


SMEC Asia Limited

Contract No. WSD/SO/16/086

Quotation Ref. WQ/16/A032

**Provision of Independent Environmental Checking
Service for Investigation, Review and Design of
First Stage of Tseung Kwan O Desalination Plant**


Updated Vegetation Survey Report
for Slope Mitigation Works

Verified by:	 Vivian Chan
Position:	Independent Environmental Checker
Date:	19 Jul 17

Black & Veatch Hong Kong Limited

Agreement No. CE 8/2015 (WS)
First Stage of Desalination Plant at Tseung Kwan O
– Investigation, Design, Construction

Updated Vegetation Survey Report
for Slope Mitigation Works

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Date:	3 July 2017

ISSUE 212-2

UPDATED VEGETATION SURVEY REPORT FOR SLOPE MITIGATION WORKS


Agreement No. CE 8/2015 (WS)

First Stage of Desalination Plant at
Tseung Kwan O

– Investigation, Design and Construction

B&V PROJECT NO. 190495/29.2120

Report Authorized For
Issue By:



For and on Behalf of
Black & Veatch Hong Kong Limited

PREPARED FOR

Water Supplies Department

3 JULY 2017



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	Name	Signature	Date
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Checked	Amy Cheung		3 July 2017
Reviewed	Christina Ko		3 July 2017

1 Introduction

1.1 Background and Purpose

- 1.1.1 Water Supplies Department appointed Black & Veatch Hong Kong Limited (B&V) to undertake the consultancy “Agreement No. CE 8/2015 (WS) First Stage of Desalination Plant at Tseung Kwan O – Investigation, Design, and Construction” on 16 November 2015.
- 1.1.2 The purpose of the project is to construct a sea water reverse osmosis (SWRO) desalination plant at Tseung Kwan O (TKO) Area 137, together with all ancillary facilities and the slope mitigation works in the adjoining Clear Water Bay Country Park.
- 1.1.3 The first stage of the proposed SWRO desalination plant will have a water production capacity of 135,000 cubic meters (m³) per day with provision for future expansion to the ultimate capacity up to 270,000 m³ per day when necessary.
- 1.1.4 The proposed desalination plant is a key supply management initiative under the Total Water Management (TWM) strategy promulgated in 2008. As one of the key supply management initiatives, the desalination plant will help diversify the water supply resources and serve as a new water source to better prepare Hong Kong for uncertainties such as acute climate change and low rainfall. Under the TWM strategy, Hong Kong should broaden its strategic investment in advanced water treatment for desalination of seawater.

1.2 Project Elements

- 1.2.1 The Project comprises of the following elements:
- Formation of the reserved site of about 10 hectares in TKO Area 137 to provide sufficient space for a desalination plant with an ultimate water production output at 270,000 m³ per day.
 - Design and construction of the desalination plant including:
 - Seawater treatment components using RO technology with a water production output at 135,000 m³ per day with provision for future expansion of the desalination plant to an ultimate water production output at 270,000 m³ per day.
 - Associated facilities including the intake pipes, outfall pipes, administration building, laboratory, maintenance workshop, chemical building, chlorine building, sludge filter press building, seawater intake pumping station, fresh water pumping station and power supply facilities, etc. with provision for future expansion of the desalination plant to cater for an ultimate water production output at 270,000 m³ per day.
 - Provision of all associated civil, structural, architectural, geotechnical, landscaping, marine, electrical and mechanical works, including landscaping, permanent and temporary access, etc.
 - Operation and maintenance of the desalination plant for the initial operation period which will start upon commissioning of the plant for 1 year.
 - Slope mitigation works in the Country Park Area to mitigate the natural terrain hazards affecting the site.
- 1.2.2 Fresh water produced by the desalination plant will be transferred via a trunk main to the existing Tseung Kwan O Fresh Water Primary Service Reservoir (TKOFWPSR) and/or other existing fresh water service reservoirs. Detailed design of the trunk main is being carried out by WSD Design Division and the associated main laying works will be procured by WSD.

1.3 Site Description

- 1.3.1 The proposed site at TKO Area 137 is located on the Clearwater Bay Peninsula. The site is at the southern tip of the TKO Phase III (Area 137) reclamation. The Area 137 reclamation involves reclaiming the sea between the islands of Fat Tong Chau and Tit Cham Chau. The site covers about 10 hectares. The existing land use of the site is public fill area managed by Civil Engineering and Development Department (CEDD). Intake and outfall pipes will be extended to the east and south from the coastline of Tit Cham Chau.
- 1.3.2 The site boundary of the project is shown in Figure 190495/B/DSR/00-10001, attached in Appendix A. Trunk main to the existing TKOFWPSR and/or other existing fresh water service reservoirs is excluded from our Project scope and will under WSD separate contract.

1.4 Objective of the Updated Vegetation Survey Report (“this report”)

- 1.4.1 According to Condition 2.7 of Environmental Permit No. EP-503/2015, to reduce ecological impact on plant species of conservation importance, including but not limited to *Marsdenia Iachnostoma*, due to the slope mitigation works of the Project, no later than 3 months before the commencement of site clearance works for the slope mitigation works, the Updated Vegetation Survey Report (“this report”) shall be submitted to the Director of Environmental Protection for approval.
- 1.4.2 The Permit Holder shall consult the Director of Agriculture, Fisheries and Conservation in preparing the Updated Vegetation Survey Report prior to the submission to the Director of Environmental Protection for approval.
- 1.4.3 This report had been circulated to AFCD for comments and AFCD has no comment on this report.
- 1.4.4 This report presents the findings of the survey and the potential impacts, if any which may be caused by the proposed slope mitigation works, and the recommended protection and mitigation measures for the plant species of conservation importance as identified in the survey.

1.5 Structure of this Report

- 1.5.1 The report is structured as follows:
- Section 1: Introduction, this section
 - Section 2: Presents the updated vegetation survey as required in the Environmental Impact Assessment (EIA) Report and Environmental Permit
 - Section 3: Presents the agreed methodology and extent of the updated vegetation survey at the proposed location of the slope mitigation works within the Country Park
 - Section 4: Presents the results of the updated vegetation survey
 - Section 5: Presents the design development of the slope mitigation works and proposed mitigation measures
 - Section 6: Presents the recommendations of protection/mitigation measures

2 Updated Vegetation Survey

2.1 Environmental Impact Assessment (EIA) Report (Register No. AEIAR-192/2015)

- 2.1.1 In the Environmental Impact Assessment (EIA) carried out for “Agreement No. CE21/2012 (WS) Desalination Plant at Tseung Kwan O - Feasibility Study”, a plant species of conservation importance *Marsdenia lachnostoma* was recorded in the shrubland/grassland habitat along the proposed alignment of the flexible barriers at the lower portion of the natural hill of the Clear Water Bay Country Park. Mitigation measures were recommended to avoid and minimize potential impact on the plant species of conservation importance in the slope mitigation works area.
- 2.1.2 As said in the EIA, at the detailed design stage prior to the commencement of the slope mitigation works, a vegetation survey shall be carried out at the slope mitigation areas within the Clear Water Bay Country Park to assess the condition and identify the location of each individual of *Marsdenia lachnostoma* and other plant species of conservation importance that may be directly affected by the construction works.

2.2 Environmental Permit No. EP-503/2015

- 2.2.1 To reduce ecological impact on plant species of conservation importance, including but not limited to *Marsdenia lachnostoma*, due to the slope mitigation works of the Project as shown in Figure 3 of EP-503/2015 (appended in Appendix B of this report), the Permit Holder shall, no later than 3 months before commencement of site clearance works for the slope mitigation works, submit 4 hardcopies and 1 electronic copy of the Updated Vegetation Survey Report to the Director of Environmental Protection for Approval. The report shall include:
- (i) details of updated vegetation survey including the survey methodology , duration and schedule (discussed in Section 3 below);
 - (ii) findings of updated vegetation survey, particularly on species, numbers and locations of the plant species of conservation importance including but not limited to *Marsdenia lachnostoma*, identified within the works area of slope mitigation works (discussed in Section 4 below);
 - (iii) recommended protection and mitigation measures for the plant species of conservation importance as identified in the updated vegetation survey (discussed in Section 5 below); and
 - (iv) if transplantation is eventually proposed for the plant species of conservation importance, the transplantation proposal shall include the locations of reception sites for transplanted plants, methodology of transplantation and detailed schedule for post-transplantation monitoring and maintenance requirements (discussed in Section 6 below).

