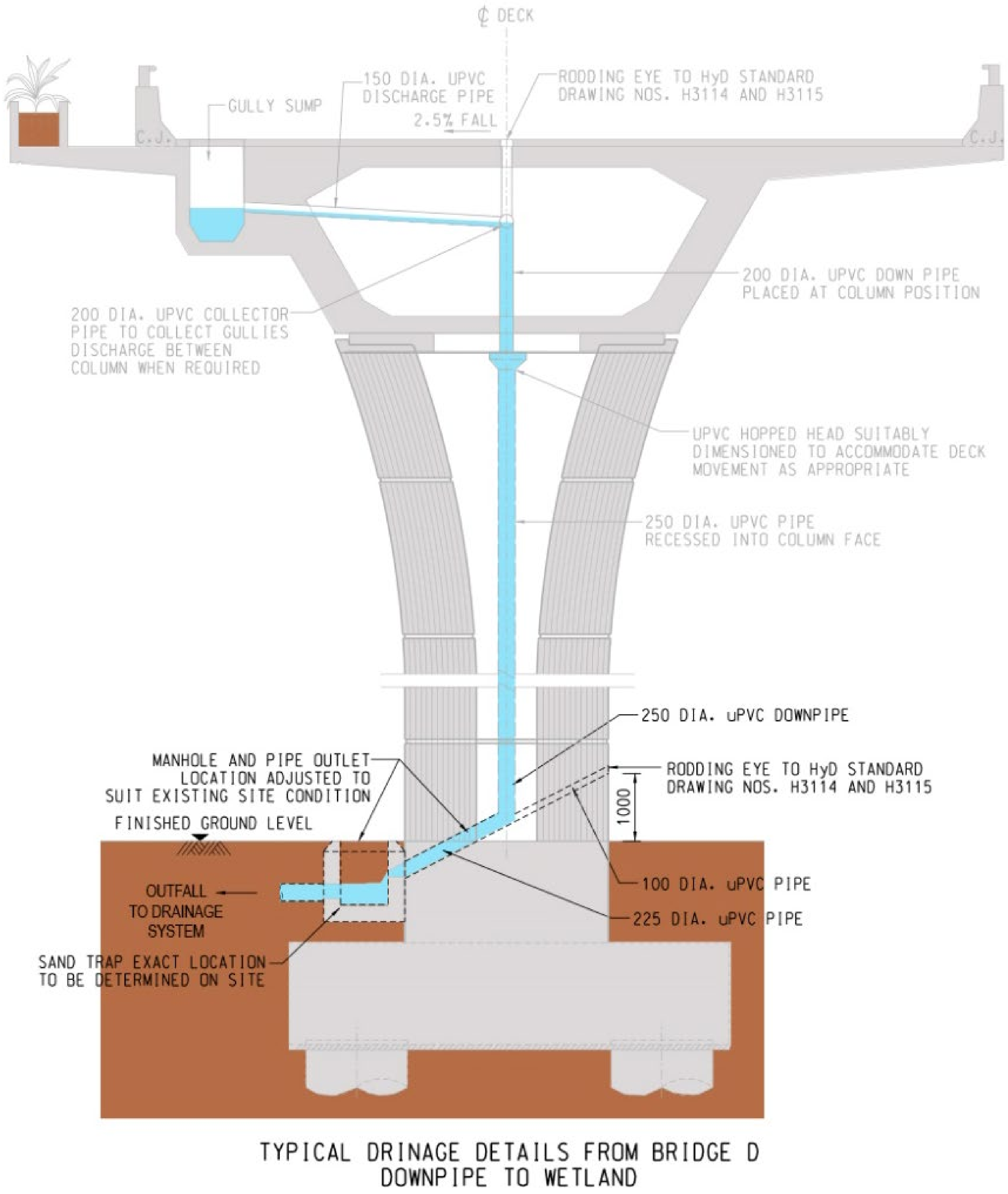


SECTION A – A
IRRIGATION WATER POINT

Typical Water Point Details for Fresh Water Supply

Figure 3.7

*** Please note that all dimensions to be confirmed on site.**

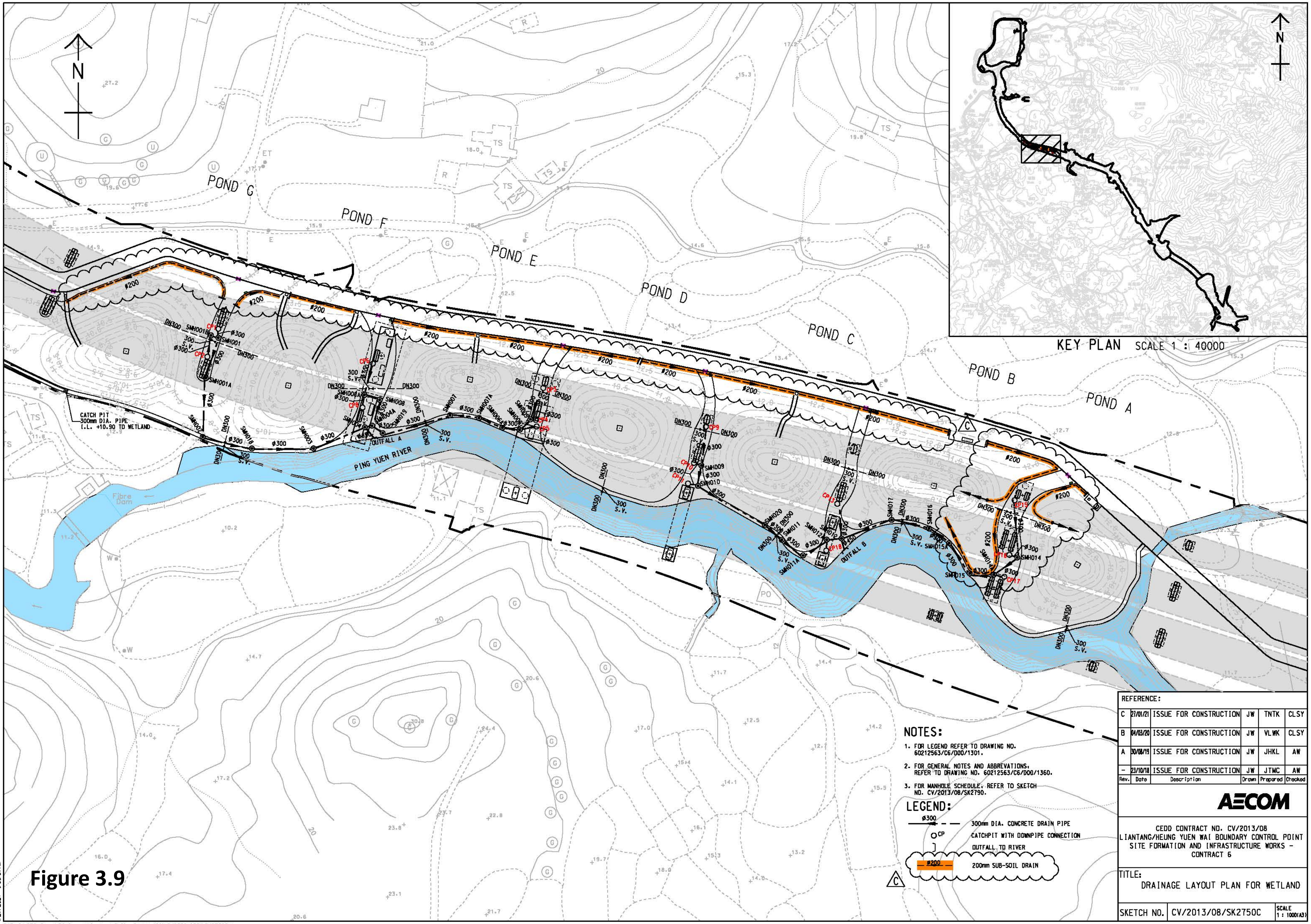


Greywater harvested form Bridge D will be discharged to drainage system.

*** Please note that all dimensions to be confirmed.**

Typical Drainage Details From Bridge D Downpipe to Wetland

Figure 3.8



NOTES:

1. FOR LEGEND REFER TO DRAWING NO. 60212563/C6/D00/1301.
2. FOR GENERAL NOTES AND ABBREVATIONS, REFER TO DRAWING NO. 60212563/C6/D00/1360.
3. FOR MANHOLE SCHEDULE, REFER TO SKETCH NO. CV/2013/08/SK2790.

LEGEND:

- ø300 — 300mm DIA. CONCRETE DRAIN PIPE
- CP — CATCHPIT WITH DOWNPIPE CONNECTION
- OUTFALL TO RIVER
- ø200 — 200mm SUB-SOIL DRAIN

REFERENCE:

Rev.	Date	Description	Drawn	Prepared	Checked
C	27/01/21	ISSUE FOR CONSTRUCTION	JW	TNTK	CLSY
B	04/03/20	ISSUE FOR CONSTRUCTION	JW	VLWK	CLSY
A	30/08/19	ISSUE FOR CONSTRUCTION	JW	JHKL	AW
-	23/10/18	ISSUE FOR CONSTRUCTION	JW	JTMC	AW

AECOM

CEDD CONTRACT NO. CV/2013/08
LIANTANG/HEUNG YUEN WAI BOUNDARY CONTROL POINT
SITE FORMATION AND INFRASTRUCTURE WORKS - CONTRACT 6

TITLE: DRAINAGE LAYOUT PLAN FOR WETLAND

SKETCH NO. CV/2013/08/SK2750C | SCALE 1 : 1000(A3)

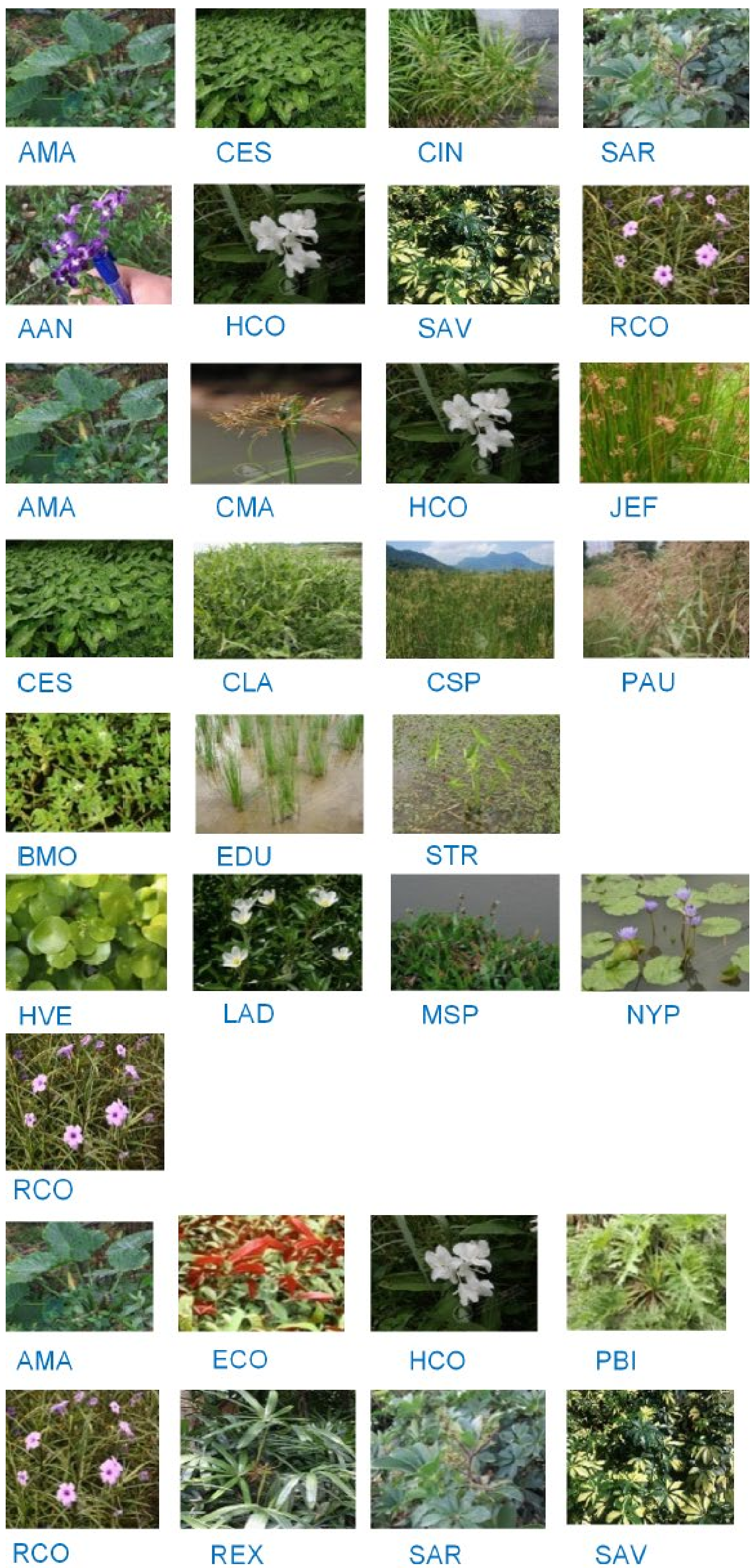
Figure 3.9

1/27/2021 9:38:51 AM

PATH:S:\STO Group\TO-General\Contract 6\Site Sketch (C6)\SK2750-2751\SK2750C.dgn

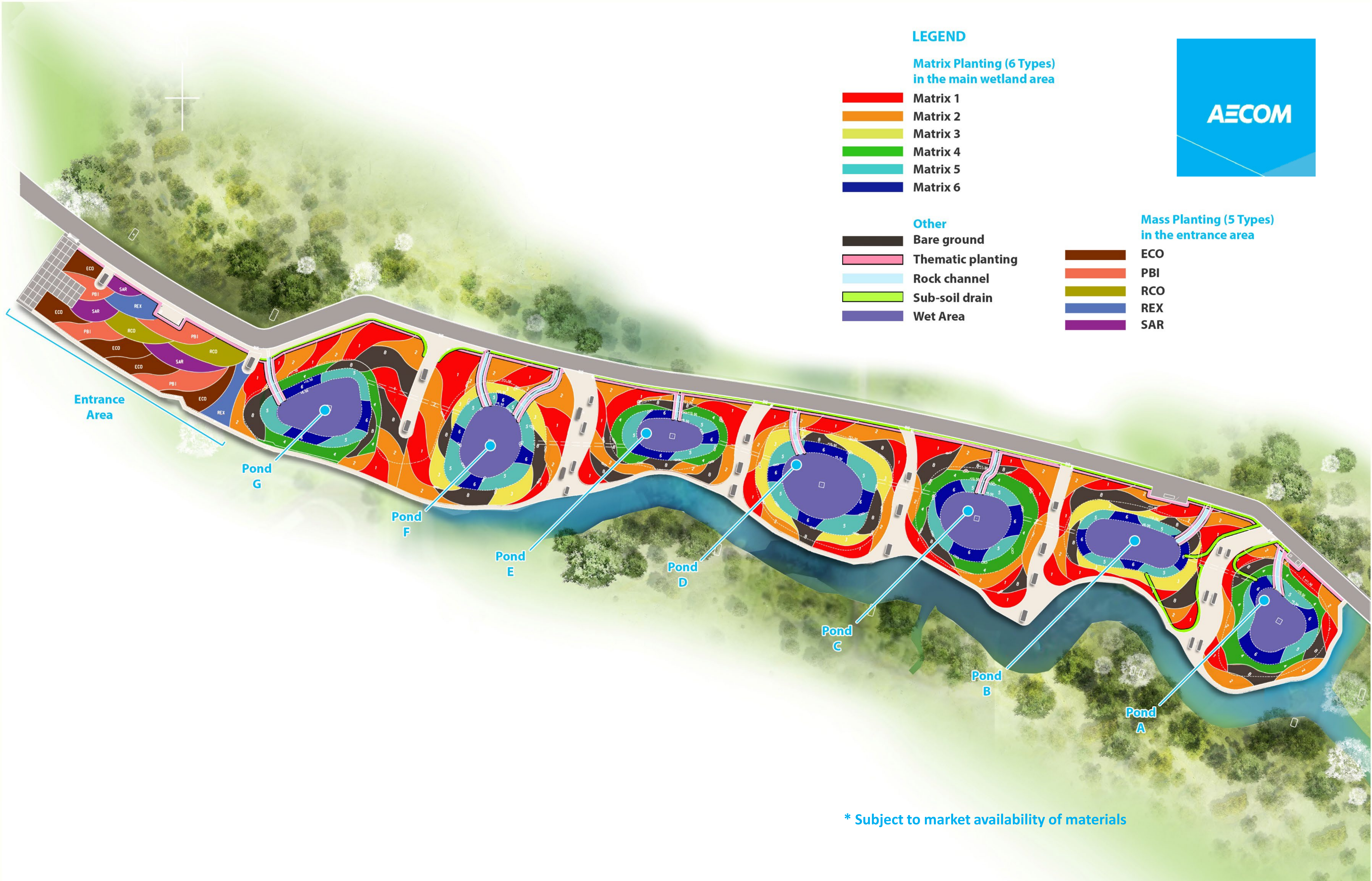
* Subject to market availability of materials

CODE	BOTANICAL NAME	CHINESE NAME	SIZE(mm) HEIGHT (H) x SPREAD (S)	SPACING (mm)	% MIX	QUANTITY
MATRIX 1						
AMA	*Alocasia macrorrhizos*	海芋	300x200	500	10%	841
CES	*Colocasia esculenta*	芋	300x200	500		139
CIN	*Cyperus involucratus*	風車草	300x200	500	45%	4,416
SAR	*Schefflera arboricola*	鵝掌藤	300x300	500	45%	4,400
MATRIX 2						
AAN	*Angelonia angustifolia*	香彩雀	300x200	500	35%	3,210
HCO	*Hedychium coronarium*	薑花	300x300	500	30%	1,709
SAV	*Schefflera arboricola var.*	花葉鵝掌藤	300x300	500		1,026
RCO	*Ruellia coerulea*	蘭花草	300x300	500	35%	3,234
MATRIX 3						
AMA	*Alocasia macrorrhizos*	海芋	300x200	500	35%	802
CMA	*Cyperus malaccensis*	茳芏	200x100	500	15%	344
HCO	*Hedychium coronarium*	薑花	300x300	500	35%	802
JEF	*Juncus effusus*	燈心草	200x100	500	15%	344
MATRIX 4						
CES	*Colocasia esculenta*	芋	300x200	500	30%	752
CLA	*Coix lacryma-jobi*	薏苡	200x100	300	10%	696
CSP	*Cyperus spp.*	莎草屬	200x100	300	30%	2,088
PAU	*Phragmites australis*	蘆葦	200x200	300	30%	2,088
MATRIX 5						
BMO	*Bacopa monnieri*	假馬齒莧	200x100	300	35%	1,050
EDU	*Eleocharis dulcis*	荸薺	200x100	300	35%	1,050
STR	*Sagittaria trifolia* subsp. *leucopetala*	慈姑	200x100	300	30%	896
MATRIX 6						
HVE	*Hydrocotyle verticillata*	銅錢草	200x200	300	25%	1,178
LAD	*Ludwigia adscendens*	水龍	200x200	300	25%	1,178
MSP	*Murdannia spp.*	水竹葉屬	200x200	300	25%	1,178
NYP	*Nymphaea spp.*	睡蓮屬	200x200	300	25%	1,178
THEMATIC PLANTING						
RCO	*Ruellia coerulea*	蘭花草	300x300	500	-	2,218
ENTRANCE AREA						
AMA	*Alocasia macrorrhizos*	海芋	300x200	500	-	150
ECO	*Excoecaria cochinchinensis*	紅背桂	500x400	500	-	1,922
HCO	*Hedychium coronarium*	薑花	300x300	500	-	1,234
PBI	*Philodendron bipinnatifidum*	春羽	500x400	500	-	1,113
RCO	*Ruellia coerulea*	蘭花草	300x300	500	-	416
REX	*Rhapis excelsa*	棕竹	1000x500	500	-	439
SAR	*Schefflera arboricola*	鵝掌藤	500x400	500	-	892
SAV	*Schefflera arboricola var.*	花葉鵝掌藤	300x300	500	-	300



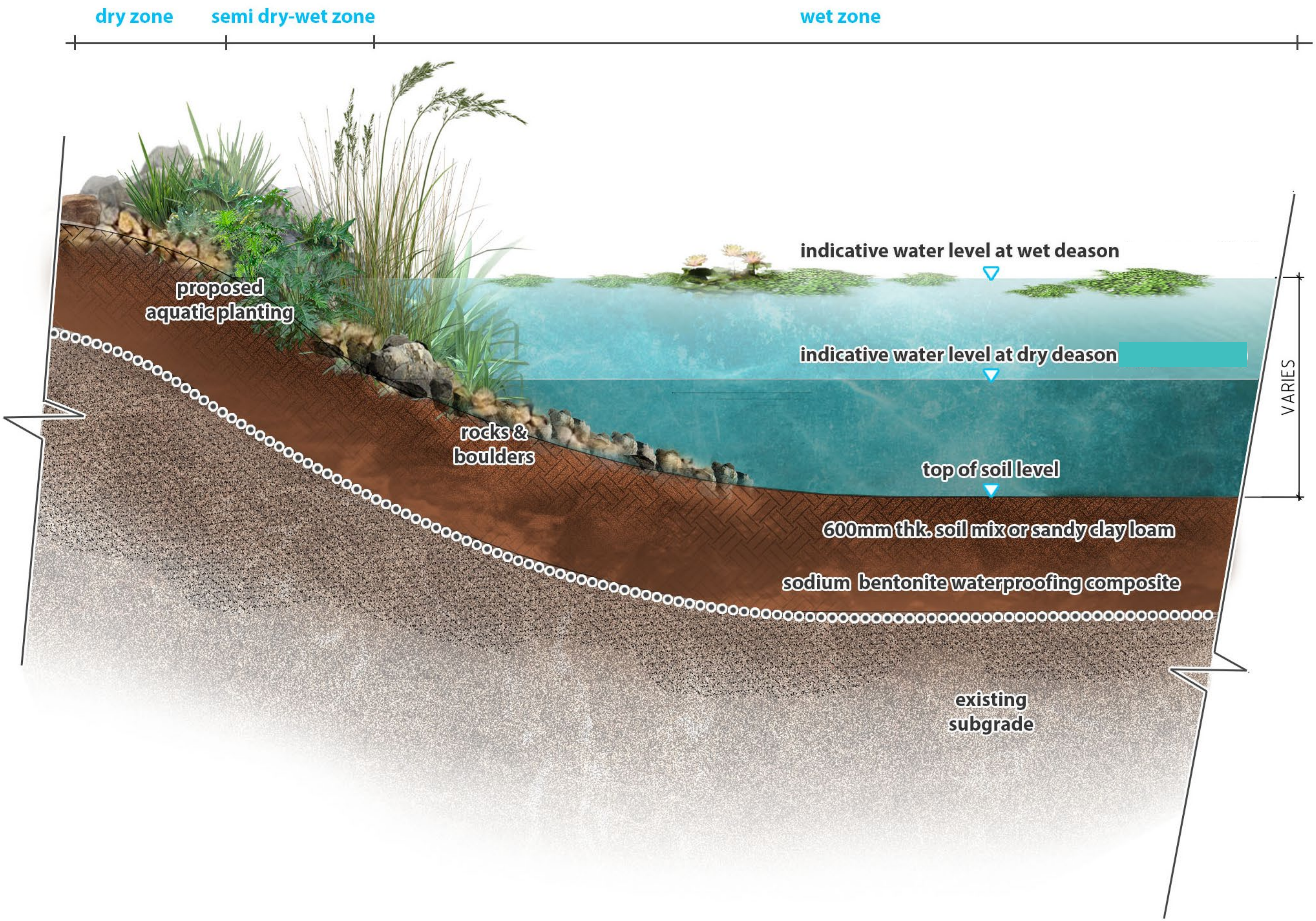
Planting Schedule

Figure 3.10



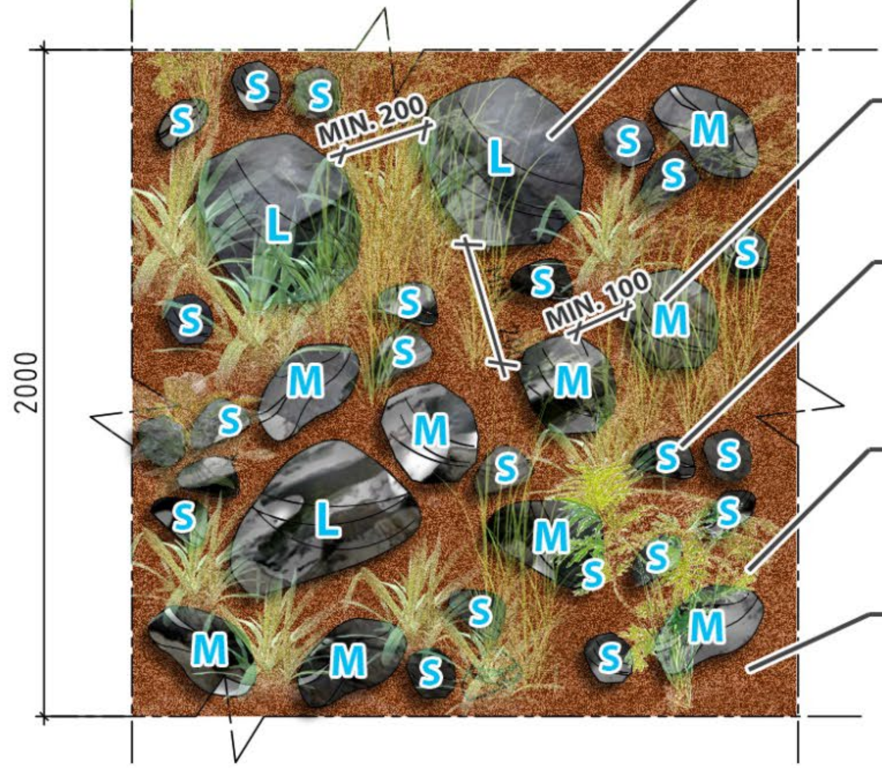
Planting Plan

Figure 3.11



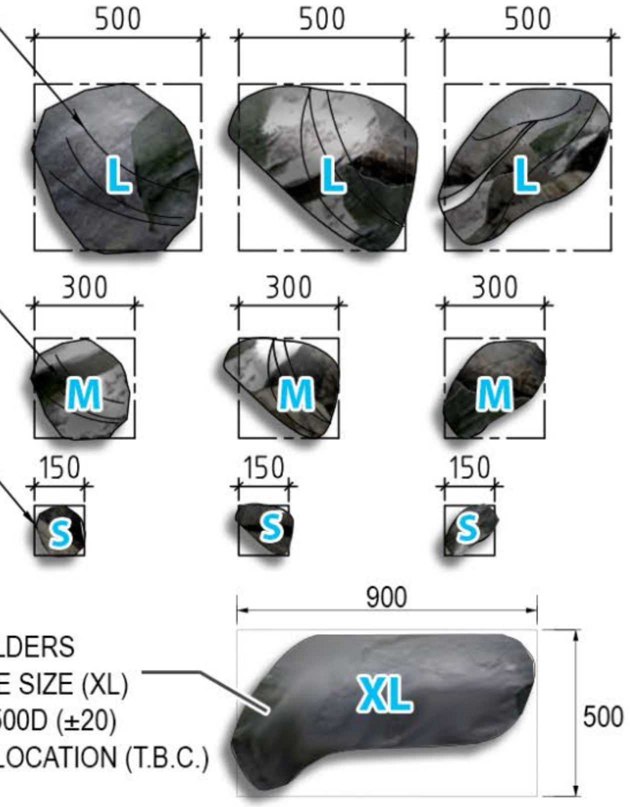
Typical Pond Edge Treatment

Figure 3.12

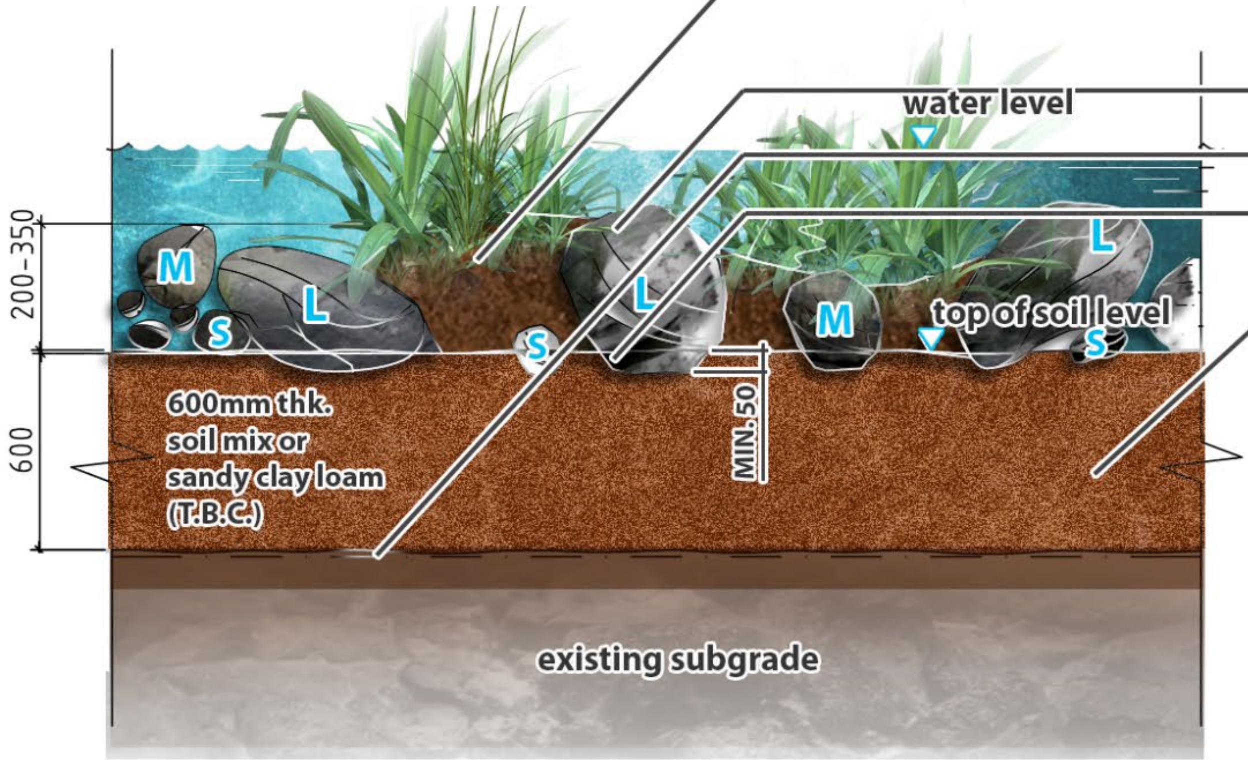


rocks/ plant arrangement

rock sizes



* Subject to market availability of materials

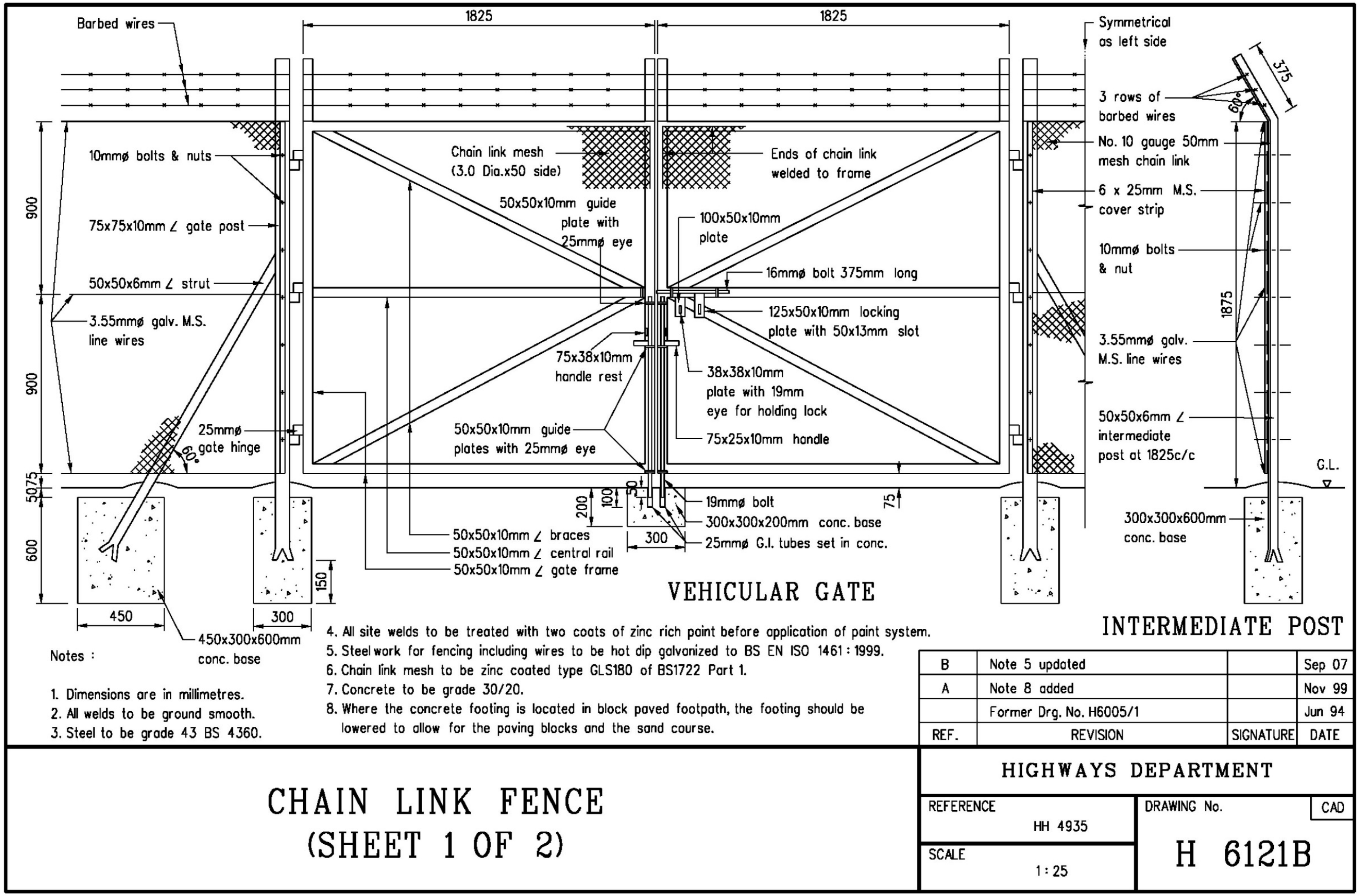


pond section

reference image

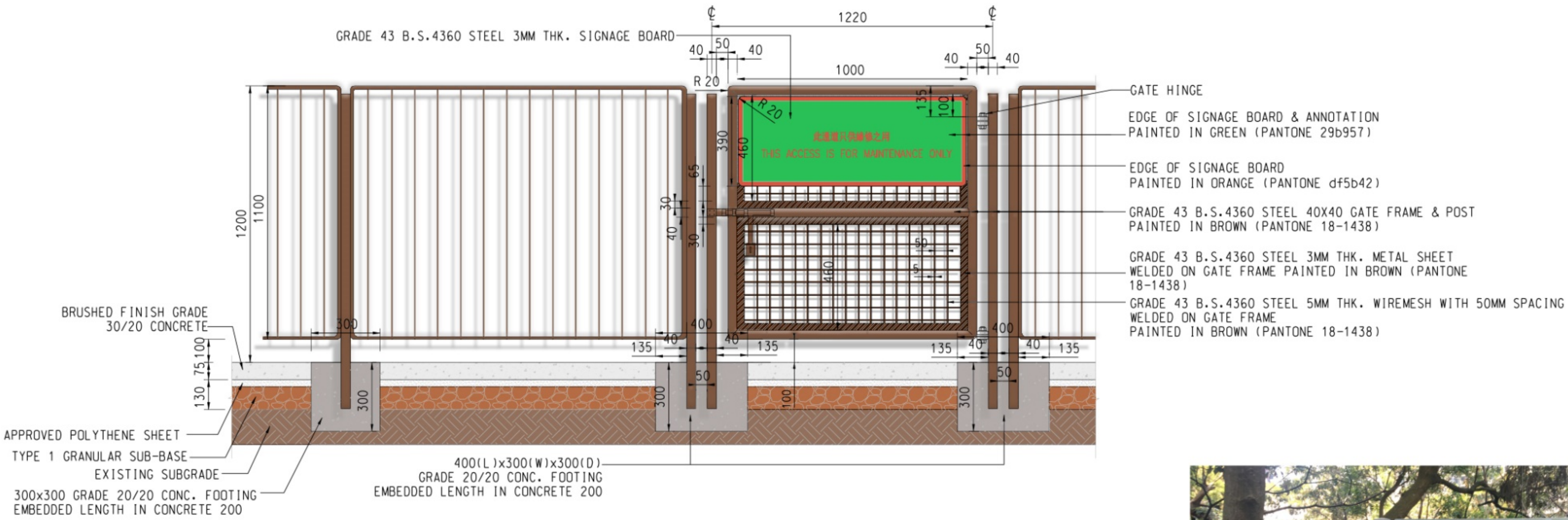
Typical Plant Pocket at the semi-dry-wet zone

Figure 3.13



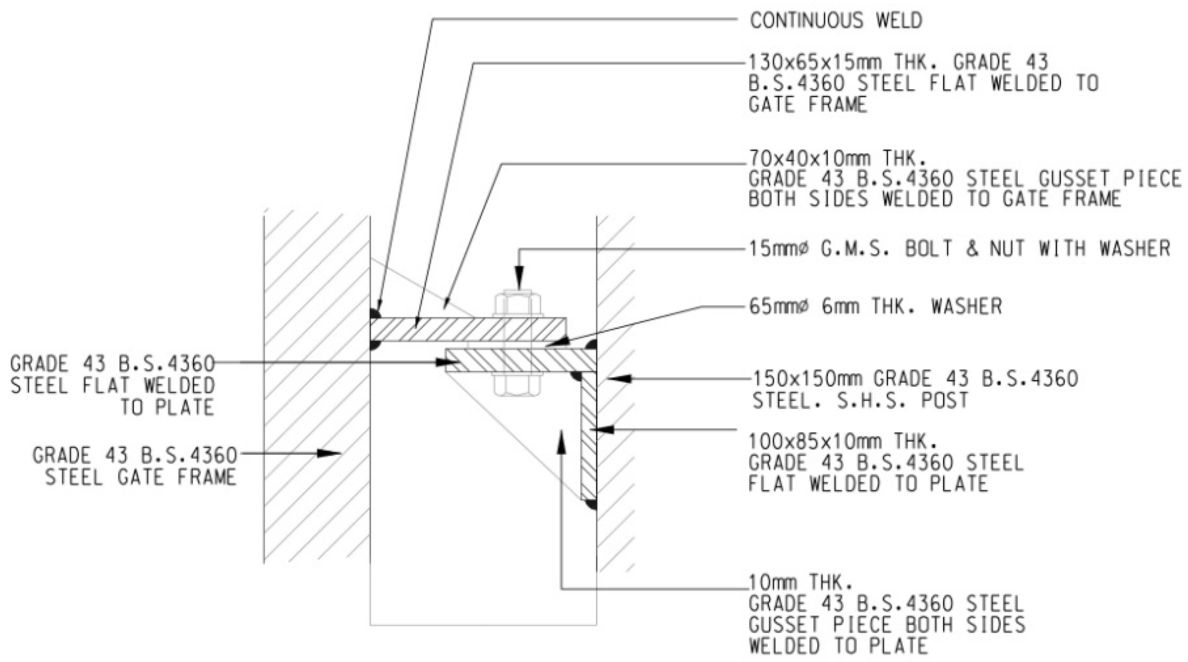
Typical HyD Standard Vehicular Gate

Figure 3.14



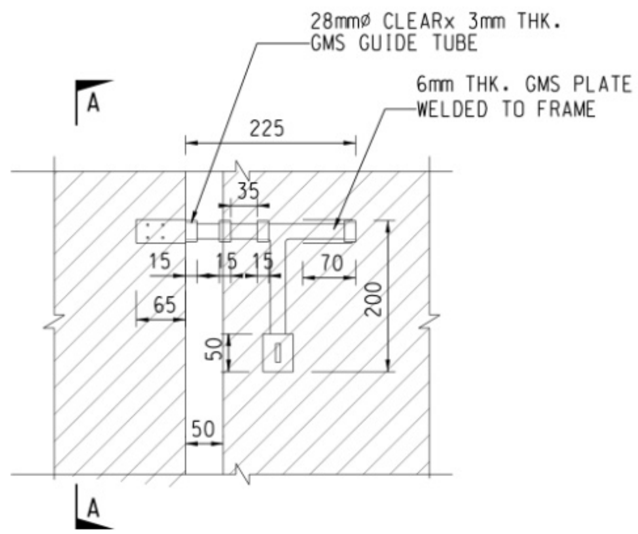
TYPICAL INTERFACE BETWEEN ACCESS GATE AND RAILING

SCALE 1 : 20



GATE HINGE DETAIL

SCALE 1 : 5

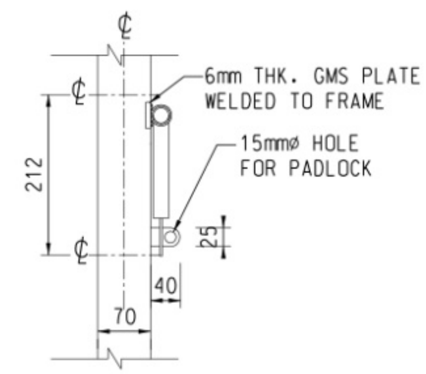


PADLOCK ELEVATION

SCALE 1 : 5

REFERENCE IMAGE

N.T.S.