The Updated Vegetation Survey Report shall be prepared by the Qualified Ecologist as appointed under Condition of EP -503/2015 and shall be certified by the ET leader and verified by IEC as conforming to the information and recommendations contained in the approved EIA report (Register No. AEIAR-192/2015). All recommended mitigation measures as set out in the approved Vegetation Survey Report shall be fully and properly implemented. No site clearance works for the slope mitigation works of the Project shall be allowed prior to the approval of the Vegetation Survey Report, as well as completion of any protection/mitigations works or transplantation as proposed in (iii) and (iv) above.

The Permit Holder shall consult the Director of Agriculture, Fisheries and Conservation in preparing the Updated Vegetation Survey Report prior to the submission to the Director of Environmental Protection for approval.

3 Survey Methodology

- 3.1.1 The survey methodology made reference to the technical guidelines of ecological assessment in Annex 16 of EIAO-TM and the relevant Guidance Notes (GN 7/2010 and GN 10/2010). This report is prepared to the requirements stipulated in Condition 2.7 of EP-503/2015 Submission of Updated Vegetation Survey Report for Slope Mitigation Works.
- 3.1.2 The updated vegetation survey is conducted to obtain the up-to-date ecological information at the proposed locations of the original slope mitigation works based on the desktop review and the findings from the EIA report.
- 3.1.3 Correspondences with AFCD and the agreed survey methodology are appended in Appendix C and D respectively. The CVs of the Qualified Ecologist conducting the survey as appointed under Condition 2.3⁽¹⁾ of EP-503/2015 is appended in Annex A of Appendix D.

3.2 Survey Duration and Schedule

- 3.2.1 The survey consisted of the habitat and vegetation survey. The surveys were conducted between the months of May and December 2016 to cover the wet and dry seasons within the Works and Study Area. Day-time surveys were conducted for the habitat and vegetation surveys. A total of 7 surveys have been conducted and is presented in Table 3-1.

Table 3-1 Programme of the Updated Vegetation Survey

Season	Wet					Transition	Dry	
Month	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Day-time								
Habitat & Vegetation	18/5	22/6	22/7	22/8	20/9		29/11	23/12

Note:

Survey dates are presented in the shaded cells.

- 3.2.2 The habitat and vegetation survey was carried out to assess the existing condition and to identify the locations of plant species including the location of each individual *Marsdenia lachnostoma* and other plant species of conservation importance that may be directly affected by the proposed slope mitigation works.

4 Survey Results

- 4.1.1 A total of six habitats were identified in the Study Area, including mixed woodland, shrubland and hillside grassland mosaic, urbanised/disturbed area, wasteland, watercourse and marine habitats (including rocky shore, sandy shore and seawall, which are outside of the scope of this Assignment). The findings are appended in Appendix E – Figure 3.1.
- 4.1.2 A total of 139 plant species were recorded between May and December 2016 within the study area. Of the 139 plant species recorded, 2 were considered as plant species of conservation importance, including Hairy-throat Condorvine *Marsdenia lachnostom* and Balloon Flower *Platycodon grandiflorus*. Only *Marsdenia lachnostom* was found within the Works Area and within the shrubland and hillside grassland mosaic habitat. Location of the identified plant species of conservation importance are shown in Appendix E - Figure 3.2 and their representative photos are presented in Appendix E - Figure 3.3. Full list of the plant species recorded between May and December 2016 is provided in Appendix E – Annex A.

⁽¹⁾ Employment of Qualified Ecologist for Updated Vegetation Survey: The Permit Holder shall appoint a Qualified Ecologist who has at least 5 years of relevant experience to be responsible for carrying out the updated vegetation survey for slope mitigation works and preparing submission for the Project as required under Condition 2.7 of EP-503/2015.

4.1.3 The summary of the plant species of conservation importance identified in each habitat is presented in Table 4-1.

Table 4-1 Summary of Plant Species of Conservation Importance Identified

HABITAT TYPE	PLANT SPECIES OF CONSERVATION IMPORTANCE
Mixed Woodland	No plant species of conservation importance identified
Shrubland and Hillside Grassland Mosaic	A total of two species of conservation importance identified, - <i>Marsdenia lachnostoma</i> - <i>Platycodon grandiflorus</i> Only <i>Marsdenia lachnostoma</i> were also recorded within the Works Area
Urbanised/ Disturbed area	No plant species of conservation importance identified
Wasteland	No plant species of conservation importance identified
Watercourse	No plant species of conservation importance identified
Marine	Outside of the scope of this Assignment

5 Design Development

5.1 Original Slope Mitigation Works

5.1.1 The original proposed slope mitigation works planned during the Feasibility Study stage of the Project includes:

- (a) Flexible barriers installed along the coastal slope crest within the Country Park and along the slope toe;
- (b) Rock slope stabilization works along the toe of the natural terrain within the Clearwater Bay Country Park area; and
- (c) Soil nailing above the rock face within the Country Park.

5.1.2 During the updated vegetation survey, it was noted that species of conservation importance were identified within or were in close proximity to the proposed flexible barriers and soil nails in the Country Park, as indicated in Figure 3.2 of Appendix E.

5.1.3 To minimize the impact on those species of conservation importance, the proposed slope mitigation measures of installing flexible barriers and soil nails within the Country Park were reviewed and the proposed works revised.

5.2 Revised Slope Mitigation Works

5.2.1 The revised slope mitigation works includes:

- (a) Flexible barriers are redesigned and located away from the slope toe of the Clearwater Bay Country Park area, thus no flexible barriers will be installed within the Clearwater Bay Country Park area. Soil nailing works as stated in Section 5.1.1 item (c) is not required and omitted due to the relocation of flexible barriers;
- (b) Rock slope stabilization works along the toe of the natural terrain within the Clearwater Bay Country Park area (the design is similar to the Section 5.1.1 item (b) including rock bolt, buttress/dentition & wire mesh); and
- (c) Boulder removal/break-off of 15 unstable boulders, identified at the natural terrain within the Clearwater Bay Country Park area.

- 5.2.2 The revised slope mitigation works scheme is shown in Appendix E – Figure 4.1. The flexible barriers will be located outside the Clearwater Bay Country Park area as discussed in Section 5.2.1. However, localised trimming of the ground vegetation within the works areas of the flexible barrier will be needed. The flexible barrier will be located in close proximity to mixed woodland, the footprint of vegetation clearance would therefore be localised and very limited. The ecological impact due to the construction of flexible barriers is considered insignificant. With the implementation of proposed good site practices, no mitigation measure is required.
- 5.2.3 Access to the boulders for the boulder removal break-off works will be required, to minimise the disturbance to the existing habitat and vegetation from the works, temporary elevated accesses of 600mm width shall be provided. Five nos. of the temporary elevated accesses with a total length of approximately 433m, ranging from 9m to 290m, extending from temporary working platform for rock slope works will be provided. To facilitate the boulder removal / break-off works, temporary elevated access of 600mm width around each of the 15 nos. of boulders will be provided (total area = 0.006 ha). Two temporary working platforms for rock slope works (~0.02ha and ~0.26ha respectively) will also be provided. The temporary elevated access and temporary working platform for boulder and rock slope works are indicated in Appendix E – Figure 4.1.

5.3 Mitigation Measures

Slope Stabilisation Works

- 5.3.1 Rock stabilization works shall be adjusted such that no tree felling and plant species of conservation importance shall be affected. The anchorage for the temporary working platform and access to be erected will be designed to avoid the plant species of conservation importance.
- 5.3.2 Landscaping works will be provided in the form of hydroseeding and/or planting shrub seedlings to reinstate vegetation loss and disturbance at the area of slope stabilization works, with regular monitoring and appropriate maintenance works carried out for a 12-month establishment period. Stone facing to constructed concrete surfaces (such as buttress wall and dentition) at the rock slope will be provided to restore the natural finishes of the slopes.
- 5.3.3 No unacceptable impact to the habitat loss and disturbance from rock slope stabilization is anticipated.