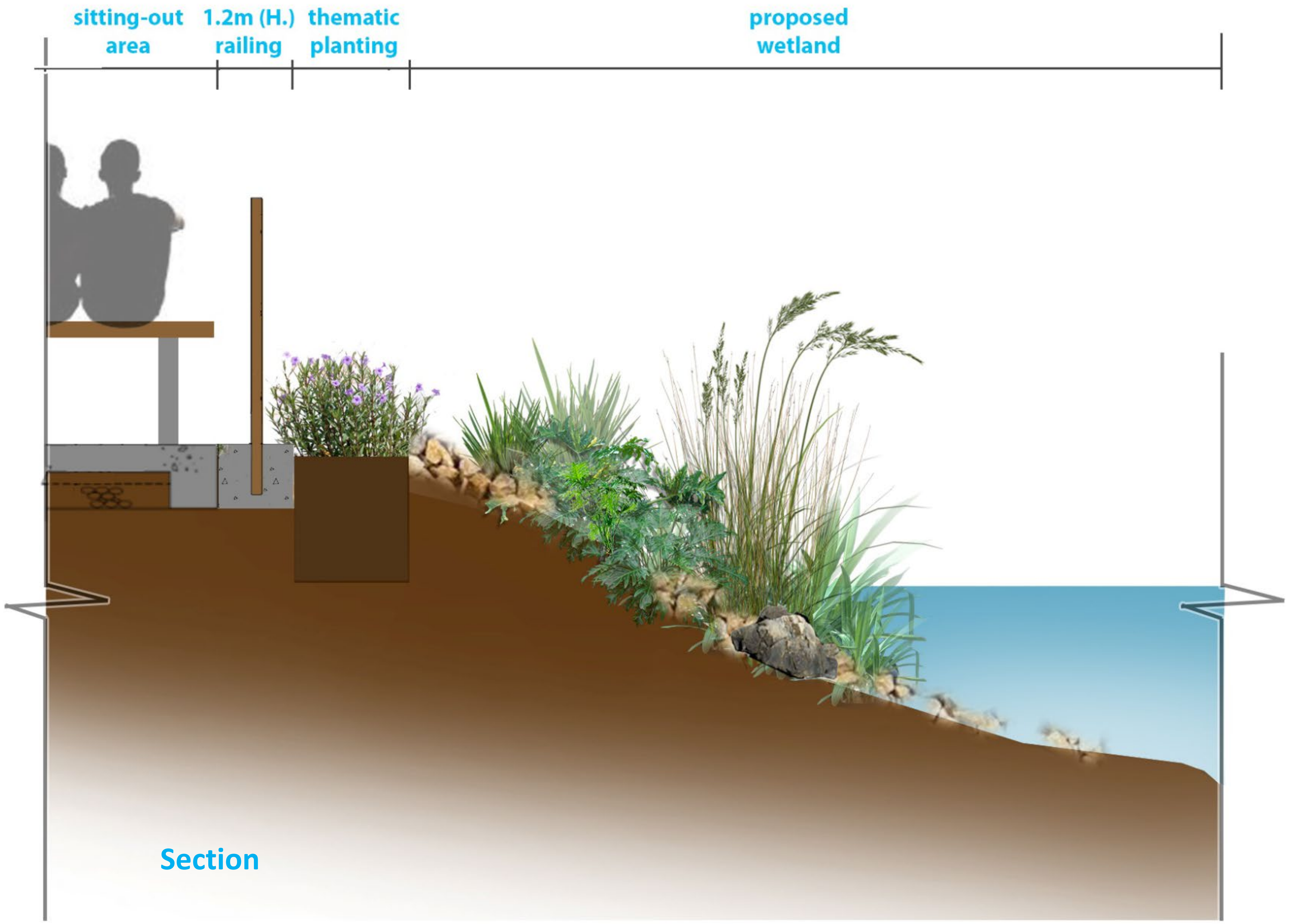
SECTION A – A

SCALE 1 : 5

*** Aesthetic appearance subject to further coordination with AFCD**

Typical Pedestrian Access Gate

Figure 3.15



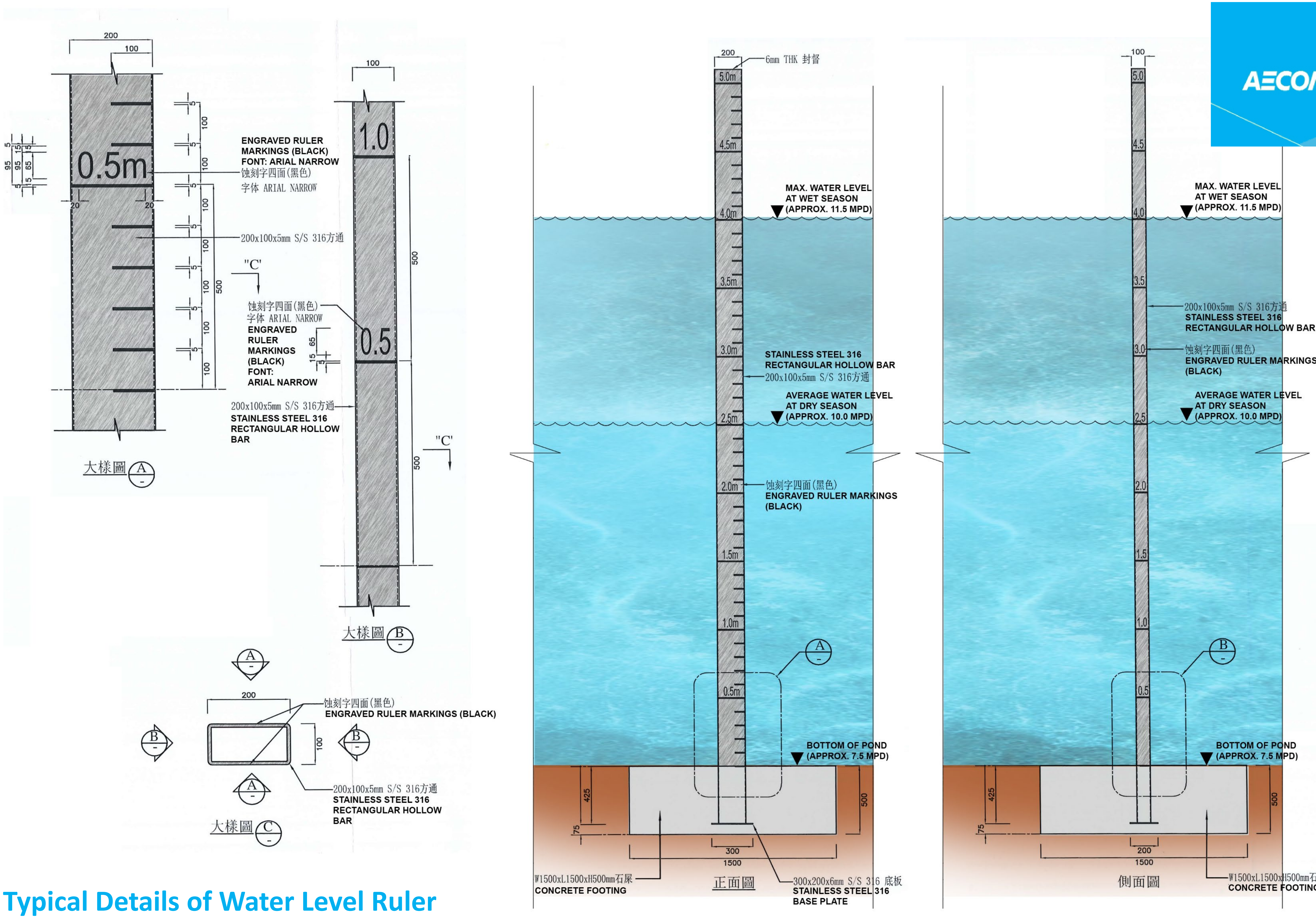
*** Aesthetic appearance subject to further coordination with AFCD**

2-seaters bench

- **Approx. 1200 x 600 x 800 mm**

Sitting-out Area & Thematic Planting

Figure 3.16

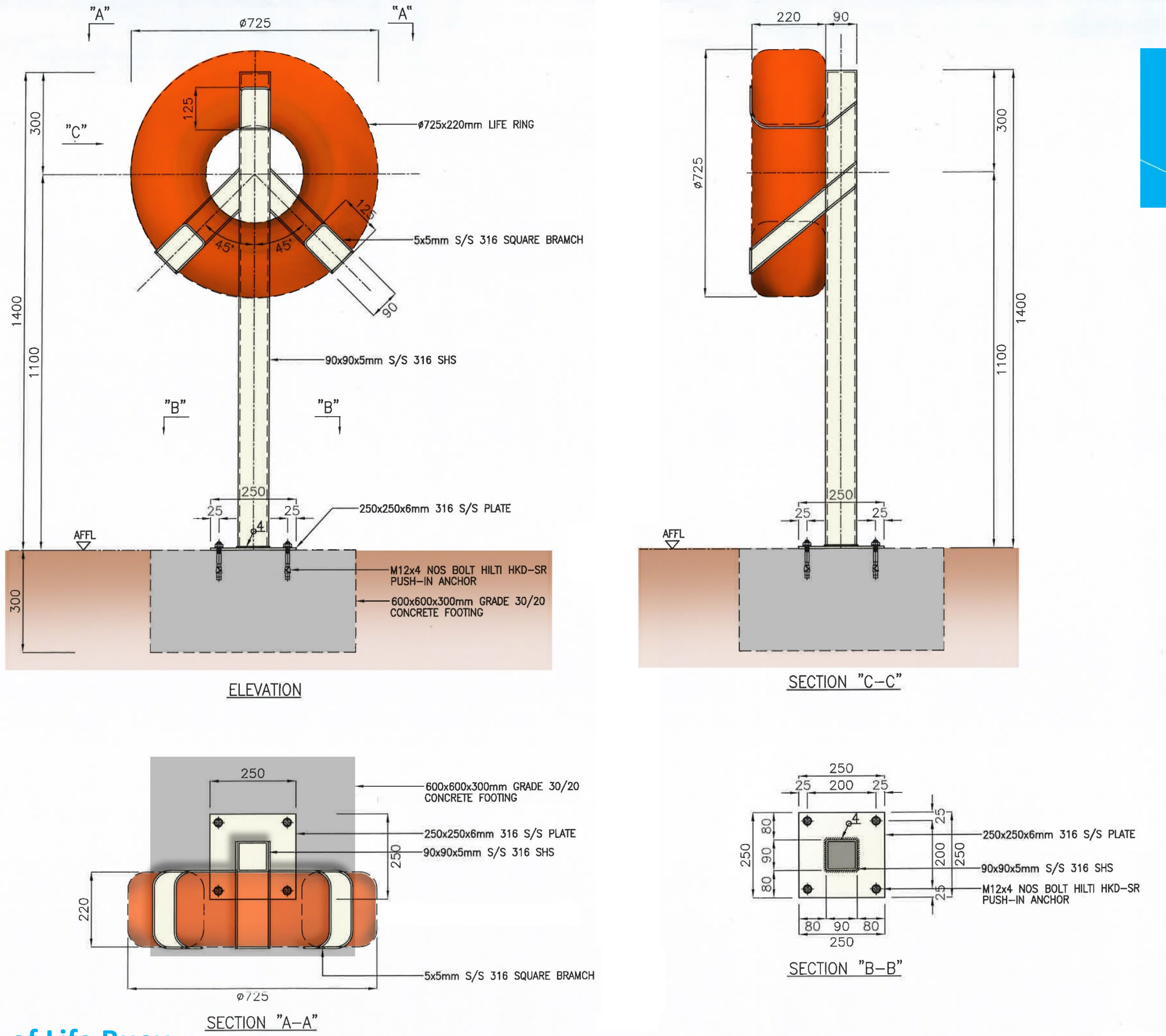


Typical Details of Water Level Ruler

Contractor's Shop Drawing

Figure 3.17

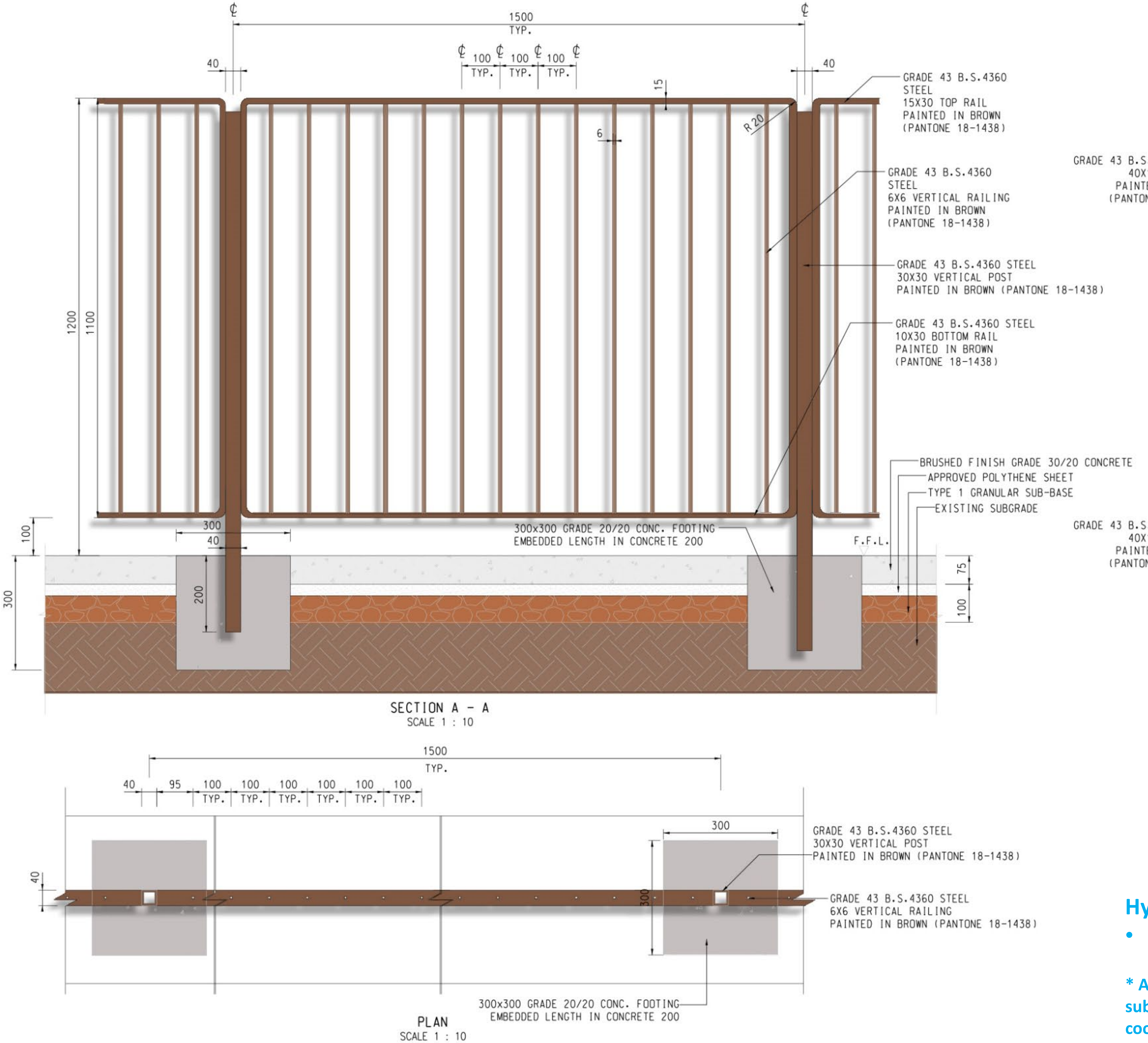
- Water level ruler to be installed at the lowest level of each ponds.

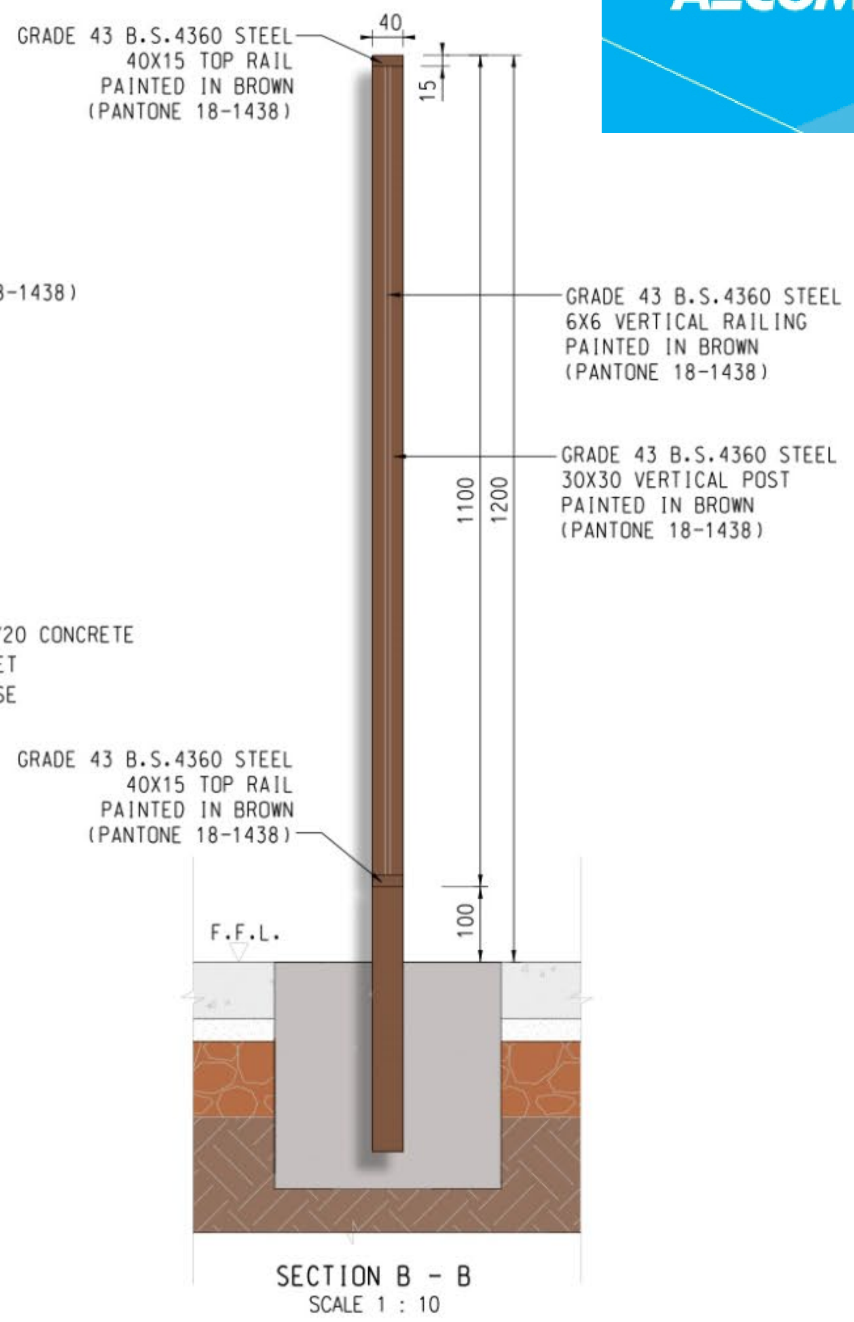


Typical Details of Life Buoy

Contractor's Shop Drawing

Figure 3.18





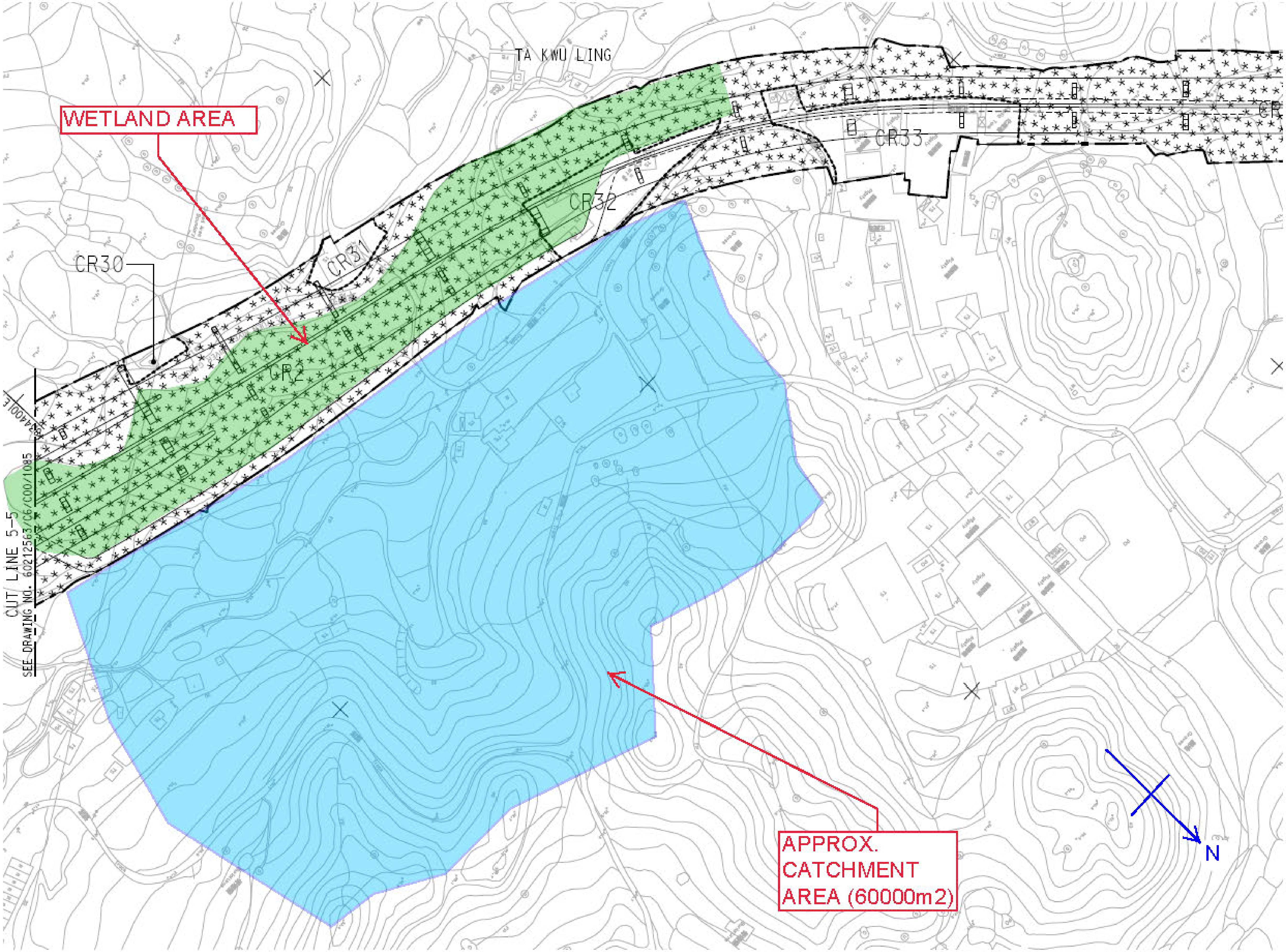
HyD Standard Type 2 Railing

- **1.2m (H), painted in brown**

**** Aesthetic appearance subject to further coordination with AFCD***

Typical HyD Standard Type 2 Railing

Figure 3.19

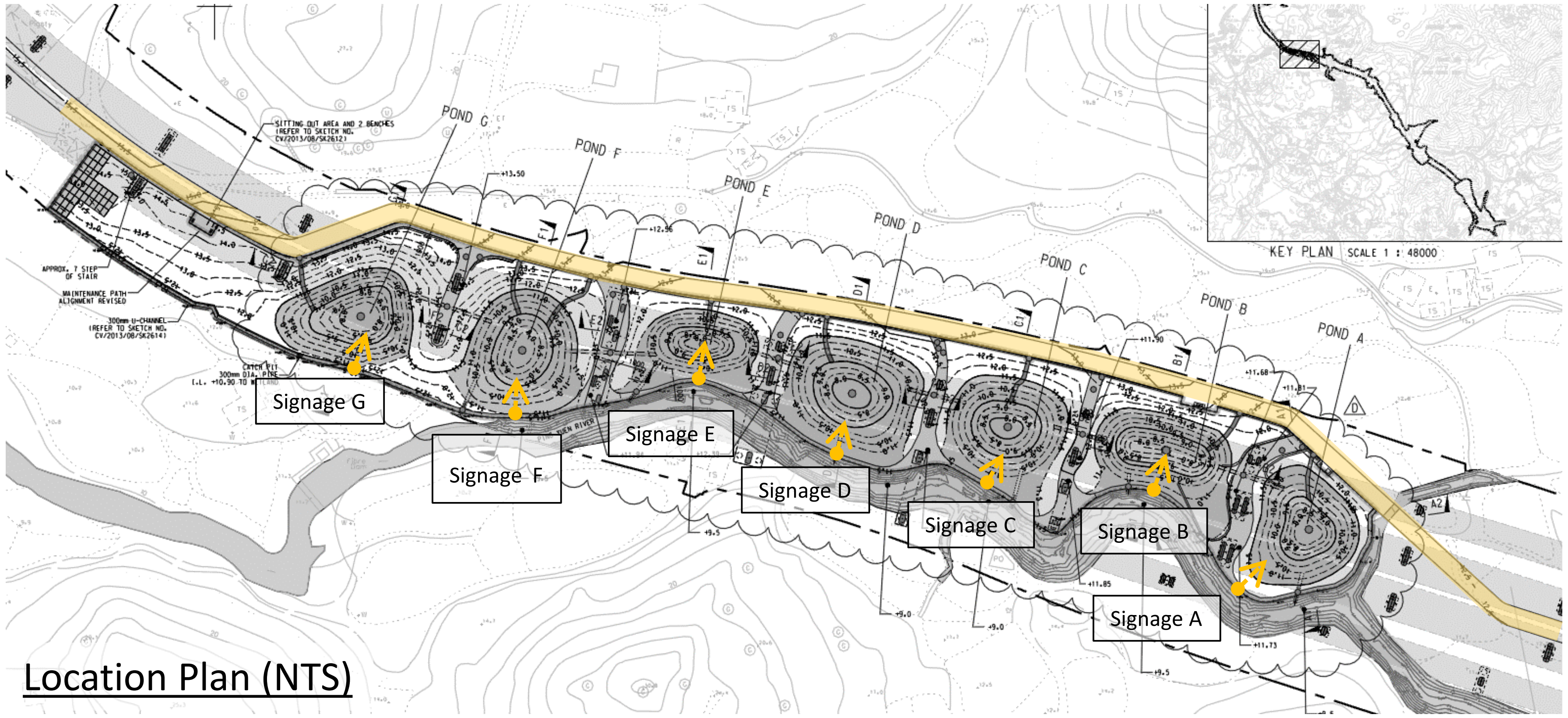


Source of Surface Runoff Water

Figure 3.20

6m path

Proposed location of Signage and facing direction
(to be handed over to AFCD, and exact location to be confirmed on site)

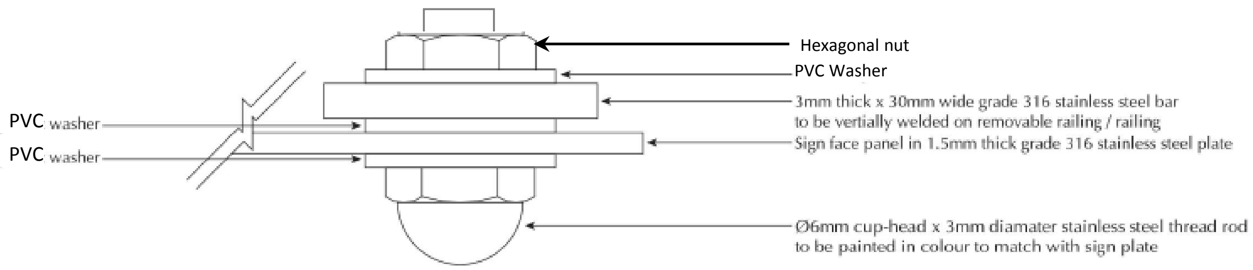


Location Plan (NTS)

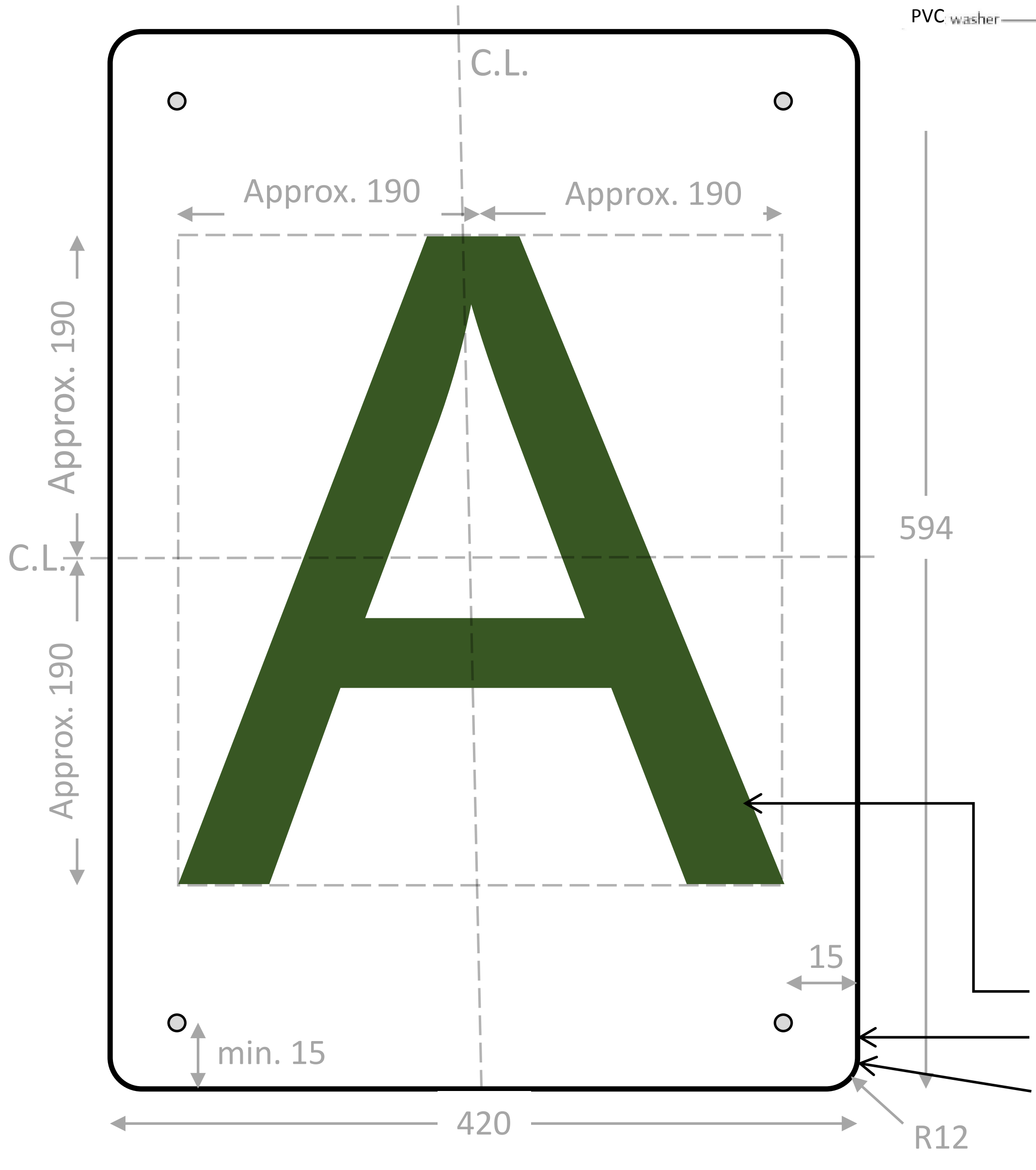
Reference Images

6mm dia cup-head x 3mm dia. stainless steel thread rod to be painted in colour to match with sign plate

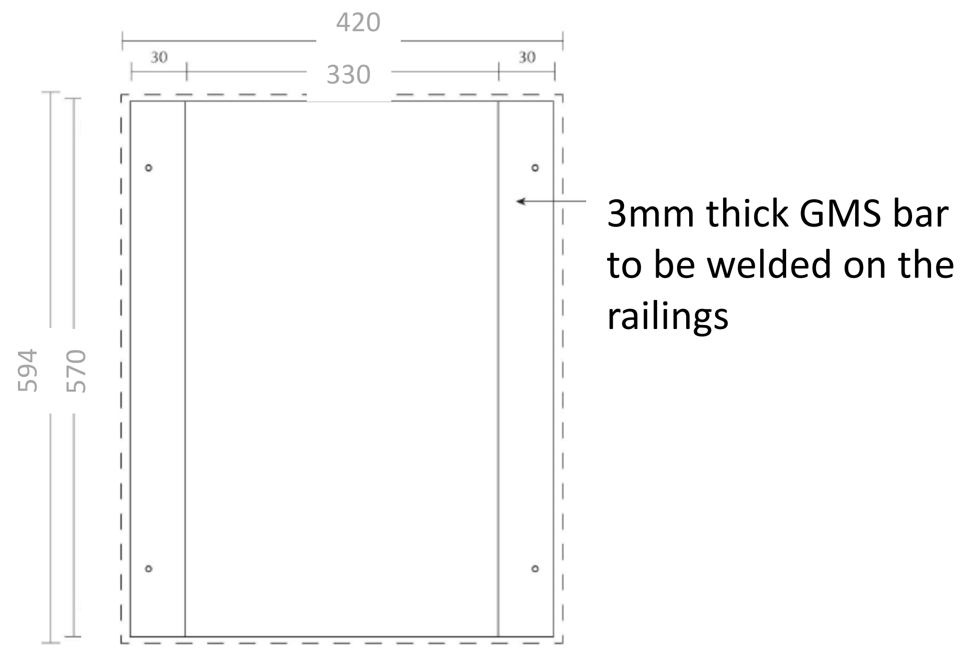
Typical Fixing Details (NTS)

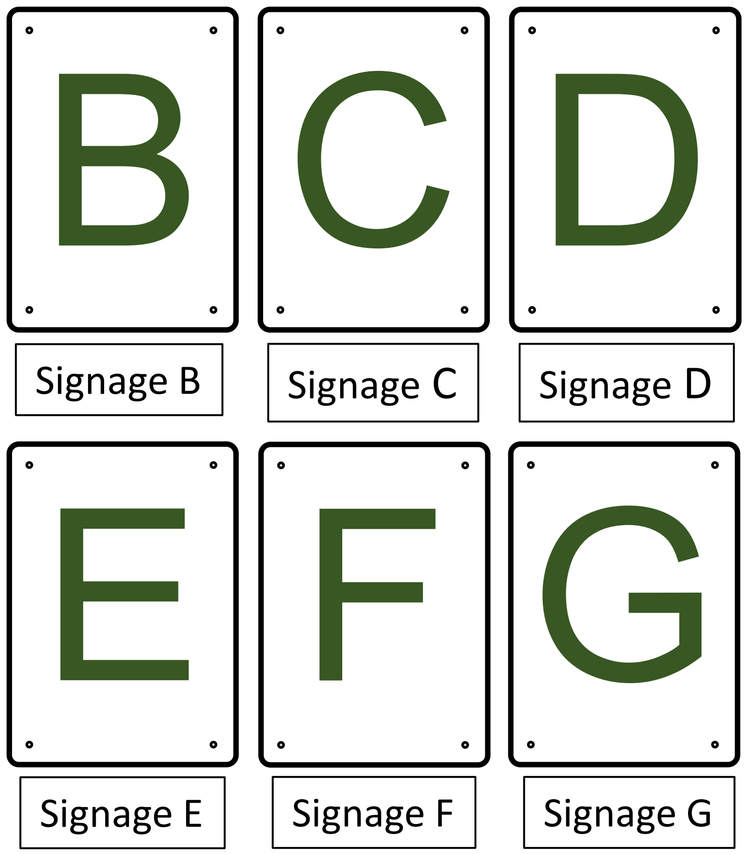


Typical Details (Signage A)



GMS Back plate to be welded on railings (NTS)

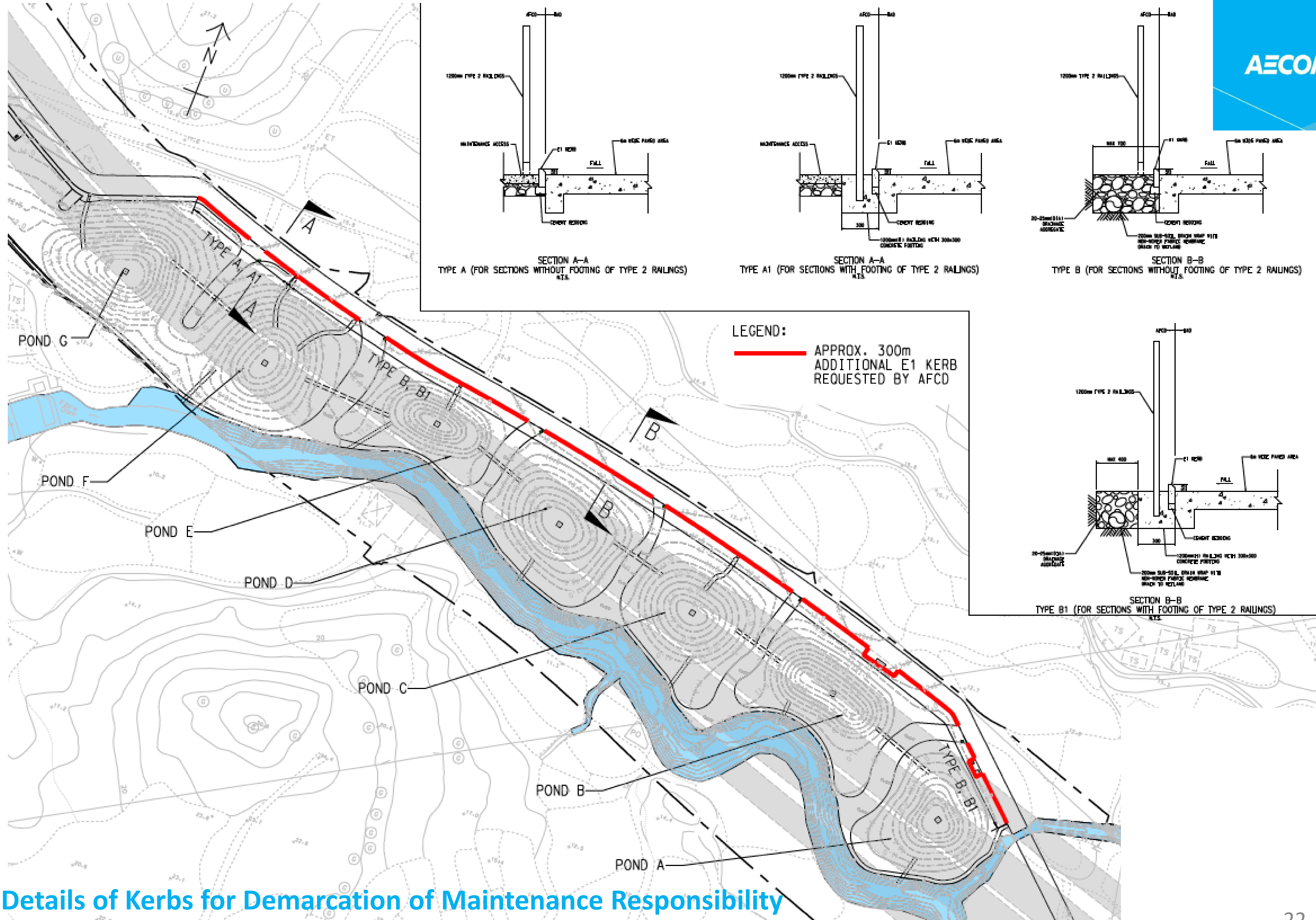




Prints for Signage B to Signage G (NTS)

Details of Pond Signage

Figure 3.21



Details of Kerbs for Demarcation of Maintenance Responsibility

Figure 3.22

Appendices

Appendix 1 Wetland Compensation Area - Site Photos


Wetland Area

Wetland Compensation Area – Site Photos taken on 7 July 2015

Photo No. 1

Photo No. 2

Photo No. 3

Photo No. 4

Photo No. 5

Photo No. 6

Photo No. 7

Appendix 2 Flora Species Recorded within Site Boundary

Flora Species Recorded within Site Boundary

Common Name	**Scientific Name**	中文名	**Abundance**
Big-leaved Acacia	*Acacia mangium*	大葉相思	+
Lebbeck Tree	*Albizia lebbeck*	大葉合歡	+
Giant Alocasia	*Alocasia macrorrhizos*	海芋	++
Water Hyssop (1)	*Bacopa monnieri*	假馬齒莧	++
-	*Bidens alba*	白花鬼針草	++
Blunt Signal-grass (1)	*Brachiaria mutica*	巴拉草, 爬拉草	+++
Pop-gun Seed	*Bridelia tomentosa*	土蜜樹, 逼迫仔	++
Paper Mulberry	*Broussonetia papyrifera*	構, 楮桑	+
Corniculate Cayratia	*Cayratia corniculata*	角花烏蘞莓	+
Chinese Hackberry	*Celtis sinensis*	朴樹	+
Pummelo	*Citrus maxima*	柚	+
Mandarin	*Citrus reticulata*	柑橘	+
Wampi	*Clausena lansium*	黃皮	+
Taro (1)	*Colocasia esculenta*	芋	++
Diffuse Day-flower (1)	*Commelina diffusa*	節節草	+++
Wood-fern	*Cyclosorus parasiticus*	華南毛蕨, 密毛小毛蕨	++
Laxspiculate Galingale (1)	*Cyperus distans*	疏穗莎草, 疏穎莎草	+
Umbrella Plant (1)	*Cyperus involucratus*	風車草	++
Dianella	*Dianella ensifolia*	山菅蘭	+
Longan	*Dimocarpus longan*	龍眼	+
India-rubber Tree	*Ficus elastica*	印度榕 ，印度橡樹	+
Opposite-leaved Fig	*Ficus hispida*	對葉榕 ，牛乳樹	++
Chinese Banyan	*Ficus microcarpa*	榕樹 ，細葉榕	+
Creeping Fig	*Ficus pumila*	薜荔 ，文頭郎	+
Annual Bluegrass , Imperial Japanese Morning Glory	*Ipomoea cairica*	五爪金龍	+
-	*Ipomoea obscura*	小心葉薯 ，紫心牽牛	++
Short-leaved Kyllinga (1)	*Kyllinga brevifolia*	短葉水蜈蚣	++
Lantana	*Lantana camara*	馬纓丹	++
White Popinac	*Leucaena leucocephala*	銀合歡	+++
Chinese Privet	*Ligustrum sinense*	山指甲	+
Lychee	*Litchi chinensis*	荔枝	+
Climbing Fern	*Lygodium japonicum*	海金沙 ，羅網藤	+
Elephant's Ear	*Macaranga tanarius*	血桐	++
Turn-in-the-wind	*Mallotus paniculatus*	白楸	+
China-berry	*Melia azedarach*	楝 ，苦楝, 森樹	+
Mile-a-minute Weed	*Mikania micrantha*	薇甘菊	++
-	*Mimosa diplotricha*	巴西含羞草	++
Common Banana	*Musa* x paradisiaca	大蕉, 甘蕉	++++
Guinea Grass	*Panicum maximum*	大黍	++++

Hilo Grass	*Paspalum conjugatum*	兩耳草	++
Hairy Knotweed [(1)]	*Polygonum barbatum*	毛蓼	++
Chinese Knotweed	*Polygonum chinense*	火炭母, 五毒草	+
Guava	*Psidium guajava*	番石榴	++
Bracken Fern	*Pteridium aquilinum* Kuhn var. *latiusculum*	蕨	+++
Wild Kudzu Vine	*Pueraria phaseoloides*	三裂葉野葛	++
Sumac	*Rhus hypoleuca*	白背鹽膚木, 白背漆	+
Reed-like Sugarcane	*Saccharum arundinaceum*	斑茅, 大密	+
-	*Wedelia trilobata*	三裂葉蟛蜞菊	++
Indian Wikstroemia	*Wikstroemia indica*	了哥王, 山雁皮	+
Shiny-leaved Prickly Ash	*Zanthoxylum nitidum*	兩面針, 入地金牛	+
Weaver's Bamboo	*Bambusa textilis*	青皮竹	++

Notes:
[(1)] Wetland dependent species.
[The wetland dependent species was assessed with reference to Yip, Y., Yip, K. L., Liu, K. U., Ngar Y. N. and Lai, C. C. (2010). *A Floristic Survey of Marshes in Hong Kong.* Hong Kong Biodiversity. Agriculture, Fisheries and Conservation Department Newsletter Issue No. 19.]
Code for Abundance: +++++=dominant; ++++=abundant; +++=frequent; ++=occasional; +=scarce

Appendix 3 Report on Water Balancing Analysis for the Wetland Compensation Area

Civil Engineering and Development Department

Agreement No. CE 38/2010 (CE)
Liantang/Heung Yuen Boundary Control Point and Associated Works
(Site Formation and Infrastructure) – Design and Construction

Report on Water Balancing Analysis for the Wetland Compensation Area

(Rev. 3)

October 2021

QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
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Prepared by	Simon, TANG	Simon, TANG	Simon, TANG	Simon, TANG
Signature				
Checked by	Gallacher, David	Gallacher, David	Gallacher, David	Gallacher, David
Signature				
Authorized by	Owen, NG	Owen, NG	Owen, NG	Carol, LEUNG
Signature				
Project number	60212563/5.3-C2	60212563/5.3-C2	60212563/5.3-C2	60212563/5.3-C2
Report number	01	02	03	04

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FIGURES

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APPENDIX

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1 INTRODUCTION

1.1 Background

1.1.1.1 The "Liantang/Heung Yuen Wai Boundary Control Point and Associated Works Project" (hereinafter referred to as "the Project") comprises a new Boundary Control Point (BCP) proposed at Liantang/Heung Yuen Wai (LT/HYW), its connecting road and other associated works.