Boulder Removal/Break-off

- 5.3.4 The proposed boulder removal works will involve provision of temporary working platform and access of 600mm around the boulder. To avoid direct conflict between the boulder removal and nearby plant species of conservation importance, protection zones/works exclusion zones will be established at least 1m radius from the identified plant species of conservation importance to preserve them on site.
- 5.3.5 The protection zones/works exclusion zones will be established prior to site clearance and throughout the construction period to separate the identified protected plant individuals from the works.
- 5.3.6 The temporary working platform and temporary access will be designed to avoid anchorage on the plant species of conservation importance.
- 5.3.7 With proper implementation of the recommended mitigation measures, no unacceptable impact to the plant species of conservation importance is anticipated.

Recommended Good Site Practices

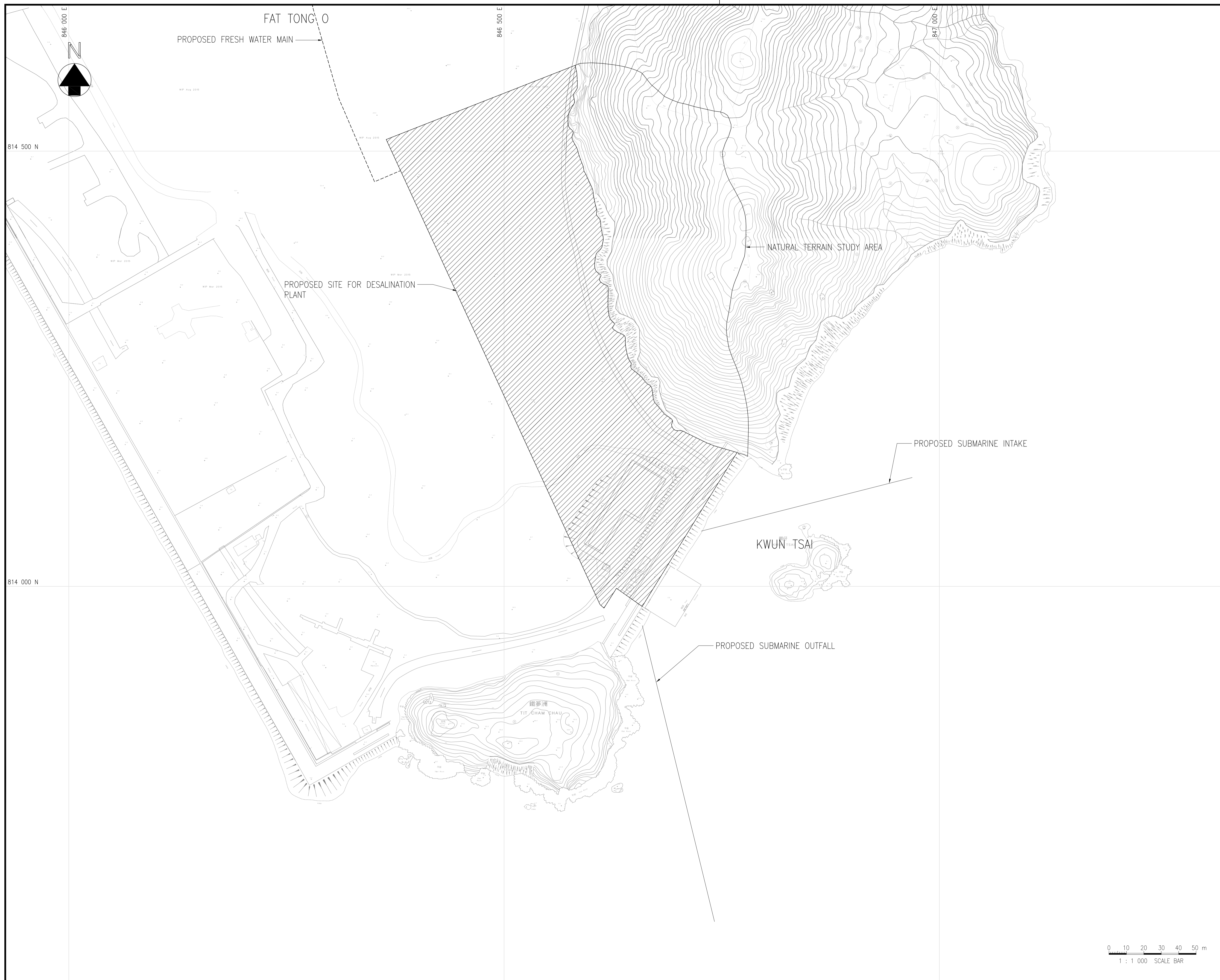
- 5.3.8 Prior to the commencement of construction works, the location and condition of the plant species of conservation importance along the direct footprint of the slope mitigation works shall be conducted by a qualified plant ecologist.
- 5.3.9 Protection zones/works exclusion zones will be established, prior to site clearance and throughout the construction period, at least 1m radius and 1m height to surround the plant species of conservation importance to preserve them on site. Signage to identify the protection zones/works exclusion zones shall be implemented.
- 5.3.10 Upon completion of the works, the species of conservation importance that will be potentially affected will be revisited to assess the condition.
- 5.3.11 Induction training will be provided to all site staff to ensure that every staff will fully understand the preservation method and location of the identified species of conservation importance.
- 5.3.12 The Environmental Team shall monitor the condition of the plant species of conservation concern within the protection zone/works exclusion zones during the construction period on a monthly basis with representative photographic record to present the updated conditions of the plant specimens in the monthly monitoring report.
- 5.3.13 Where vegetation clearance and/or trimming is required, a qualified ecologist/arborist will be appointed to provide on-site supervision and monitoring to ensure no tree canopy or tree roots will be adversely impacted.
- 5.3.14 Standard good site practice will considerably reduce any potential disturbance from slope works including:
- (a) All construction materials shall be stockpiled offsite to minimize the disturbance to areas in particular inside the country park area;
 - (b) Construction activities will be restricted to the clearly demarcated slope mitigation works areas; and
 - (c) Boulders works will be carried out by handheld tool to minimize the works area. No excavation works, tree felling and removal of vegetation should be allowed during the boulder removal/break-off works.

6 Recommendation

- 6.1.1 With revised slope mitigation works as discussed in Section 5.2 and implementation of mitigation measures as discussed in Section 5.3, plant species of conservation importance is identified and no transplantation is proposed for the plant species of conservation importance due to slope mitigation works in this Project.
- 6.1.2 All recommended protection/mitigation measures (Section 5.3) as set out in this report shall be fully and properly implemented on site during the construction stage of this Project. No site clearance works for slope mitigation works of this Project shall be allowed prior to the completion of such protection/mitigation works on site.

END OF TEXT

APPENDIX A
SITE BOUNDARY OF THE PROJECT



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MAP NOS. 12SW11D, 12SW12C,
12SW16B, 12SW16D,
12SW17A, 12SW17C

Revision	Date	Description			Initial
		Designed	Checked	Drawn	
A	08/16	UPDATED SITE BOUNDARY			KHC
Initial		YLC	CKH	SZ	WLS
Date		11/15	11/15	11/15	11/15

Approved

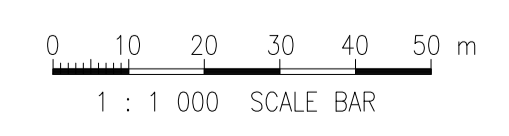
Agreement No. CE 8/2015 (WS)