1.1.1.2 An Environmental Impact Assessment (EIA) study for the Project was conducted in accordance with EIA Study Brief No. ESB-199/2008. According to the latest Environmental Permit (No. EP-404/2011/D), the loss of freshwater wetland due to the Project was proposed to be compensated by creating a freshwater wetland in size of not less than 1.4ha.

1.1.1.3 AECOM Asia Co. Ltd (AECOM) has been commissioned by the Civil Engineering and Development Department (CEDD) for the design and associated works of the Wetland Compensation Area (WCA). The layout plan of the as-built WCA is shown in **Figure 1-1** below.

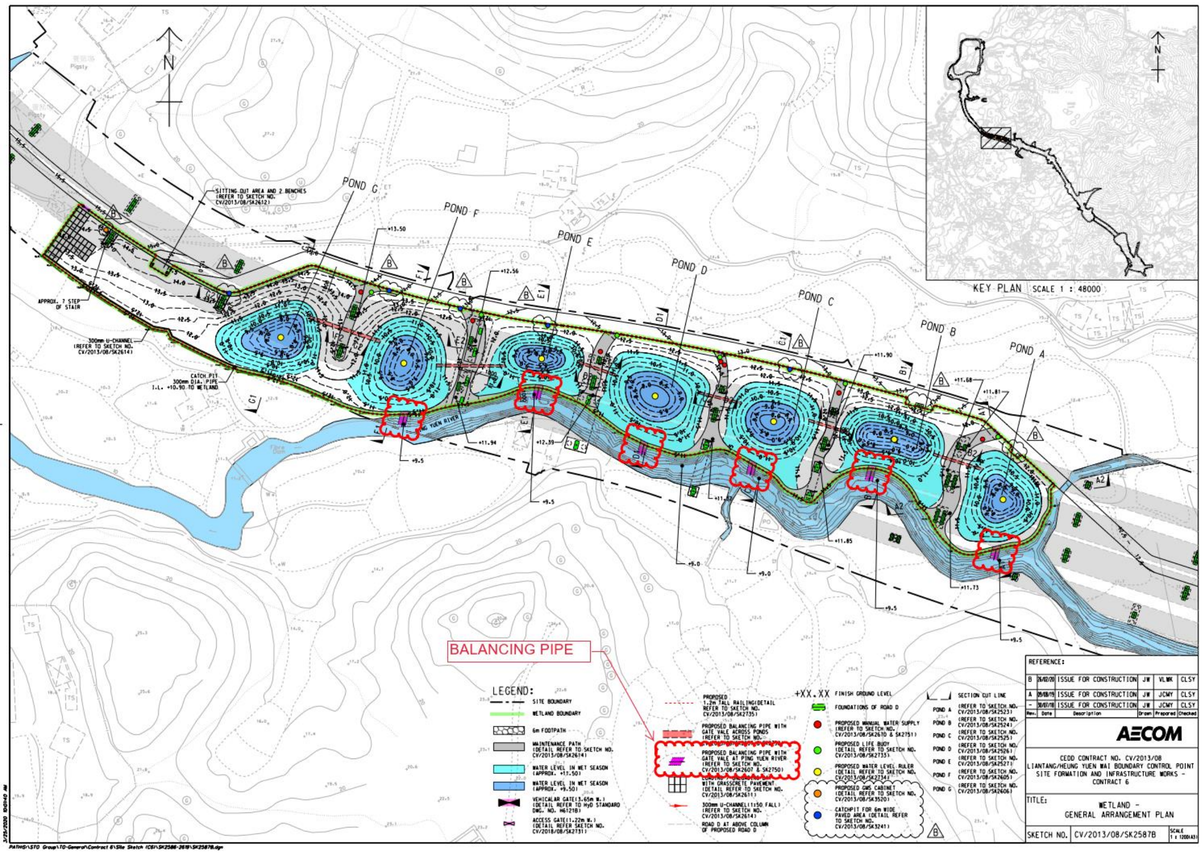

Figure 1-1 The Layout Plan of the Wetland Compensation Area (WCA)

1.2 Objectives of the Report

1.2.1.1 The HCMP (Habitat Creation and Management Plan) Report specifies that water levels within the wetland area should be maintained between +10.00mPD (dry season) and +11.50mPD (wet season). This report will review the water balance analysis for the WCA, including:

- provide integrated water balancing study for the wetland taking into account water evaporation rate and water supply sources from direct rainfall, surface runoff, and Ping Yuen River;
- provide hydraulic modeling simulation to study the inter-connection pond and PY River.
- prepare an action plan under what circumstances to use potable water supply source and the anticipated annual frequencies; and
- demonstrate the design of the as-built wetland pond is sound and sustainable.

1.3 Structure of the Report

1.3.1.1 The report is divided into the following sections:

- Section 1 describes the project background and scope of work of this report.
- Section 2 details the baseline analysis comprised of the as-built drawing of WCA, rainfall/evaporation characteristics, potential water supply source, drainage basin, etc. The baseline analysis aims to provide a factual basis for water balancing work.
- Section 3 presents the multi-year average monthly water balancing for the WCA and the water depth change. A daily water balancing will be further conducted based on the selected typical dry year.
- Section 4 studies each pond's water depth variations using hydraulic modeling simulation under a typical dry year.
- Section 5 provides a summary of findings and recommendations.

2 REVIEW OF BASELINE CONDITIONS

2.1 Rainfall and Evaporation

2.1.1 Rainfall

2.1.1.1 The long-term time-series data of measured rainfall at Ta Kwu Ling was used for assessment [1]. The data was extracted from 2003 to 2019, considering the data completeness. In the recent 17 years, the average annual rainfall has been 1,966 mm, while the minimum/maximum rainfall is 1,245mm and 2,625mm, respectively.

2.1.1.2 The monthly water balancing was conducted based on the monthly rainfall analysis in **Figure 2-1**.

2.1.1.3 As shown in **Figure 2-2**, the year's dataset from 2010 to 2011 was selected for daily water balancing analysis. This is because the 2010 wet season data corresponds to an average wet season, and the 2011 dry season corresponds to a very dry season when examined with the Ta Kwu Ling's historic rainfall records. In Chapter 4, the 2011 data will be adopted for hydraulic modeling simulation on the inter-connection among each pond.

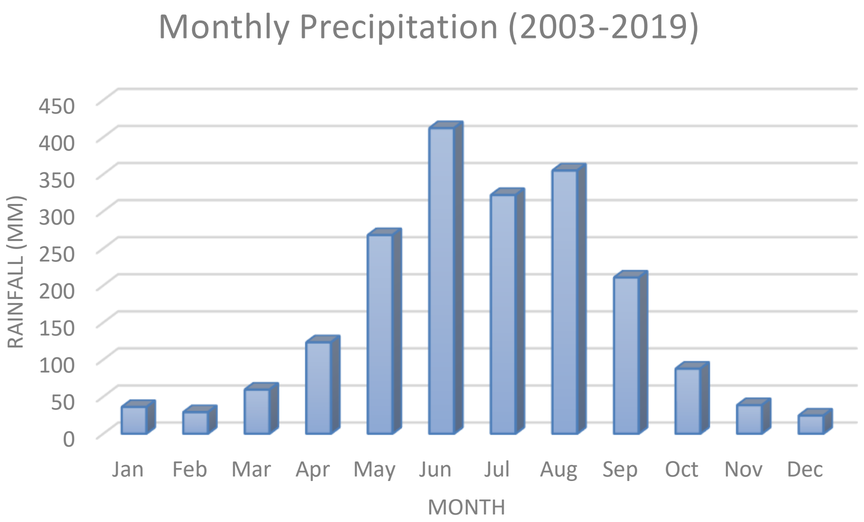

Figure 2-1 The Multi-year Averaged Monthly Precipitation at Ta Kwu Ling

1 https://www.hko.gov.hk/tc/cis/awsDailyElement.htm?stn=TKL&ele=RF&y=2020

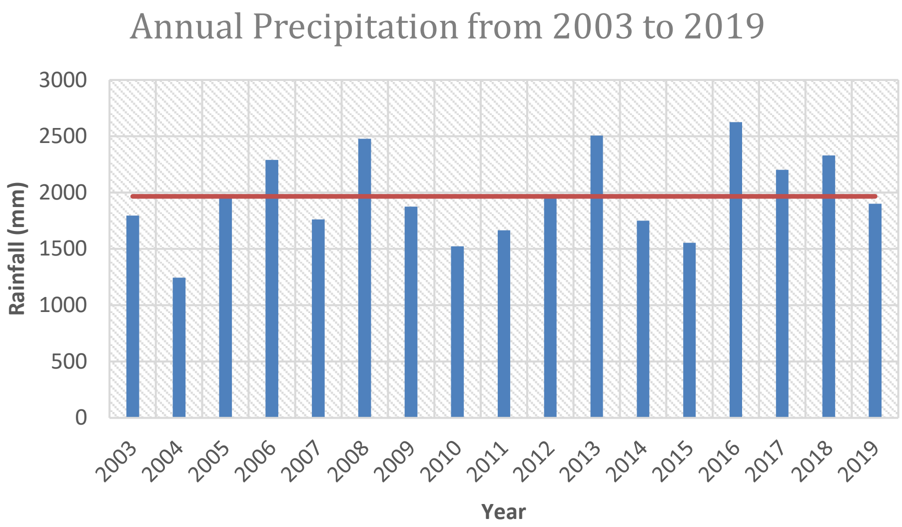

Figure 2-2 The Annual Precipitation at Ta Kwu Ling

2.1.2 Evaporation

2.1.2.1 Evaporation is the primary water loss for the WCA. The daily evaporation is measured at King's Park [2]. The monthly total evaporation at King's Park from 2003 to 2019 is adopted for monthly water balancing, as given in **Figure 2-3**. The multi-year averaged annual evaporation is 1,221mm.

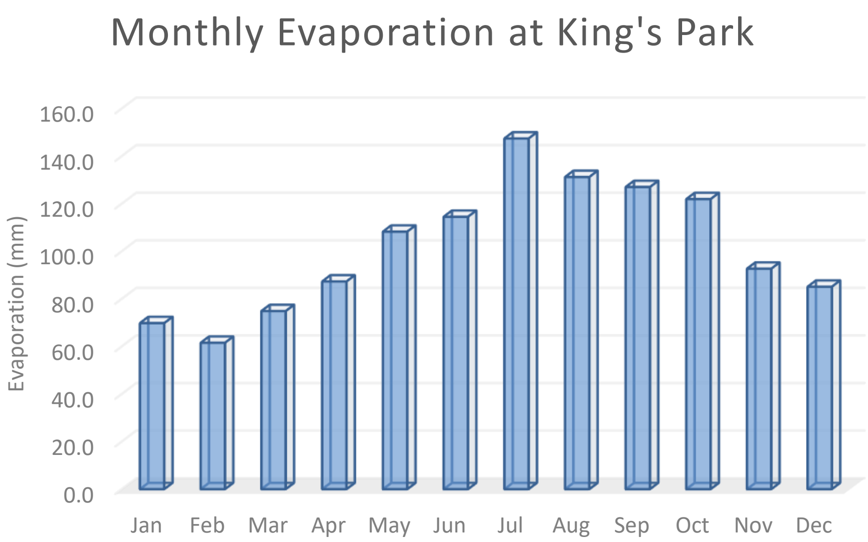

Figure 2-3 The Multi-year Averaged Monthly Evaporation at King's Park

2 https://www.hko.gov.hk/en/cis/monthlyElement.htm?ele=EVAPO

2.2 The Wetland Compensation Area (WCA)

2.2.1 Volume-Area-Stage Curve

2.2.1.1 The layout plan of the as-built WCA is shown in **Figure 1-1**, with a typical section indicated in **Figure 2-4**. Summary of the as-built WCA are:

- The designated wet season water level is +11.5mPD, while the dry season water level is +10.00mPD;
- Aquatic plants with boulders planted above +10.00mPD;
- Provision of 600mm thick soil mix with sandy clay loam;
- Sodium bentonite waterproofing composite to minimize leakage; and
- Provision of maintenance access, footpath, and railing.

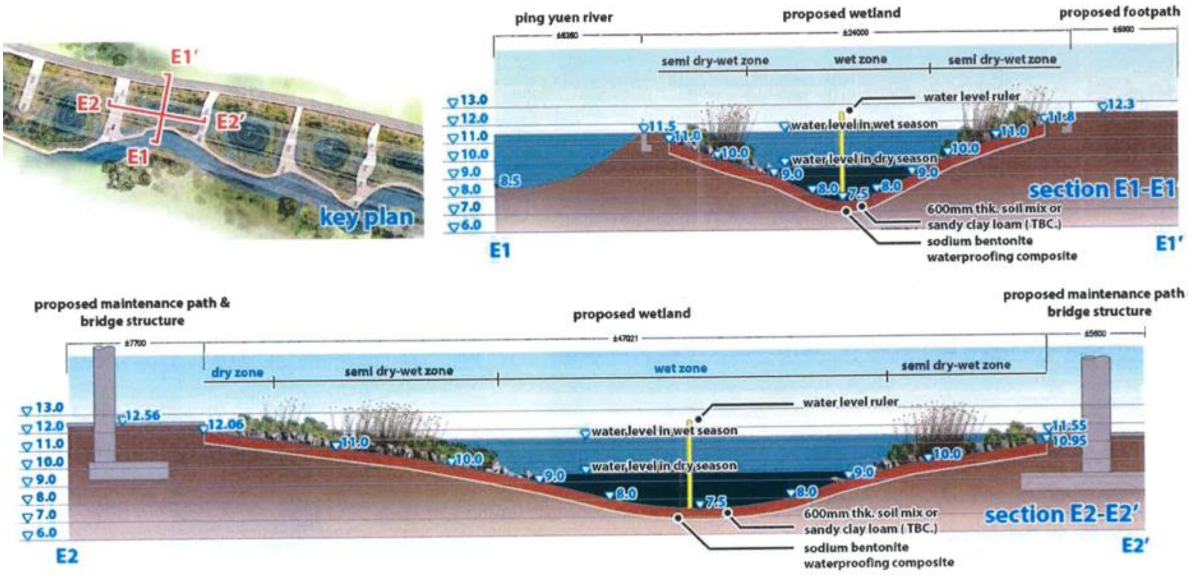

Figure 2-4 The Typical Section of WCA

2.2.1.2 The accuracy of water balancing analysis relies on the precise pond volume-area-stage relation. The as-built drawings were extracted for the estimation of the volume-area-stage curve. A typical volume-stage curve is presented in **Figure 2-5**, while **Table 2-1** shows the area-stage relation for each pond.

2.2.1.3 Based on the site visit dated 16th Oct 2020 (dry season in a year), the existing water depth is approx. 3.0m in each pond. That is, the current water level is estimated to be 10.5mPD.

Table 2-1 The Water Surface Area under Various Water Level

Water level (mPD)	Pond A (m^2)	Pond B (m^2)	Pond C (m^2)	Pond D (m^2)	Pond E (m^2)	Pond F (m^2)	Pond G (m^2)
11.5	911.9	1047.7	1089.7	1287.2	770.2	1123.2	931.2
11.0	684.5	711.4	744.0	932.8	475.3	835.6	763.1
9.5	236.4	298.8	292.0	372.9	166.5	315.3	335.8

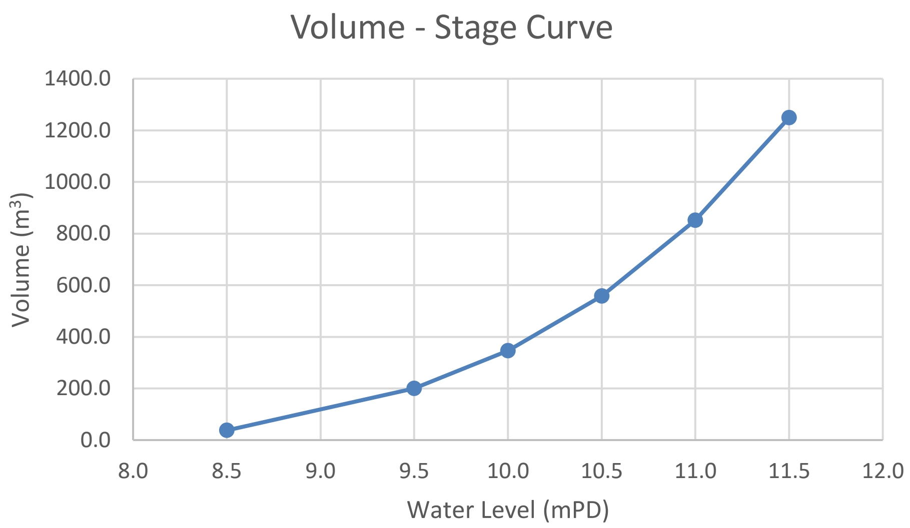

Figure 2-5 The Volume-Stage Curve of Pond A

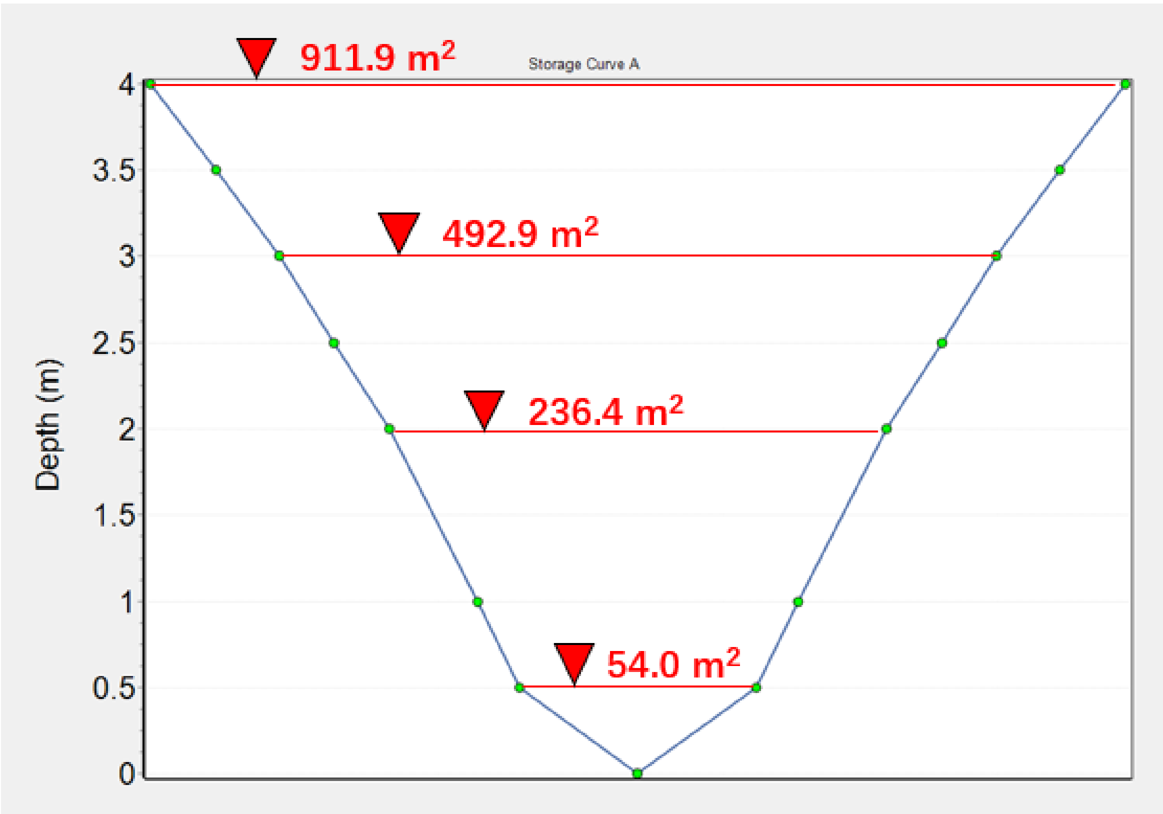

Figure 2-6 The Water Depth – Coverage Curve of Pond A

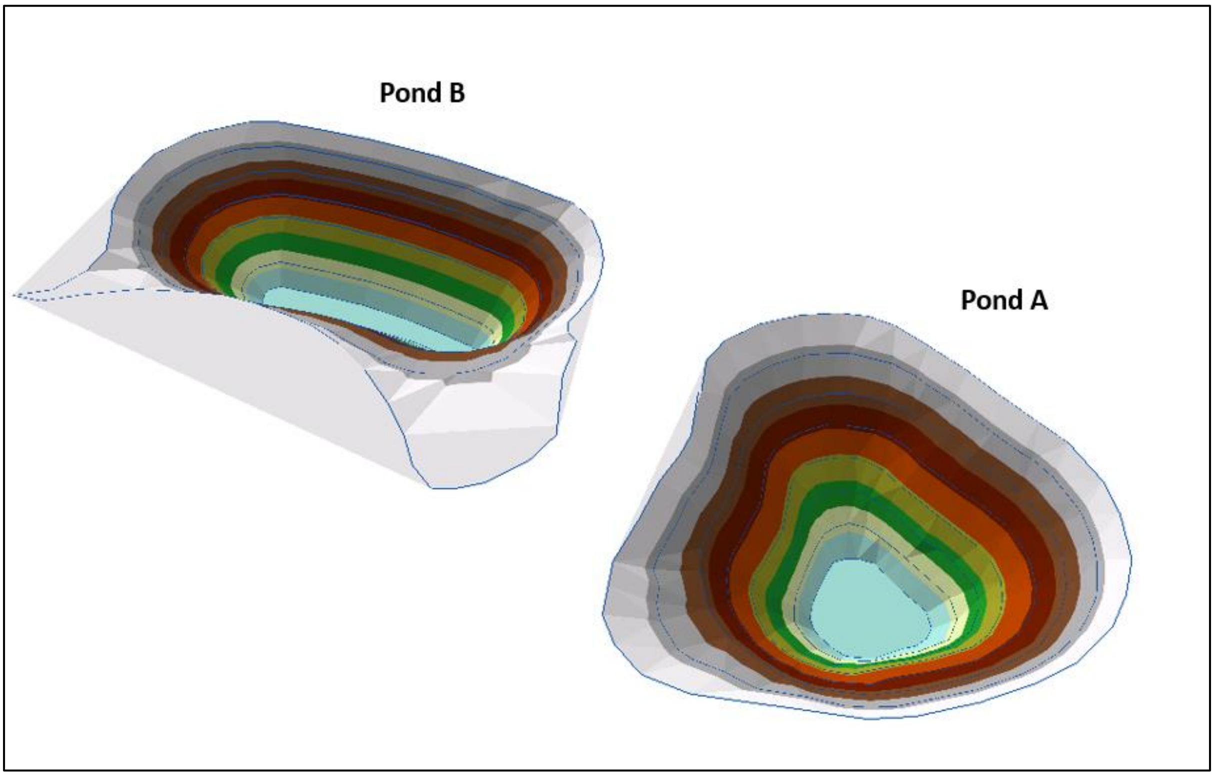

Figure 2-7 3D Topo of the As-built WCA (Pond A and Pond B)

Figure 2-8 The Site Visit Dated 16th Oct 2020 (Typical Dry Season)

2.2.2 Balancing Pipe

2.2.2.1 The balancing pipes are presented in **Figure 2-9** and **Figure 2-10**. For the pipe between the wetland and PY river, the invert level of the inlet is 10.55mPD while the outlet is 10.50mPD. For the interconnection pipe among the wetlands, the invert levels are all set at 10.50mPD.

2.2.2.2 The seven ponds are connected each by an interconnection pipe with invert levels at 10.50mPD. Thus, the seven ponds can be treated as one integrated water system with the same water surface level in the subsequent water balancing analysis. The observed water level (10.5mPD) is in line with the balancing pipe as-built drawing. As confirmed with the site engineer, all the balancing pipes have remained open since the wetland completion in early 2020.

2.2.2.3 Moreover, when the pond water level drops below +10.5mPD, some pond interconnection will be disconnected. The hillside surface runoff would be discharged into the pond via rock channel, as shown in **Figure 2-12**. Thus, comprehensive hydraulic modeling will be performed to simulate each pond's actual water depth variation under a typical dry year condition.

Figure 2-9 The As-built Drawing of Balancing Pipe

Figure 2-10 The Balancing Pipe of Wetland-PY River and Wetland-Wetland

2.3 The Contributed Catchment

2.3.1.1 The surface runoff from the adjacent catchment is the WCA's primary water source (**Figure 2-11**). 300mm dia U-channel intercepts the surface runoff along the footpath, then flows into wetland via the catch-pit and rock channel, as shown in **Figure 2-12** and **Figure 2-14**.

2.3.1.2 The catchment area is approximately the size of 60,000 m^2. The satellite image and reference check based on the site visit shows that the land coverage is mostly natural greenfield.

2.3.1.3 To ensure the runoff distribution to each pond equably, the existing rock channel arrangements (**Figure 2-12**) will be replaced by a new proposed scheme (**Figure 2-13**). That is, each pond will have a separated rock channel to collect the runoff. Chapter 4 hydraulic modeling analysis will simulate both rock channel arrangements.

Figure 2-11 The Contributed Catchment Area for the WCA

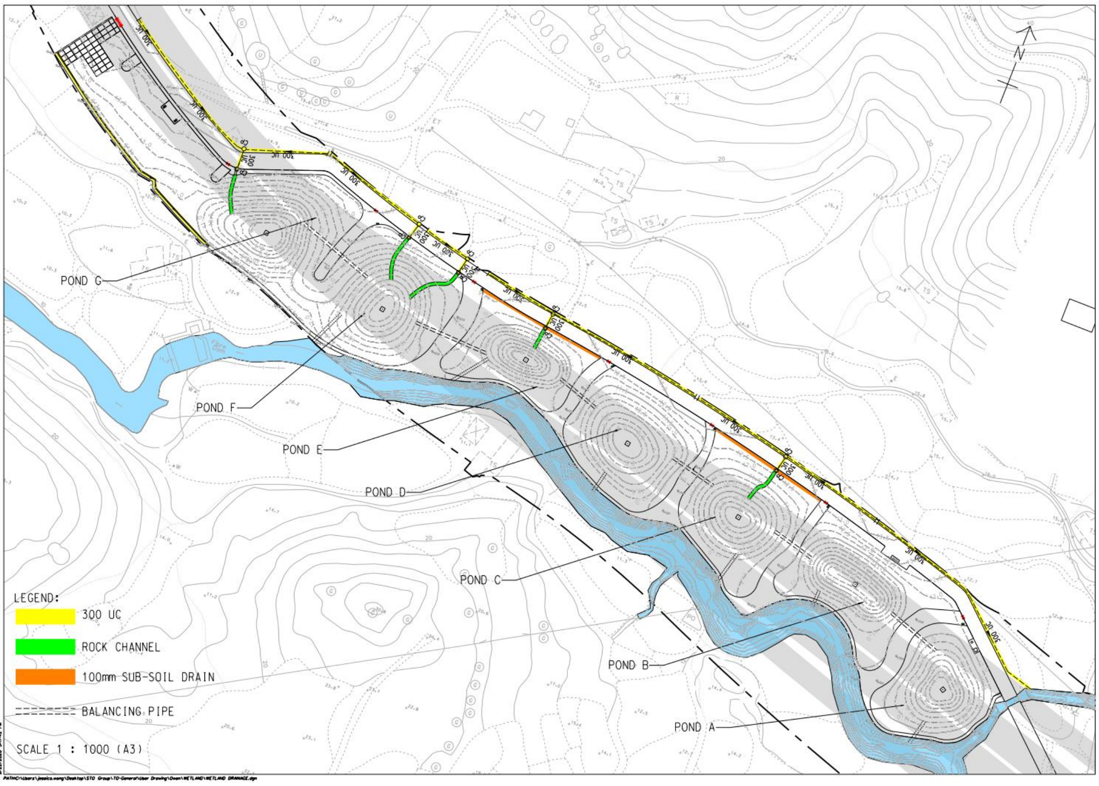

Figure 2-12 The Drainage System of WCA and the Rock Channel Arrangement Dated on 16th Oct 2020

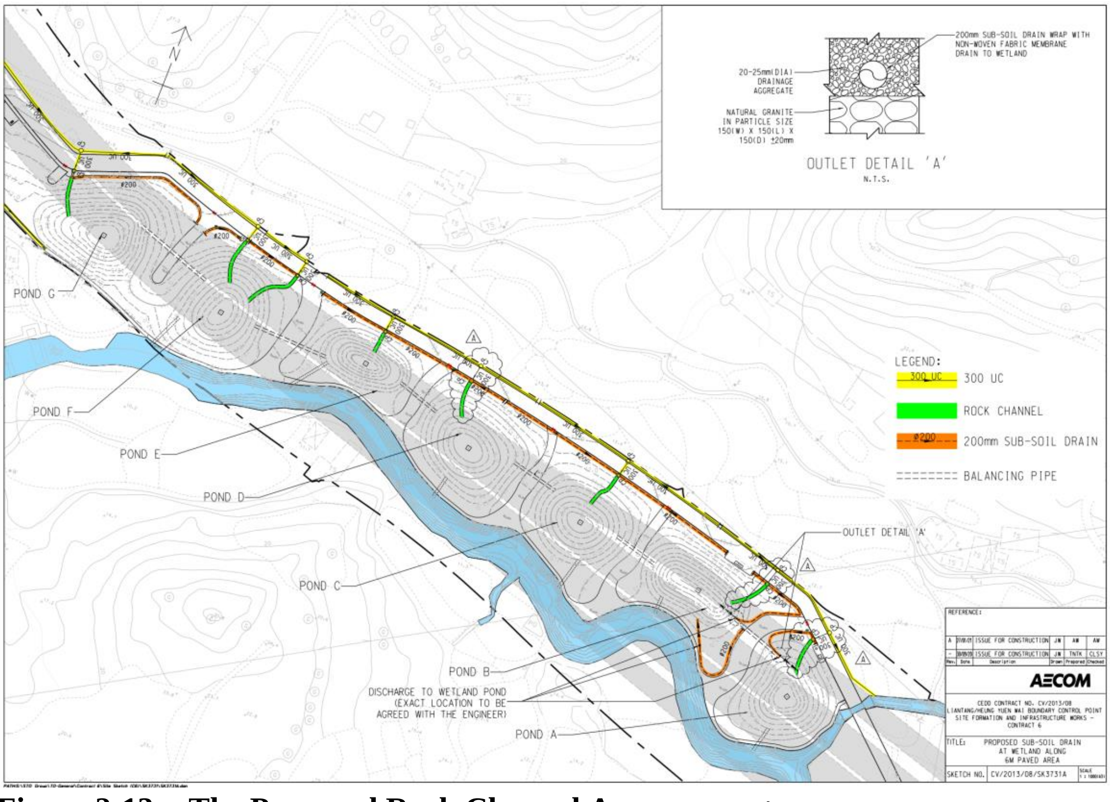

Figure 2-13 The Proposed Rock Channel Arrangement

Figure 2-14 The 300mm U-Channel, Catchpit, and Rock Channel

2.4 Direct Water Surface Area Collecting Rainfall

2.4.1.1 Surface runoff from the bridge would be collected by a 250 dia uPVC downpipe into the sand trap system and ultimately discharged to the PY river. Thus, only part of the wetland surface area can collect direct rainfall.

2.4.1.2 As shown in **Figure 2-15**, the green area is the exact wetland surface that can collect direct rainfall. The wetland surface area that can collect direct rainfall has already excluded those covered areas underneath HYWH. The estimated direct area is 5,856m^2.

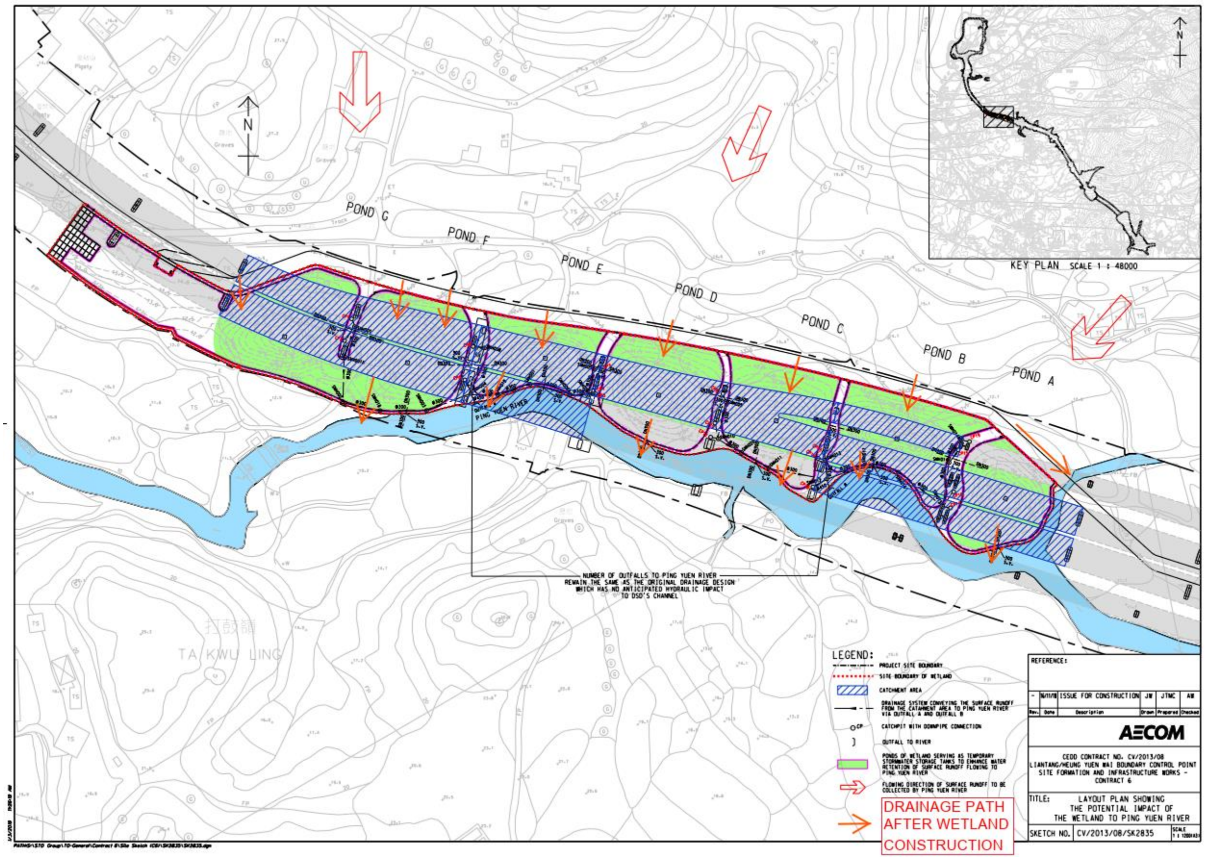

Figure 2-15 The Water Surface Area Collecting Direct Rainfall (Greening Area)

2.5 The Ping Yuen River

2.5.1 Water Flow at PY River

2.5.1.1 Various references have been checked to investigate the water flow characteristics in PY River, which comprise:

- monthly Environmental Monitoring and Audit (EM&A) Report [3]; and
- monthly monitoring data by the Environmental Protection Department (EPD) [4].

1) Data from EM&A Report

2.5.1.2 PY River bed level varies from around +10mPD (Pond A) to +9mPD (Pond F) along the wetland. An independent Environmental Team has completed over two years of monitoring PY River's water depth for the wetland construction stage.

2.5.1.3 PY River was usually at a low water level. The recorded water depths were frequently below 300mm and rarely up to 1m after an occasional heavy rainstorm, based on Monitoring Station ID No. WM2A from Appendix I in the Monthly Environmental Monitoring and Audit (EM&A) Report.

3 http://www.lthywbcpema.com/index.php?p=emanda_report
4 https://cd.epic.epd.gov.hk/EPICRIVER/riveryear/?lang=en

2.5.1.4 Quoted from the Drainage Impact Assessment report (No. 25228/71B) [5], PY River's water level can only reach up to a maximum of 12.0mPD under a 1 in 2-year design rainstorm. Most of the time, the PY River's water depth is below 300mm.

Figure 2-16 The Existing Water Depth of PY River dated 16th Oct 2020

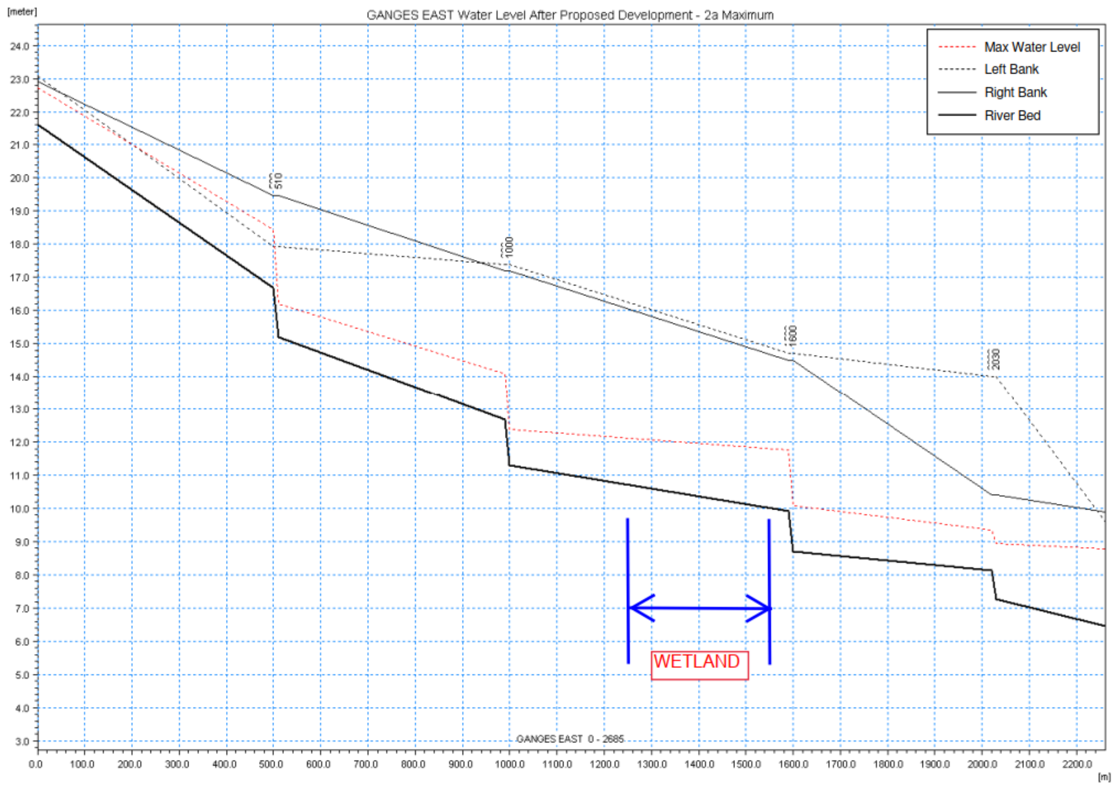

Figure 2-17 Maximum Water Level of PY River under 1 in 2-year Design Rainstorm

5 Drainage Impact Assessment (Final). Agreement No. CE 45/2008 (CE) Liantang/Heung Yuen Wai Boundary Control Point and Associated Works. August 2010.

2) Data from EPD

2.5.1.5 The EPD has had a comprehensive river water quality monitoring programme in Hong Kong since 1986, which covers 82 stations at 30 main rivers and streams running through urban areas. PY River's long-term series data (1999 to 2018) was downloaded from the EPD website for analysis.

2.5.1.6 The multi-year monthly averaged water flow (**Figure 2-18**) indicated a low PY River flow exists as baseline conditions. The average water flow is 0.094 m^3/s, while 0.054 m^3/s during the dry season and 0.175 m^3/s during the wet season.

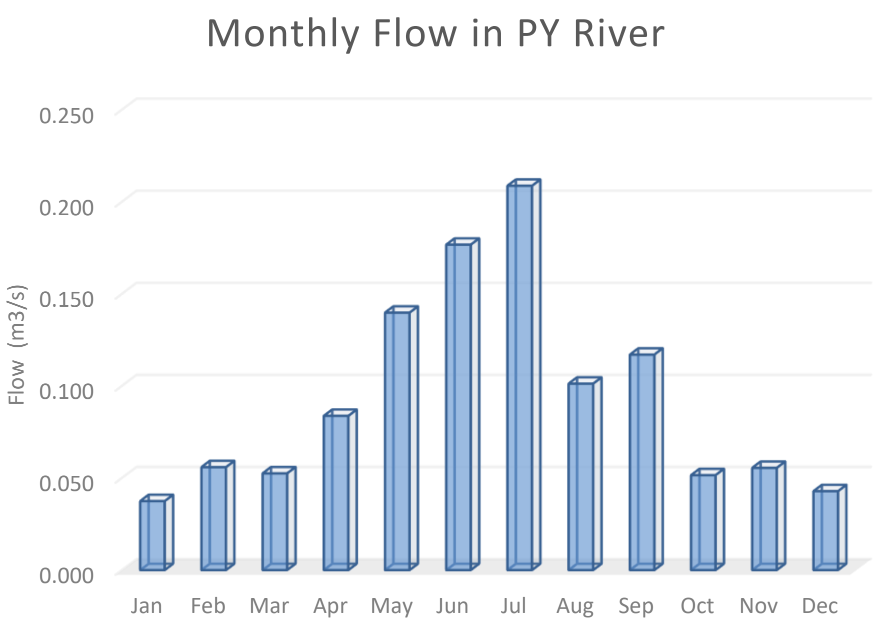

Figure 2-18 The Multi-years Monthly Averaged Water Flow at PY River (EPD)

2.5.2 Feasibility of Direct use of Water from PY River at Upstream End Near Pond A

2.5.2.1 The topo plan of PY River is attached in **Figure 2-19**. When we look at section A-A' near pond A, the existing riverbed is around +9.72mPD (**Figure 2-20**). We can use the Manning Equation to analyze the open channel flows and the water depth in PY River.

2.5.2.2 With Manning Equation, the cross-sectional water depth distribution can be derived from the multi-year monthly averaged water flow by EPD (**Figure 2-18**), as shown in **Table 2-2**. The calculated averaged water depth near pond A is 197mm. The average water depth is 166mm during the dry season, while 240mm during the wet season.

2.5.2.3 The calculation has been cross-validated by the monitoring results by EM&A, which is that PY River was usually at a low water level (below 300mm). The water surface during the dry and wet seasons has been presented in **Figure 2-20**. The results revealed that the PY River could not provide water supply to pond A most of the time except during significant storm events.

Table 2-2 The Multi-years Monthly Average Water Depth at PY River

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Flow (m^3/s)	0.037	0.056	0.053	0.084	0.140	0.177	0.209	0.101	0.117	0.052	0.056	0.043
Water Level (mPD)	9.865	9.890	9.890	9.914	9.962	9.987	10	9.915	9.938	9.890	9.890	9.865
Water Depth (m)	0.145	0.170	0.170	0.194	0.242	0.267	0.280	0.195	0.218	0.170	0.170	0.145

2.5.2.4 If we install a gravity/balancing pipe at the riverbed connecting to Pond A, we have discussed with the Contractor and concluded that it was feasible to do it during a dry season in PY River. However, the water level of Pond A would be definitely lowered from the current +10.5mPD to +10mPD. It would reduce the pond water and also violate the intent to secure the pond water-retaining capacity.

2.5.2.5 The water balancing analysis in Chapter 3 indicated that surface runoff from the hillside could maintain the water demand most of the time. PY River water levels are low in the dry season. The PY River’s flow is quite low during the dry season (only 0.054 m^3/s). The amount of low water flow during the dry season needs to sustain the diversity of aquatic life and the PY River's functioning ecosystem. We will treat this low flow as **ecological flow**. If we set a dam near pond A or use pumping facilities to abstract water to supply the wetlands in the dry season, this could have a secondary impact on river ecology itself. The water abstraction will affect the existing flow regime that protects river ecological integrity in PY River.

2.5.2.6 On the other hand, dam or pumping facilities may be constructed and provided in PY River near Pond A. However, it would take time to conduct further assessments such as DIA, EIA, ecological impact assessment, etc., for PY River. This artificial provision may also be contrary to the EIA requirement that the wetland habitats should be largely self-sustaining. Once the compensation wetlands are established, management should largely limit to maintenance works.

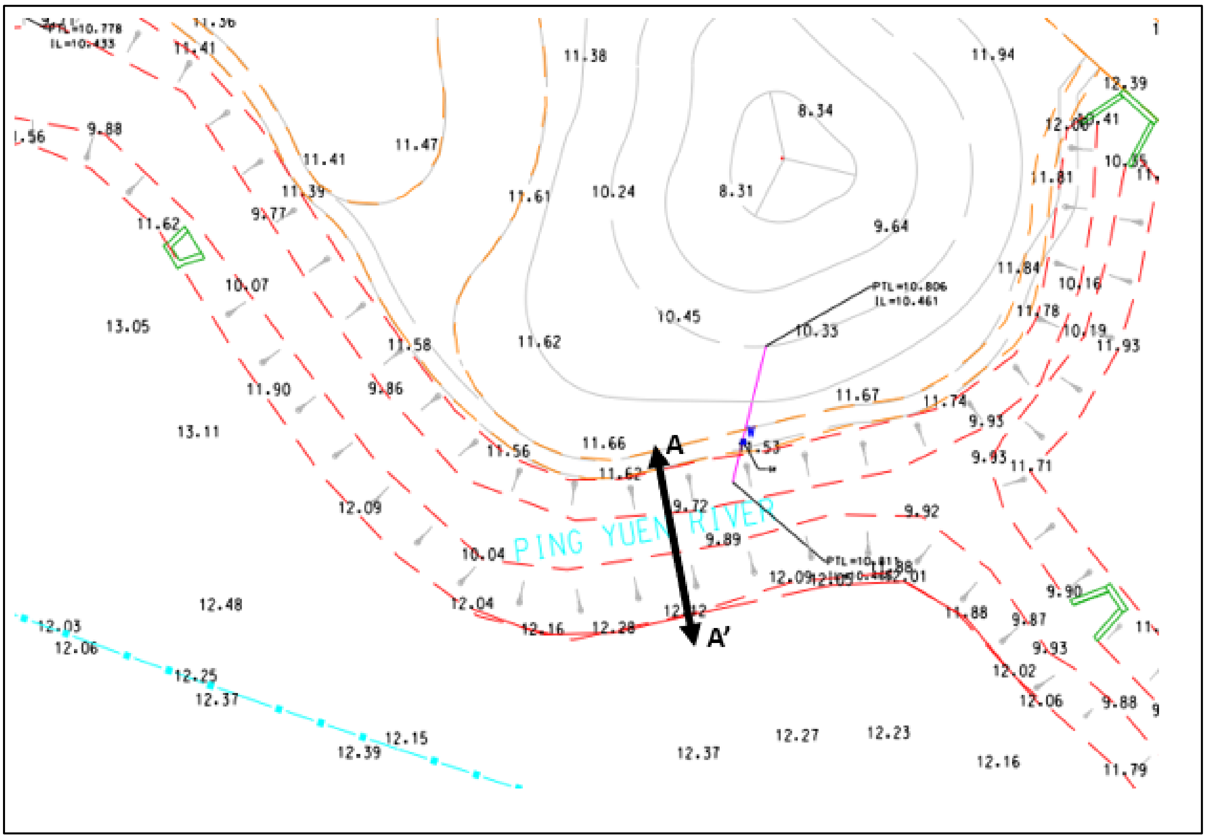

Figure 2-19 The Topo of As-built Pond and the PY River

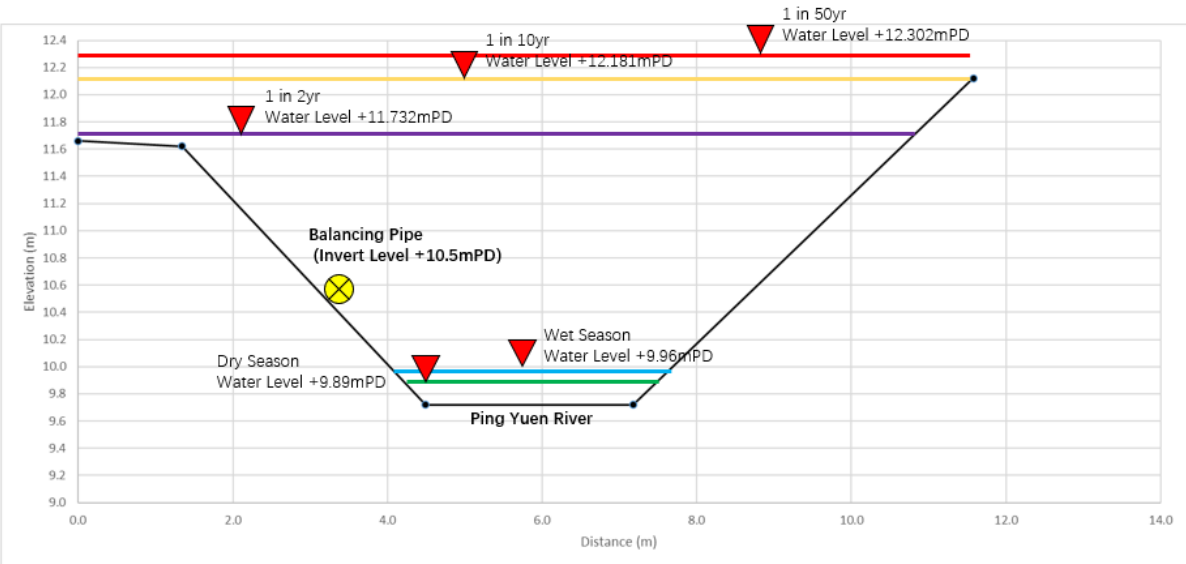

Figure 2-20 The Cross-Section of PY River (A-A') and Water Surface

3 WATER BALANCING ANALYSIS

3.1 General

3.1.1.1 This section examines the multi-year averaged monthly water balancing for the WCA and the change of water depth. The water balancing (**Figure 3-1**) would consider the water evaporation rate and water supply sources from direct rainfall, surface runoff, Ping Yuen River, etc.

3.1.1.2 A detailed daily water balancing will be further carried out based on the selected typical dry year data set.

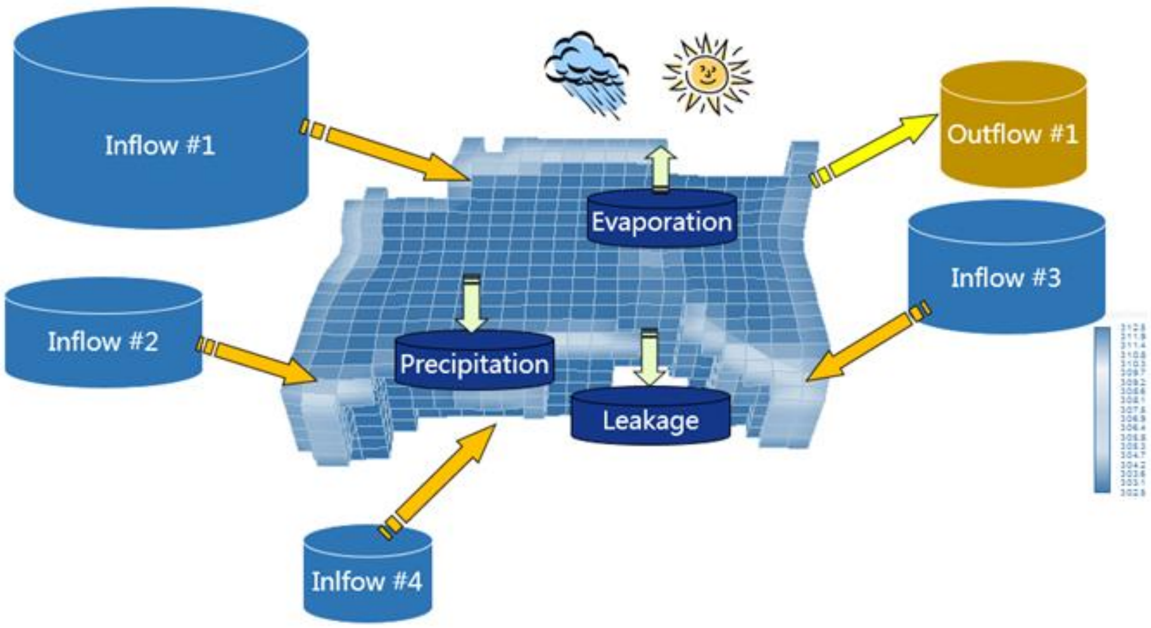

Figure 3-1 The Concept of Water Balancing

3.2 Water Supply

3.2.1 Direct Rainfall on the WCA

3.2.1.1 The direct rainfall on the pond can be estimated by:

$$Q_{direct} = P \times A$$

Where: $P - rainfall\ (mm/d)$
$A - direct\ wetland\ surface\ area\ (m^2)$

3.2.1.2 The rainfall can be referred to section 2.1.1, while the direct water surface area can be referred to section 2.4.

3.2.2 Surface Runoff from Adjacent Catchment

3.2.2.1 The surface runoff from adjacent catchments can be derived by the rational method:

$$Q_{runoff} = C \times P \times A$$

Where: $P - rainfall\ (mm/d)$
$C - runoff\ coefficient\ (-)$
$A - catchment\ area\ (m^2)$

3.2.2.2 The runoff coefficient was adopted following the latest *DSD Stormwater Drainage Manual* (DSD-SDM). For the conservative purpose, the runoff coefficient of 0.20 was used.

3.2.3 Tap Water (Potable Water)

3.2.3.1 The tap water supply source will be used in extremely dry conditions. For the water balancing analysis, the potable was not included for conservative analysis.

3.2.4 Ping Yuen River

3.2.4.1 As described in section 2.5, PY River was usually at a low water level, and the recorded water depths were frequently below 300mm. Therefore, for conservative water balancing analysis, the PY River supply was not included.

3.3 Water Loss

3.3.1 Evaporation

3.3.1.1 The evaporation is calculated to be:

$$Q_{evaporation} = E \times A$$

Where: $E - evaporation\ rate\ (mm/d)$
$A - wetland\ area\ (m^2)$

3.3.1.2 The evaporation rate can be referred to in section 2.1.2.

3.3.2 Seepage

3.3.2.1 The sodium bentonite waterproofing composite has been provided at the pond bottom (**Figure 2-4**). The seepage would not be anticipated. However, we assume a typical seepage rate at 0.002m/day[6,7,8] in the water balancing for a conservative analysis.

$$Q_{seepage} = L \times A$$

6 Carter, M. and Bentley, S. (1991). Correlations of soil properties. Penetech Press Publishers, London.
7 Leonards G. A. Ed. 1962, Foundation Engineering. McGraw Hill Book Company
8 Dysli M. and Steiner W., 2011, Correlations in soil mechanics, PPUR

Where: $L -\ seepage\ rate\ (m/d)$
$A -\ wetland\ area\ (m^2)$

3.3.3 Outflow

3.3.3.1 As described in section 2.2.2, the invert level of the balancing pipe has been set at 10.5mPD. Thus, the water will overflow into the PY River for conservative analysis when the water level exceeds 10.5mPD. Adequate pond water outflow should be allowed from the hydraulic point of view to maintain an adequate water exchange, avoiding stagnant water and water quality deterioration.

3.3.3.2 The setting was based on the site visit dated 16th Oct 2020, the valve remains open, and the invert level of balancing pipe between PY river and pond is set at +10.5mPD. When we close the balancing pipe between the pond and PY River in the sensitivity analysis of water balancing, the pond water level can exceed +11.5mPD.

3.3.4 Other use of Pond Water

3.3.4.1 As confirmed with the site engineer, the irrigation will be provided by potable water.

3.4 Monthly Water Balancing Analysis

3.4.1.1 Water balancing calculation is based on the following equation:

$$\Delta Q = Q_{runoff} + Q_{direct} - Q_{evaporation} - Q_{seepage} - Q_{overflow} - Q_{usage}$$

3.4.1.2 The water exchange rate can be estimated as follow:

$$T = \frac{\Delta Q}{V}$$

Where: T is the exchange rate (times/year)
V is the total pond volume (m^3)
ΔQ is water balancing (m^3/year).

3.4.1.3 The multi-year (2003-2019) averaged monthly water balancing is detailed in **Table 3-1**. The evaporation loss is based on the maximum wetland surface area (at 11.5mPD) for the conservative purpose. The value highlighted in red means water deficit in the month. To maintain a good water exchange capacity, the pond water would overflow to the PY River when the water level exceeds 10.5mPD.

3.4.1.4 For a conservative analysis purpose, the startup water level on day 1 of Jan was assumed to be 8.5mPD. Thus, the monthly water level change due to the variation of water balancing can be accumulated. Though a slight water deficit was estimated in Feb, Nov and Dec, the water level can still be maintained at approx. 10.5mPD.

3.4.1.5 The annual water exchange rate (times/year) can be estimated to be 2.5 times/year (annual water balancing divide by wetland volume).

Table 3-1 The Multi-year Averaged Monthly Water Balancing Analysis

		Dry Season				Wet Season					Dry Season		
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)		36.1	29.1	59.5	123.3	267.9	412.1	321.9	355.0	210.7	87.7	38.6	24.5
Evaporation (mm)		69.8	61.5	74.9	87.3	108.3	114.5	147.4	131.2	127.0	122.0	92.7	85.1
Water Loss	Evaporation (m^3)	499.9	440.7	536.2	625.3	775.2	820.0	1,055.7	939.8	909.7	873.3	663.8	609.5
	Seepage (m^3)	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1
Water Supply	Direct Rainfall on The Wetland (m^3)	211.2	170.2	348.3	721.8	1,568.9	2,413.4	1,885.3	2,078.7	1,233.7	513.8	225.8	143.6
	Hillside Surface Runoff (m^3)	432.7	348.7	713.6	1,479.2	3,214.9	4,945.4	3,863.3	4,259.6	2,528.1	1,052.8	462.7	294.4
	Tap Water (m^3)	-	-	-	-	-	-	-	-	-	-	-	-
	Ping Yuen River (m^3)	-	-	-	-	-	-	-	-	-	-	-	-
Balancing (m^3)		22.9	-42.9	404.7	1,454.7	3,887.5	6,417.7	4,571.8	5,277.5	2,731.1	572.2	-96.3	-292.5
Water Level (mPD)		8.503	8.497	8.554	8.757	9.300	10.196	10.500	10.500	10.500	10.500	10.487	10.446
Water Depth (m)		1.00	1.00	1.05	1.26	1.80	2.70	3.00	3.00	3.00	3.00	2.99	2.95

Notes: 1) The evaporation loss is based on the maximum wetland surface area for the conservative purpose.
2) The value highlighted in red means water deficit.
3) The pond water would overflow to PY River when the water level exceeds 10.5mPD.
4) The initial water level in early of Jan was assumed to be 8.5m.
5) The water supply from both PY River and tap water is assumed to be zero.

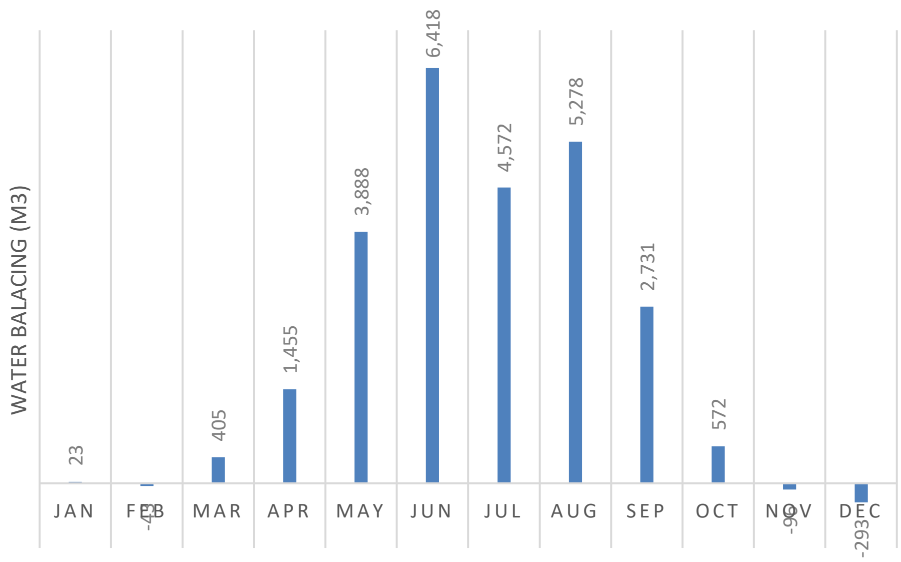

Figure 3-2 The Monthly Water Balancing Analysis

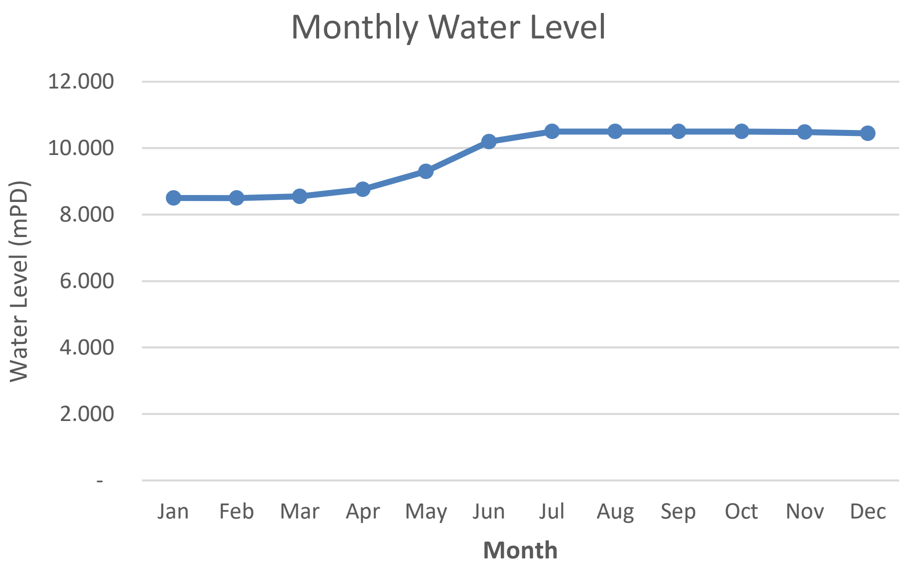

Figure 3-3 The Monthly Water Level Change

3.5 Daily Water Balancing Analysis

3.5.1.1 The daily water balancing is calculated to be as follow:

$$h = h_0 + \frac{Q_{runoff} + Q_{direct} - Q_{evaporation} - Q_{seepage} - Q_{overflow} - Q_{usage}}{A}$$

$$if\ \ (h \geq h_{control})\ \ then$$
$$h = h_{control}$$
$$else$$
$$h = h$$

Where: $h -\ caculated\ pond\ water\ level\ (m)$
$h_0 -\ pond\ water\ level\ at\ previous\ day\ (m)$
$h_{control} -\ the\ control\ high\ water\ level\ when\ overflow\ \ (m)$

3.5.1.2 It is assumed the initial water level on day one of Jan was set at 8.5mPD, which is 1m water depth. The daily water level change due to water balancing variation can be accumulated (**Appendix A**).

3.5.1.3 As shown in **Figure 3-4**, even during the typical dry year from 2010 to 2011, the water level can maintain higher than the water level (+10.00mPD) most of the time without water supply from both PY River and potable water. The water level can increase gradually from 8.5mPD in Jan 2010, to 10.5mPD in Jul 2010 even without any water supply from PY River and potable water. The water level would decrease from Oct 2010 and fluctuate to another wet season in May 2011.

3.5.1.4 The estimated annual water exchange is 1.8 times/year, which is smaller than the average 2.5 times per year.

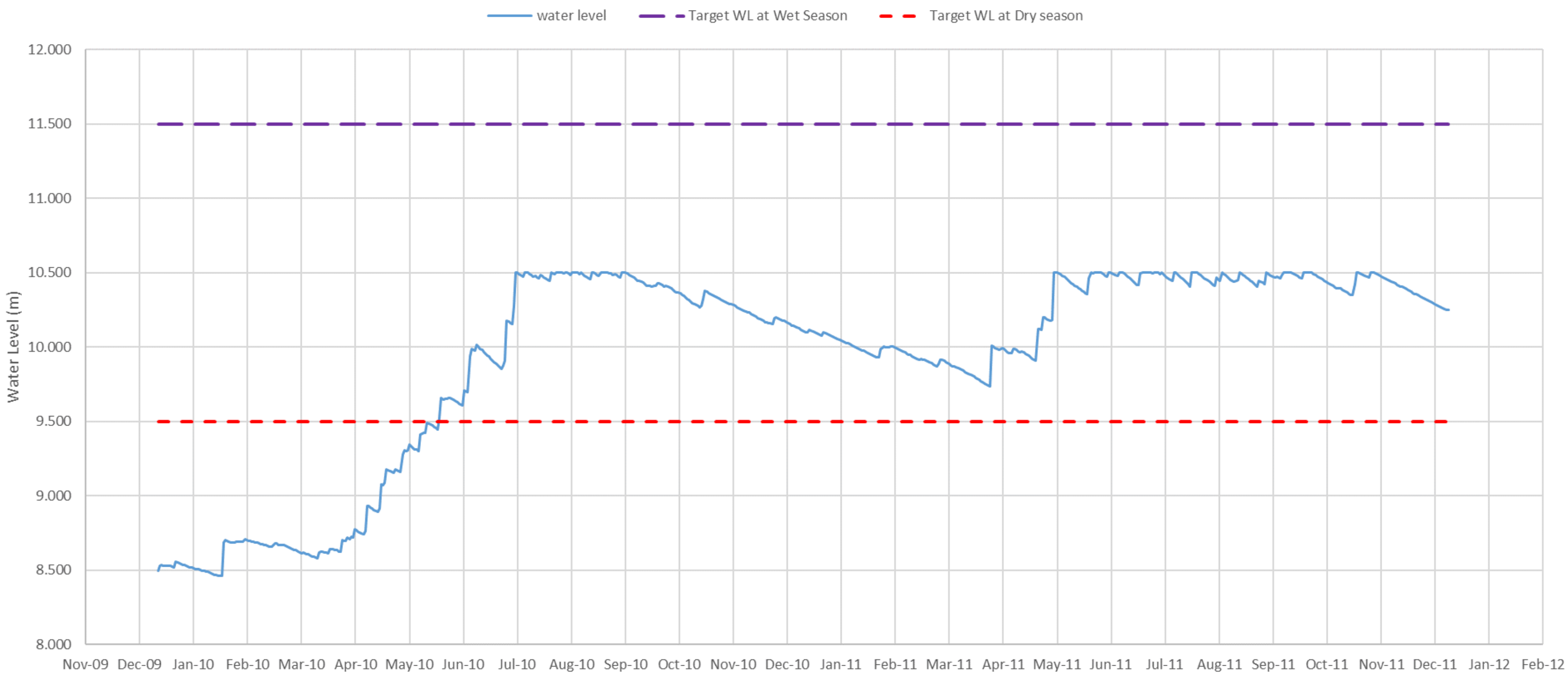

Figure 3-4 The Daily Water Level Change from 2010 to 2011

3.5.2 Water Depth Frequency

3.5.2.1 Based on daily water balancing analysis, each water level's frequency can be derived (**Figure 3-5** and **Table 3-2**). For the targeted dry season water level (+10.00mPD), the exceedance is 84.7%.

3.5.2.2 This analysis is based on the initial day one water level at 8.5m. If we assume the day one water level at 9.5mPD or even higher such as 10.0mPD, the exceedance of 9.5mPD will be 100%.

3.5.2.3 Nevertheless, both the monthly and daily water balancing analyses have proved that surface runoff from the adjacent catchment can maintain the wetland fluctuation levels between +10.00mPD (dry season) and +11.5mPD (wet season).

Table 3-2 The Frequency Analysis of Daily Water Level of Wetland from 2010 to 2011

Water Level (m)	Nos of Days Achievable (days)	Exceedance (%)	Remarks
10.5	89	12.2%	Overflow to PY River
10.0	618	84.7%	Dry Season Target Level
9.5	730	100.0%	
8.5	730	100.0%	

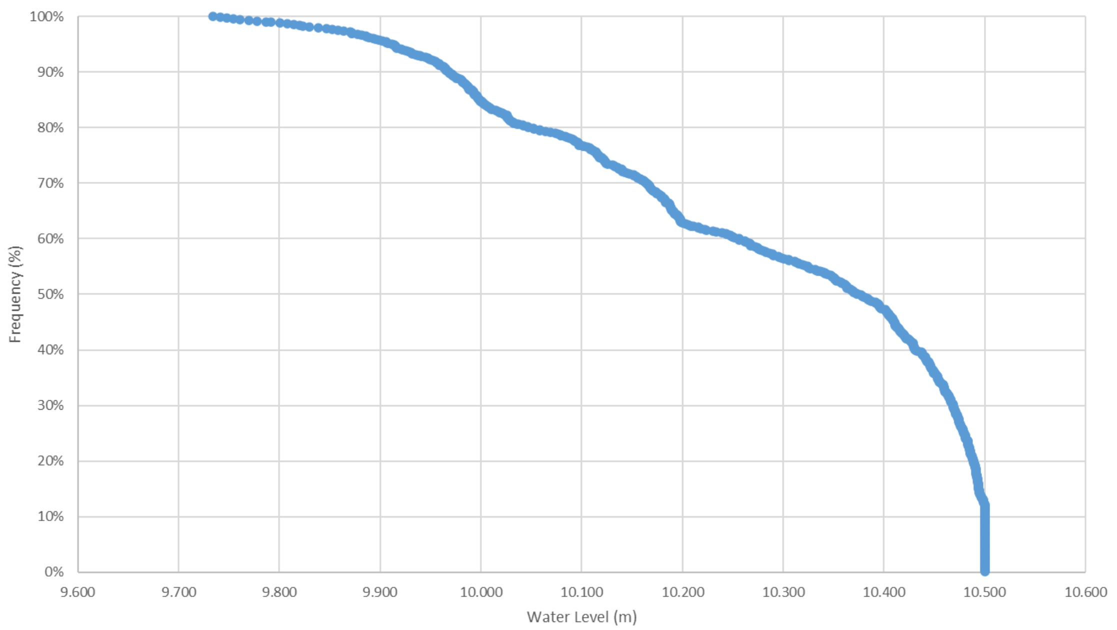

Figure 3-5 The Frequency Analysis of Water Level from 2010 to 2011

3.6 Water Exchange

3.6.1.1 The average annual water exchange rate (times/year) can be estimated to be 2.5 times/year. However, this conservative estimation was based on the assumption that seepage would exist. As described in section 2.2, sodium bentonite waterproofing composite has been provided at the pond bed. Therefore, no seepage would be anticipated. In this case, the water exchange time would be 2.8 times per year.

3.6.1.2 The year 2011 dry season corresponds to a very dry season when examined with the Ta Kwu Ling's historic rainfall records. Under such circumstances, the estimated water exchange is 1.8 times per year. As mentioned above, if no seepage would be anticipated, the water exchange times can be 1.95 times/year.

3.6.1.3 A similar existing case is a wetland in Long Valley Nature Park [9]. The average water exchange rate is 3.1 times per year, while 2.1 times per year during the typical dry year. A higher exchange rate for LT wetland is unnecessary considering there is no need for irrigation usage of the pond water as for LVNP. Moreover, effluent from the treatment wetland in LVNP is used for irrigation of farmland area in LVNP. Water loss at WCA in Lian Tang site is only via evaporation and transpiration via riparian plants inside the wetland. Water balance based on these assumptions and usage of water shows it should sustain water quantity in WCA.

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4 HYDRAULIC MODELING

4.1 General

4.1.1.1 As shown in **Figure 2-12**, when the pond water level drops to below +10.5mpD, some of the pond inter-connection will be disconnected. The hillside surface runoff would be discharged into the pond via rock channel. That is, under existing conditions, only pond C/E/F could receive hillside surface runoff. Only when the runoff fills up pond C/E/F to a water level above +10.5mpD, the pond A/B/D/G can be supplemented afterward.

4.1.1.2 To ensure the runoff distribution to each pond evenly, the existing rock channel arrangements (**Figure 2-12**) will be replaced by a new proposed scheme (**Figure 2-13**). That is, each pond will have a separated rock channel to collect the runoff.

4.1.1.3 Comprehensive hydraulic modeling will be performed to simulate each pond's actual water depth variation under a typical dry year condition. The 2011 dry season corresponds to a very dry season when examined with the Ta Kwu Ling's historic rainfall records.

4.2 Rainfall and Evaporation

4.2.1 Rainfall

4.2.1.1 The figure below shows that monthly rainfall in 2011 indicates a distinct pattern of the wet season from May to October with monthly precipitation of more than 100mm. In contrast, from December, January to March, rainfall is below 30mm. April and November are transition months with precipitation from 50mm to 80mm in 2011.

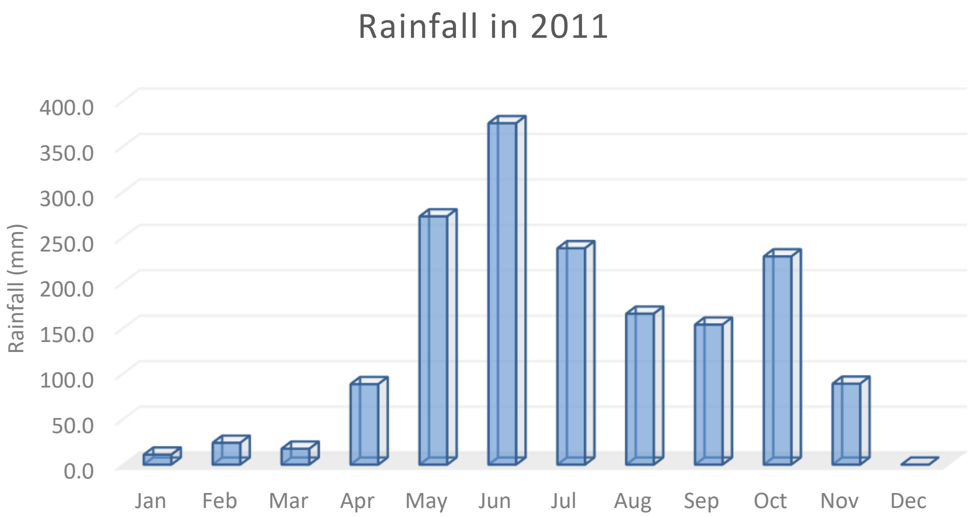

Figure 4-1 The Monthly Rainfall at Ta Kwu Ling Station in 2011

4.2.2 Evaporation

4.2.2.1 Evaporation is the primary water loss for the WCA. The daily evaporation is available from Hong Kong Observatory's monitoring station at King's Park [10]. The monthly total evaporation at King's Park station in 2011 was adopted for hydraulic modeling for inter-connecting ponds at WCA. The year 2011 total evaporation record is also the highest annual evaporation of 1376.3mm in the past 20 years (2000~2019).

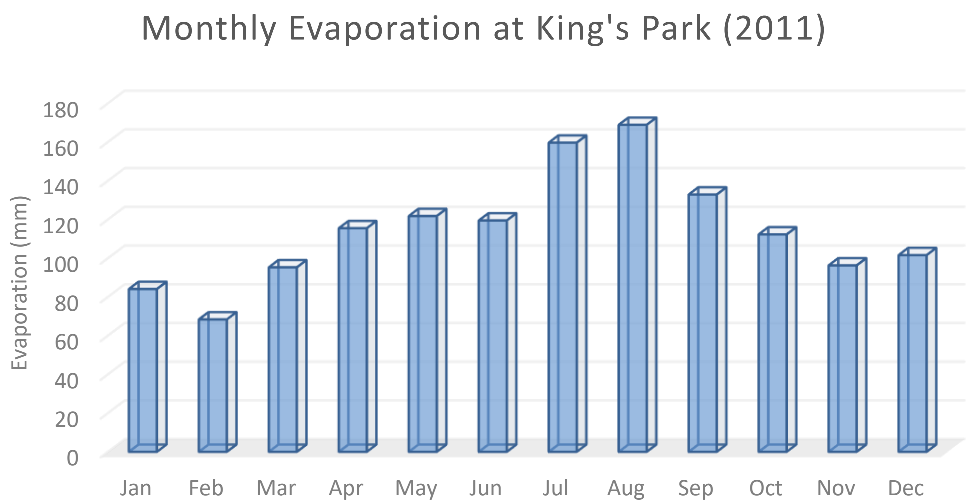

Figure 4-2 The 2011 Monthly Evaporation at King's Park

4.3 SWMM Model Setup

4.3.1 What is SWMM

4.3.1.1 The EPA Storm Water Management Model (SWMM) is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas[11].

4.3.1.2 The runoff component of SWMM operates on a collection of sub-catchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators.