Contract Title
FIRST STAGE OF
DESALINATION PLANT AT
TSEUNG KWAN O - INVESTIGATION,
DESIGN AND CONSTRUCTION

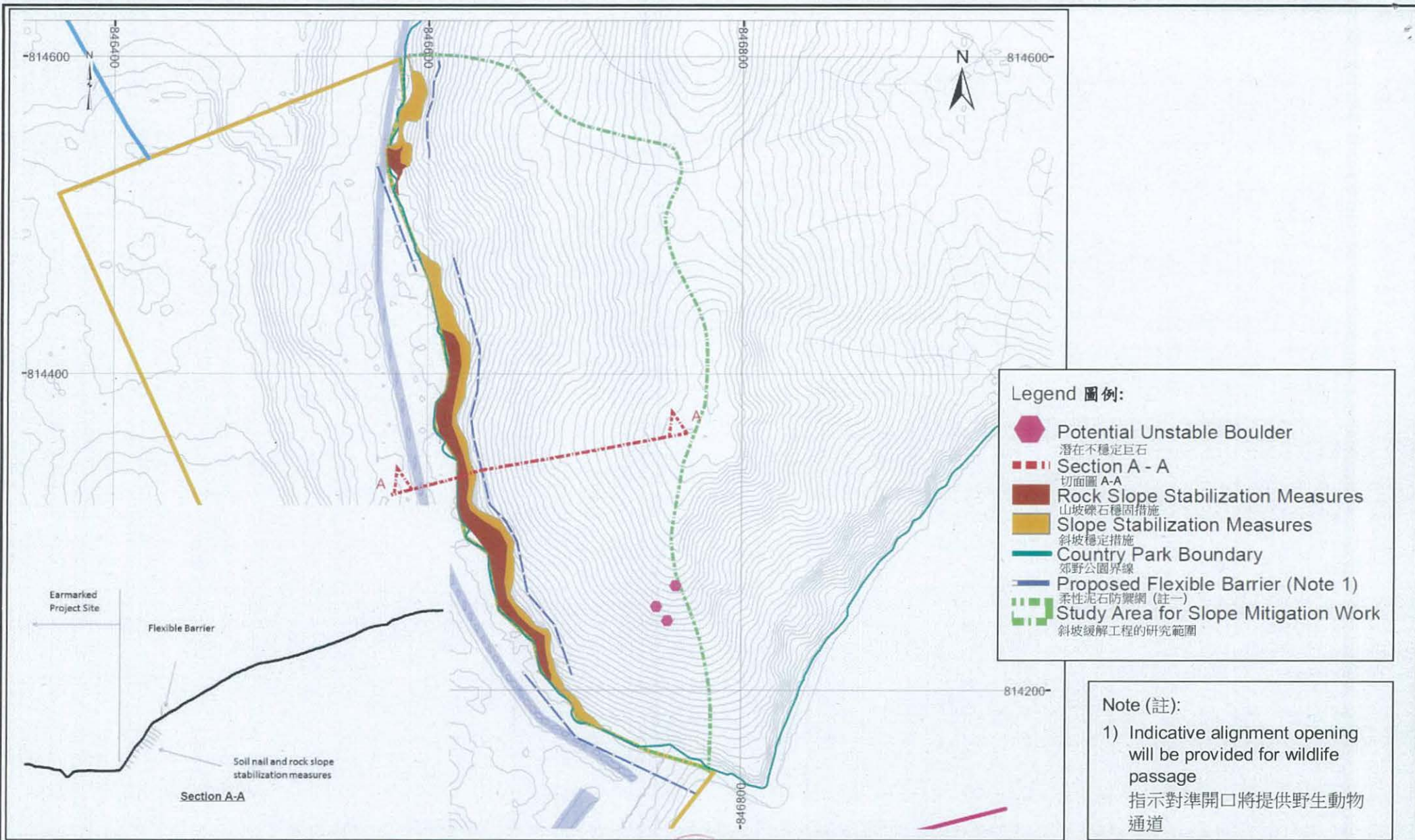
Drawing Title
SITE BOUNDARY

Drawing No. Appendix A

Scale
A1 1 : 2000
A3 1 : 4000



APPENDIX B
SLOPE MITIGATION WORKS AREA OF THE PROJECT
(FIGURE 3 OF ENVIRONMENTAL PERMIT)



Project Title: Desalination Plant at Tseung Kwan O
 工程項目名稱: 將軍澳海水化淡廠
 Slope Mitigation Works within the Clear Water Bay Country Park
 位於清水灣郊野公園範圍內的斜坡緩解工程



Plan originated from the Figure 2.3d of approved EIA Report: AEIAR-192/2015
 圖則源自已批准環評報告-AEIAR-192/2015 內的圖 2.3d

Environmental Protection Department
 環境保護署



Environmental Permit No. EP-503/2015
 環境許可證編號: EP-503/2015

Figure 3
 圖三

APPENDIX C
NOT USED

APPENDIX D
AGREED SURVEY METHODOLOGY

First Stage of Desalination Plant at
Tseung Kwan O – Investigation,
Design and Construction: *Pre-
construction Ecology Survey &
Updated Vegetation Survey for Slope
Mitigation Works*

April 2016

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First Stage of Desalination Plant at Tseung Kwan O – Investigation, Design and Construction: *Pre-construction Ecology Survey & Updated Vegetation Survey for Slope Mitigation Works*

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Survey Methodology of the Pre-construction Ecology Survey & Updated Vegetation Survey for Slope Mitigation Works

Document Code: 0332378 Desal IDC Ecology Methodology_v2.docx

Client: Black & Veatch Hong Kong Limited		Project No: 0332378			
Summary: This document presents the <i>Survey Methodology of the Pre-construction Ecology Survey & Updated Vegetation Survey for Slope Mitigation Works</i> for undertaking the First Stage of Desalination Plant at Tseung Kwan O – Investigation, Design and Construction.		Date: 12 April 2016			
		Approved by:  <i>Craig A. Reid</i> Partner			
2	Revised Methodology	JY	JNG	CAR	12/04/16
1	Methodology	JY	JNG	CAR	24/03/16
Revision	Description	By	Checked	Approved	Date
<p>This report has been prepared by Environmental Resources Management the trading name of 'ERM Hong-Kong, Limited', with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.</p> <p>We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.</p> <p>This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.</p>		<p>Distribution</p> <p><input checked="" type="checkbox"/> Government</p> <p> </p>			

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ANNEXES

ANNEX A

CV OF QUALIFIED ECOLOGIST

1 INTRODUCTION

1.1 BACKGROUND

The Water Supplies Department (WSD) is undertaking a project named “Desalination Plant at Tseung Kwan O” (hereinafter referred to as the “Project”). This Project will have a water production capacity of 135,000 cubic meters (m³) per day with provision for future expansion to the ultimate capacity up to 270,000 m³ per day when necessary.

In November 2015, WSD commissioned the study “*First Stage of Desalination Plant at Tseung Kwan O – Investigation, Design and Construction*” (Agreement No. CE 8/2015 (WS)) for the investigation, design and construction studies of the Project.

The Project requires an Environmental Permit (EP) from the Hong Kong SAR Government. In relation to this, WSD has prepared an Environmental Impact Assessment (EIA) Report which was submitted to the Director of Environmental Protection (DEP) on 27 May 2015 and was subsequently approved on 4 November 2015 (Register No.: AEIAR-192/2015). The EP (EP-503/2015) for the construction and operation of the Project was granted on 4 December 2015.

Condition 2.7 of the EP of the Project specifies that an Updated Vegetation Survey for Slope Mitigation Works shall be carried out to reduce ecological impact on plant species of conservation importance, including but not limited to *Marsdenia lachnostoma*, due to the slope mitigation works of the Project. The Updated Vegetation Survey for Slope Mitigation Works shall be completed before the commencement of site clearance works for the slope mitigation works.

Agreement No. CE 8/2015 (WS) also requires that a Pre-construction Ecology Survey be completed to record the habitat types and the conditions flora and fauna at the proposed location of the slope mitigation works within the Clear Water Bay Country Park area. A Pre-construction Ecology Survey to be completed in accordance with the requirements of *Condition 2.7* of the EP and Agreement No. CE 8/2015 (WS) is consequently required.

1.2 OBJECTIVE & SCOPE OF THIS SURVEY METHODOLOGY

The main purpose of this Pre-construction Ecology Survey is to gather up-to-date ecological information in the proposed location of the slope mitigation works within the Clear Water Bay Country Park area for the Project under Agreement No. CE 8/2015 (WS).

The objectives of the Pre-construction Ecology Survey and Updated Vegetation Survey are as follows:

- To identify the habitat type, species of vegetation, terrestrial mammal, bird, herpetofauna, butterflies and dragonflies, etc. found and their locations, their abundances and general conditions;
- To highlight any species of special interest or conservation importance, particularly on species, numbers and locations of the plant species of conservation importance including but not limited to *Marsdenia lachnostoma*, identified within the proposed location of slope mitigation works;
- To assess the potential impacts on ecology in particular any species of conservation importance caused by the proposed slope mitigation works;
- To propose appropriate protection or mitigation measures for the plant and wildlife species of conservation importance as identified in the survey; and
- To recommend monitoring required to be implemented during the slope mitigation works within the Country Park Area.