4.3.1.3 SWMM tracks the quantity and quality of runoff generated within each sub-catchment, and the flow rate, flow depth, and quality of water in each pipe and channel during a simulation period comprised of multiple time steps.

4.3.2 Detention Ponds Setup

4.3.2.1 The WCA is represented by seven interconnection detention ponds in SWMM as shown in **Figure 4-3,** and each pond has a profile following the as-built drawing of

10 https://www.hko.gov.hk/en/cis/monthlyElement.htm?ele=EVAPO
11 US EPA, https://www.epa.gov/water-research/storm-water-management-model-swmm

WCA. **Figure 4-4** shows a typical depth-area curve of Pond B: lowest water depth of 0m at +7.5mPD with a maximum depth of 4m at +11.5mPD with maximum water surface area of 991.9m^2 for Pond B.

4.3.3 Balancing Pipe

4.3.3.1 Balancing pipes are represented as circular conduits with 0.30m diameter with invert elevation set at +10.5mPD and connecting the seven ponds.

4.3.3.2 Each pond is connected to an outlet to Ping Yuen River via an orifice with an outlet offset at +10.55mPD. This is also based on an as-built drawing given by the Engineer.

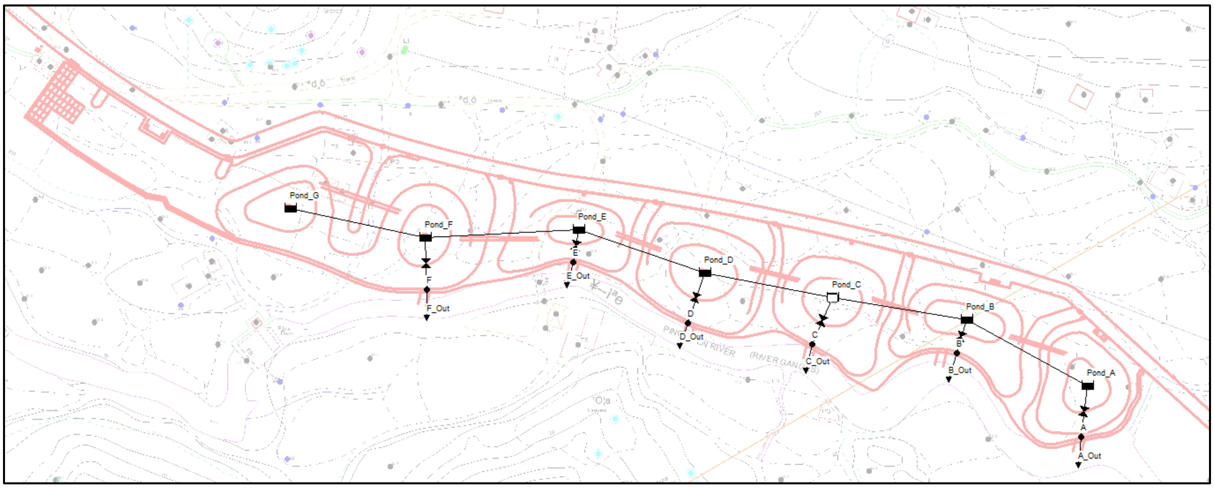

Figure 4-3 Layout of Inter-connecting Ponds and SWMM Model Setup

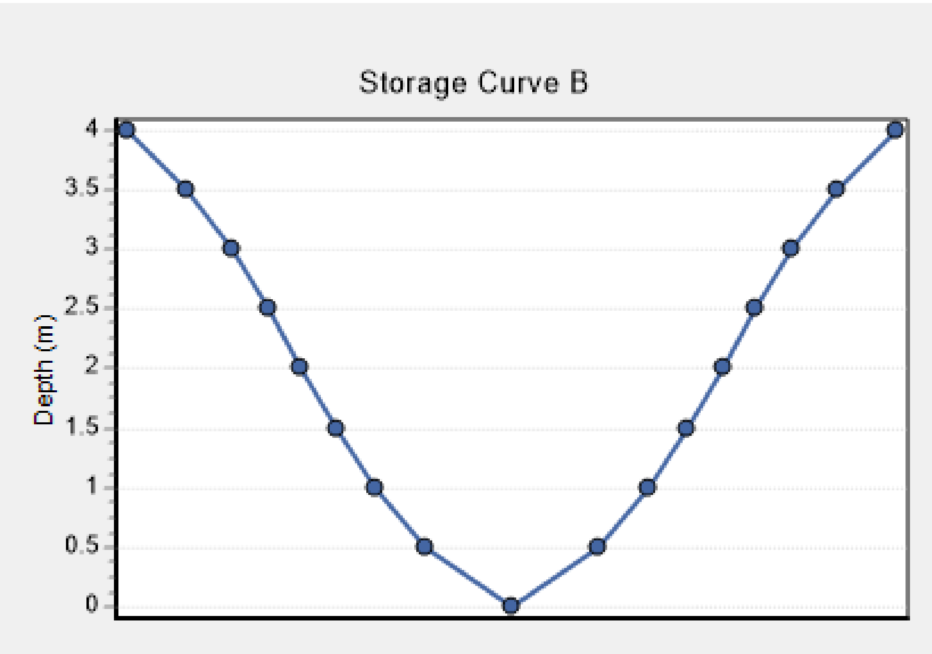

Figure 4-4 A Typical Depth – Area Curve of Pond B for the WCA

4.3.4 Surface Runoff and Direct Rainfall

4.3.4.1 Runoff from the hillside and direct rainfall on the WCA as calculated in the previous sections are used directly as combined inflow into the pond system. The combined flow is evenly distributed as inflow into the ponds with rock channel inlet.

4.3.5 Assumptions

4.3.5.1 For conservative assessment purposes, all ponds are filled with 1m water as the initial depth for hydraulic routing. However, it is believed 1m initial depth is a conservative assumption as the observed water depth during the site visit on 16 Oct 2020, all ponds were filled up to 3m at +10.5mPD.

4.3.5.2 All the balancing pipes will be set as opening, even the outlet to PY river is also open. This assumption will make hydraulic modeling more conservative as no water will be stored when pond water exceeds 10.55mPD. Water will flow out to PY River accordingly.

4.4 Model Results and Discussion (Existing Rock Channels Arrangement)

4.4.1.1 This section presents the model results based on the existing rock channels arrangement in **Figure 2-12**. That is, under existing conditions, only pond C/E/F could receive hillside surface runoff. Only when the runoff fills up pond C/E/F to a water level above +10.5mpD, the pond A/B/D/G can be supplemented afterward.

4.4.2 Predicted Pond Depths Variation

4.4.2.1 The time-series variation of each pond's water level is shown in the figure below. Modeled data shows the furthest pond, Pond A, has the most depth variation and is less than 1.5m.

4.4.2.2 All ponds are filled to 3m (+10.5mPD) in a couple of months, and depth stabilizes at 3m depth for all ponds. The furthest pond from rock channel intake, Pond A, experiences most water loss due to evaporation during the dry season (Dec – April). Still, it is replenished as soon as there is natural precipitation as the onset of wet season in May 2011.

4.4.2.3 The simulation shows a maximum decline in water level in a dry year is 0.5m, and it will be replenished as soon as there is rainfall. Simulation with 1m initial depth is a conservative approach that shows the worst-case scenario. However, based on our site visit dated 16th Oct 2020, the existing pond water depth is approximately 3m. Hence water quantity is self-sustained under normal circumstances. We have also provided two consecutive dry year simulation with 1.0m initial depth – shows Pond A would not dry up and it will normalize at minimum 2.5m and average 3.0m. (See figure below).

4.4.2.4 Hence, we may conclude none of the ponds would dry up during the driest year in the past 20 years, and the WCA is self-sufficient with natural precipitations under the normal rainfall-runoff condition.

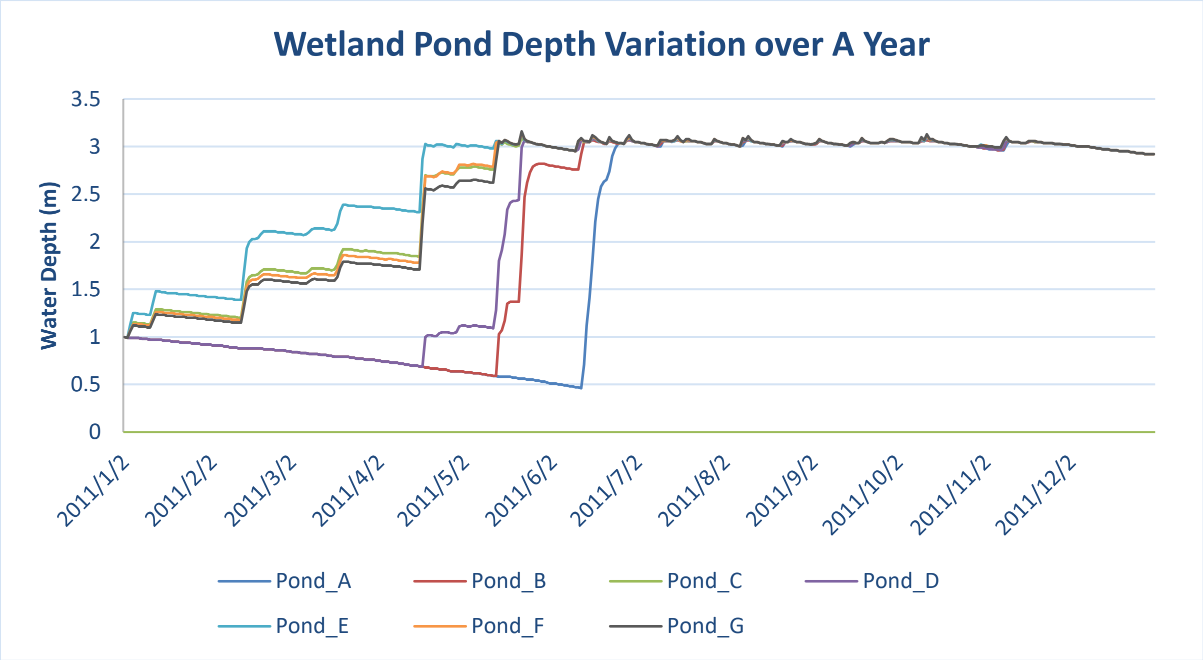

Figure 4-5 The Time Series Variation of Water Depths at Each Pond (2011)

4.4.3 Pond Elevation Profile

4.4.3.1 The following figures (**Figure 4-6** to **Figure 4-11**) show water depth profile snapshots at each pond and balancing pipe at every quarter of the modeling period in 2011.

4.4.3.2 At the beginning of the dry season, as the water level is lower than the invert of balance pipes +10.5mPD, all ponds are disconnected (**Figure 4-6, 4-7**). Runoff starts to fill in Ponds C, E, F and G as wet season starts in May 2011 (**Figure 4-8**).

4.4.3.3 When it exceeds elevation +10.5mPD, it starts to fill Pond D, B and Pond A consecutively. At the end of June 2011, all ponds are filled to +10.5mPD and connected via the balancing pipes.

4.4.3.4 Simulation results show the inter-connected ponds water depth remains at 3m throughout a year and decreases slightly as evaporation exceeds precipitation as the dry season starts in November.

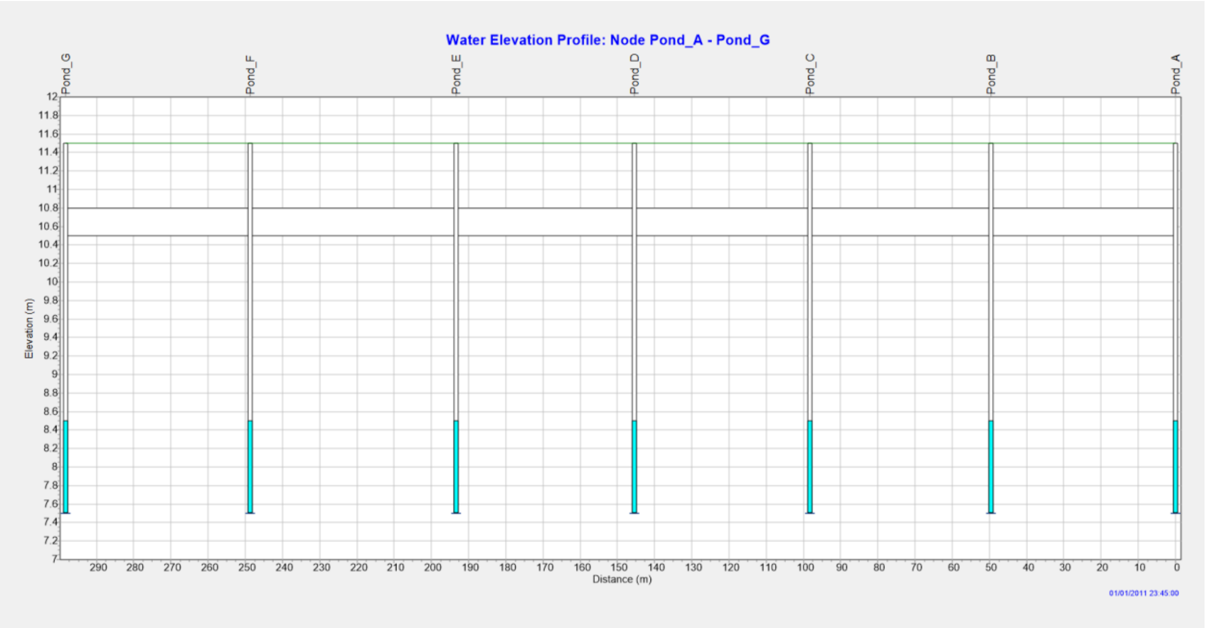

Figure 4-6 The Water Depth at Each Pond (1/1/2011)

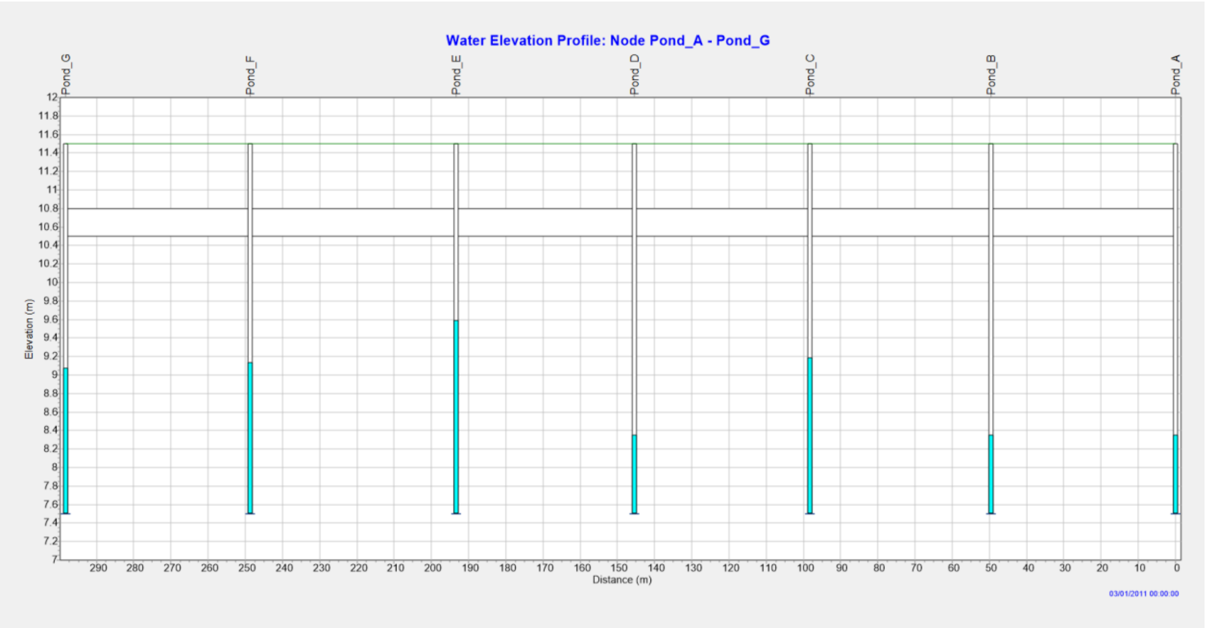

Figure 4-7 The Water Depth at Each Pond (3/1/2011)

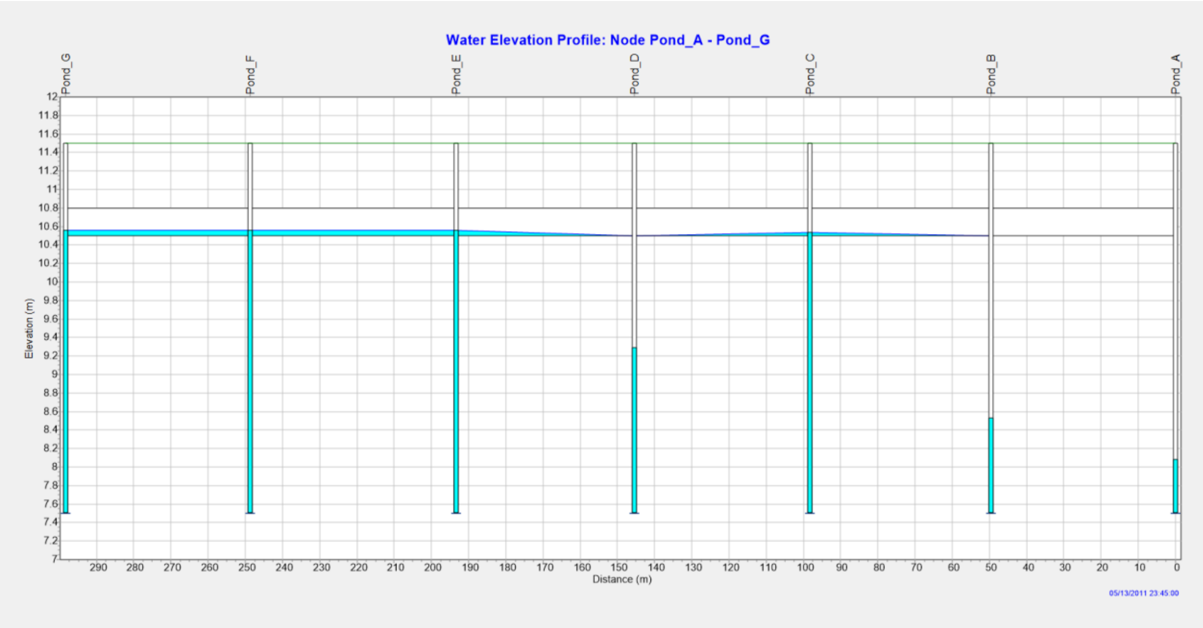

Figure 4-8 The Water Depth at Each Pond (5/13/2011)

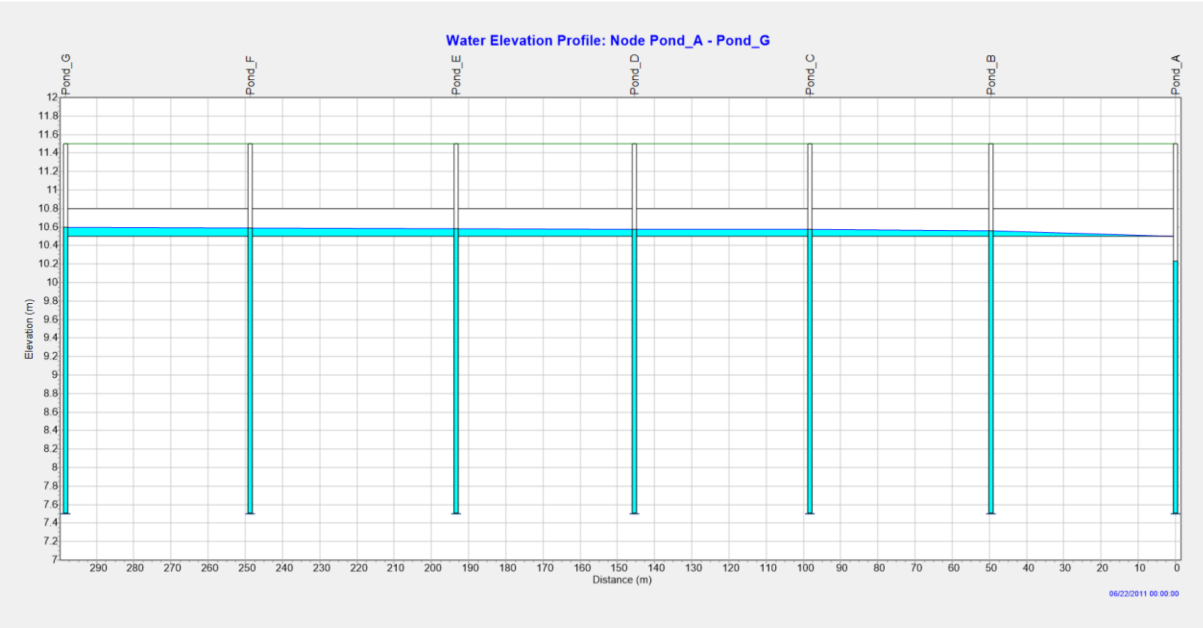

Figure 4-9 The Water Depth at Each Pond (6/22/2011)

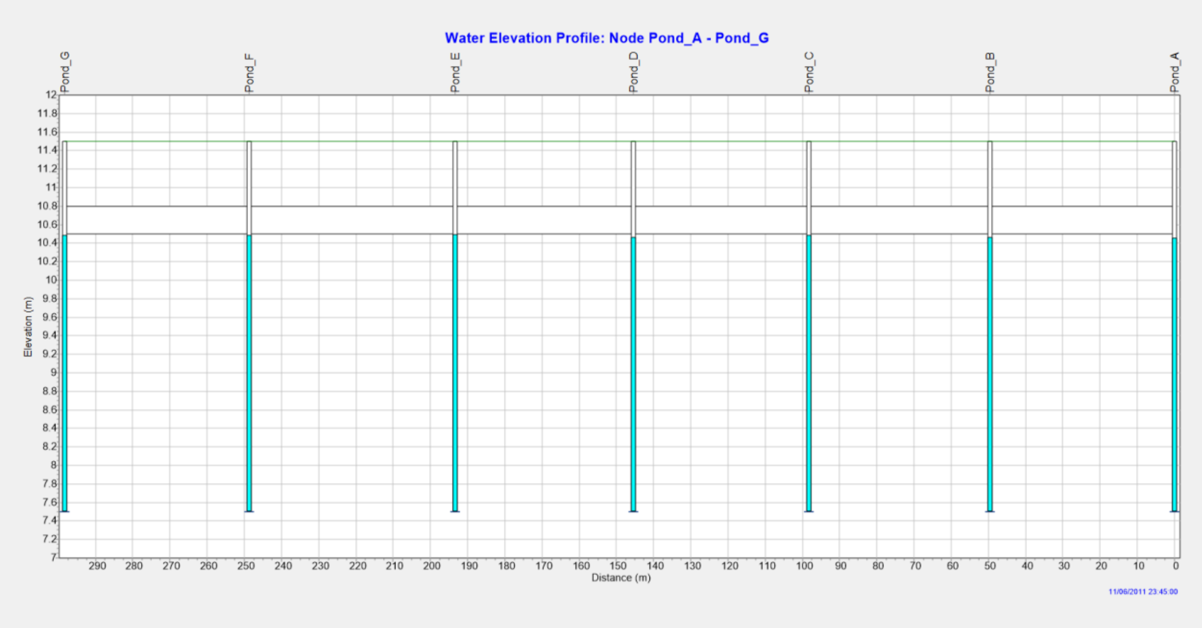

Figure 4-10 The Water Depth at Each Pond (11/6/2011)

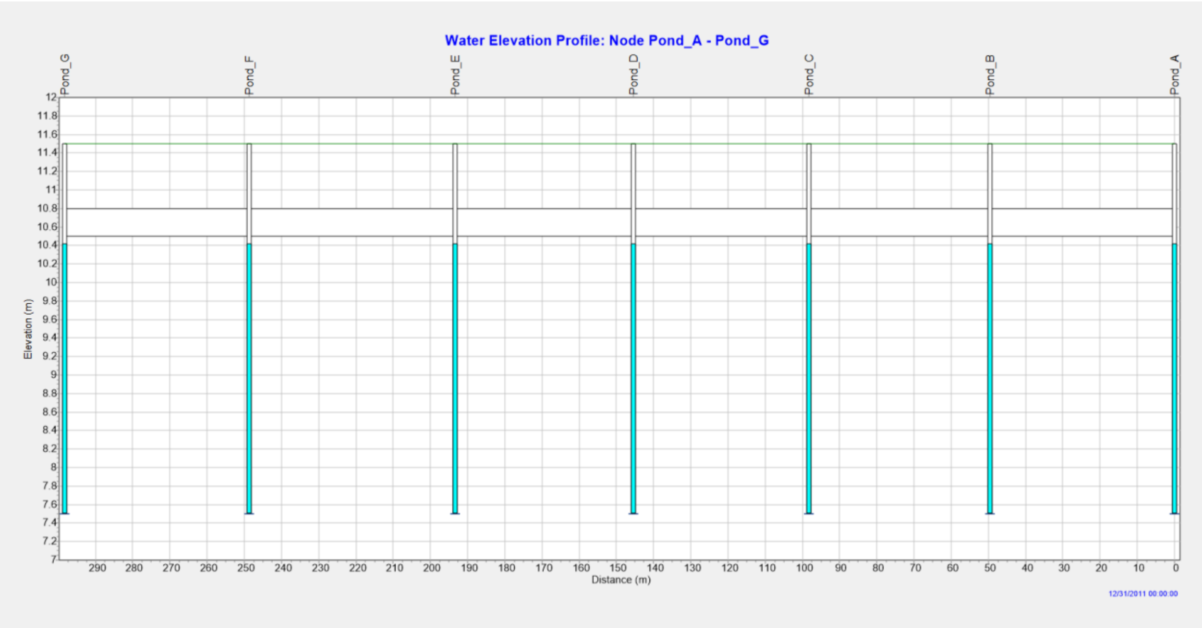

Figure 4-11 The Water Depth at Each Pond (12/31/2011)

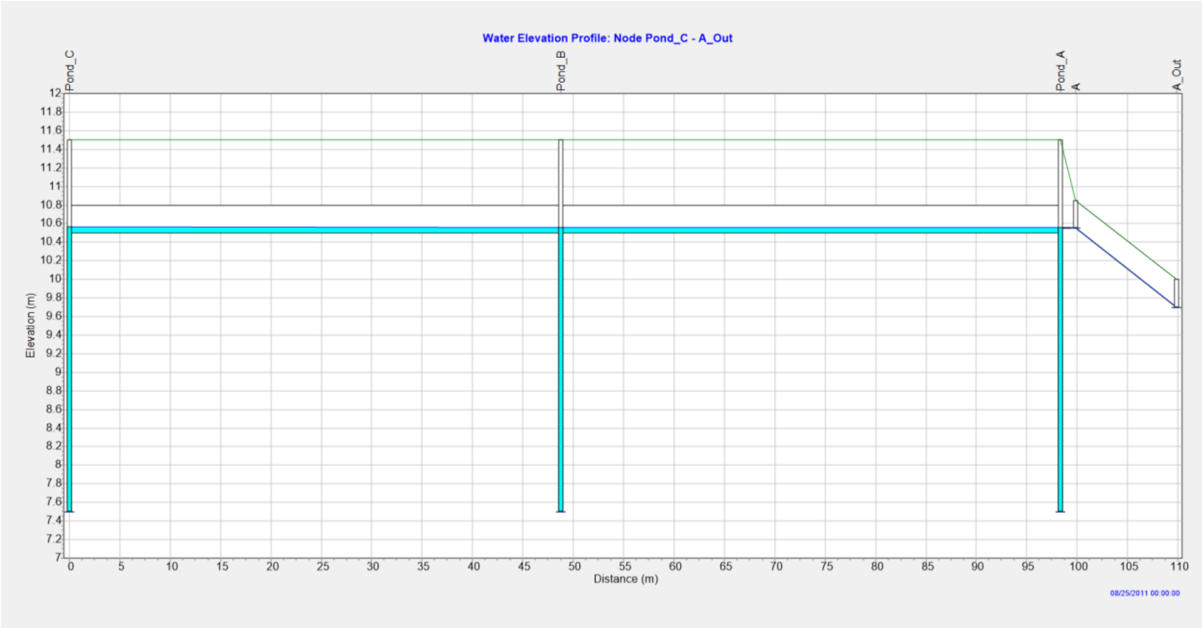

Figure 4-12 The Water Depth from Pond C to Pond A to PY River (08/25/2011)

4.5 Model Results and Discussion (The New Rock Channel Arrangement)

4.5.1.1 This section presents the model results based on the new rock channels arrangement in **Figure 2-13**. That is, under the new proposal, the pond A/B/C/D/E/F/G could receive hillside surface runoff evenly.

4.5.1.2 The **Figure 4-13** shows that under the existing rock channel arrangement, only when the runoff fills up pond C/E/F to a water level above +10.5mpD, the pond A/B/D/G can be supplemented afterward.

4.5.1.3 With even runoff distribution, all the pond water level can be filled up and replenished gradually above +10.5mpD. The new rock channel arrangement proves a better supplement to the pond as compared to the existing scheme.

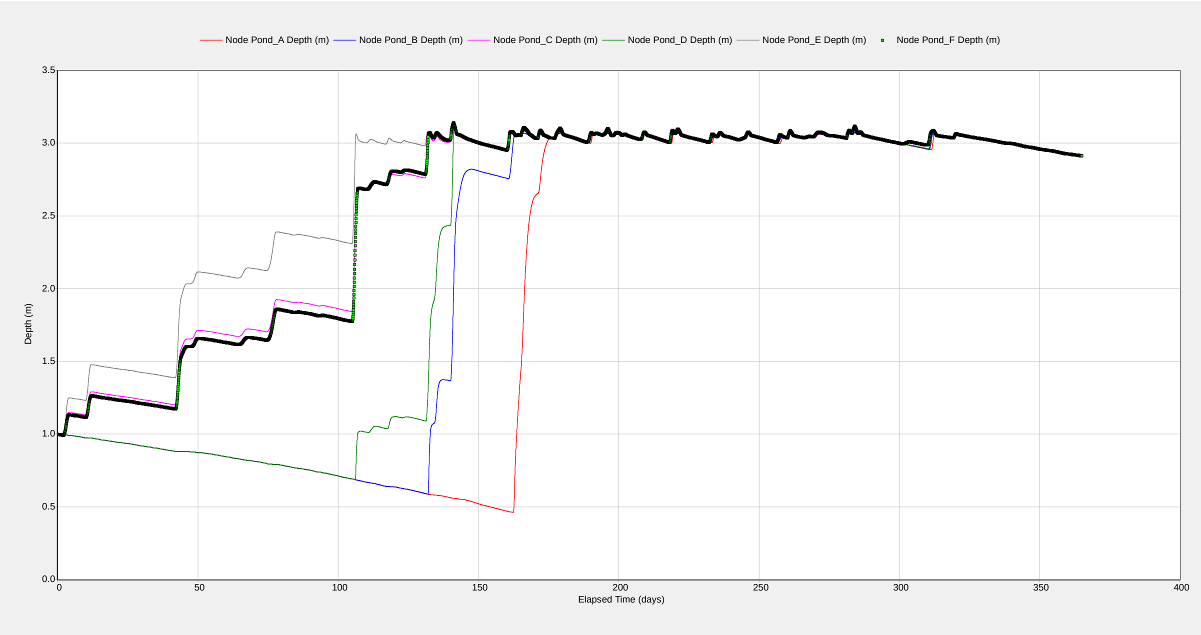

Figure 4-13 The Time Series Variation of Water Depths at Each Pond (Existing Rock Channel Arrangement)

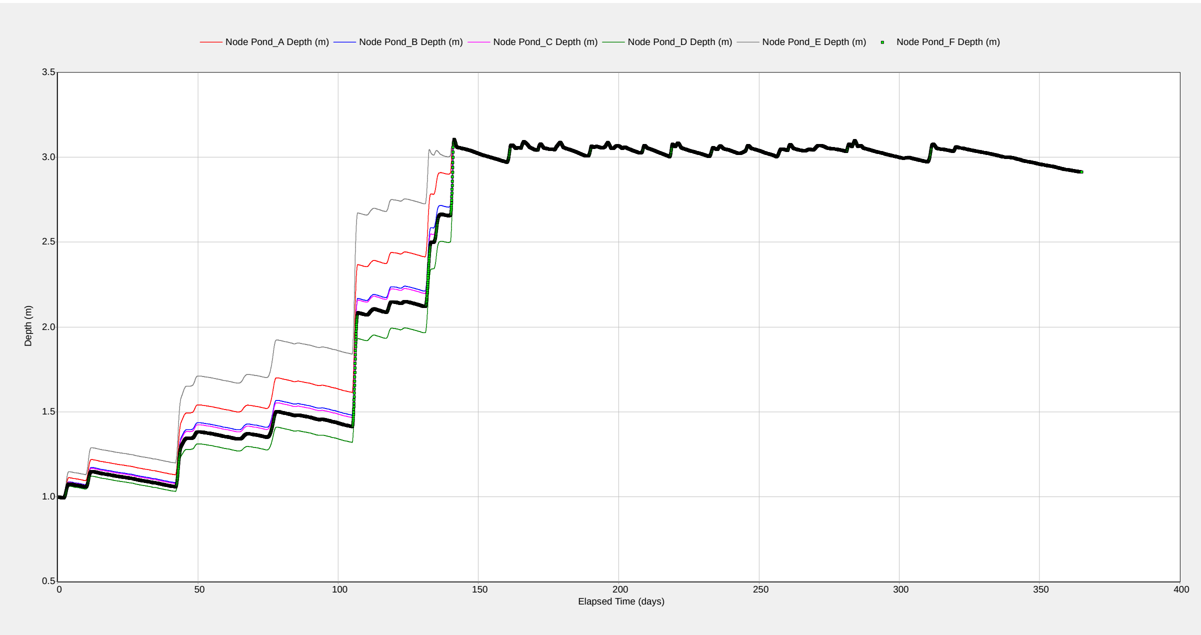

Figure 4-14 The Time Series Variation of Water Depths at Each Pond (New Rock Channel Arrangement)

4.6 Emergency and Action plan

4.6.1.1 Though the water balancing analysis has indicated that adequate replenishment can be provided via surface runoff from adjacent hillside catchment, an emergency and action plan shall be prepared.

- The irrigation and road flushing shall be provided with potable water. No water extraction from WCA for such water use.
- Monitoring of water level at the center of each pool will be conducted on a regular basis.
- Special attention and monitoring shall be given to December, January, and February.
- During an extremely dry season, if the water coverage (in m^2) decreases by 10%, but the water level is still higher than +9.5mPD, increase the monitoring frequency from monthly to bi-weekly.
- If such water level decline keeps persistent for more than two weeks, add the water in all ponds and maintain the water level at the acceptance level in the dry season (i.e., not lower than +9.5mPD).

5 SUMMARY

5.1.1.1 The summary of water balancing analysis is as follow:

- While the multi-year averaged monthly water balancing indicated a slight water deficit in Feb, Nov and Dec, the pond water level can still be maintained at approx. +10.5mPD. Even without water supply from both PY River and potable water.
- The average annual water exchange rate (times/year) can be estimated to be 2.5 times/year.
- Even during the typical dry year from 2010 to 2011, the water level can increase gradually from +8.5mPD in Jan 2010 to +10.5mPD in Jul 2010, without any water supply from PY River and potable water. The water level would decrease from Oct 2010 and fluctuate to another wet season in May 2011. Most of the time, the water level can maintain higher than the target dry season water level (+10.00mPD). During the typical dry year, the estimated water exchange is 1.8 times/year.
- Both the monthly and daily water balancing analyses have demonstrated that surface runoff from the adjacent catchment can maintain the wetland fluctuation levels between +10.00mPD (dry season) and +11.5mPD (wet season).
- The hydraulic modeling revealed that the individual pond would not dry out even during a typical dry year in the last 20 years. Under the existing rock channel arrangement, the runoff can fill up ponds C/E/F and subsequently replenish ponds A/B/D/G when the wet season starts. All ponds can remain at the water level at +10.5mpD via balancing pipes. Simulation results show the inter-connected pond's water depth remains at 3m throughout a year and decreases slightly as evaporation exceeds precipitation as the dry season starts in November.
- The hydraulic modeling reveals the new rock channel arrangement can improve replenishment to WCA.
- According to the water balance calculation, the wetlands will contain water year round, supplied by relatively clean runoff from the hillsides north of the site. As such, they should provide suitable habitats for general wetland communities. These animals (including dragonflies, amphibians, etc.) can be expected to naturally colonize the wetland habitats.