This *Survey Methodology* presents the survey plan to achieve the objectives of the Pre-construction Ecology Survey and Updated Vegetation Survey for the slope mitigation works.

1.3

STRUCTURE OF THIS METHOD STATEMENT

Following this introductory section, the remainder of this *Survey Methodology* is presented as follows:

- *Section 2* presents the methodologies for the Pre-construction Ecology Survey, including habitat and vegetation survey, and wildlife survey; and,
- *Section 3* describes the reporting arrangement upon the completion of the ecological surveys.

2 SURVEY METHODOLOGY

2.1 INTRODUCTION

The survey methodology of the Pre-Construction Ecological Survey has made reference to the technical guidelines of ecological assessment in *Annex 16 of EIAO-TM* and the relevant Guidance Notes (*GN 7/2010* and *GN 10/2010*) as well as the requirements stipulated in *Condition 2.7 of EP-503/2015*.

Based on the desktop review and findings from the EIA Report, an updated ecological survey is proposed to be conducted in the wet and dry seasons for a duration of at least 6 months between May and December 2016 to provide up-to-date information on existing condition of terrestrial ecological profile within the Study Area, which is 500 m from the slope mitigation works area (“Works Area”) (*Figure 2.1*). Study boundary is drawn up with due consideration of the diversity of habitats and presence of species of conservation importance within the terrestrial habitats of the Study Area, in particular the Works Area within the Clear Water Bay Country Park.

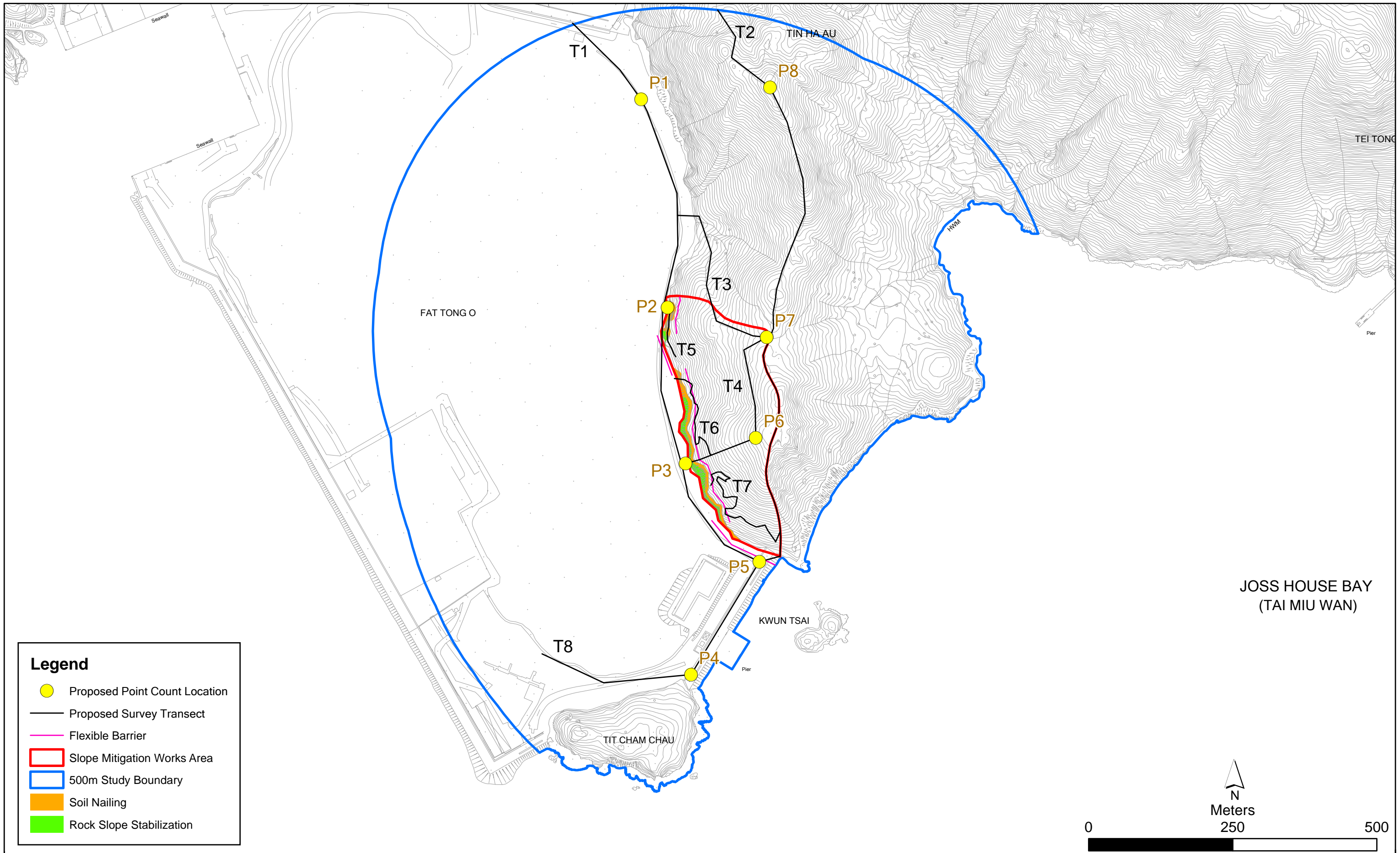
2.1.1 *Habitat & Vegetation Survey*

Field surveys focusing on habitat and vegetation within the Study Area will be performed to establish the general terrestrial ecological profile of the Study Area and Works Area.

A preliminary habitat map of suitable scale will be prepared during the desktop review, which will be used during the ecological survey. The preliminary habitat map will be produced based on government latest aerial photos and findings from the approved EIA Report, which will be verified by field ground-truthing to generate the final habitat map. Representative areas of each habitat type and the proposed slope mitigation works area will be surveyed on foot.

As part of the Updated Vegetation Survey, plant species within each habitat type of the Study Area will be identified, and their relative abundance will be recorded with special attention to rare or protected species. Species, number and locations of plant species of conservation importance, including but not limited to *Marsdenia lachnostoma*, will be recorded in accordance with requirements stated in the *EP Condition 2.7*. According to the approved EIA Report (Register No.: AEIAR-192/2015), the Updated Vegetation Survey will be carried out at the slope mitigation areas within the Clear Water Bay Country Park to assess the condition and identify the location of each individual of *Marsdenia lachnostoma* and other flora species of conservation interest that may be directly affected by the construction works.

Nomenclature and conservation status of the plant species followed those documented in the AFCD’s biodiversity database as well as Xing et al., (2000)



(1), Wu and Lee (2000) (2), Siu (2000) (3), Yip et al., (2010) (4) and Hong Kong Herbarium (2016) (5).

2.1.2

Wildlife Survey

Terrestrial Mammal

All sightings, tracks, and signs of mammals (including scats, footprints) of terrestrial mammals will be actively searched along survey transects in day- and night-time surveys. Night surveys will be conducted to survey nocturnal mammal species. Visual inspection will be conducted at potential usage area for bats (e.g. vegetation with fruits and/or a complex growth form) during night survey. The survey transects cover all representative habitats recorded within the Study Area. Nomenclature for mammals followed Shek (2006) (6). Whilst quantification of abundance of mammals in the Study Area is not required, due to the difficulties in translating sights and tracks (e.g. burrows) to actual abundance, a list of mammals recorded during the surveys will be provided.

Avifauna

The presence and abundance of bird species at various habitats shall be recorded visually and aurally during day- and night-time surveys. Birds in each habitat type within the Study Area will be surveyed quantitatively at each habitat type using transect count and/or point count method based on on-site condition. In each survey location, survey transects will be established according to site conditions and also subject to accessibility. For transect count or point count methods, all birds seen or heard within 30m from either sides of the sampling transect/ point will be counted and identified to species where possible. Signs of breeding (e.g. nests, recently fledged juveniles), if any, within the Study Area will also be recorded. Bird species encountered outside transects but within the Study Area will also be recorded to produce a complete species list. Night surveys will be conducted to survey nocturnal bird species. The locations of any bird species of conservation importance will be recorded. Observations will be made using binoculars (at least 8x) and photographic records will be taken, if possible. Ornithological nomenclature followed List of Hong Kong Birds (2013) of Hong Kong Bird Watching Society (7) or the most updated checklist.

- (1) Xing FW, Ng SC, Chau LKC (2000) Gymnosperms and angiosperms of Hong Kong. *Memoirs of the Hong Kong Natural History Society* 23: 21-136
- (2) Wu SH, Lee TC (2000) Pteridophytes of Hong Kong. *Memoirs of the Hong Kong Natural History Society*: 23:5-20
- (3) Siu LPG (2000) Orchidaceae of Hong Kong. *Memoirs of the Hong Kong Natural History Society*: 23:137-148
- (4) Yip JY., Yip JKL, Liu EKY, Ngar YN and Lai PCC (2010) A Floristic Survey of Marshes in Hong Kong. *Hong Kong Biodiversity. Agriculture, Fisheries and Conservation Department Newsletter*, 19: 7-16.
- (5) Hong Kong Herbarium (2016) Available at: <http://herbarium.gov.hk/Introduction.aspx>
- (6) Shek, C.T. (2006) *A Field Guide to the Terrestrial Mammals of Hong Kong*.
- (7) Hong Kong Bird Watching Society List of Hong Kong Birds, (2012). Hong Kong Bird Watching Society: http://www.hkbws.org.hk/web/eng/download_eng.htm

Herpetofauna

Herpetofauna surveys will be conducted qualitatively through direct observation and active searching in all habitat types along survey transects established during avifauna survey (including day- and night-time), and also in potential hiding places such as among leaf litter, inside holes, under stones and logs within the Study Area. Particular attention shall be given to streams and watercourses, if any. Since reptile and amphibian are mostly nocturnal, night surveys will be carried out. Auditory detection of species-specific calls will also be used to survey frogs and toads. During the surveys, all reptiles and amphibians sighted and heard will be recorded. Nomenclature and status used for reptiles followed Karsen et al., (1998) ⁽¹⁾ and Chan et al., (2006) ⁽²⁾ while those of amphibians followed Chan et al., (2005) ⁽³⁾.

Odonate (i.e. Dragonflies & Damselflies) & Butterfly

Odonates and butterflies in different habitats of the Study Area will be surveyed quantitatively in daytime using transect count and/or point count method based on on-site situation. The survey transects follow those adopted for avifauna survey and cover representative habitats within the Study Area. Odonates and butterflies encountered outside survey transects but within the Study Area will also be recorded in order to produce a complete species list. Odonates and butterflies seen within 30m from either sides of the sampling transect/point will be identified and counted. Relative abundance of odonates and butterflies in each type of habitat will be estimated. Nomenclature for butterflies followed Chan et al., (2011) ⁽⁴⁾ and odonates nomenclature followed Tam et al., (2011) ⁽⁵⁾.

Aquatic Fauna

Aquatic fauna survey, including freshwater macro-invertebrates and fishes, in accessible channel, stream (both perennial and seasonal) and associated riparian habitats identified within the Study Area will be conducted by direct observation and active searching. Organisms will be recorded and identified to the lowest possible taxon, and their relative abundances will be reported. Nomenclature for fish followed Lee et al., (2004) ⁽⁶⁾, while those for the macro-invertebrates followed Dudgeon (1999) ⁽⁷⁾.

- (1) Karsen SJ, Lau MWN, Bogadek A (1998) Hong Kong Amphibians and Reptiles. Urban Council, Hong Kong
- (2) Chan, K.F., Cheung, K.S., Ho, C.Y., Lam, F.N, Tang, W.S., Tse, M.L. (2006) A Field Guide to the Venomous Land Snakes of Hong Kong.
- (3) Chan KF, Cheung KS, Ho CY, Lam FN, Tang WS, Lau WN, Bogadek A (2005) Field Guide to the Amphibians of Hong Kong.
- (4) Chan ACH, Cheung JKH, Sze PWC, Wong AKC, Wong EYH and Yau EYW (2011) A Review of the Local Restrictedness of Hong Kong Butterflies. Hong Kong Biodiversity Newsletter of Agriculture, Fisheries and Conservation Department (21): 1 - 12.
- (5) Tam TW, Leung KK, Kwan BSP, Wu KKY, Tang SSH, So IWY, Cheng JCY, Yuen EFM, Tsang YM, Hui WL (2011) The Dragonflies of Hong Kong.
- (6) Lee LF, Lam KS, Ng KY, Chan KT and Young LC (2004) Field Guide to the Freshwater Fish of Hong Kong.
- (7) Dudgeon D (1999) Tropical Asian Streams: Zoobenthos, Ecology and Conservation.

2.2 **PROPOSED SURVEY SCHEDULE**

The Pre-construction Ecological Survey will be conducted at least twice in wet season and dry season. The tentative survey schedule is presented in *Table 2.1*.

Table 2.1 *Tentative Survey Schedule for Pre-construction Ecological Survey*

Season	Wet					Transition	Dry	
Month	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Day-time								
Habitat & Vegetation	✓	✓	✓	✓	✓		✓	✓
Terrestrial Mammal	✓		✓		✓		✓	✓
Avifauna	✓		✓		✓		✓	✓
Herpetofauna	✓		✓		✓		✓	✓
Odonata & Butterfly	✓		✓		✓		✓	✓
Aquatic Fauna	✓		✓		✓		✓	✓
Night-time								
Terrestrial Mammal		✓		✓			✓	✓
Avifauna		✓		✓			✓	✓
Herpetofauna		✓		✓			✓	✓

Following the approval of this *Methodology*, the *Pre-Construction Ecology Survey* will be undertaken tentatively between May and December 2016.

Upon the completion of all field surveys, the scope, methodology and details of survey findings will be documented in the *Pre-construction Ecology Survey for Slope Mitigation Works Report* to demonstrate comprehensive knowledge and updated ecological condition in the Study Area.

In addition, an *Updated Vegetation Survey Report for Slope Mitigation Works* will be prepared in accordance with *EP Condition 2.7* by the Qualified Ecologist (*Annex A*) ⁽¹⁾, in which the recommended protection and mitigation measures for the plant species of conservation importance identified within the slope mitigation works area will be proposed as appropriate. In accordance with the approved EIA Report, mitigation measures shall aim to preserve individuals of *Marsdenia lachnostoma* in its totality. Also all individuals of *Marsdenia lachnostoma* within the slope mitigation areas shall be retained in-situ, by positioning the alignment of flexible barriers at a minimum 1.5m in a radius away from these individuals

The reports will be certified by the Environmental Team Leader and verified by the Independent Environmental Checker as conforming to the information and recommendations contained in the approved EIA report.

(1) In accordance with *EP Condition 2.3*, "The Permit Holder shall appoint a Qualified Ecologist who has at least 5 years of relevant experience to be responsible for carrying out the updated vegetation survey for slope mitigation works and preparing submission for the Project as required under *EP Condition 2.7*".

Annex A

CV of Qualified Ecologist

Terence Fong

Ecologist

Terence Fong is Partner responsible for overseeing ecological impact assessments, landscape and visual impact assessment, and permitting works for development projects. He has over fifteen years experience and has managed, designed and supervised numerous habitat/ biodiversity baseline surveys and IFC compliant Biodiversity Impact Assessments in the Asia Pacific region including: Kalimantan and Java (Indonesia), Vladivostok (Russia), Brunei, Philippines, Vietnam, Thailand, Saudi Arabia, Myanmar, Laos, Singapore, Korea, China, Hong Kong and Taiwan.

Terence has been involved in and managed numerous local and overseas EIAs for examining the impacts of developments (including power plant, housing, port, mining, landfill, highways, railways, pipelines and cables) on ecological resources, particularly sensitive habitats, such as:

- Riparian vegetation
- Migratory bird habitats;
- Marshes and wetland bird habitats;
- Raptor nesting and foraging areas;
- Montane and lowland forest;
- Endemic amphibian habitats;
- Butterfly and larval host plants;
- Protection freshwater fish habitats;
- Orchid and pitcher plant habitats;
- Seagrass beds;
- Mangroves and horseshoe crab habitats;
- Coral reefs;
- Fish nursery ground.