Appendix A

The Daily Water Balancing Analysis

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2010/1/1	0	2	0.0	0.0	0	0	14.3	4.0	-18.4	9.996	2.496
2010/1/2	8.5	1.4	49.8	102.0	0	0	10.0	4.0	137.7	10.026	2.526
2010/1/3	2.5	1.3	14.6	30.0	0	0	9.3	4.0	31.3	10.033	2.533
2010/1/4	0	2.4	0.0	0.0	0	0	17.2	4.0	-21.2	10.028	2.528
2010/1/5	0	0.9	0.0	0.0	0	0	6.4	4.0	-10.5	10.026	2.526
2010/1/6	1	0.8	5.9	12.0	0	0	5.7	4.0	8.1	10.028	2.528
2010/1/7	1	0.7	5.9	12.0	0	0	5.0	4.0	8.8	10.030	2.530
2010/1/8	0	1.6	0.0	0.0	0	0	11.5	4.0	-15.5	10.026	2.526
2010/1/9	0	2.4	0.0	0.0	0	0	17.2	4.0	-21.2	10.022	2.522
2010/1/10	0	1.2	0.0	0.0	0	0	8.6	4.0	-12.6	10.019	2.519
2010/1/11	11	1.6	64.4	132.0	0	0	11.5	4.0	180.9	10.058	2.558
2010/1/12	0	3.4	0.0	0.0	0	0	24.3	4.0	-28.4	10.052	2.552
2010/1/13	0	3	0.0	0.0	0	0	21.5	4.0	-25.5	10.047	2.547
2010/1/14	0	3	0.0	0.0	0	0	21.5	4.0	-25.5	10.041	2.541
2010/1/15	0	2.9	0.0	0.0	0	0	20.8	4.0	-24.8	10.036	2.536
2010/1/16	0	2.3	0.0	0.0	0	0	16.5	4.0	-20.5	10.031	2.531
2010/1/17	0	2.7	0.0	0.0	0	0	19.3	4.0	-23.4	10.026	2.526
2010/1/18	0	2.9	0.0	0.0	0	0	20.8	4.0	-24.8	10.021	2.521
2010/1/19	0	2	0.0	0.0	0	0	14.3	4.0	-18.4	10.017	2.517
2010/1/20	0	0.6	0.0	0.0	0	0	4.3	4.0	-8.3	10.015	2.515
2010/1/21	0	2.1	0.0	0.0	0	0	15.0	4.0	-19.1	10.011	2.511
2010/1/22	0	1.7	0.0	0.0	0	0	12.2	4.0	-16.2	10.007	2.507
2010/1/23	0.5	0.9	2.9	6.0	0	0	6.4	4.0	-1.6	10.007	2.507
2010/1/24	0	0.9	0.0	0.0	0	0	6.4	4.0	-10.5	10.004	2.504
2010/1/25	0	2.6	0.0	0.0	0	0	18.6	4.0	-22.7	10.000	2.500
2010/1/26	0	1.4	0.0	0.0	0	0	10.0	4.0	-14.1	9.996	2.496
2010/1/27	0	1.2	0.0	0.0	0	0	8.6	4.0	-12.6	9.994	2.494
2010/1/28	0	1.2	0.0	0.0	0	0	8.6	4.0	-12.6	9.991	2.491
2010/1/29	0	1.8	0.0	0.0	0	0	12.9	4.0	-16.9	9.987	2.487
2010/1/30	0	3	0.0	0.0	0	0	21.5	4.0	-25.5	9.982	2.482
2010/1/31	0	2.3	0.0	0.0	0	0	16.5	4.0	-20.5	9.977	2.477
2010/2/1	0	3.1	0.0	0.0	0	0	22.2	4.0	-26.2	9.972	2.472
2010/2/2	0	1.3	0.0	0.0	0	0	9.3	4.0	-13.3	9.969	2.469
2010/2/3	0	0.5	0.0	0.0	0	0	3.6	4.0	-7.6	9.967	2.467
2010/2/4	0	1.5	0.0	0.0	0	0	10.7	4.0	-14.8	9.964	2.464
2010/2/5	0	0.8	0.0	0.0	0	0	5.7	4.0	-9.8	9.962	2.462
2010/2/6	0	1.4	0.0	0.0	0	0	10.0	4.0	-14.1	9.959	2.459
2010/2/7	59	0.5	345.5	708.0	0	0	3.6	4.0	1045.9	10.186	2.686
2010/2/8	3.5	0.1	20.5	42.0	0	0	0.7	4.0	57.7	10.199	2.699
2010/2/9	0	1.4	0.0	0.0	0	0	10.0	4.0	-14.1	10.196	2.696
2010/2/10	0	1.9	0.0	0.0	0	0	13.6	4.0	-17.6	10.192	2.692
2010/2/11	0	2.9	0.0	0.0	0	0	20.8	4.0	-24.8	10.187	2.687
2010/2/12	0	2.4	0.0	0.0	0	0	17.2	4.0	-21.2	10.182	2.682

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2010/2/13	0.5	0.1	2.9	6.0	0	0	0.7	4.0	4.2	10.183	2.683
2010/2/14	1.5	0.1	8.8	18.0	0	0	0.7	4.0	22.0	10.188	2.688
2010/2/15	0.5	0.8	2.9	6.0	0	0	5.7	4.0	-0.8	10.188	2.688
2010/2/16	1	0.5	5.9	12.0	0	0	3.6	4.0	10.2	10.190	2.690
2010/2/17	0.5	1.3	2.9	6.0	0	0	9.3	4.0	-4.4	10.189	2.689
2010/2/18	1	0.4	5.9	12.0	0	0	2.9	4.0	11.0	10.191	2.691
2010/2/19	4.5	0.8	26.4	54.0	0	0	5.7	4.0	70.6	10.207	2.707
2010/2/20	0	1.8	0.0	0.0	0	0	12.9	4.0	-16.9	10.203	2.703
2010/2/21	0	2.5	0.0	0.0	0	0	17.9	4.0	-21.9	10.198	2.698
2010/2/22	0	1.1	0.0	0.0	0	0	7.9	4.0	-11.9	10.196	2.696
2010/2/23	0	2.3	0.0	0.0	0	0	16.5	4.0	-20.5	10.191	2.691
2010/2/24	0	0.9	0.0	0.0	0	0	6.4	4.0	-10.5	10.189	2.689
2010/2/25	0.5	1.7	2.9	6.0	0	0	12.2	4.0	-7.3	10.187	2.687
2010/2/26	0	2.3	0.0	0.0	0	0	16.5	4.0	-20.5	10.183	2.683
2010/2/27	0	1.8	0.0	0.0	0	0	12.9	4.0	-16.9	10.179	2.679
2010/2/28	0	2.3	0.0	0.0	0	0	16.5	4.0	-20.5	10.175	2.675
2010/3/1	0	1.5	0.0	0.0	0	0	10.7	4.0	-14.8	10.171	2.671
2010/3/2	0	1.2	0.0	0.0	0	0	8.6	4.0	-12.6	10.169	2.669
2010/3/3	0	0.6	0.0	0.0	0	0	4.3	4.0	-8.3	10.167	2.667
2010/3/4	0	1.4	0.0	0.0	0	0	10.0	4.0	-14.1	10.164	2.664
2010/3/5	0	3.1	0.0	0.0	0	0	22.2	4.0	-26.2	10.158	2.658
2010/3/6	0	2	0.0	0.0	0	0	14.3	4.0	-18.4	10.154	2.654
2010/3/7	4.5	0.8	26.4	54.0	0	0	5.7	4.0	70.6	10.169	2.669
2010/3/8	2.5	0.4	14.6	30.0	0	0	2.9	4.0	37.7	10.178	2.678
2010/3/9	1	2.5	5.9	12.0	0	0	17.9	4.0	-4.1	10.177	2.677
2010/3/10	0	3.4	0.0	0.0	0	0	24.3	4.0	-28.4	10.171	2.671
2010/3/11	0	2.9	0.0	0.0	0	0	20.8	4.0	-24.8	10.165	2.665
2010/3/12	1	0.2	5.9	12.0	0	0	1.4	4.0	12.4	10.168	2.668
2010/3/13	0	0.9	0.0	0.0	0	0	6.4	4.0	-10.5	10.166	2.666
2010/3/14	0	1.9	0.0	0.0	0	0	13.6	4.0	-17.6	10.162	2.662
2010/3/15	0	3.5	0.0	0.0	0	0	25.1	4.0	-29.1	10.155	2.655
2010/3/16	0	1.9	0.0	0.0	0	0	13.6	4.0	-17.6	10.152	2.652
2010/3/17	0	2	0.0	0.0	0	0	14.3	4.0	-18.4	10.148	2.648
2010/3/18	0	2.7	0.0	0.0	0	0	19.3	4.0	-23.4	10.142	2.642
2010/3/19	0	3.6	0.0	0.0	0	0	25.8	4.0	-29.8	10.136	2.636
2010/3/20	0	2.1	0.0	0.0	0	0	15.0	4.0	-19.1	10.132	2.632
2010/3/21	0	4.8	0.0	0.0	0	0	34.4	4.0	-38.4	10.123	2.623
2010/3/22	0	3.9	0.0	0.0	0	0	27.9	4.0	-32.0	10.116	2.616
2010/3/23	0	2.8	0.0	0.0	0	0	20.1	4.0	-24.1	10.111	2.611
2010/3/24	3.5	4.7	20.5	42.0	0	0	33.7	4.0	24.8	10.117	2.617
2010/3/25	1.5	4.4	8.8	18.0	0	0	31.5	4.0	-8.8	10.115	2.615
2010/3/26	0	3.3	0.0	0.0	0	0	23.6	4.0	-27.7	10.109	2.609
2010/3/27	0	1.5	0.0	0.0	0	0	10.7	4.0	-14.8	10.105	2.605
2010/3/28	0	5.2	0.0	0.0	0	0	37.2	4.0	-41.3	10.096	2.596
2010/3/29	0	2.2	0.0	0.0	0	0	15.8	4.0	-19.8	10.092	2.592

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2010/3/30	0	1	0.0	0.0	0	0	7.2	4.0	-11.2	10.090	2.590
2010/3/31	0	3.3	0.0	0.0	0	0	23.6	4.0	-27.7	10.084	2.584
2010/4/1	0	2.6	0.0	0.0	0	0	18.6	4.0	-22.7	10.079	2.579
2010/4/2	11.5	1.8	67.3	138.0	0	0	12.9	4.0	188.4	10.120	2.620
2010/4/3	1.5	0.7	8.8	18.0	0	0	5.0	4.0	17.7	10.124	2.624
2010/4/4	0	0.9	0.0	0.0	0	0	6.4	4.0	-10.5	10.121	2.621
2010/4/5	0.5	1.6	2.9	6.0	0	0	11.5	4.0	-6.6	10.120	2.620
2010/4/6	0	1.1	0.0	0.0	0	0	7.9	4.0	-11.9	10.117	2.617
2010/4/7	0	1.4	0.0	0.0	0	0	10.0	4.0	-14.1	10.114	2.614
2010/4/8	7	0.2	41.0	84.0	0	0	1.4	4.0	119.5	10.140	2.640
2010/4/9	0.5	1.5	2.9	6.0	0	0	10.7	4.0	-5.8	10.139	2.639
2010/4/10	0.5	0.1	2.9	6.0	0	0	0.7	4.0	4.2	10.140	2.640
2010/4/11	0	1.4	0.0	0.0	0	0	10.0	4.0	-14.1	10.137	2.637
2010/4/12	0	2.1	0.0	0.0	0	0	15.0	4.0	-19.1	10.133	2.633
2010/4/13	0	4	0.0	0.0	0	0	28.6	4.0	-32.7	10.126	2.626
2010/4/14	0	1.3	0.0	0.0	0	0	9.3	4.0	-13.3	10.123	2.623
2010/4/15	20.5	1	120.0	246.0	0	0	7.2	4.0	354.9	10.200	2.700
2010/4/16	0	0.9	0.0	0.0	0	0	6.4	4.0	-10.5	10.198	2.698
2010/4/17	0	1.3	0.0	0.0	0	0	9.3	4.0	-13.3	10.195	2.695
2010/4/18	6	1.2	35.1	72.0	0	0	8.6	4.0	94.5	10.215	2.715
2010/4/19	0	3.7	0.0	0.0	0	0	26.5	4.0	-30.5	10.209	2.709
2010/4/20	4.5	1	26.4	54.0	0	0	7.2	4.0	69.2	10.224	2.724
2010/4/21	0	3	0.0	0.0	0	0	21.5	4.0	-25.5	10.218	2.718
2010/4/22	16	3.5	93.7	192.0	0	0	25.1	4.0	256.6	10.274	2.774
2010/4/23	0	3.6	0.0	0.0	0	0	25.8	4.0	-29.8	10.268	2.768
2010/4/24	0	6.6	0.0	0.0	0	0	47.3	4.0	-51.3	10.257	2.757
2010/4/25	0	3.8	0.0	0.0	0	0	27.2	4.0	-31.2	10.250	2.750
2010/4/26	1	3	5.9	12.0	0	0	21.5	4.0	-7.7	10.248	2.748
2010/4/27	0	2.6	0.0	0.0	0	0	18.6	4.0	-22.7	10.243	2.743
2010/4/28	6.5	2	38.1	78.0	0	0	14.3	4.0	97.7	10.264	2.764
2010/4/29	43.5	1.7	254.7	522.0	0	0	12.2	4.0	760.5	10.430	2.930
2010/4/30	1	3.5	5.9	12.0	0	0	25.1	4.0	-11.2	10.428	2.928
2010/5/1	0	4.8	0.0	0.0	0	0	34.4	4.0	-38.4	10.419	2.919
2010/5/2	0	4.7	0.0	0.0	0	0	33.7	4.0	-37.7	10.411	2.911
2010/5/3	0	4.8	0.0	0.0	0	0	34.4	4.0	-38.4	10.403	2.903
2010/5/4	0	2.9	0.0	0.0	0	0	20.8	4.0	-24.8	10.397	2.897
2010/5/5	0	1.6	0.0	0.0	0	0	11.5	4.0	-15.5	10.394	2.894
2010/5/6	6.5	4.6	38.1	78.0	0	0	32.9	4.0	79.1	10.411	2.911
2010/5/7	44.5	4.1	260.6	534.0	0	0	29.4	4.0	761.2	10.500	3.000
2010/5/8	0	3.3	0.0	0.0	0	0	23.6	4.0	-27.7	10.494	2.994
2010/5/9	6.5	5.3	38.1	78.0	0	0	38.0	4.0	74.1	10.500	3.000
2010/5/10	24	1.7	140.5	288.0	0	0	12.2	4.0	412.3	10.500	3.000
2010/5/11	0	3.2	0.0	0.0	0	0	22.9	4.0	-27.0	10.494	2.994
2010/5/12	0	2.9	0.0	0.0	0	0	20.8	4.0	-24.8	10.489	2.989
2010/5/13	0	2.8	0.0	0.0	0	0	20.1	4.0	-24.1	10.483	2.983

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2010/5/14	0	1.9	0.0	0.0	0	0	13.6	4.0	-17.6	10.480	2.980
2010/5/15	7	2.7	41.0	84.0	0	0	19.3	4.0	101.6	10.500	3.000
2010/5/16	0	4.3	0.0	0.0	0	0	30.8	4.0	-34.8	10.492	2.992
2010/5/17	0	3.1	0.0	0.0	0	0	22.2	4.0	-26.2	10.487	2.987
2010/5/18	0	4	0.0	0.0	0	0	28.6	4.0	-32.7	10.480	2.980
2010/5/19	32.5	3.4	190.3	390.0	0	0	24.3	4.0	551.9	10.500	3.000
2010/5/20	8.5	3	49.8	102.0	0	0	21.5	4.0	126.3	10.500	3.000
2010/5/21	0	3.2	0.0	0.0	0	0	22.9	4.0	-27.0	10.494	2.994
2010/5/22	2	2.6	11.7	24.0	0	0	18.6	4.0	13.1	10.497	2.997
2010/5/23	11.5	3.6	67.3	138.0	0	0	25.8	4.0	175.5	10.500	3.000
2010/5/24	0	5.6	0.0	0.0	0	0	40.1	4.0	-44.1	10.490	2.990
2010/5/25	0	6.3	0.0	0.0	0	0	45.1	4.0	-49.2	10.480	2.980
2010/5/26	0	5.8	0.0	0.0	0	0	41.5	4.0	-45.6	10.470	2.970
2010/5/27	0	1.5	0.0	0.0	0	0	10.7	4.0	-14.8	10.467	2.967
2010/5/28	0	4.5	0.0	0.0	0	0	32.2	4.0	-36.3	10.459	2.959
2010/5/29	29.5	3.2	172.8	354.0	0	0	22.9	4.0	499.8	10.500	3.000
2010/5/30	3.5	1.9	20.5	42.0	0	0	13.6	4.0	44.9	10.500	3.000
2010/5/31	1.5	1.7	8.8	18.0	0	0	12.2	4.0	10.6	10.500	3.000
2010/6/1	2	3.9	11.7	24.0	0	0	27.9	4.0	3.7	10.500	3.000
2010/6/2	17.5	0.3	102.5	210.0	0	0	2.1	4.0	306.3	10.500	3.000
2010/6/3	0	2.1	0.0	0.0	0	0	15.0	4.0	-19.1	10.496	2.996
2010/6/4	0	2.2	0.0	0.0	0	0	15.8	4.0	-19.8	10.492	2.992
2010/6/5	0	5.1	0.0	0.0	0	0	36.5	4.0	-40.6	10.483	2.983
2010/6/6	0	4.3	0.0	0.0	0	0	30.8	4.0	-34.8	10.475	2.975
2010/6/7	0	6	0.0	0.0	0	0	43.0	4.0	-47.0	10.465	2.965
2010/6/8	0	4.7	0.0	0.0	0	0	33.7	4.0	-37.7	10.457	2.957
2010/6/9	21	1.7	123.0	252.0	0	0	12.2	4.0	358.8	10.500	3.000
2010/6/10	35	0.1	205.0	420.0	0	0	0.7	4.0	620.2	10.500	3.000
2010/6/11	0	6.1	0.0	0.0	0	0	43.7	4.0	-47.7	10.490	2.990
2010/6/12	2	1.9	11.7	24.0	0	0	13.6	4.0	18.1	10.494	2.994
2010/6/13	0.5	0.2	2.9	6.0	0	0	1.4	4.0	3.5	10.494	2.994
2010/6/14	2.5	3.8	14.6	30.0	0	0	27.2	4.0	13.4	10.497	2.997
2010/6/15	0.5	1.5	2.9	6.0	0	0	10.7	4.0	-5.8	10.496	2.996
2010/6/16	1	3.6	5.9	12.0	0	0	25.8	4.0	-12.0	10.493	2.993
2010/6/17	0	4.3	0.0	0.0	0	0	30.8	4.0	-34.8	10.486	2.986
2010/6/18	0	6.5	0.0	0.0	0	0	46.5	4.0	-50.6	10.475	2.975
2010/6/19	0	3.3	0.0	0.0	0	0	23.6	4.0	-27.7	10.469	2.969
2010/6/20	0	5.7	0.0	0.0	0	0	40.8	4.0	-44.9	10.459	2.959
2010/6/21	0	4.4	0.0	0.0	0	0	31.5	4.0	-35.5	10.451	2.951
2010/6/22	1.5	4.3	8.8	18.0	0	0	30.8	4.0	-8.0	10.449	2.949
2010/6/23	27.5	5.5	161.0	330.0	0	0	39.4	4.0	447.6	10.500	3.000
2010/6/24	0	2.5	0.0	0.0	0	0	17.9	4.0	-21.9	10.495	2.995
2010/6/25	0	1.8	0.0	0.0	0	0	12.9	4.0	-16.9	10.492	2.992
2010/6/26	62	1.5	363.1	744.0	0	0	10.7	4.0	1092.3	10.500	3.000
2010/6/27	14	1.4	82.0	168.0	0	0	10.0	4.0	235.9	10.500	3.000

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2010/6/28	0	2.7	0.0	0.0	0	0	19.3	4.0	-23.4	10.495	2.995
2010/6/29	0	3.7	0.0	0.0	0	0	26.5	4.0	-30.5	10.488	2.988
2010/6/30	12	5.2	70.3	144.0	0	0	37.2	4.0	173.0	10.500	3.000
2010/7/1	0	6.3	0.0	0.0	0	0	45.1	4.0	-49.2	10.489	2.989
2010/7/2	0	7.8	0.0	0.0	0	0	55.9	4.0	-59.9	10.476	2.976
2010/7/3	0	6	0.0	0.0	0	0	43.0	4.0	-47.0	10.466	2.966
2010/7/4	0	7.4	0.0	0.0	0	0	53.0	4.0	-57.0	10.454	2.954
2010/7/5	0	7.2	0.0	0.0	0	0	51.6	4.0	-55.6	10.441	2.941
2010/7/6	0	6.2	0.0	0.0	0	0	44.4	4.0	-48.4	10.431	2.931
2010/7/7	0	5.7	0.0	0.0	0	0	40.8	4.0	-44.9	10.421	2.921
2010/7/8	0	7.4	0.0	0.0	0	0	53.0	4.0	-57.0	10.409	2.909
2010/7/9	0	7.2	0.0	0.0	0	0	51.6	4.0	-55.6	10.397	2.897
2010/7/10	0	7.2	0.0	0.0	0	0	51.6	4.0	-55.6	10.384	2.884
2010/7/11	0	7.1	0.0	0.0	0	0	50.8	4.0	-54.9	10.373	2.873
2010/7/12	0	6.2	0.0	0.0	0	0	44.4	4.0	-48.4	10.362	2.862
2010/7/13	0	6.3	0.0	0.0	0	0	45.1	4.0	-49.2	10.351	2.851
2010/7/14	0	5.6	0.0	0.0	0	0	40.1	4.0	-44.1	10.342	2.842
2010/7/15	7.5	4.7	43.9	90.0	0	0	33.7	4.0	96.2	10.363	2.863
2010/7/16	11	5.9	64.4	132.0	0	0	42.3	4.0	150.1	10.395	2.895
2010/7/17	72	6.1	421.6	864.0	0	0	43.7	4.0	1237.9	10.500	3.000
2010/7/18	0.5	4.8	2.9	6.0	0	0	34.4	4.0	-29.5	10.494	2.994
2010/7/19	0	5.6	0.0	0.0	0	0	40.1	4.0	-44.1	10.484	2.984
2010/7/20	0	5.5	0.0	0.0	0	0	39.4	4.0	-43.4	10.474	2.974
2010/7/21	34	4.5	199.1	408.0	0	0	32.2	4.0	570.8	10.500	3.000
2010/7/22	121.5	4.3	711.5	1458.0	0	0	30.8	4.0	2134.7	10.500	3.000
2010/7/23	12.5	3.3	73.2	150.0	0	0	23.6	4.0	195.5	10.500	3.000
2010/7/24	0.5	6.1	2.9	6.0	0	0	43.7	4.0	-38.8	10.492	2.992
2010/7/25	0	4.5	0.0	0.0	0	0	32.2	4.0	-36.3	10.484	2.984
2010/7/26	0	6.3	0.0	0.0	0	0	45.1	4.0	-49.2	10.473	2.973
2010/7/27	23	4.1	134.7	276.0	0	0	29.4	4.0	377.3	10.500	3.000
2010/7/28	58	2.5	339.6	696.0	0	0	17.9	4.0	1013.7	10.500	3.000
2010/7/29	15.5	3.8	90.8	186.0	0	0	27.2	4.0	245.5	10.500	3.000
2010/7/30	0	5.3	0.0	0.0	0	0	38.0	4.0	-42.0	10.491	2.991
2010/7/31	0	4.1	0.0	0.0	0	0	29.4	4.0	-33.4	10.484	2.984
2010/8/1	0	7.6	0.0	0.0	0	0	54.4	4.0	-58.5	10.471	2.971
2010/8/2	5	6	29.3	60.0	0	0	43.0	4.0	42.3	10.480	2.980
2010/8/3	0	6.6	0.0	0.0	0	0	47.3	4.0	-51.3	10.469	2.969
2010/8/4	0	5.9	0.0	0.0	0	0	42.3	4.0	-46.3	10.459	2.959
2010/8/5	10	7	58.6	120.0	0	0	50.1	4.0	124.4	10.486	2.986
2010/8/6	0	4.9	0.0	0.0	0	0	35.1	4.0	-39.1	10.477	2.977
2010/8/7	1	7.5	5.9	12.0	0	0	53.7	4.0	-39.9	10.469	2.969
2010/8/8	0	5.2	0.0	0.0	0	0	37.2	4.0	-41.3	10.460	2.960
2010/8/9	0	6	0.0	0.0	0	0	43.0	4.0	-47.0	10.449	2.949
2010/8/10	2	6.3	11.7	24.0	0	0	45.1	4.0	-13.4	10.447	2.947
2010/8/11	16.5	7	96.6	198.0	0	0	50.1	4.0	240.5	10.499	2.999

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2010/8/12	0.5	4.7	2.9	6.0	0	0	33.7	4.0	-28.8	10.493	2.993
2010/8/13	2	5.2	11.7	24.0	0	0	37.2	4.0	-5.6	10.491	2.991
2010/8/14	45	3.1	263.5	540.0	0	0	22.2	4.0	777.3	10.500	3.000
2010/8/15	6	2.8	35.1	72.0	0	0	20.1	4.0	83.0	10.500	3.000
2010/8/16	33.5	2.5	196.2	402.0	0	0	17.9	4.0	576.2	10.500	3.000
2010/8/17	6	4.1	35.1	72.0	0	0	29.4	4.0	73.7	10.500	3.000
2010/8/18	0	4.2	0.0	0.0	0	0	30.1	4.0	-34.1	10.493	2.993
2010/8/19	5	4.2	29.3	60.0	0	0	30.1	4.0	55.2	10.500	3.000
2010/8/20	4.5	4.9	26.4	54.0	0	0	35.1	4.0	41.2	10.500	3.000
2010/8/21	0	4.2	0.0	0.0	0	0	30.1	4.0	-34.1	10.493	2.993
2010/8/22	0	3.9	0.0	0.0	0	0	27.9	4.0	-32.0	10.486	2.986
2010/8/23	28.5	3.5	166.9	342.0	0	0	25.1	4.0	479.8	10.500	3.000
2010/8/24	12.5	2.2	73.2	150.0	0	0	15.8	4.0	203.4	10.500	3.000
2010/8/25	9	3.7	52.7	108.0	0	0	26.5	4.0	130.2	10.500	3.000
2010/8/26	2	3.5	11.7	24.0	0	0	25.1	4.0	6.6	10.500	3.000
2010/8/27	0	5.9	0.0	0.0	0	0	42.3	4.0	-46.3	10.490	2.990
2010/8/28	5	5.6	29.3	60.0	0	0	40.1	4.0	45.1	10.500	3.000
2010/8/29	0	6	0.0	0.0	0	0	43.0	4.0	-47.0	10.490	2.990
2010/8/30	0	5.2	0.0	0.0	0	0	37.2	4.0	-41.3	10.481	2.981
2010/8/31	0	5.5	0.0	0.0	0	0	39.4	4.0	-43.4	10.471	2.971
2010/9/1	0	6.2	0.0	0.0	0	0	44.4	4.0	-48.4	10.461	2.961
2010/9/2	0	3.1	0.0	0.0	0	0	22.2	4.0	-26.2	10.455	2.955
2010/9/3	45.5	3.8	266.4	546.0	0	0	27.2	4.0	781.2	10.500	3.000
2010/9/4	11	2.3	64.4	132.0	0	0	16.5	4.0	175.9	10.500	3.000
2010/9/5	0	3.9	0.0	0.0	0	0	27.9	4.0	-32.0	10.493	2.993
2010/9/6	0	5.7	0.0	0.0	0	0	40.8	4.0	-44.9	10.483	2.983
2010/9/7	1.5	6	8.8	18.0	0	0	43.0	4.0	-20.2	10.479	2.979
2010/9/8	24.5	6.7	143.5	294.0	0	0	48.0	4.0	385.5	10.500	3.000
2010/9/9	25.5	5.2	149.3	306.0	0	0	37.2	4.0	414.1	10.500	3.000
2010/9/10	31	2.5	181.5	372.0	0	0	17.9	4.0	531.6	10.500	3.000
2010/9/11	38	1.5	222.5	456.0	0	0	10.7	4.0	663.8	10.500	3.000
2010/9/12	16.5	1.1	96.6	198.0	0	0	7.9	4.0	282.7	10.500	3.000
2010/9/13	0.5	5.2	2.9	6.0	0	0	37.2	4.0	-32.3	10.493	2.993
2010/9/14	2	3.4	11.7	24.0	0	0	24.3	4.0	7.3	10.495	2.995
2010/9/15	0	5.2	0.0	0.0	0	0	37.2	4.0	-41.3	10.486	2.986
2010/9/16	3.5	4.5	20.5	42.0	0	0	32.2	4.0	26.2	10.491	2.991
2010/9/17	0	5.6	0.0	0.0	0	0	40.1	4.0	-44.1	10.482	2.982
2010/9/18	0.5	5.7	2.9	6.0	0	0	40.8	4.0	-35.9	10.474	2.974
2010/9/19	0.5	5.3	2.9	6.0	0	0	38.0	4.0	-33.1	10.467	2.967
2010/9/20	51	3.6	298.7	612.0	0	0	25.8	4.0	880.8	10.500	3.000
2010/9/21	49.5	2.7	289.9	594.0	0	0	19.3	4.0	860.5	10.500	3.000
2010/9/22	0.5	1.2	2.9	6.0	0	0	8.6	4.0	-3.7	10.499	2.999
2010/9/23	0.5	3.7	2.9	6.0	0	0	26.5	4.0	-21.6	10.494	2.994
2010/9/24	0.5	6.3	2.9	6.0	0	0	45.1	4.0	-40.2	10.486	2.986
2010/9/25	0	2.7	0.0	0.0	0	0	19.3	4.0	-23.4	10.481	2.981

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2010/9/26	0	4.4	0.0	0.0	0	0	31.5	4.0	-35.5	10.473	2.973
2010/9/27	0	4.7	0.0	0.0	0	0	33.7	4.0	-37.7	10.465	2.965
2010/9/28	0	6.1	0.0	0.0	0	0	43.7	4.0	-47.7	10.454	2.954
2010/9/29	0	4.6	0.0	0.0	0	0	32.9	4.0	-37.0	10.446	2.946
2010/9/30	2	4	11.7	24.0	0	0	28.6	4.0	3.0	10.447	2.947
2010/10/1	1	5.3	5.9	12.0	0	0	38.0	4.0	-24.1	10.442	2.942
2010/10/2	0	5.6	0.0	0.0	0	0	40.1	4.0	-44.1	10.432	2.932
2010/10/3	0	7	0.0	0.0	0	0	50.1	4.0	-54.2	10.420	2.920
2010/10/4	0	3.6	0.0	0.0	0	0	25.8	4.0	-29.8	10.414	2.914
2010/10/5	0	0.1	0.0	0.0	0	0	0.7	4.0	-4.8	10.413	2.913
2010/10/6	0.5	2.9	2.9	6.0	0	0	20.8	4.0	-15.9	10.409	2.909
2010/10/7	0	2.3	0.0	0.0	0	0	16.5	4.0	-20.5	10.405	2.905
2010/10/8	2.5	2.1	14.6	30.0	0	0	15.0	4.0	25.6	10.410	2.910
2010/10/9	1.5	2.4	8.8	18.0	0	0	17.2	4.0	5.6	10.412	2.912
2010/10/10	5	0.6	29.3	60.0	0	0	4.3	4.0	80.9	10.429	2.929
2010/10/11	1	1.4	5.9	12.0	0	0	10.0	4.0	3.8	10.430	2.930
2010/10/12	0	4.5	0.0	0.0	0	0	32.2	4.0	-36.3	10.422	2.922
2010/10/13	0	4	0.0	0.0	0	0	28.6	4.0	-32.7	10.415	2.915
2010/10/14	0	4.6	0.0	0.0	0	0	32.9	4.0	-37.0	10.407	2.907
2010/10/15	2	3.4	11.7	24.0	0	0	24.3	4.0	7.3	10.409	2.909
2010/10/16	0	2.9	0.0	0.0	0	0	20.8	4.0	-24.8	10.403	2.903
2010/10/17	2	5.1	11.7	24.0	0	0	36.5	4.0	-4.8	10.402	2.902
2010/10/18	0	6	0.0	0.0	0	0	43.0	4.0	-47.0	10.392	2.892
2010/10/19	0	5.3	0.0	0.0	0	0	38.0	4.0	-42.0	10.383	2.883
2010/10/20	0	5.3	0.0	0.0	0	0	38.0	4.0	-42.0	10.374	2.874
2010/10/21	0	3.6	0.0	0.0	0	0	25.8	4.0	-29.8	10.367	2.867
2010/10/22	1	2	5.9	12.0	0	0	14.3	4.0	-0.5	10.367	2.867
2010/10/23	0	4.6	0.0	0.0	0	0	32.9	4.0	-37.0	10.359	2.859
2010/10/24	0	4.8	0.0	0.0	0	0	34.4	4.0	-38.4	10.350	2.850
2010/10/25	0	5.1	0.0	0.0	0	0	36.5	4.0	-40.6	10.342	2.842
2010/10/26	0	4	0.0	0.0	0	0	28.6	4.0	-32.7	10.335	2.835
2010/10/27	0	6.1	0.0	0.0	0	0	43.7	4.0	-47.7	10.324	2.824
2010/10/28	0	5.6	0.0	0.0	0	0	40.1	4.0	-44.1	10.315	2.815
2010/10/29	0	4.8	0.0	0.0	0	0	34.4	4.0	-38.4	10.306	2.806
2010/10/30	0	6.4	0.0	0.0	0	0	45.8	4.0	-49.9	10.295	2.795
2010/10/31	0	3.3	0.0	0.0	0	0	23.6	4.0	-27.7	10.289	2.789
2010/11/1	0	3.9	0.0	0.0	0	0	27.9	4.0	-32.0	10.282	2.782
2010/11/2	0	4.4	0.0	0.0	0	0	31.5	4.0	-35.5	10.275	2.775
2010/11/3	0	3.7	0.0	0.0	0	0	26.5	4.0	-30.5	10.268	2.768
2010/11/4	3	0.9	17.6	36.0	0	0	6.4	4.0	43.1	10.277	2.777
2010/11/5	12.5	0.6	73.2	150.0	0	0	4.3	4.0	214.9	10.324	2.824
2010/11/6	15	1.6	87.8	180.0	0	0	11.5	4.0	252.3	10.379	2.879
2010/11/7	0	3.5	0.0	0.0	0	0	25.1	4.0	-29.1	10.373	2.873
2010/11/8	0	5.4	0.0	0.0	0	0	38.7	4.0	-42.7	10.363	2.863
2010/11/9	0	3	0.0	0.0	0	0	21.5	4.0	-25.5	10.358	2.858

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2010/11/10	0	3.6	0.0	0.0	0	0	25.8	4.0	-29.8	10.351	2.851
2010/11/11	0	4	0.0	0.0	0	0	28.6	4.0	-32.7	10.344	2.844
2010/11/12	0	4.4	0.0	0.0	0	0	31.5	4.0	-35.5	10.336	2.836
2010/11/13	0	2.7	0.0	0.0	0	0	19.3	4.0	-23.4	10.331	2.831
2010/11/14	0	3.2	0.0	0.0	0	0	22.9	4.0	-27.0	10.326	2.826
2010/11/15	0	3.9	0.0	0.0	0	0	27.9	4.0	-32.0	10.319	2.819
2010/11/16	0	3.5	0.0	0.0	0	0	25.1	4.0	-29.1	10.312	2.812
2010/11/17	0	3.5	0.0	0.0	0	0	25.1	4.0	-29.1	10.306	2.806
2010/11/18	0	2.4	0.0	0.0	0	0	17.2	4.0	-21.2	10.301	2.801
2010/11/19	0	3	0.0	0.0	0	0	21.5	4.0	-25.5	10.296	2.796
2010/11/20	0	3.2	0.0	0.0	0	0	22.9	4.0	-27.0	10.290	2.790
2010/11/21	0	1.6	0.0	0.0	0	0	11.5	4.0	-15.5	10.286	2.786
2010/11/22	0	3.5	0.0	0.0	0	0	25.1	4.0	-29.1	10.280	2.780
2010/11/23	0	2.9	0.0	0.0	0	0	20.8	4.0	-24.8	10.275	2.775
2010/11/24	0	4.2	0.0	0.0	0	0	30.1	4.0	-34.1	10.267	2.767
2010/11/25	0	3.1	0.0	0.0	0	0	22.2	4.0	-26.2	10.262	2.762
2010/11/26	0	3	0.0	0.0	0	0	21.5	4.0	-25.5	10.256	2.756
2010/11/27	0	3.3	0.0	0.0	0	0	23.6	4.0	-27.7	10.250	2.750
2010/11/28	0	3.2	0.0	0.0	0	0	22.9	4.0	-27.0	10.244	2.744
2010/11/29	0	2.4	0.0	0.0	0	0	17.2	4.0	-21.2	10.239	2.739
2010/11/30	0	3	0.0	0.0	0	0	21.5	4.0	-25.5	10.234	2.734
2010/12/1	0	2	0.0	0.0	0	0	14.3	4.0	-18.4	10.230	2.730
2010/12/2	0	4.2	0.0	0.0	0	0	30.1	4.0	-34.1	10.222	2.722
2010/12/3	0	4	0.0	0.0	0	0	28.6	4.0	-32.7	10.215	2.715
2010/12/4	0	2.1	0.0	0.0	0	0	15.0	4.0	-19.1	10.211	2.711
2010/12/5	0	3.1	0.0	0.0	0	0	22.2	4.0	-26.2	10.205	2.705
2010/12/6	0	6	0.0	0.0	0	0	43.0	4.0	-47.0	10.195	2.695
2010/12/7	0	4.1	0.0	0.0	0	0	29.4	4.0	-33.4	10.188	2.688
2010/12/8	0	5	0.0	0.0	0	0	35.8	4.0	-39.8	10.179	2.679
2010/12/9	0	3	0.0	0.0	0	0	21.5	4.0	-25.5	10.174	2.674
2010/12/10	0	3.8	0.0	0.0	0	0	27.2	4.0	-31.2	10.167	2.667
2010/12/11	0	2.1	0.0	0.0	0	0	15.0	4.0	-19.1	10.163	2.663
2010/12/12	0	0.6	0.0	0.0	0	0	4.3	4.0	-8.3	10.161	2.661
2010/12/13	0	0.9	0.0	0.0	0	0	6.4	4.0	-10.5	10.159	2.659
2010/12/14	0	2.1	0.0	0.0	0	0	15.0	4.0	-19.1	10.155	2.655
2010/12/15	11	1.7	64.4	132.0	0	0	12.2	4.0	180.2	10.194	2.694
2010/12/16	2	2.5	11.7	24.0	0	0	17.9	4.0	13.8	10.197	2.697
2010/12/17	0	2.3	0.0	0.0	0	0	16.5	4.0	-20.5	10.192	2.692
2010/12/18	0	2.6	0.0	0.0	0	0	18.6	4.0	-22.7	10.187	2.687
2010/12/19	0	1.8	0.0	0.0	0	0	12.9	4.0	-16.9	10.184	2.684
2010/12/20	0	2.4	0.0	0.0	0	0	17.2	4.0	-21.2	10.179	2.679
2010/12/21	0	2.8	0.0	0.0	0	0	20.1	4.0	-24.1	10.174	2.674
2010/12/22	0	3.5	0.0	0.0	0	0	25.1	4.0	-29.1	10.167	2.667
2010/12/23	0	3	0.0	0.0	0	0	21.5	4.0	-25.5	10.162	2.662
2010/12/24	0	5.8	0.0	0.0	0	0	41.5	4.0	-45.6	10.152	2.652

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2010/12/25	0	3.7	0.0	0.0	0	0	26.5	4.0	-30.5	10.145	2.645
2010/12/26	0	2.5	0.0	0.0	0	0	17.9	4.0	-21.9	10.141	2.641
2010/12/27	0	2.7	0.0	0.0	0	0	19.3	4.0	-23.4	10.135	2.635
2010/12/28	0	2.6	0.0	0.0	0	0	18.6	4.0	-22.7	10.131	2.631
2010/12/29	0	3.5	0.0	0.0	0	0	25.1	4.0	-29.1	10.124	2.624
2010/12/30	0	5.2	0.0	0.0	0	0	37.2	4.0	-41.3	10.115	2.615
2010/12/31	0	3.7	0.0	0.0	0	0	26.5	4.0	-30.5	10.109	2.609
2011/1/1	0	3.3	0.0	0.0	0.0	0.0	23.6	4.0	-27.7	10.103	2.603
2011/1/2	0	2.8	0.0	0.0	0.0	0.0	20.1	4.0	-24.1	10.097	2.597
2011/1/3	0	0.6	0.0	0.0	0.0	0.0	4.3	4.0	-8.3	10.095	2.595
2011/1/4	5	1.1	29.3	60.0	0.0	0.0	7.9	4.0	77.4	10.112	2.612
2011/1/5	0	2.1	0.0	0.0	0.0	0.0	15.0	4.0	-19.1	10.108	2.608
2011/1/6	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.101	2.601
2011/1/7	0	2.1	0.0	0.0	0.0	0.0	15.0	4.0	-19.1	10.097	2.597
2011/1/8	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	10.092	2.592
2011/1/9	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.085	2.585
2011/1/10	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	10.079	2.579
2011/1/11	0	1.3	0.0	0.0	0.0	0.0	9.3	4.0	-13.3	10.076	2.576
2011/1/12	6	1	35.1	72.0	0.0	0.0	7.2	4.0	95.9	10.097	2.597
2011/1/13	0	1.9	0.0	0.0	0.0	0.0	13.6	4.0	-17.6	10.093	2.593
2011/1/14	0	3.3	0.0	0.0	0.0	0.0	23.6	4.0	-27.7	10.087	2.587
2011/1/15	0	4.3	0.0	0.0	0.0	0.0	30.8	4.0	-34.8	10.080	2.580
2011/1/16	0	3.1	0.0	0.0	0.0	0.0	22.2	4.0	-26.2	10.074	2.574
2011/1/17	0	2.6	0.0	0.0	0.0	0.0	18.6	4.0	-22.7	10.069	2.569
2011/1/18	0	2.7	0.0	0.0	0.0	0.0	19.3	4.0	-23.4	10.064	2.564
2011/1/19	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	10.058	2.558
2011/1/20	0	3.3	0.0	0.0	0.0	0.0	23.6	4.0	-27.7	10.052	2.552
2011/1/21	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	10.047	2.547
2011/1/22	0	2.7	0.0	0.0	0.0	0.0	19.3	4.0	-23.4	10.042	2.542
2011/1/23	0	2.1	0.0	0.0	0.0	0.0	15.0	4.0	-19.1	10.038	2.538
2011/1/24	0	2.6	0.0	0.0	0.0	0.0	18.6	4.0	-22.7	10.033	2.533
2011/1/25	0	2.6	0.0	0.0	0.0	0.0	18.6	4.0	-22.7	10.028	2.528
2011/1/26	0	2.6	0.0	0.0	0.0	0.0	18.6	4.0	-22.7	10.023	2.523
2011/1/27	0	2.8	0.0	0.0	0.0	0.0	20.1	4.0	-24.1	10.018	2.518
2011/1/28	0	4.6	0.0	0.0	0.0	0.0	32.9	4.0	-37.0	10.010	2.510
2011/1/29	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	10.004	2.504
2011/1/30	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	9.998	2.498
2011/1/31	0	2.8	0.0	0.0	0.0	0.0	20.1	4.0	-24.1	9.993	2.493
2011/2/1	0	2.5	0.0	0.0	0.0	0.0	17.9	4.0	-21.9	9.988	2.488
2011/2/2	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	9.983	2.483
2011/2/3	0	3.9	0.0	0.0	0.0	0.0	27.9	4.0	-32.0	9.976	2.476
2011/2/4	0	1.4	0.0	0.0	0.0	0.0	10.0	4.0	-14.1	9.972	2.472
2011/2/5	0	3.9	0.0	0.0	0.0	0.0	27.9	4.0	-32.0	9.966	2.466
2011/2/6	0	3.8	0.0	0.0	0.0	0.0	27.2	4.0	-31.2	9.959	2.459
2011/2/7	0	3.4	0.0	0.0	0.0	0.0	24.3	4.0	-28.4	9.953	2.453

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2011/2/8	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	9.947	2.447
2011/2/9	0	3.6	0.0	0.0	0.0	0.0	25.8	4.0	-29.8	9.940	2.440
2011/2/10	0	2.9	0.0	0.0	0.0	0.0	20.8	4.0	-24.8	9.935	2.435
2011/2/11	0	2.4	0.0	0.0	0.0	0.0	17.2	4.0	-21.2	9.930	2.430
2011/2/12	0	1.1	0.0	0.0	0.0	0.0	7.9	4.0	-11.9	9.928	2.428
2011/2/13	15.5	1.1	90.8	186.0	0.0	0.0	7.9	4.0	264.9	9.986	2.486
2011/2/14	2.5	1.3	14.6	30.0	0.0	0.0	9.3	4.0	31.3	9.992	2.492
2011/2/15	2.5	0.1	14.6	30.0	0.0	0.0	0.7	4.0	39.9	10.001	2.501
2011/2/16	0	0.4	0.0	0.0	0.0	0.0	2.9	4.0	-6.9	10.000	2.500
2011/2/17	0	0.9	0.0	0.0	0.0	0.0	6.4	4.0	-10.5	9.997	2.497
2011/2/18	0.5	1	2.9	6.0	0.0	0.0	7.2	4.0	-2.3	9.997	2.497
2011/2/19	3	3.5	17.6	36.0	0.0	0.0	25.1	4.0	24.5	10.002	2.502
2011/2/20	0	0.4	0.0	0.0	0.0	0.0	2.9	4.0	-6.9	10.001	2.501
2011/2/21	0	2.2	0.0	0.0	0.0	0.0	15.8	4.0	-19.8	9.996	2.496
2011/2/22	0	2.9	0.0	0.0	0.0	0.0	20.8	4.0	-24.8	9.991	2.491
2011/2/23	0	2.4	0.0	0.0	0.0	0.0	17.2	4.0	-21.2	9.986	2.486
2011/2/24	0	2.5	0.0	0.0	0.0	0.0	17.9	4.0	-21.9	9.981	2.481
2011/2/25	0	4	0.0	0.0	0.0	0.0	28.6	4.0	-32.7	9.974	2.474
2011/2/26	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	9.969	2.469
2011/2/27	0	3.3	0.0	0.0	0.0	0.0	23.6	4.0	-27.7	9.963	2.463
2011/2/28	0	4.5	0.0	0.0	0.0	0.0	32.2	4.0	-36.3	9.955	2.455
2011/3/1	0	2.7	0.0	0.0	0.0	0.0	19.3	4.0	-23.4	9.950	2.450
2011/3/2	0	2.5	0.0	0.0	0.0	0.0	17.9	4.0	-21.9	9.945	2.445
2011/3/3	0	4.1	0.0	0.0	0.0	0.0	29.4	4.0	-33.4	9.938	2.438
2011/3/4	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	9.931	2.431
2011/3/5	0	3.1	0.0	0.0	0.0	0.0	22.2	4.0	-26.2	9.925	2.425
2011/3/6	0	2.5	0.0	0.0	0.0	0.0	17.9	4.0	-21.9	9.921	2.421
2011/3/7	0.5	4.7	2.9	6.0	0.0	0.0	33.7	4.0	-28.8	9.914	2.414
2011/3/8	2	2.9	11.7	24.0	0.0	0.0	20.8	4.0	10.9	9.917	2.417
2011/3/9	1	2.5	5.9	12.0	0.0	0.0	17.9	4.0	-4.1	9.916	2.416
2011/3/10	0	2	0.0	0.0	0.0	0.0	14.3	4.0	-18.4	9.912	2.412
2011/3/11	0	3.4	0.0	0.0	0.0	0.0	24.3	4.0	-28.4	9.906	2.406
2011/3/12	0	1.7	0.0	0.0	0.0	0.0	12.2	4.0	-16.2	9.902	2.402
2011/3/13	0	3.8	0.0	0.0	0.0	0.0	27.2	4.0	-31.2	9.895	2.395
2011/3/14	0	3.6	0.0	0.0	0.0	0.0	25.8	4.0	-29.8	9.889	2.389
2011/3/15	0	4	0.0	0.0	0.0	0.0	28.6	4.0	-32.7	9.882	2.382
2011/3/16	0	5.6	0.0	0.0	0.0	0.0	40.1	4.0	-44.1	9.872	2.372
2011/3/17	1	2.1	5.9	12.0	0.0	0.0	15.0	4.0	-1.2	9.872	2.372
2011/3/18	4.5	1.1	26.4	54.0	0.0	0.0	7.9	4.0	68.4	9.887	2.387
2011/3/19	8	0.7	46.8	96.0	0.0	0.0	5.0	4.0	133.8	9.916	2.416
2011/3/20	0	1.1	0.0	0.0	0.0	0.0	7.9	4.0	-11.9	9.913	2.413
2011/3/21	0	4.1	0.0	0.0	0.0	0.0	29.4	4.0	-33.4	9.906	2.406
2011/3/22	0	3.9	0.0	0.0	0.0	0.0	27.9	4.0	-32.0	9.899	2.399
2011/3/23	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	9.893	2.393
2011/3/24	0	4	0.0	0.0	0.0	0.0	28.6	4.0	-32.7	9.886	2.386

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2011/3/25	0	5.1	0.0	0.0	0.0	0.0	36.5	4.0	-40.6	9.877	2.377
2011/3/26	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	9.872	2.372
2011/3/27	0.5	1.5	2.9	6.0	0.0	0.0	10.7	4.0	-5.8	9.870	2.370
2011/3/28	0	3.4	0.0	0.0	0.0	0.0	24.3	4.0	-28.4	9.864	2.364
2011/3/29	0	3.1	0.0	0.0	0.0	0.0	22.2	4.0	-26.2	9.858	2.358
2011/3/30	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	9.853	2.353
2011/3/31	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	9.847	2.347
2011/4/1	0	4.8	0.0	0.0	0.0	0.0	34.4	4.0	-38.4	9.839	2.339
2011/4/2	0	5.1	0.0	0.0	0.0	0.0	36.5	4.0	-40.6	9.830	2.330
2011/4/3	0	3.6	0.0	0.0	0.0	0.0	25.8	4.0	-29.8	9.823	2.323
2011/4/4	0	1.7	0.0	0.0	0.0	0.0	12.2	4.0	-16.2	9.820	2.320
2011/4/5	0.5	4.3	2.9	6.0	0.0	0.0	30.8	4.0	-25.9	9.814	2.314
2011/4/6	0	3.5	0.0	0.0	0.0	0.0	25.1	4.0	-29.1	9.808	2.308
2011/4/7	0	3.9	0.0	0.0	0.0	0.0	27.9	4.0	-32.0	9.801	2.301
2011/4/8	0	5.4	0.0	0.0	0.0	0.0	38.7	4.0	-42.7	9.792	2.292
2011/4/9	0	2.4	0.0	0.0	0.0	0.0	17.2	4.0	-21.2	9.787	2.287
2011/4/10	0	5.5	0.0	0.0	0.0	0.0	39.4	4.0	-43.4	9.777	2.277
2011/4/11	0	4.6	0.0	0.0	0.0	0.0	32.9	4.0	-37.0	9.769	2.269
2011/4/12	0	5	0.0	0.0	0.0	0.0	35.8	4.0	-39.8	9.761	2.261
2011/4/13	0	3.4	0.0	0.0	0.0	0.0	24.3	4.0	-28.4	9.755	2.255
2011/4/14	0	3.9	0.0	0.0	0.0	0.0	27.9	4.0	-32.0	9.748	2.248
2011/4/15	0	3.4	0.0	0.0	0.0	0.0	24.3	4.0	-28.4	9.741	2.241
2011/4/16	0	4.1	0.0	0.0	0.0	0.0	29.4	4.0	-33.4	9.734	2.234
2011/4/17	73	5.1	427.5	876.0	0.0	0.0	36.5	4.0	1262.9	10.009	2.509
2011/4/18	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.003	2.503
2011/4/19	0	5.2	0.0	0.0	0.0	0.0	37.2	4.0	-41.3	9.994	2.494
2011/4/20	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	9.988	2.488
2011/4/21	0	4.1	0.0	0.0	0.0	0.0	29.4	4.0	-33.4	9.980	2.480
2011/4/22	3.5	2.9	20.5	42.0	0.0	0.0	20.8	4.0	37.7	9.989	2.489
2011/4/23	2.5	2.9	14.6	30.0	0.0	0.0	20.8	4.0	19.8	9.993	2.493
2011/4/24	0	5.4	0.0	0.0	0.0	0.0	38.7	4.0	-42.7	9.984	2.484
2011/4/25	0	4.8	0.0	0.0	0.0	0.0	34.4	4.0	-38.4	9.975	2.475
2011/4/26	0	6	0.0	0.0	0.0	0.0	43.0	4.0	-47.0	9.965	2.465
2011/4/27	0	3.3	0.0	0.0	0.0	0.0	23.6	4.0	-27.7	9.959	2.459
2011/4/28	0	1.4	0.0	0.0	0.0	0.0	10.0	4.0	-14.1	9.956	2.456
2011/4/29	9	1.5	52.7	108.0	0.0	0.0	10.7	4.0	145.9	9.988	2.488
2011/4/30	0	1.4	0.0	0.0	0.0	0.0	10.0	4.0	-14.1	9.985	2.485
2011/5/1	0	2.5	0.0	0.0	0.0	0.0	17.9	4.0	-21.9	9.980	2.480
2011/5/2	0	4.9	0.0	0.0	0.0	0.0	35.1	4.0	-39.1	9.971	2.471
2011/5/3	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	9.965	2.465
2011/5/4	2.5	3.2	14.6	30.0	0.0	0.0	22.9	4.0	17.7	9.969	2.469
2011/5/5	0	2.9	0.0	0.0	0.0	0.0	20.8	4.0	-24.8	9.963	2.463
2011/5/6	0	4.3	0.0	0.0	0.0	0.0	30.8	4.0	-34.8	9.956	2.456
2011/5/7	0	4.5	0.0	0.0	0.0	0.0	32.2	4.0	-36.3	9.948	2.448
2011/5/8	0	4.7	0.0	0.0	0.0	0.0	33.7	4.0	-37.7	9.940	2.440

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2011/5/9	0	4.5	0.0	0.0	0.0	0.0	32.2	4.0	-36.3	9.932	2.432
2011/5/10	0	5.6	0.0	0.0	0.0	0.0	40.1	4.0	-44.1	9.922	2.422
2011/5/11	0	4.1	0.0	0.0	0.0	0.0	29.4	4.0	-33.4	9.915	2.415
2011/5/12	0.5	5.2	2.9	6.0	0.0	0.0	37.2	4.0	-32.3	9.908	2.408
2011/5/13	56.5	2.6	330.9	678.0	0.0	0.0	18.6	4.0	986.2	10.123	2.623
2011/5/14	0	2.4	0.0	0.0	0.0	0.0	17.2	4.0	-21.2	10.118	2.618
2011/5/15	0	1.3	0.0	0.0	0.0	0.0	9.3	4.0	-13.3	10.115	2.615
2011/5/16	22.5	2.3	131.8	270.0	0.0	0.0	16.5	4.0	381.3	10.198	2.698
2011/5/17	1	2.1	5.9	12.0	0.0	0.0	15.0	4.0	-1.2	10.198	2.698
2011/5/18	0	5.2	0.0	0.0	0.0	0.0	37.2	4.0	-41.3	10.189	2.689
2011/5/19	0	2.8	0.0	0.0	0.0	0.0	20.1	4.0	-24.1	10.184	2.684
2011/5/20	0	5.1	0.0	0.0	0.0	0.0	36.5	4.0	-40.6	10.175	2.675
2011/5/21	3.5	3.8	20.5	42.0	0.0	0.0	27.2	4.0	31.2	10.182	2.682
2011/5/22	172.5	1.6	1010.2	2070.0	0.0	0.0	11.5	4.0	3064.7	10.500	3.000
2011/5/23	8.5	3.6	49.8	102.0	0.0	0.0	25.8	4.0	122.0	10.500	3.000
2011/5/24	5	1.7	29.3	60.0	0.0	0.0	12.2	4.0	73.1	10.500	3.000
2011/5/25	0.5	2.6	2.9	6.0	0.0	0.0	18.6	4.0	-13.7	10.497	2.997
2011/5/26	0	5.2	0.0	0.0	0.0	0.0	37.2	4.0	-41.3	10.488	2.988
2011/5/27	0	4.1	0.0	0.0	0.0	0.0	29.4	4.0	-33.4	10.481	2.981
2011/5/28	0	6	0.0	0.0	0.0	0.0	43.0	4.0	-47.0	10.470	2.970
2011/5/29	0	6.5	0.0	0.0	0.0	0.0	46.5	4.0	-50.6	10.459	2.959
2011/5/30	0	6.1	0.0	0.0	0.0	0.0	43.7	4.0	-47.7	10.449	2.949
2011/5/31	0	6.7	0.0	0.0	0.0	0.0	48.0	4.0	-52.0	10.438	2.938
2011/6/1	0	4.9	0.0	0.0	0.0	0.0	35.1	4.0	-39.1	10.429	2.929
2011/6/2	0	4.4	0.0	0.0	0.0	0.0	31.5	4.0	-35.5	10.421	2.921
2011/6/3	0	5.1	0.0	0.0	0.0	0.0	36.5	4.0	-40.6	10.413	2.913
2011/6/4	0	4.8	0.0	0.0	0.0	0.0	34.4	4.0	-38.4	10.404	2.904
2011/6/5	0	5	0.0	0.0	0.0	0.0	35.8	4.0	-39.8	10.396	2.896
2011/6/6	0	4.6	0.0	0.0	0.0	0.0	32.9	4.0	-37.0	10.388	2.888
2011/6/7	0	5.6	0.0	0.0	0.0	0.0	40.1	4.0	-44.1	10.378	2.878
2011/6/8	0	4.9	0.0	0.0	0.0	0.0	35.1	4.0	-39.1	10.369	2.869
2011/6/9	0	4.7	0.0	0.0	0.0	0.0	33.7	4.0	-37.7	10.361	2.861
2011/6/10	0	5	0.0	0.0	0.0	0.0	35.8	4.0	-39.8	10.352	2.852
2011/6/11	29	2.9	169.8	348.0	0.0	0.0	20.8	4.0	493.0	10.460	2.960
2011/6/12	31	2.5	181.5	372.0	0.0	0.0	17.9	4.0	531.6	10.500	3.000
2011/6/13	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.493	2.993
2011/6/14	7	5.2	41.0	84.0	0.0	0.0	37.2	4.0	83.7	10.500	3.000
2011/6/15	2	4.1	11.7	24.0	0.0	0.0	29.4	4.0	2.3	10.500	3.000
2011/6/16	86.5	1.2	506.5	1038.0	0.0	0.0	8.6	4.0	1531.9	10.500	3.000
2011/6/17	50	0.9	292.8	600.0	0.0	0.0	6.4	4.0	882.3	10.500	3.000
2011/6/18	8	3.5	46.8	96.0	0.0	0.0	25.1	4.0	113.7	10.500	3.000
2011/6/19	0	7.5	0.0	0.0	0.0	0.0	53.7	4.0	-57.7	10.487	2.987
2011/6/20	0	6.8	0.0	0.0	0.0	0.0	48.7	4.0	-52.7	10.476	2.976
2011/6/21	2	5.7	11.7	24.0	0.0	0.0	40.8	4.0	-9.1	10.474	2.974
2011/6/22	49.5	1.8	289.9	594.0	0.0	0.0	12.9	4.0	866.9	10.500	3.000

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2011/6/23	2.5	2.4	14.6	30.0	0.0	0.0	17.2	4.0	23.4	10.500	3.000
2011/6/24	1	5.1	5.9	12.0	0.0	0.0	36.5	4.0	-22.7	10.495	2.995
2011/6/25	0	3.6	0.0	0.0	0.0	0.0	25.8	4.0	-29.8	10.489	2.989
2011/6/26	1	3.8	5.9	12.0	0.0	0.0	27.2	4.0	-13.4	10.486	2.986
2011/6/27	0	6	0.0	0.0	0.0	0.0	43.0	4.0	-47.0	10.475	2.975
2011/6/28	24.5	2.5	143.5	294.0	0.0	0.0	17.9	4.0	415.5	10.500	3.000
2011/6/29	75.5	0.8	442.1	906.0	0.0	0.0	5.7	4.0	1338.4	10.500	3.000
2011/6/30	6	0.5	35.1	72.0	0.0	0.0	3.6	4.0	99.5	10.500	3.000
2011/7/1	0.5	5.1	2.9	6.0	0.0	0.0	36.5	4.0	-31.6	10.493	2.993
2011/7/2	0	5.5	0.0	0.0	0.0	0.0	39.4	4.0	-43.4	10.484	2.984
2011/7/3	0	6.3	0.0	0.0	0.0	0.0	45.1	4.0	-49.2	10.473	2.973
2011/7/4	0	6.3	0.0	0.0	0.0	0.0	45.1	4.0	-49.2	10.462	2.962
2011/7/5	0	7.7	0.0	0.0	0.0	0.0	55.1	4.0	-59.2	10.449	2.949
2011/7/6	0	6.7	0.0	0.0	0.0	0.0	48.0	4.0	-52.0	10.438	2.938
2011/7/7	0	6.8	0.0	0.0	0.0	0.0	48.7	4.0	-52.7	10.427	2.927
2011/7/8	0	6.8	0.0	0.0	0.0	0.0	48.7	4.0	-52.7	10.415	2.915
2011/7/9	2.5	6.1	14.6	30.0	0.0	0.0	43.7	4.0	-3.1	10.414	2.914
2011/7/10	23.5	7.1	137.6	282.0	0.0	0.0	50.8	4.0	364.7	10.494	2.994
2011/7/11	8	1.3	46.8	96.0	0.0	0.0	9.3	4.0	129.5	10.500	3.000
2011/7/12	17	4	99.6	204.0	0.0	0.0	28.6	4.0	270.9	10.500	3.000
2011/7/13	8	3	46.8	96.0	0.0	0.0	21.5	4.0	117.3	10.500	3.000
2011/7/14	2.5	2.5	14.6	30.0	0.0	0.0	17.9	4.0	22.7	10.500	3.000
2011/7/15	13	5.2	76.1	156.0	0.0	0.0	37.2	4.0	190.9	10.500	3.000
2011/7/16	72	1.1	421.6	864.0	0.0	0.0	7.9	4.0	1273.7	10.500	3.000
2011/7/17	0.5	4.6	2.9	6.0	0.0	0.0	32.9	4.0	-28.0	10.494	2.994
2011/7/18	2.5	2.8	14.6	30.0	0.0	0.0	20.1	4.0	20.6	10.498	2.998
2011/7/19	23	3.9	134.7	276.0	0.0	0.0	27.9	4.0	378.7	10.500	3.000
2011/7/20	19.5	2.3	114.2	234.0	0.0	0.0	16.5	4.0	327.7	10.500	3.000
2011/7/21	0	5.1	0.0	0.0	0.0	0.0	36.5	4.0	-40.6	10.491	2.991
2011/7/22	11.5	5.4	67.3	138.0	0.0	0.0	38.7	4.0	162.6	10.500	3.000
2011/7/23	0	5.5	0.0	0.0	0.0	0.0	39.4	4.0	-43.4	10.491	2.991
2011/7/24	0	7.4	0.0	0.0	0.0	0.0	53.0	4.0	-57.0	10.478	2.978
2011/7/25	0	5.5	0.0	0.0	0.0	0.0	39.4	4.0	-43.4	10.469	2.969
2011/7/26	0	6.2	0.0	0.0	0.0	0.0	44.4	4.0	-48.4	10.458	2.958
2011/7/27	0	5.7	0.0	0.0	0.0	0.0	40.8	4.0	-44.9	10.448	2.948
2011/7/28	2.5	7.9	14.6	30.0	0.0	0.0	56.6	4.0	-16.0	10.445	2.945
2011/7/29	30	5.2	175.7	360.0	0.0	0.0	37.2	4.0	494.4	10.500	3.000
2011/7/30	1.5	4.2	8.8	18.0	0.0	0.0	30.1	4.0	-7.3	10.498	2.998
2011/7/31	0	6.5	0.0	0.0	0.0	0.0	46.5	4.0	-50.6	10.487	2.987
2011/8/1	0	6.5	0.0	0.0	0.0	0.0	46.5	4.0	-50.6	10.476	2.976
2011/8/2	0	7.2	0.0	0.0	0.0	0.0	51.6	4.0	-55.6	10.464	2.964
2011/8/3	0	6.3	0.0	0.0	0.0	0.0	45.1	4.0	-49.2	10.454	2.954
2011/8/4	0	6.2	0.0	0.0	0.0	0.0	44.4	4.0	-48.4	10.443	2.943
2011/8/5	0	7	0.0	0.0	0.0	0.0	50.1	4.0	-54.2	10.431	2.931
2011/8/6	0	6.7	0.0	0.0	0.0	0.0	48.0	4.0	-52.0	10.420	2.920

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2011/8/7	0	7.7	0.0	0.0	0.0	0.0	55.1	4.0	-59.2	10.407	2.907
2011/8/8	46.5	3.9	272.3	558.0	0.0	0.0	27.9	4.0	798.3	10.500	3.000
2011/8/9	10.5	2.9	61.5	126.0	0.0	0.0	20.8	4.0	162.7	10.500	3.000
2011/8/10	65	3.2	380.6	780.0	0.0	0.0	22.9	4.0	1133.7	10.500	3.000
2011/8/11	4	4.9	23.4	48.0	0.0	0.0	35.1	4.0	32.3	10.500	3.000
2011/8/12	0	5	0.0	0.0	0.0	0.0	35.8	4.0	-39.8	10.491	2.991
2011/8/13	0	6	0.0	0.0	0.0	0.0	43.0	4.0	-47.0	10.481	2.981
2011/8/14	0	5.6	0.0	0.0	0.0	0.0	40.1	4.0	-44.1	10.471	2.971
2011/8/15	0.5	5.8	2.9	6.0	0.0	0.0	41.5	4.0	-36.6	10.463	2.963
2011/8/16	0	5.1	0.0	0.0	0.0	0.0	36.5	4.0	-40.6	10.455	2.955
2011/8/17	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.448	2.948
2011/8/18	0	5.6	0.0	0.0	0.0	0.0	40.1	4.0	-44.1	10.438	2.938
2011/8/19	0	5.5	0.0	0.0	0.0	0.0	39.4	4.0	-43.4	10.429	2.929
2011/8/20	0	6.4	0.0	0.0	0.0	0.0	45.8	4.0	-49.9	10.418	2.918
2011/8/21	0	4	0.0	0.0	0.0	0.0	28.6	4.0	-32.7	10.411	2.911
2011/8/22	15.5	3.8	90.8	186.0	0.0	0.0	27.2	4.0	245.5	10.464	2.964
2011/8/23	0	6.5	0.0	0.0	0.0	0.0	46.5	4.0	-50.6	10.453	2.953
2011/8/24	0	6.1	0.0	0.0	0.0	0.0	43.7	4.0	-47.7	10.443	2.943
2011/8/25	24	3.4	140.5	288.0	0.0	0.0	24.3	4.0	400.2	10.500	3.000
2011/8/26	0	6.3	0.0	0.0	0.0	0.0	45.1	4.0	-49.2	10.489	2.989
2011/8/27	0	2.3	0.0	0.0	0.0	0.0	16.5	4.0	-20.5	10.485	2.985
2011/8/28	0	6.4	0.0	0.0	0.0	0.0	45.8	4.0	-49.9	10.474	2.974
2011/8/29	0	6.2	0.0	0.0	0.0	0.0	44.4	4.0	-48.4	10.463	2.963
2011/8/30	0	6.3	0.0	0.0	0.0	0.0	45.1	4.0	-49.2	10.453	2.953
2011/8/31	0	6.4	0.0	0.0	0.0	0.0	45.8	4.0	-49.9	10.442	2.942
2011/9/1	1.5	3.8	8.8	18.0	0.0	0.0	27.2	4.0	-4.5	10.441	2.941
2011/9/2	2.5	3.4	14.6	30.0	0.0	0.0	24.3	4.0	16.3	10.444	2.944
2011/9/3	3	2.9	17.6	36.0	0.0	0.0	20.8	4.0	28.8	10.451	2.951
2011/9/4	27.5	4.2	161.0	330.0	0.0	0.0	30.1	4.0	456.9	10.500	3.000
2011/9/5	0	3.5	0.0	0.0	0.0	0.0	25.1	4.0	-29.1	10.494	2.994
2011/9/6	0	5	0.0	0.0	0.0	0.0	35.8	4.0	-39.8	10.485	2.985
2011/9/7	0	4.9	0.0	0.0	0.0	0.0	35.1	4.0	-39.1	10.476	2.976
2011/9/8	0	6.1	0.0	0.0	0.0	0.0	43.7	4.0	-47.7	10.466	2.966
2011/9/9	0	6.6	0.0	0.0	0.0	0.0	47.3	4.0	-51.3	10.455	2.955
2011/9/10	0	4.9	0.0	0.0	0.0	0.0	35.1	4.0	-39.1	10.446	2.946
2011/9/11	0	4.6	0.0	0.0	0.0	0.0	32.9	4.0	-37.0	10.438	2.938
2011/9/12	0	5.2	0.0	0.0	0.0	0.0	37.2	4.0	-41.3	10.429	2.929
2011/9/13	0	7.8	0.0	0.0	0.0	0.0	55.9	4.0	-59.9	10.416	2.916
2011/9/14	0	6	0.0	0.0	0.0	0.0	43.0	4.0	-47.0	10.406	2.906
2011/9/15	12.5	5.3	73.2	150.0	0.0	0.0	38.0	4.0	181.2	10.445	2.945
2011/9/16	0.5	3.6	2.9	6.0	0.0	0.0	25.8	4.0	-20.9	10.441	2.941
2011/9/17	0	6	0.0	0.0	0.0	0.0	43.0	4.0	-47.0	10.431	2.931
2011/9/18	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	10.425	2.925
2011/9/19	42.5	6.1	248.9	510.0	0.0	0.0	43.7	4.0	711.2	10.500	3.000
2011/9/20	0	4.1	0.0	0.0	0.0	0.0	29.4	4.0	-33.4	10.493	2.993

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2011/9/21	0	5	0.0	0.0	0.0	0.0	35.8	4.0	-39.8	10.484	2.984
2011/9/22	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	10.478	2.978
2011/9/23	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.472	2.972
2011/9/24	0.5	3	2.9	6.0	0.0	0.0	21.5	4.0	-16.6	10.468	2.968
2011/9/25	2.5	1.3	14.6	30.0	0.0	0.0	9.3	4.0	31.3	10.475	2.975
2011/9/26	0.5	4.1	2.9	6.0	0.0	0.0	29.4	4.0	-24.5	10.469	2.969
2011/9/27	0	4.8	0.0	0.0	0.0	0.0	34.4	4.0	-38.4	10.461	2.961
2011/9/28	7.5	3	43.9	90.0	0.0	0.0	21.5	4.0	108.4	10.485	2.985
2011/9/29	28	3.7	164.0	336.0	0.0	0.0	26.5	4.0	469.4	10.500	3.000
2011/9/30	25	3.9	146.4	300.0	0.0	0.0	27.9	4.0	414.4	10.500	3.000
2011/10/1	15.5	3.1	90.8	186.0	0.0	0.0	22.2	4.0	250.5	10.500	3.000
2011/10/2	2.5	1.9	14.6	30.0	0.0	0.0	13.6	4.0	27.0	10.500	3.000
2011/10/3	1	2.9	5.9	12.0	0.0	0.0	20.8	4.0	-6.9	10.498	2.998
2011/10/4	0.5	2.2	2.9	6.0	0.0	0.0	15.8	4.0	-10.9	10.496	2.996
2011/10/5	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	10.491	2.991
2011/10/6	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	10.485	2.985
2011/10/7	0	3.6	0.0	0.0	0.0	0.0	25.8	4.0	-29.8	10.478	2.978
2011/10/8	0	5	0.0	0.0	0.0	0.0	35.8	4.0	-39.8	10.470	2.970
2011/10/9	0	5.3	0.0	0.0	0.0	0.0	38.0	4.0	-42.0	10.460	2.960
2011/10/10	47.5	1.1	278.2	570.0	0.0	0.0	7.9	4.0	836.2	10.500	3.000
2011/10/11	8.5	2	49.8	102.0	0.0	0.0	14.3	4.0	133.4	10.500	3.000
2011/10/12	108	1.3	632.4	1296.0	0.0	0.0	9.3	4.0	1915.1	10.500	3.000
2011/10/13	11.5	2.2	67.3	138.0	0.0	0.0	15.8	4.0	185.6	10.500	3.000
2011/10/14	29	3.5	169.8	348.0	0.0	0.0	25.1	4.0	488.7	10.500	3.000
2011/10/15	1.5	3	8.8	18.0	0.0	0.0	21.5	4.0	1.3	10.500	3.000
2011/10/16	0	4.7	0.0	0.0	0.0	0.0	33.7	4.0	-37.7	10.492	2.992
2011/10/17	0	4.8	0.0	0.0	0.0	0.0	34.4	4.0	-38.4	10.483	2.983
2011/10/18	0	5	0.0	0.0	0.0	0.0	35.8	4.0	-39.8	10.475	2.975
2011/10/19	0	4.5	0.0	0.0	0.0	0.0	32.2	4.0	-36.3	10.467	2.967
2011/10/20	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.460	2.960
2011/10/21	0	3.8	0.0	0.0	0.0	0.0	27.2	4.0	-31.2	10.453	2.953
2011/10/22	0	5.3	0.0	0.0	0.0	0.0	38.0	4.0	-42.0	10.444	2.944
2011/10/23	0	3.9	0.0	0.0	0.0	0.0	27.9	4.0	-32.0	10.437	2.937
2011/10/24	0	4.2	0.0	0.0	0.0	0.0	30.1	4.0	-34.1	10.430	2.930
2011/10/25	0	3.9	0.0	0.0	0.0	0.0	27.9	4.0	-32.0	10.423	2.923
2011/10/26	0	3.6	0.0	0.0	0.0	0.0	25.8	4.0	-29.8	10.416	2.916
2011/10/27	0	4.5	0.0	0.0	0.0	0.0	32.2	4.0	-36.3	10.408	2.908
2011/10/28	0	4	0.0	0.0	0.0	0.0	28.6	4.0	-32.7	10.401	2.901
2011/10/29	0	3.3	0.0	0.0	0.0	0.0	23.6	4.0	-27.7	10.395	2.895
2011/10/30	2	4.9	11.7	24.0	0.0	0.0	35.1	4.0	-3.4	10.395	2.895
2011/10/31	1.5	4.9	8.8	18.0	0.0	0.0	35.1	4.0	-12.3	10.392	2.892
2011/11/1	0	4.4	0.0	0.0	0.0	0.0	31.5	4.0	-35.5	10.384	2.884
2011/11/2	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.377	2.877
2011/11/3	0	4.3	0.0	0.0	0.0	0.0	30.8	4.0	-34.8	10.370	2.870
2011/11/4	0	3.4	0.0	0.0	0.0	0.0	24.3	4.0	-28.4	10.364	2.864

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m³)	Hillside Surface Runoff (m³)	Tap Water (m³)	Ping Yuen River (m³)	Evaporation (m³)	Seepage (m³)	Balancing (m³)	Water Level (mPD)	Water Depth (m)
2011/11/5	0	4.5	0.0	0.0	0.0	0.0	32.2	4.0	-36.3	10.356	2.856
2011/11/6	0	4	0.0	0.0	0.0	0.0	28.6	4.0	-32.7	10.349	2.849
2011/11/7	1	2.4	5.9	12.0	0.0	0.0	17.2	4.0	-3.4	10.348	2.848
2011/11/8	21	2.9	123.0	252.0	0.0	0.0	20.8	4.0	350.2	10.424	2.924
2011/11/9	44.5	2.2	260.6	534.0	0.0	0.0	15.8	4.0	774.8	10.500	3.000
2011/11/10	1	3	5.9	12.0	0.0	0.0	21.5	4.0	-7.7	10.498	2.998
2011/11/11	0	3.3	0.0	0.0	0.0	0.0	23.6	4.0	-27.7	10.492	2.992
2011/11/12	0	1.3	0.0	0.0	0.0	0.0	9.3	4.0	-13.3	10.489	2.989
2011/11/13	0	3.3	0.0	0.0	0.0	0.0	23.6	4.0	-27.7	10.483	2.983
2011/11/14	0	3.3	0.0	0.0	0.0	0.0	23.6	4.0	-27.7	10.477	2.977
2011/11/15	0	3.9	0.0	0.0	0.0	0.0	27.9	4.0	-32.0	10.470	2.970
2011/11/16	0	2.8	0.0	0.0	0.0	0.0	20.1	4.0	-24.1	10.465	2.965
2011/11/17	13.5	1	79.1	162.0	0.0	0.0	7.2	4.0	229.9	10.500	3.000
2011/11/18	5	3.8	29.3	60.0	0.0	0.0	27.2	4.0	58.0	10.500	3.000
2011/11/19	3	2	17.6	36.0	0.0	0.0	14.3	4.0	35.2	10.500	3.000
2011/11/20	0	3.4	0.0	0.0	0.0	0.0	24.3	4.0	-28.4	10.494	2.994
2011/11/21	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.487	2.987
2011/11/22	0	3.3	0.0	0.0	0.0	0.0	23.6	4.0	-27.7	10.481	2.981
2011/11/23	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.474	2.974
2011/11/24	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	10.469	2.969
2011/11/25	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	10.463	2.963
2011/11/26	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	10.457	2.957
2011/11/27	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	10.452	2.952
2011/11/28	0	3.4	0.0	0.0	0.0	0.0	24.3	4.0	-28.4	10.446	2.946
2011/11/29	0	3.6	0.0	0.0	0.0	0.0	25.8	4.0	-29.8	10.439	2.939
2011/11/30	0	3.5	0.0	0.0	0.0	0.0	25.1	4.0	-29.1	10.433	2.933
2011/12/1	0	4	0.0	0.0	0.0	0.0	28.6	4.0	-32.7	10.426	2.926
2011/12/2	0	4.4	0.0	0.0	0.0	0.0	31.5	4.0	-35.5	10.418	2.918
2011/12/3	0	4.3	0.0	0.0	0.0	0.0	30.8	4.0	-34.8	10.410	2.910
2011/12/4	0	2	0.0	0.0	0.0	0.0	14.3	4.0	-18.4	10.406	2.906
2011/12/5	0	0.6	0.0	0.0	0.0	0.0	4.3	4.0	-8.3	10.405	2.905
2011/12/6	0	1.5	0.0	0.0	0.0	0.0	10.7	4.0	-14.8	10.401	2.901
2011/12/7	0	3.1	0.0	0.0	0.0	0.0	22.2	4.0	-26.2	10.396	2.896
2011/12/8	0	5.8	0.0	0.0	0.0	0.0	41.5	4.0	-45.6	10.386	2.886
2011/12/9	0	3.1	0.0	0.0	0.0	0.0	22.2	4.0	-26.2	10.380	2.880
2011/12/10	0	5.8	0.0	0.0	0.0	0.0	41.5	4.0	-45.6	10.370	2.870
2011/12/11	0	3.7	0.0	0.0	0.0	0.0	26.5	4.0	-30.5	10.363	2.863
2011/12/12	0	3.1	0.0	0.0	0.0	0.0	22.2	4.0	-26.2	10.358	2.858
2011/12/13	0	2.8	0.0	0.0	0.0	0.0	20.1	4.0	-24.1	10.353	2.853
2011/12/14	0	2.9	0.0	0.0	0.0	0.0	20.8	4.0	-24.8	10.347	2.847
2011/12/15	0	4.5	0.0	0.0	0.0	0.0	32.2	4.0	-36.3	10.339	2.839
2011/12/16	0	3.9	0.0	0.0	0.0	0.0	27.9	4.0	-32.0	10.332	2.832
2011/12/17	0	2.7	0.0	0.0	0.0	0.0	19.3	4.0	-23.4	10.327	2.827
2011/12/18	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	10.321	2.821
2011/12/19	0	3.2	0.0	0.0	0.0	0.0	22.9	4.0	-27.0	10.315	2.815

Date	Rainfall (mm)	Evaporation (mm)	Direct Rainfall on The Lake (m^3)	Hillside Surface Runoff (m^3)	Tap Water (m^3)	Ping Yuen River (m^3)	Evaporation (m^3)	Seepage (m^3)	Balancing (m^3)	Water Level (mPD)	Water Depth (m)
2011/12/20	0	1.9	0.0	0.0	0.0	0.0	13.6	4.0	-17.6	10.312	2.812
2011/12/21	0	3.5	0.0	0.0	0.0	0.0	25.1	4.0	-29.1	10.305	2.805
2011/12/22	0	4	0.0	0.0	0.0	0.0	28.6	4.0	-32.7	10.298	2.798
2011/12/23	0	4.3	0.0	0.0	0.0	0.0	30.8	4.0	-34.8	10.291	2.791
2011/12/24	0	4.2	0.0	0.0	0.0	0.0	30.1	4.0	-34.1	10.283	2.783
2011/12/25	0	4	0.0	0.0	0.0	0.0	28.6	4.0	-32.7	10.276	2.776
2011/12/26	0	2	0.0	0.0	0.0	0.0	14.3	4.0	-18.4	10.272	2.772
2011/12/27	0	2.6	0.0	0.0	0.0	0.0	18.6	4.0	-22.7	10.267	2.767
2011/12/28	0	2.9	0.0	0.0	0.0	0.0	20.8	4.0	-24.8	10.262	2.762
2011/12/29	0	3	0.0	0.0	0.0	0.0	21.5	4.0	-25.5	10.256	2.756
2011/12/30	0	2.2	0.0	0.0	0.0	0.0	15.8	4.0	-19.8	10.252	2.752
2011/12/31	0	2.4	0.0	0.0	0.0	0.0	17.2	4.0	-21.2	10.247	2.747