Terence has been invited by the PRC Environmental State Protection Administration, to be one of the experts to participant in the Project "Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand", whereas the project is funded by UNEP/GEF, and appointed by UNEP as the Final Evaluator for one of the Demonstrate Site. The Project involves six components, coral, mangrove, seagrass, wetland, land-based pollution and over-exploitation of fisheries.

As Terence is specialized in terrestrial and wetland ecology and EIA, he has been invited to give lectures in different universities in Hong Kong since 1998, and also invited by East Asian Seas Regional Coordinating

Unit, UNEP (United Nations Environment Programme) to attend "The International Symposium on Protection and Management of Coastal Marine Ecosystems" and present on specialized in wetland and coastal ecology. Terence is recently appointed by The University of Hong Kong as Assistant Professor (part-time) and teaching "Ecology and Landscape Sciences" and "Ecology and Design", and Adjunct Professor (part-time) leading an EIA course for MSc programme in The City University of Hong Kong.

Fields of Competence

- Environmental Impact Assessment/Planning
- Habitat Assessment
- Renewable Energy
- Natural Resources and Conservation

Education

- MPhil, Wetland Ecology The University of Hong Kong, 1998
- BSc (Hons), Environmental Science, University of Hong Kong, 1993
- Certificate of Tropical Marine Invertebrate, 1995 Bermuda Biological Station for Research, Bermuda

Professional Affiliations & Registrations

- Adjunct Professor (part-time), The City University of Hong Kong
- Assistant Professor (part-time), The University of Hong Kong
- China-Hong Kong co-ordinator and trainer of Global Reef Check survey
- Councillor of the Marine Conservation Society, Hong Kong
- Co-opt Council Member of the Marine Biological Association of Hong Kong

Languages

- English
- Chinese (Cantonese & Mandarin)

Key Projects

Biodiversity Review for Yang Gong Windfarm Project in China (Confidential Client), 2015. Mr Fong provided technical review of the EIA Report.

Biodiversity Impact Assessment for a 100MW Photovoltaic Power Project in Jiangsu Province, China (Confidential Client), 2014. The Project involves building a solar photovoltaic system with total area of approximately 418 hectares. ERM was commissioned to conduct a detailed Biodiversity Impact Assessment and recommend feasible and practical mitigation measures for the Project. Mr Fong is the Project Director.

A Proposed Wind Farm Development, Jilin Province, China (Confidential Client), 2009-2010. ERM assessed the environmental and social management of the wind farm using Chinese regulatory, IFC performance standards and Equator Principles to identify potential environmental and social impacts of the project. ERM also assisted to implement IFC requirement including bird monitoring and staff training. Mr Fong was responsible for the design and conducting bird monitoring, as well as reassessment of bird collision risk due to the updated information.

Environmental Impact Assessment for Development of a 100MW Wind Farm in Hong Kong (Hong Kong Electric Co.), 2008-2014. ERM was commissioned to conduct the EIA for 2 alternative offshore wind farm locations in Hong Kong. Key issues for the project included impact to seabirds and migratory birds as well as impacts to two species of resident marine cetaceans. Mr Fong was responsible for the design of ecological baseline surveys including habitat mapping, seabird, marine mammal, intertidal, benthic and coral, and technical review of the ecological impact assessment and fisheries impact assessment for the Project during EIA stage. The EIA was approved, with conditions, by the Advisory Council on the Environment in April 2010. As part of the ongoing work, a Fisheries Review and Consultation Programme (FRCP) is being implemented to consult with the fishery sector and determine whether there is scope for fishing operations to be conducted within the development area and to explore the possibility of enhancing fishery resources there. In addition, Mr Fong also provided technical support and attended Stakeholder Liaison Group meetings.

Hong Kong Offshore Wind Farm in Southeastern Waters (CAPCO), Hong Kong, 2009-2014. ERM were commissioned to implement certain conditions of approval of the EIA for a wind farm in southeastern waters of Hong Kong. Mr. Fong led the work on one such condition, to develop a fisheries enhancement

plan (FEP) in consultation with the fishery sector and the Hong Kong government, incorporating such measures as the deployment of artificial reefs. The FEP will ensure the views of fishermen are heard, addressed and utilized. In addition, Mr Fong provided technical support and attended Stakeholder Liaison Group meetings.

Offshore Wind Farm Pilot EIA (Unitech Engineering Inc.), Taiwan, 2013-2014. ERM was engaged to conduct bird collision risk assessment for an offshore wind farm pilot EIA which built upon Taiwan regulatory approvals. Mr Fong provided technical input on the bird collision risk assessment.

Environmental Assessment for the Town Island Renewable Energy Supply (CLP Power), Hong Kong, 2009-2010. CLP proposed to establish permanent Renewable Energy including photovoltaic arrays, two 6kW wind turbines, underground cabling system and associated equipment for a residential drug rehabilitation facility. The key concerns of the project include ecology, tree felling, visual and landscape, and electric and magnetic field. Mr Fong was responsible for the design of ecological baseline surveys and technical review of the ecological impact assessment (including bird collision risk assessment) for the Project.

Environmental Assessment for the Town Island Renewable Energy Supply (CLP Power), Hong Kong, 2009-2010. CLP proposed to establish permanent Renewable Energy including photovoltaic arrays, two 6kW wind turbines, underground cabling system and associated equipment for a residential drug rehabilitation facility. The project involved 6 months avifauna surveys. Mr Fong was responsible for the design of ecological baseline surveys and technical review of the ecological impact assessment for the Project.

Environmental, Social and Health Impact Assessment of a Proposed 380 MW Hydropower Project, (Confidential Client), Philippines, 2014-2015. ERM is presently conducting the ESHIA for a hydropower facility in Luzon Province in the Philippines. ERM is also tasked with supervising the local consultants who are responsible for obtaining the Environmental Compliance Certificate. Key issues include dam safety, changes in seasonal flooding patterns, habitat loss and ecological flow assessment. Terence is the Project Director.

Coc San Hydropower Project: Environmental and Social Impact Assessment Study, Vietnam (Colben Energy (Vietnam) Joint Stock Company and Viet Hydro Pte. Ltd.), 2013. ERM were commissioned to conduct the ESIA for the development of a hydroelectric project in Trung Chai Commune, Sa Pa

District and Coc San Commune, Bat Xat District, close to the Chinese border in northern Vietnam. The Coc San Hydropower Project (HPP) will utilise the waters of the Dum River (Ngoi Dum) to potentially generate 134.2 GWh of energy per year from an installed capacity of 29.7 MW. The study involved detailed biodiversity field surveys including habitat mapping, vegetation and wildlife surveys and social baseline surveys. Terence was the Project Manager and Biodiversity Specialist responsible for overseeing the EIA, biodiversity baseline survey design and technical review of the EIA and recommendations for mitigation measures and monitoring requirements.

Nam Ngiep 1 Hydropower Project: Biodiversity Offset Assessment & Environmental Flow Assessment, Laos, (Kansai Electric Power Company Inc.), 2013. Nam Ngiep 1 Hydropower Project (NNHP1) Project involves construction and operation of a 290MW hydroelectric power generation facility on a build-operate-transfer basis at the Nam Ngiep River. The Project site is in the provinces of Vientiane and Bolikhamxay, Lao PDR with the majority of generated power exported to Thailand and some for domestic supply. ERM were commissioned to conduct biodiversity offset assessment including undertaking comprehensive baseline biodiversity surveys, assessing biodiversity impact and suitability of a biodiversity offset, as well as its design of measures. The scope of works also included technical review of environmental flow assessment. Terence was the Biodiversity Specialist of the study.

Nam Sane 3 Hydro-Power Plant Environmental Impact Assessment Study, (Rohas) Laos, 2008. ERM were commissioned to conduct the EIA for the development of a hydroelectric project in a remote region of Xieng Khouang province in Laos. The study involved detailed biodiversity field survey including habitat mapping, vegetation and wildlife surveys to gather baseline information as well as conducting stakeholder consultation meetings with various NGOs and government departments. Mr Fong was responsible for biodiversity baseline survey design and technical review of the ecological impact assessment and recommendations for mitigation measures and monitoring requirements.