Appendix B

The SWMM Model Input File

```
[TITLE]
;;Project Title/Notes
Liantang wetland simulation

[OPTIONS]
;;Option             Value
FLOW_UNITS           CMS
INFILTRATION         HORTON
FLOW_ROUTING         DYNWAVE
LINK_OFFSETS         ELEVATION
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           01/01/2011
START_TIME           00:00:00
REPORT_START_DATE    01/01/2011
REPORT_START_TIME    00:00:00
END_DATE             12/31/2011
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:05:00
DRY_STEP             01:00:00
ROUTING_STEP         0:00:30

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         1.14
MAX_TRIALS           8
HEAD_TOLERANCE       0.0015
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
```

```
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
TIMESERIES       evaporation_2011
DRY_ONLY         NO

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
A                10.55      0          0          0          0
B                10.55      0          0          0          0
C                10.55      0          0          0          0
D                10.55      0          0          0          0
E                10.55      0          0          0          0
F                10.55      0          0          0          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
A_Out            9.7        FREE                        NO
B_Out            9.7        FREE                        NO
C_Out            9.7        FREE                        NO
D_Out            9.7        FREE                        NO
E_Out            9.7        FREE                        NO
F_Out            9.7        FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi
Ksat     IMD
;;-------------- -------- ---------- ----------- ---------- ---------------------------- -------- --------
-------- --------
Pond_A           7.5      4          1          TABULAR    A                            0        1
Pond_C           7.5      4          1          TABULAR    C                            0        1
Pond_B           7.5      4          1          TABULAR    B                            0        1
Pond_D           7.5      4          1          TABULAR    D                            0        1
Pond_E           7.5      4          1          TABULAR    E                            0        1
Pond_F           7.5      4          1          TABULAR    F                            0        1
```

```
Pond_G           7.5      4          1          TABULAR    G                            0        1

[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
20               A                A_Out            10         0.015      *          *          0          0
21               B                B_Out            10         0.015      *          *          0          0
22               C                C_Out            10         0.015      *          *          0          0
23               D                D_Out            10         0.015      *          *          0          0
24               E                E_Out            10         0.015      *          *          0          0
25               F                F_Out            10         0.015      *          *          0          0
26               Pond_A           Pond_B           49.56      0.015      10.5       10.5       0          0
27               Pond_B           Pond_C           48.77      0.015      10.5       10.5       0          0
28               Pond_C           Pond_D           47.13      0.015      10.5       10.5       0          0
29               Pond_D           Pond_E           47.85      0.015      10.5       10.5       0          0
30               Pond_E           Pond_F           55.44      0.015      10.5       10.5       0          0
31               Pond_F           Pond_G           49.54      0.015      10.5       10.5       0          0

[ORIFICES]
;;Name           From Node        To Node          Type         Offset     Qcoeff     Gated    CloseTime
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- ----------
9                Pond_A           A                SIDE         10.5       0.65       NO       0
10               Pond_B           B                SIDE         10.5       0.65       NO       0
11               Pond_C           C                SIDE         10.5       0.65       NO       0
12               Pond_D           D                SIDE         10.5       0.65       NO       0
13               Pond_E           E                SIDE         10.5       0.65       NO       0
14               Pond_F           F                SIDE         10.5       0.65       NO       0

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
20               CIRCULAR     0.3              0          0          0          1
21               CIRCULAR     0.3              0          0          0          1
22               CIRCULAR     0.3              0          0          0          1
23               CIRCULAR     0.3              0          0          0          1
24               CIRCULAR     0.3              0          0          0          1
25               CIRCULAR     0.3              0          0          0          1
26               CIRCULAR     0.3              0          0          0          1
27               CIRCULAR     0.3              0          0          0          1
```

```
28               CIRCULAR     0.3              0           0           0           1
29               CIRCULAR     0.3              0           0           0           1
30               CIRCULAR     0.3              0           0           0           1
31               CIRCULAR     0.3              0           0           0           1
9                CIRCULAR     0.3              0           0           0
10               CIRCULAR     0.3              0           0           0
11               CIRCULAR     0.3              0           0           0
12               CIRCULAR     0.3              0           0           0
13               CIRCULAR     0.3              0           0           0
14               CIRCULAR     0.3              0           0           0

[INFLOWS]
;;Node           Constituent      Time Series      Type     Mfactor  Sfactor  Baseline Pattern
;;-------------- ---------------- ---------------- -------- -------- -------- -------- --------
Pond_C           FLOW             surface_runoff_1/4 FLOW     1.0      1.0
Pond_E           FLOW             surface_runoff_1/4 FLOW     1.0      1.0
Pond_F           FLOW             surface_runoff_1/4 FLOW     1.0      1.0
Pond_G           FLOW             surface_runoff_1/4 FLOW     1.0      1.0

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
A                Storage    0.5        54
A                           1          99.00414182
A                           2          236.3567639
A                           2.5        355.1419555
A                           3          492.9209356
A                           3.5        684.4967749
A                           4          911.9442444
;
B                Storage    0.5        50.6
B                           1          126.5979358
B                           1.5        207.3154624
B                           2          298.8198589
B                           2.5        398.9724157
B                           3          522.3232892
B                           3.5        711.4157184
B                           4          991.9314208
;
```

```
C                 Storage    0.5        49.9
C                            2          293
C                            3.5        744
C                            4          1090
;
D                 Storage    0.5        79.4
D                            2          373
D                            3.5        933
D                            4          1287
;
E                 Storage    0.5        30
E                            2          167
E                            3.5        475
E                            4          770
;
F                 Storage    0.5        62
F                            2          315
F                            3.5        836
F                            4          1123
;
G                 Storage    0.5        82.4
G                            2          336
G                            3.5        763
G                            4          931

[TIMESERIES]
;;Name            Date       Time       Value
;;--------------- ---------- ---------- ----------
evaporation_2011 01/01/2011 0:00        3.30
evaporation_2011 01/02/2011 0:00        2.80
evaporation_2011 01/03/2011 0:00        0.60
evaporation_2011 01/04/2011 0:00        1.10
evaporation_2011 01/05/2011 0:00        2.10
evaporation_2011 01/06/2011 0:00        3.70
evaporation_2011 01/07/2011 0:00        2.10
evaporation_2011 01/08/2011 0:00        3.00
evaporation_2011 01/09/2011 0:00        3.70
evaporation_2011 01/10/2011 0:00        3.20
evaporation_2011 01/11/2011 0:00        1.30
```

```
evaporation_2011 01/12/2011 0:00       1.00
evaporation_2011 01/13/2011 0:00       1.90
evaporation_2011 01/14/2011 0:00       3.30
evaporation_2011 01/15/2011 0:00       4.30
evaporation_2011 01/16/2011 0:00       3.10
evaporation_2011 01/17/2011 0:00       2.60
evaporation_2011 01/18/2011 0:00       2.70
evaporation_2011 01/19/2011 0:00       3.00
evaporation_2011 01/20/2011 0:00       3.30
evaporation_2011 01/21/2011 0:00       3.00
evaporation_2011 01/22/2011 0:00       2.70
evaporation_2011 01/23/2011 0:00       2.10
evaporation_2011 01/24/2011 0:00       2.60
evaporation_2011 01/25/2011 0:00       2.60
evaporation_2011 01/26/2011 0:00       2.60
evaporation_2011 01/27/2011 0:00       2.80
evaporation_2011 01/28/2011 0:00       4.60
evaporation_2011 01/29/2011 0:00       3.00
evaporation_2011 01/30/2011 0:00       3.20
evaporation_2011 01/31/2011 0:00       2.80
evaporation_2011 02/01/2011 0:00       2.50
evaporation_2011 02/02/2011 0:00       3.00
evaporation_2011 02/03/2011 0:00       3.90
evaporation_2011 02/04/2011 0:00       1.40
evaporation_2011 02/05/2011 0:00       3.90
evaporation_2011 02/06/2011 0:00       3.80
evaporation_2011 02/07/2011 0:00       3.40
evaporation_2011 02/08/2011 0:00       3.00
evaporation_2011 02/09/2011 0:00       3.60
evaporation_2011 02/10/2011 0:00       2.90
evaporation_2011 02/11/2011 0:00       2.40
evaporation_2011 02/12/2011 0:00       1.10
evaporation_2011 02/13/2011 0:00       1.10
evaporation_2011 02/14/2011 0:00       1.30
evaporation_2011 02/15/2011 0:00       0.10
evaporation_2011 02/16/2011 0:00       0.40
evaporation_2011 02/17/2011 0:00       0.90
evaporation_2011 02/18/2011 0:00       1.00
evaporation_2011 02/19/2011 0:00       3.50
```

```
evaporation_2011 02/20/2011 0:00       0.40
evaporation_2011 02/21/2011 0:00       2.20
evaporation_2011 02/22/2011 0:00       2.90
evaporation_2011 02/23/2011 0:00       2.40
evaporation_2011 02/24/2011 0:00       2.50
evaporation_2011 02/25/2011 0:00       4.00
evaporation_2011 02/26/2011 0:00       3.00
evaporation_2011 02/27/2011 0:00       3.30
evaporation_2011 02/28/2011 0:00       4.50
evaporation_2011 03/01/2011 0:00       2.70
evaporation_2011 03/02/2011 0:00       2.50
evaporation_2011 03/03/2011 0:00       4.10
evaporation_2011 03/04/2011 0:00       3.70
evaporation_2011 03/05/2011 0:00       3.10
evaporation_2011 03/06/2011 0:00       2.50
evaporation_2011 03/07/2011 0:00       4.70
evaporation_2011 03/08/2011 0:00       2.90
evaporation_2011 03/09/2011 0:00       2.50
evaporation_2011 03/10/2011 0:00       2.00
evaporation_2011 03/11/2011 0:00       3.40
evaporation_2011 03/12/2011 0:00       1.70
evaporation_2011 03/13/2011 0:00       3.80
evaporation_2011 03/14/2011 0:00       3.60
evaporation_2011 03/15/2011 0:00       4.00
evaporation_2011 03/16/2011 0:00       5.60
evaporation_2011 03/17/2011 0:00       2.10
evaporation_2011 03/18/2011 0:00       1.10
evaporation_2011 03/19/2011 0:00       0.70
evaporation_2011 03/20/2011 0:00       1.10
evaporation_2011 03/21/2011 0:00       4.10
evaporation_2011 03/22/2011 0:00       3.90
evaporation_2011 03/23/2011 0:00       3.20
evaporation_2011 03/24/2011 0:00       4.00
evaporation_2011 03/25/2011 0:00       5.10
evaporation_2011 03/26/2011 0:00       3.00
evaporation_2011 03/27/2011 0:00       1.50
evaporation_2011 03/28/2011 0:00       3.40
evaporation_2011 03/29/2011 0:00       3.10
evaporation_2011 03/30/2011 0:00       3.20
```

```
evaporation_2011 03/31/2011 0:00       3.00
evaporation_2011 04/01/2011 0:00       4.80
evaporation_2011 04/02/2011 0:00       5.10
evaporation_2011 04/03/2011 0:00       3.60
evaporation_2011 04/04/2011 0:00       1.70
evaporation_2011 04/05/2011 0:00       4.30
evaporation_2011 04/06/2011 0:00       3.50
evaporation_2011 04/07/2011 0:00       3.90
evaporation_2011 04/08/2011 0:00       5.40
evaporation_2011 04/09/2011 0:00       2.40
evaporation_2011 04/10/2011 0:00       5.50
evaporation_2011 04/11/2011 0:00       4.60
evaporation_2011 04/12/2011 0:00       5.00
evaporation_2011 04/13/2011 0:00       3.40
evaporation_2011 04/14/2011 0:00       3.90
evaporation_2011 04/15/2011 0:00       3.40
evaporation_2011 04/16/2011 0:00       4.10
evaporation_2011 04/17/2011 0:00       5.10
evaporation_2011 04/18/2011 0:00       3.70
evaporation_2011 04/19/2011 0:00       5.20
evaporation_2011 04/20/2011 0:00       3.20
evaporation_2011 04/21/2011 0:00       4.10
evaporation_2011 04/22/2011 0:00       2.90
evaporation_2011 04/23/2011 0:00       2.90
evaporation_2011 04/24/2011 0:00       5.40
evaporation_2011 04/25/2011 0:00       4.80
evaporation_2011 04/26/2011 0:00       6.00
evaporation_2011 04/27/2011 0:00       3.30
evaporation_2011 04/28/2011 0:00       1.40
evaporation_2011 04/29/2011 0:00       1.50
evaporation_2011 04/30/2011 0:00       1.40
evaporation_2011 05/01/2011 0:00       2.50
evaporation_2011 05/02/2011 0:00       4.90
evaporation_2011 05/03/2011 0:00       3.70
evaporation_2011 05/04/2011 0:00       3.20
evaporation_2011 05/05/2011 0:00       2.90
evaporation_2011 05/06/2011 0:00       4.30
evaporation_2011 05/07/2011 0:00       4.50
evaporation_2011 05/08/2011 0:00       4.70
```

```
evaporation_2011 05/09/2011 0:00       4.50
evaporation_2011 05/10/2011 0:00       5.60
evaporation_2011 05/11/2011 0:00       4.10
evaporation_2011 05/12/2011 0:00       5.20
evaporation_2011 05/13/2011 0:00       2.60
evaporation_2011 05/14/2011 0:00       2.40
evaporation_2011 05/15/2011 0:00       1.30
evaporation_2011 05/16/2011 0:00       2.30
evaporation_2011 05/17/2011 0:00       2.10
evaporation_2011 05/18/2011 0:00       5.20
evaporation_2011 05/19/2011 0:00       2.80
evaporation_2011 05/20/2011 0:00       5.10
evaporation_2011 05/21/2011 0:00       3.80
evaporation_2011 05/22/2011 0:00       1.60
evaporation_2011 05/23/2011 0:00       3.60
evaporation_2011 05/24/2011 0:00       1.70
evaporation_2011 05/25/2011 0:00       2.60
evaporation_2011 05/26/2011 0:00       5.20
evaporation_2011 05/27/2011 0:00       4.10
evaporation_2011 05/28/2011 0:00       6.00
evaporation_2011 05/29/2011 0:00       6.50
evaporation_2011 05/30/2011 0:00       6.10
evaporation_2011 05/31/2011 0:00       6.70
evaporation_2011 06/01/2011 0:00       4.90
evaporation_2011 06/02/2011 0:00       4.40
evaporation_2011 06/03/2011 0:00       5.10
evaporation_2011 06/04/2011 0:00       4.80
evaporation_2011 06/05/2011 0:00       5.00
evaporation_2011 06/06/2011 0:00       4.60
evaporation_2011 06/07/2011 0:00       5.60
evaporation_2011 06/08/2011 0:00       4.90
evaporation_2011 06/09/2011 0:00       4.70
evaporation_2011 06/10/2011 0:00       5.00
evaporation_2011 06/11/2011 0:00       2.90
evaporation_2011 06/12/2011 0:00       2.50
evaporation_2011 06/13/2011 0:00       3.70
evaporation_2011 06/14/2011 0:00       5.20
evaporation_2011 06/15/2011 0:00       4.10
evaporation_2011 06/16/2011 0:00       1.20
```

```
evaporation_2011 06/17/2011 0:00       0.90
evaporation_2011 06/18/2011 0:00       3.50
evaporation_2011 06/19/2011 0:00       7.50
evaporation_2011 06/20/2011 0:00       6.80
evaporation_2011 06/21/2011 0:00       5.70
evaporation_2011 06/22/2011 0:00       1.80
evaporation_2011 06/23/2011 0:00       2.40
evaporation_2011 06/24/2011 0:00       5.10
evaporation_2011 06/25/2011 0:00       3.60
evaporation_2011 06/26/2011 0:00       3.80
evaporation_2011 06/27/2011 0:00       6.00
evaporation_2011 06/28/2011 0:00       2.50
evaporation_2011 06/29/2011 0:00       0.80
evaporation_2011 06/30/2011 0:00       0.50
evaporation_2011 07/01/2011 0:00       5.10
evaporation_2011 07/02/2011 0:00       5.50
evaporation_2011 07/03/2011 0:00       6.30
evaporation_2011 07/04/2011 0:00       6.30
evaporation_2011 07/05/2011 0:00       7.70
evaporation_2011 07/06/2011 0:00       6.70
evaporation_2011 07/07/2011 0:00       6.80
evaporation_2011 07/08/2011 0:00       6.80
evaporation_2011 07/09/2011 0:00       6.10
evaporation_2011 07/10/2011 0:00       7.10
evaporation_2011 07/11/2011 0:00       1.30
evaporation_2011 07/12/2011 0:00       4.00
evaporation_2011 07/13/2011 0:00       3.00
evaporation_2011 07/14/2011 0:00       2.50
evaporation_2011 07/15/2011 0:00       5.20
evaporation_2011 07/16/2011 0:00       1.10
evaporation_2011 07/17/2011 0:00       4.60
evaporation_2011 07/18/2011 0:00       2.80
evaporation_2011 07/19/2011 0:00       3.90
evaporation_2011 07/20/2011 0:00       2.30
evaporation_2011 07/21/2011 0:00       5.10
evaporation_2011 07/22/2011 0:00       5.40
evaporation_2011 07/23/2011 0:00       5.50
evaporation_2011 07/24/2011 0:00       7.40
evaporation_2011 07/25/2011 0:00       5.50
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```
evaporation_2011 07/26/2011 0:00       6.20
evaporation_2011 07/27/2011 0:00       5.70
evaporation_2011 07/28/2011 0:00       7.90
evaporation_2011 07/29/2011 0:00       5.20
evaporation_2011 07/30/2011 0:00       4.20
evaporation_2011 07/31/2011 0:00       6.50
evaporation_2011 08/01/2011 0:00       6.50
evaporation_2011 08/02/2011 0:00       7.20
evaporation_2011 08/03/2011 0:00       6.30
evaporation_2011 08/04/2011 0:00       6.20
evaporation_2011 08/05/2011 0:00       7.00
evaporation_2011 08/06/2011 0:00       6.70
evaporation_2011 08/07/2011 0:00       7.70
evaporation_2011 08/08/2011 0:00       3.90
evaporation_2011 08/09/2011 0:00       2.90
evaporation_2011 08/10/2011 0:00       3.20
evaporation_2011 08/11/2011 0:00       4.90
evaporation_2011 08/12/2011 0:00       5.00
evaporation_2011 08/13/2011 0:00       6.00
evaporation_2011 08/14/2011 0:00       5.60
evaporation_2011 08/15/2011 0:00       5.80
evaporation_2011 08/16/2011 0:00       5.10
evaporation_2011 08/17/2011 0:00       3.70
evaporation_2011 08/18/2011 0:00       5.60
evaporation_2011 08/19/2011 0:00       5.50
evaporation_2011 08/20/2011 0:00       6.40
evaporation_2011 08/21/2011 0:00       4.00
evaporation_2011 08/22/2011 0:00       3.80
evaporation_2011 08/23/2011 0:00       6.50
evaporation_2011 08/24/2011 0:00       6.10
evaporation_2011 08/25/2011 0:00       3.40
evaporation_2011 08/26/2011 0:00       6.30
evaporation_2011 08/27/2011 0:00       2.30
evaporation_2011 08/28/2011 0:00       6.40
evaporation_2011 08/29/2011 0:00       6.20
evaporation_2011 08/30/2011 0:00       6.30
evaporation_2011 08/31/2011 0:00       6.40
evaporation_2011 09/01/2011 0:00       3.80
evaporation_2011 09/02/2011 0:00       3.40
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```
evaporation_2011 09/03/2011 0:00       2.90
evaporation_2011 09/04/2011 0:00       4.20
evaporation_2011 09/05/2011 0:00       3.50
evaporation_2011 09/06/2011 0:00       5.00
evaporation_2011 09/07/2011 0:00       4.90
evaporation_2011 09/08/2011 0:00       6.10
evaporation_2011 09/09/2011 0:00       6.60
evaporation_2011 09/10/2011 0:00       4.90
evaporation_2011 09/11/2011 0:00       4.60
evaporation_2011 09/12/2011 0:00       5.20
evaporation_2011 09/13/2011 0:00       7.80
evaporation_2011 09/14/2011 0:00       6.00
evaporation_2011 09/15/2011 0:00       5.30
evaporation_2011 09/16/2011 0:00       3.60
evaporation_2011 09/17/2011 0:00       6.00
evaporation_2011 09/18/2011 0:00       3.20
evaporation_2011 09/19/2011 0:00       6.10
evaporation_2011 09/20/2011 0:00       4.10
evaporation_2011 09/21/2011 0:00       5.00
evaporation_2011 09/22/2011 0:00       3.20
evaporation_2011 09/23/2011 0:00       3.70
evaporation_2011 09/24/2011 0:00       3.00
evaporation_2011 09/25/2011 0:00       1.30
evaporation_2011 09/26/2011 0:00       4.10
evaporation_2011 09/27/2011 0:00       4.80
evaporation_2011 09/28/2011 0:00       3.00
evaporation_2011 09/29/2011 0:00       3.70
evaporation_2011 09/30/2011 0:00       3.90
evaporation_2011 10/01/2011 0:00       3.10
evaporation_2011 10/02/2011 0:00       1.90
evaporation_2011 10/03/2011 0:00       2.90
evaporation_2011 10/04/2011 0:00       2.20
evaporation_2011 10/05/2011 0:00       3.00
evaporation_2011 10/06/2011 0:00       3.20
evaporation_2011 10/07/2011 0:00       3.60
evaporation_2011 10/08/2011 0:00       5.00
evaporation_2011 10/09/2011 0:00       5.30
evaporation_2011 10/10/2011 0:00       1.10
evaporation_2011 10/11/2011 0:00       2.00
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evaporation_2011 10/12/2011 0:00       1.30
evaporation_2011 10/13/2011 0:00       2.20
evaporation_2011 10/14/2011 0:00       3.50
evaporation_2011 10/15/2011 0:00       3.00
evaporation_2011 10/16/2011 0:00       4.70
evaporation_2011 10/17/2011 0:00       4.80
evaporation_2011 10/18/2011 0:00       5.00
evaporation_2011 10/19/2011 0:00       4.50
evaporation_2011 10/20/2011 0:00       3.70
evaporation_2011 10/21/2011 0:00       3.80
evaporation_2011 10/22/2011 0:00       5.30
evaporation_2011 10/23/2011 0:00       3.90
evaporation_2011 10/24/2011 0:00       4.20
evaporation_2011 10/25/2011 0:00       3.90
evaporation_2011 10/26/2011 0:00       3.60
evaporation_2011 10/27/2011 0:00       4.50
evaporation_2011 10/28/2011 0:00       4.00
evaporation_2011 10/29/2011 0:00       3.30
evaporation_2011 10/30/2011 0:00       4.90
evaporation_2011 10/31/2011 0:00       4.90
evaporation_2011 11/01/2011 0:00       4.40
evaporation_2011 11/02/2011 0:00       3.70
evaporation_2011 11/03/2011 0:00       4.30
evaporation_2011 11/04/2011 0:00       3.40
evaporation_2011 11/05/2011 0:00       4.50
evaporation_2011 11/06/2011 0:00       4.00
evaporation_2011 11/07/2011 0:00       2.40
evaporation_2011 11/08/2011 0:00       2.90
evaporation_2011 11/09/2011 0:00       2.20
evaporation_2011 11/10/2011 0:00       3.00
evaporation_2011 11/11/2011 0:00       3.30
evaporation_2011 11/12/2011 0:00       1.30
evaporation_2011 11/13/2011 0:00       3.30
evaporation_2011 11/14/2011 0:00       3.30
evaporation_2011 11/15/2011 0:00       3.90
evaporation_2011 11/16/2011 0:00       2.80
evaporation_2011 11/17/2011 0:00       1.00
evaporation_2011 11/18/2011 0:00       3.80
evaporation_2011 11/19/2011 0:00       2.00
```

```
evaporation_2011 11/20/2011 0:00       3.40
evaporation_2011 11/21/2011 0:00       3.70
evaporation_2011 11/22/2011 0:00       3.30
evaporation_2011 11/23/2011 0:00       3.70
evaporation_2011 11/24/2011 0:00       3.00
evaporation_2011 11/25/2011 0:00       3.00
evaporation_2011 11/26/2011 0:00       3.20
evaporation_2011 11/27/2011 0:00       3.00
evaporation_2011 11/28/2011 0:00       3.40
evaporation_2011 11/29/2011 0:00       3.60
evaporation_2011 11/30/2011 0:00       3.50
evaporation_2011 12/01/2011 0:00       4.00
evaporation_2011 12/02/2011 0:00       4.40
evaporation_2011 12/03/2011 0:00       4.30
evaporation_2011 12/04/2011 0:00       2.00
evaporation_2011 12/05/2011 0:00       0.60
evaporation_2011 12/06/2011 0:00       1.50
evaporation_2011 12/07/2011 0:00       3.10
evaporation_2011 12/08/2011 0:00       5.80
evaporation_2011 12/09/2011 0:00       3.10
evaporation_2011 12/10/2011 0:00       5.80
evaporation_2011 12/11/2011 0:00       3.70
evaporation_2011 12/12/2011 0:00       3.10
evaporation_2011 12/13/2011 0:00       2.80
evaporation_2011 12/14/2011 0:00       2.90
evaporation_2011 12/15/2011 0:00       4.50
evaporation_2011 12/16/2011 0:00       3.90
evaporation_2011 12/17/2011 0:00       2.70
evaporation_2011 12/18/2011 0:00       3.20
evaporation_2011 12/19/2011 0:00       3.20
evaporation_2011 12/20/2011 0:00       1.90
evaporation_2011 12/21/2011 0:00       3.50
evaporation_2011 12/22/2011 0:00       4.00
evaporation_2011 12/23/2011 0:00       4.30
evaporation_2011 12/24/2011 0:00       4.20
evaporation_2011 12/25/2011 0:00       4.00
evaporation_2011 12/26/2011 0:00       2.00
evaporation_2011 12/27/2011 0:00       2.60
evaporation_2011 12/28/2011 0:00       2.90
```

```
evaporation_2011 12/29/2011 0:00       3.00
evaporation_2011 12/30/2011 0:00       2.20
evaporation_2011 12/31/2011 0:00       2.40
;
surface_runoff_1/4 1/1/2011   0:00       0.00000000
surface_runoff_1/4 1/2/2011   0:00       0.00000000
surface_runoff_1/4 1/3/2011   0:00       0.00000000
surface_runoff_1/4 1/4/2011   0:00       0.00025833
surface_runoff_1/4 1/5/2011   0:00       0.00000000
surface_runoff_1/4 1/6/2011   0:00       0.00000000
surface_runoff_1/4 1/7/2011   0:00       0.00000000
surface_runoff_1/4 1/8/2011   0:00       0.00000000
surface_runoff_1/4 1/9/2011   0:00       0.00000000
surface_runoff_1/4 1/10/2011  0:00       0.00000000
surface_runoff_1/4 1/11/2011  0:00       0.00000000
surface_runoff_1/4 1/12/2011  0:00       0.00031000
surface_runoff_1/4 1/13/2011  0:00       0.00000000
surface_runoff_1/4 1/14/2011  0:00       0.00000000
surface_runoff_1/4 1/15/2011  0:00       0.00000000
surface_runoff_1/4 1/16/2011  0:00       0.00000000
surface_runoff_1/4 1/17/2011  0:00       0.00000000
surface_runoff_1/4 1/18/2011  0:00       0.00000000
surface_runoff_1/4 1/19/2011  0:00       0.00000000
surface_runoff_1/4 1/20/2011  0:00       0.00000000
surface_runoff_1/4 1/21/2011  0:00       0.00000000
surface_runoff_1/4 1/22/2011  0:00       0.00000000
surface_runoff_1/4 1/23/2011  0:00       0.00000000
surface_runoff_1/4 1/24/2011  0:00       0.00000000
surface_runoff_1/4 1/25/2011  0:00       0.00000000
surface_runoff_1/4 1/26/2011  0:00       0.00000000
surface_runoff_1/4 1/27/2011  0:00       0.00000000
surface_runoff_1/4 1/28/2011  0:00       0.00000000
surface_runoff_1/4 1/29/2011  0:00       0.00000000
surface_runoff_1/4 1/30/2011  0:00       0.00000000
surface_runoff_1/4 1/31/2011  0:00       0.00000000
surface_runoff_1/4 2/1/2011   0:00       0.00000000
surface_runoff_1/4 2/2/2011   0:00       0.00000000
surface_runoff_1/4 2/3/2011   0:00       0.00000000
surface_runoff_1/4 2/4/2011   0:00       0.00000000
```

```
surface_runoff_1/4 2/5/2011   0:00        0.00000000
surface_runoff_1/4 2/6/2011   0:00        0.00000000
surface_runoff_1/4 2/7/2011   0:00        0.00000000
surface_runoff_1/4 2/8/2011   0:00        0.00000000
surface_runoff_1/4 2/9/2011   0:00        0.00000000
surface_runoff_1/4 2/10/2011  0:00        0.00000000
surface_runoff_1/4 2/11/2011  0:00        0.00000000
surface_runoff_1/4 2/12/2011  0:00        0.00000000
surface_runoff_1/4 2/13/2011  0:00        0.00080083
surface_runoff_1/4 2/14/2011  0:00        0.00012917
surface_runoff_1/4 2/15/2011  0:00        0.00012917
surface_runoff_1/4 2/16/2011  0:00        0.00000000
surface_runoff_1/4 2/17/2011  0:00        0.00000000
surface_runoff_1/4 2/18/2011  0:00        0.00002583
surface_runoff_1/4 2/19/2011  0:00        0.00015500
surface_runoff_1/4 2/20/2011  0:00        0.00000000
surface_runoff_1/4 2/21/2011  0:00        0.00000000
surface_runoff_1/4 2/22/2011  0:00        0.00000000
surface_runoff_1/4 2/23/2011  0:00        0.00000000
surface_runoff_1/4 2/24/2011  0:00        0.00000000
surface_runoff_1/4 2/25/2011  0:00        0.00000000
surface_runoff_1/4 2/26/2011  0:00        0.00000000
surface_runoff_1/4 2/27/2011  0:00        0.00000000
surface_runoff_1/4 2/28/2011  0:00        0.00000000
surface_runoff_1/4 3/1/2011   0:00        0.00000000
surface_runoff_1/4 3/2/2011   0:00        0.00000000
surface_runoff_1/4 3/3/2011   0:00        0.00000000
surface_runoff_1/4 3/4/2011   0:00        0.00000000
surface_runoff_1/4 3/5/2011   0:00        0.00000000
surface_runoff_1/4 3/6/2011   0:00        0.00000000
surface_runoff_1/4 3/7/2011   0:00        0.00002583
surface_runoff_1/4 3/8/2011   0:00        0.00010333
surface_runoff_1/4 3/9/2011   0:00        0.00005167
surface_runoff_1/4 3/10/2011  0:00        0.00000000
surface_runoff_1/4 3/11/2011  0:00        0.00000000
surface_runoff_1/4 3/12/2011  0:00        0.00000000
surface_runoff_1/4 3/13/2011  0:00        0.00000000
surface_runoff_1/4 3/14/2011  0:00        0.00000000
surface_runoff_1/4 3/15/2011  0:00        0.00000000
```

```
surface_runoff_1/4 3/16/2011  0:00       0.00000000
surface_runoff_1/4 3/17/2011  0:00       0.00005167
surface_runoff_1/4 3/18/2011  0:00       0.00023250
surface_runoff_1/4 3/19/2011  0:00       0.00041333
surface_runoff_1/4 3/20/2011  0:00       0.00000000
surface_runoff_1/4 3/21/2011  0:00       0.00000000
surface_runoff_1/4 3/22/2011  0:00       0.00000000
surface_runoff_1/4 3/23/2011  0:00       0.00000000
surface_runoff_1/4 3/24/2011  0:00       0.00000000
surface_runoff_1/4 3/25/2011  0:00       0.00000000
surface_runoff_1/4 3/26/2011  0:00       0.00000000
surface_runoff_1/4 3/27/2011  0:00       0.00002583
surface_runoff_1/4 3/28/2011  0:00       0.00000000
surface_runoff_1/4 3/29/2011  0:00       0.00000000
surface_runoff_1/4 3/30/2011  0:00       0.00000000
surface_runoff_1/4 3/31/2011  0:00       0.00000000
surface_runoff_1/4 4/1/2011   0:00       0.00000000
surface_runoff_1/4 4/2/2011   0:00       0.00000000
surface_runoff_1/4 4/3/2011   0:00       0.00000000
surface_runoff_1/4 4/4/2011   0:00       0.00000000
surface_runoff_1/4 4/5/2011   0:00       0.00002583
surface_runoff_1/4 4/6/2011   0:00       0.00000000
surface_runoff_1/4 4/7/2011   0:00       0.00000000
surface_runoff_1/4 4/8/2011   0:00       0.00000000
surface_runoff_1/4 4/9/2011   0:00       0.00000000
surface_runoff_1/4 4/10/2011  0:00       0.00000000
surface_runoff_1/4 4/11/2011  0:00       0.00000000
surface_runoff_1/4 4/12/2011  0:00       0.00000000
surface_runoff_1/4 4/13/2011  0:00       0.00000000
surface_runoff_1/4 4/14/2011  0:00       0.00000000
surface_runoff_1/4 4/15/2011  0:00       0.00000000
surface_runoff_1/4 4/16/2011  0:00       0.00000000
surface_runoff_1/4 4/17/2011  0:00       0.00377167
surface_runoff_1/4 4/18/2011  0:00       0.00000000
surface_runoff_1/4 4/19/2011  0:00       0.00000000
surface_runoff_1/4 4/20/2011  0:00       0.00000000
surface_runoff_1/4 4/21/2011  0:00       0.00000000
surface_runoff_1/4 4/22/2011  0:00       0.00018083
surface_runoff_1/4 4/23/2011  0:00       0.00012917
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surface_runoff_1/4 4/24/2011  0:00       0.00000000
surface_runoff_1/4 4/25/2011  0:00       0.00000000
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surface_runoff_1/4 4/27/2011  0:00       0.00000000
surface_runoff_1/4 4/28/2011  0:00       0.00000000
surface_runoff_1/4 4/29/2011  0:00       0.00046500
surface_runoff_1/4 4/30/2011  0:00       0.00000000
surface_runoff_1/4 5/1/2011   0:00       0.00000000
surface_runoff_1/4 5/2/2011   0:00       0.00000000
surface_runoff_1/4 5/3/2011   0:00       0.00000000
surface_runoff_1/4 5/4/2011   0:00       0.00012917
surface_runoff_1/4 5/5/2011   0:00       0.00000000
surface_runoff_1/4 5/6/2011   0:00       0.00000000
surface_runoff_1/4 5/7/2011   0:00       0.00000000
surface_runoff_1/4 5/8/2011   0:00       0.00000000
surface_runoff_1/4 5/9/2011   0:00       0.00000000
surface_runoff_1/4 5/10/2011  0:00       0.00000000
surface_runoff_1/4 5/11/2011  0:00       0.00000000
surface_runoff_1/4 5/12/2011  0:00       0.00002583
surface_runoff_1/4 5/13/2011  0:00       0.00291917
surface_runoff_1/4 5/14/2011  0:00       0.00000000
surface_runoff_1/4 5/15/2011  0:00       0.00000000
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surface_runoff_1/4 5/17/2011  0:00       0.00005167
surface_runoff_1/4 5/18/2011  0:00       0.00000000
surface_runoff_1/4 5/19/2011  0:00       0.00000000
surface_runoff_1/4 5/20/2011  0:00       0.00000000
surface_runoff_1/4 5/21/2011  0:00       0.00018083
surface_runoff_1/4 5/22/2011  0:00       0.00891250
surface_runoff_1/4 5/23/2011  0:00       0.00043917
surface_runoff_1/4 5/24/2011  0:00       0.00025833
surface_runoff_1/4 5/25/2011  0:00       0.00002583
surface_runoff_1/4 5/26/2011  0:00       0.00000000
surface_runoff_1/4 5/27/2011  0:00       0.00000000
surface_runoff_1/4 5/28/2011  0:00       0.00000000
surface_runoff_1/4 5/29/2011  0:00       0.00000000
surface_runoff_1/4 5/30/2011  0:00       0.00000000
surface_runoff_1/4 5/31/2011  0:00       0.00000000
surface_runoff_1/4 6/1/2011   0:00       0.00000000
```

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surface_runoff_1/4 6/2/2011   0:00        0.00000000
surface_runoff_1/4 6/3/2011   0:00        0.00000000
surface_runoff_1/4 6/4/2011   0:00        0.00000000
surface_runoff_1/4 6/5/2011   0:00        0.00000000
surface_runoff_1/4 6/6/2011   0:00        0.00000000
surface_runoff_1/4 6/7/2011   0:00        0.00000000
surface_runoff_1/4 6/8/2011   0:00        0.00000000
surface_runoff_1/4 6/9/2011   0:00        0.00000000
surface_runoff_1/4 6/10/2011  0:00        0.00000000
surface_runoff_1/4 6/11/2011  0:00        0.00149833
surface_runoff_1/4 6/12/2011  0:00        0.00160167
surface_runoff_1/4 6/13/2011  0:00        0.00000000
surface_runoff_1/4 6/14/2011  0:00        0.00036167
surface_runoff_1/4 6/15/2011  0:00        0.00010333
surface_runoff_1/4 6/16/2011  0:00        0.00446917
surface_runoff_1/4 6/17/2011  0:00        0.00258333
surface_runoff_1/4 6/18/2011  0:00        0.00041333
surface_runoff_1/4 6/19/2011  0:00        0.00000000
surface_runoff_1/4 6/20/2011  0:00        0.00000000
surface_runoff_1/4 6/21/2011  0:00        0.00010333
surface_runoff_1/4 6/22/2011  0:00        0.00255750
surface_runoff_1/4 6/23/2011  0:00        0.00012917
surface_runoff_1/4 6/24/2011  0:00        0.00005167
surface_runoff_1/4 6/25/2011  0:00        0.00000000
surface_runoff_1/4 6/26/2011  0:00        0.00005167
surface_runoff_1/4 6/27/2011  0:00        0.00000000
surface_runoff_1/4 6/28/2011  0:00        0.00126583
surface_runoff_1/4 6/29/2011  0:00        0.00390083
surface_runoff_1/4 6/30/2011  0:00        0.00031000
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surface_runoff_1/4 7/2/2011   0:00        0.00000000
surface_runoff_1/4 7/3/2011   0:00        0.00000000
surface_runoff_1/4 7/4/2011   0:00        0.00000000
surface_runoff_1/4 7/5/2011   0:00        0.00000000
surface_runoff_1/4 7/6/2011   0:00        0.00000000
surface_runoff_1/4 7/7/2011   0:00        0.00000000
surface_runoff_1/4 7/8/2011   0:00        0.00000000
surface_runoff_1/4 7/9/2011   0:00        0.00012917
surface_runoff_1/4 7/10/2011  0:00        0.00121417
```

```
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surface_runoff_1/4 7/14/2011  0:00        0.00012917
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surface_runoff_1/4 7/16/2011  0:00        0.00372000
surface_runoff_1/4 7/17/2011  0:00        0.00002583
surface_runoff_1/4 7/18/2011  0:00        0.00012917
surface_runoff_1/4 7/19/2011  0:00        0.00118833
surface_runoff_1/4 7/20/2011  0:00        0.00100750
surface_runoff_1/4 7/21/2011  0:00        0.00000000
surface_runoff_1/4 7/22/2011  0:00        0.00059417
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surface_runoff_1/4 7/24/2011  0:00        0.00000000
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surface_runoff_1/4 7/27/2011  0:00        0.00000000
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surface_runoff_1/4 7/29/2011  0:00        0.00155000
surface_runoff_1/4 7/30/2011  0:00        0.00007750
surface_runoff_1/4 7/31/2011  0:00        0.00000000
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surface_runoff_1/4 8/2/2011   0:00        0.00000000
surface_runoff_1/4 8/3/2011   0:00        0.00000000
surface_runoff_1/4 8/4/2011   0:00        0.00000000
surface_runoff_1/4 8/5/2011   0:00        0.00000000
surface_runoff_1/4 8/6/2011   0:00        0.00000000
surface_runoff_1/4 8/7/2011   0:00        0.00000000
surface_runoff_1/4 8/8/2011   0:00        0.00240250
surface_runoff_1/4 8/9/2011   0:00        0.00054250
surface_runoff_1/4 8/10/2011  0:00        0.00335833
surface_runoff_1/4 8/11/2011  0:00        0.00020667
surface_runoff_1/4 8/12/2011  0:00        0.00000000
surface_runoff_1/4 8/13/2011  0:00        0.00000000
surface_runoff_1/4 8/14/2011  0:00        0.00000000
surface_runoff_1/4 8/15/2011  0:00        0.00002583
surface_runoff_1/4 8/16/2011  0:00        0.00000000
surface_runoff_1/4 8/17/2011  0:00        0.00000000
surface_runoff_1/4 8/18/2011  0:00        0.00000000
```

```
surface_runoff_1/4 8/19/2011  0:00       0.00000000
surface_runoff_1/4 8/20/2011  0:00       0.00000000
surface_runoff_1/4 8/21/2011  0:00       0.00000000
surface_runoff_1/4 8/22/2011  0:00       0.00080083
surface_runoff_1/4 8/23/2011  0:00       0.00000000
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surface_runoff_1/4 8/30/2011  0:00       0.00000000
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surface_runoff_1/4 9/1/2011   0:00       0.00007750
surface_runoff_1/4 9/2/2011   0:00       0.00012917
surface_runoff_1/4 9/3/2011   0:00       0.00015500
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surface_runoff_1/4 9/13/2011  0:00       0.00000000
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surface_runoff_1/4 9/22/2011  0:00       0.00000000
surface_runoff_1/4 9/23/2011  0:00       0.00000000
surface_runoff_1/4 9/24/2011  0:00       0.00002583
surface_runoff_1/4 9/25/2011  0:00       0.00012917
surface_runoff_1/4 9/26/2011  0:00       0.00002583
```

```
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surface_runoff_1/4 10/3/2011  0:00       0.00005167
surface_runoff_1/4 10/4/2011  0:00       0.00002583
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surface_runoff_1/4 10/16/2011 0:00       0.00000000
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surface_runoff_1/4 10/18/2011 0:00       0.00000000
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surface_runoff_1/4 10/25/2011 0:00       0.00000000
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surface_runoff_1/4 10/27/2011 0:00       0.00000000
surface_runoff_1/4 10/28/2011 0:00       0.00000000
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surface_runoff_1/4 10/30/2011 0:00       0.00010333
surface_runoff_1/4 10/31/2011 0:00       0.00007750
surface_runoff_1/4 11/1/2011  0:00       0.00000000
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surface_runoff_1/4 11/3/2011  0:00       0.00000000
surface_runoff_1/4 11/4/2011  0:00       0.00000000
```

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surface_runoff_1/4 11/11/2011 0:00        0.00000000
surface_runoff_1/4 11/12/2011 0:00        0.00000000
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surface_runoff_1/4 11/14/2011 0:00        0.00000000
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surface_runoff_1/4 11/20/2011 0:00        0.00000000
surface_runoff_1/4 11/21/2011 0:00        0.00000000
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surface_runoff_1/4 11/30/2011 0:00        0.00000000
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surface_runoff_1/4 12/12/2011 0:00        0.00000000
surface_runoff_1/4 12/13/2011 0:00        0.00000000
```

```
surface_runoff_1/4 12/14/2011 0:00       0.00000000
surface_runoff_1/4 12/15/2011 0:00       0.00000000
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surface_runoff_1/4 12/24/2011 0:00       0.00000000
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surface_runoff_1/4 12/26/2011 0:00       0.00000000
surface_runoff_1/4 12/27/2011 0:00       0.00000000
surface_runoff_1/4 12/28/2011 0:00       0.00000000
surface_runoff_1/4 12/29/2011 0:00       0.00000000
surface_runoff_1/4 12/30/2011 0:00       0.00000000
surface_runoff_1/4 12/31/2011 0:00       0.00000000

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 834015.353 844350.455 834568.664 844639.183
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord           
;;-------------- ------------------ ------------------
A                834436.549         844422.313        
B                834391.881         844452.511        
C                834339.665         844455.656        
```

```
D                834294.997         844463.206
E                834253.790         844485.225
F                834200.944         844475.159
A_Out            834435.653         844412.124
B_Out            834388.989         844442.916
C_Out            834337.562         844446.091
D_Out            834292.167         844454.979
E_Out            834251.534         844476.883
F_Out            834201.060         844465.138
Pond_A           834438.751         844440.557
Pond_C           834347.214         844472.328
Pond_B           834395.342         844464.464
Pond_D           834300.974         844481.450
Pond_E           834255.677         844496.864
Pond_F           834200.314         844494.033
Pond_G           834151.872         844504.413

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------


[BACKDROP]
FILE       "D:\Project\Liantang wetland\SWMM\basemap.jpg"
DIMENSIONS 834015.353 844350.455 834568.664 844639.183
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