Biodiversity Impact Assessment for Downtown Line Stages 2 & 3 Alignment (Land Transport Authority), Singapore, 2009. The biodiversity impact assessment forms part of the EIA study for the Downtown Line Stages 2 & 3 Alignment. Mr Fong was responsible for the design and coordination of the terrestrial biodiversity baseline surveys including habitat mapping, vegetation and wildlife, surveys, and the biodiversity assessment.

Scoping Environmental Impact Assessment of the Mount Faber Development (Sentosa Development Corporation), Singapore, 2007. Sentosa Development Corporation (SDC) intended to develop 65 hectares of land at the foothill of Mount Faber, which include low intensity developments such as themed leisure experiences, unique accommodations and transport nodes connecting the precinct to the Mount Faber Ridge top, a cluster of attractions that leverage on the natural landscape and terrain. Mr Fong was responsible for biodiversity and ecological assessment.

EIA for Marina Bay Sands in Singapore (Venetian Macau Limited) 2007. Mr Fong was responsible for the design and coordination of the terrestrial and marine biodiversity baseline surveys including habitat mapping, vegetation, wildlife, coastal and benthic surveys. The biodiversity assessment evaluated the biodiversity and ecological conditions of the site and identified the potential impacts due the development.

The Baroque on Lamma (Confidential Client) 2010-2012. ERM has been commissioned to undertake the EIA and planning applications for a marina development off southeast Lamma Island. Key issues for the EIAs include impacts of sensitive habitats for Romer's Tree Frog, birds, finless porpoise, green turtle, and fisheries. ERM is therefore responsible for the design of ecological baseline surveys including habitat mapping, terrestrial wildlife, marine mammal, intertidal, benthic and coral. Mr Fong is the Ecology Team Leader responsible for co-ordinating and organizing ecological field surveys, identifying potential environmental constraints of the proposed project, providing appropriate mitigation measures and preparing the ecological and LVIA sections of the EIA Report.

Pilot Project for Public - Private Conservation Scheme, Sha Lo Tung Valley, Tai Po (Sha Lo Tung Development Company), 2005-2009. The Pilot Project is proposed to be one of the pilot projects under the scheme of Public-Private Partnership (PPP) further to HKSAR government's Nature Conservation Policy. This Project establishes the framework for a public-private partnership to conserve the Sha Lo Tung Valley in Tai Po which is well known dragonfly heaven and of ecological significance. Endorsement of the Project will ensure long-term active conservation management of the ecologically sensitive areas currently located on private land owned by the Sha Lo Tung Development Company. The Project will provide a source of funds to sustain conservation action of the ecological sensitive area. This balance between development and conservation expectations, will enable the Valley to become a unique nature

attraction and educational resource for both locals and tourists, which can be achieved quickly and without Government funding. Mr Fong was the Project Manager responsible for the environmental impacts assessment due to the proposed development outside the Sha Lo Tung Valley, as well as the development of Conservation Management Plan.

2008 Update of Terrestrial Habitat Mapping and Ranking Based on Conservation Value (Sustainable Development Division of the Environment Bureau, HKSAR), Hong Kong, 2008-2009. The main objectives of the Study are to update the findings of the previous Habitat Mapping Studies (in 2000, 2003, 2005 and 2007) to review and update the existing terrestrial habitat and ecological baseline database (including the maps contained in the Computer-Aided Sustainability Evaluation Tool (CASET)) and maintain the data integrity through (a) remote sensing analysis using up-to-date satellite images; (b) desktop truthing using orthophotos; and (c) field truthing surveys including for freshwater/brackish wetland, natural watercourse, rocky shore, sandy shore, mangrove and intertidal mudflats in Hong Kong, amongst others. Mr. Fong was the Project Manager and habitat mapping specialist on this project, having also been the Project Manager or deputy for the previous 2006-7 and 2002-2003 Habitat Mapping Projects that ERM were commissioned for as well as the original 2000 Project whereby the Habitat Map baseline was established.

Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand, for UNEP/GEF, 2002-2008. Mr Fong was invited by the PRC Environmental State Protection Administration to work along-side other international experts from the project region. The project involves six components: coral, mangrove, seagrass, wetland, land-based pollution and over-exploitation of fisheries, and aims to develop Demonstration Sites for each component. As one of the experts, Mr Fong was responsible for conducting ecological surveys, proposing suitable demonstration sites and collaborating with local government, community stakeholders and academics, etc to preserve and manage the area properly. Due to the lack of ecologists in Mainland China, Mr Fong instructed some training courses for the South China Sea Institute of Oceanology. Mr Fong also appointed by UNEP as the Final Evaluator for one of the Demonstrate Site.

Environmental Consultancy Services (Confidential Theme Park Group), 2014-2015. ERM has been commissioned by a theme park group to provide consultancy services around its environmental permitting, advising on what is permissible within the limits of the current permit and what would require

an application for a variation. Mr. Fong has been a key advisor on all environmental and strategic elements, also leading the ecological and LVIA inputs to any reporting.

Environmental Consultancy Services (Confidential Theme Park Group), 2013-2014. ERM has been commissioned by a theme park in Hong Kong to provide consultancy services around its environmental permitting, particularly with regards to the scope of existing permits and any requirement for additional permit applications for proposed new developments. Mr. Fong, with his detailed knowledge of the environmental legislation and permitting processes, was key strategic advisor for this Project, particularly with regards to LVIA and biodiversity inputs.

Infrastructure for Penny's Bay Development - Contract 1: Vegetation Transplantation (China State), 2002-2005. ERM has been commissioned to conduct vegetation survey and transplantation works for two restricted sedge species impacted by the development of Penny's Bay. Mr Fong was the Project Manager and was responsible for preparation of transplantation proposal, supervision of the overall transplantation procedures. The plants have been transplanted to Sze Pak Wan and monitored for three years before handover to AFCDD.

Detailed Design for Wetland Recreation, Kowloon and Canton Railway Corporation (KCRC), Hong Kong, 2000-2004. Mr Fong was the Deputy Project Manager of this study. Its overall objective is to compensate for the loss of ecologically-rich wetland habitat in the Kam Tin Valley through a habitat creation programme based on the guiding principles established in the HCMP. As the ecology of the Kam Tin Valley has been disrupted through the West Rail project, the guiding principles should facilitate the early establishment of ecological resources on commissioning of the re-created wetland habitat. With this overall objective in mind, broad principles will be applied for the expeditious wetland design and creation process.

APPENDIX E
UPDATED VEGETATION SURVEY REPORT BY ERM

First Stage of Desalination Plant at
Tseung Kwan O – Investigation,
Design and Construction: *Updated
Vegetation Survey for Slope
Mitigation Works*

June 2017

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First Stage of Desalination Plant at Tseung Kwan O – Investigation, Design and Construction: *Updated Vegetation Survey for Slope Mitigation Works*

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Final Report for the Updated Vegetation Survey for Slope Mitigation Works

Document Code: 0332378_Final Report for Updated Vegetation Survey for Slope Mitigation Works.docx

Client: Black & Veatch Hong Kong Limited		Project No: 0332378			
Summary: This document presents the <i>Final Report of the Updated Vegetation Survey for Slope Mitigation Works</i> for the First Stage of Desalination Plant at Tseung Kwan O – Investigation, Design and Construction.		Date: 30 June 2017			
		Approved by:   Craig A. Reid Terence Fong <i>Partner</i> <i>Partner</i>			
1	Final	PT	TF	TF	16/06/17
0	Draft	VAR	JNG	CAR/ TF	20/02/17
Revision	Description	By	Checked	Approved	Date
<p>This report has been prepared by Environmental Resources Management the trading name of 'ERM Hong-Kong, Limited', with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.</p> <p>We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.</p> <p>This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.</p>		<p>Distribution</p> <p><input checked="" type="checkbox"/> Government</p>  			

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1.1 BACKGROUND

The Water Supplies Department (WSD) is undertaking a project named “Desalination Plant at Tseung Kwan O” (hereinafter referred to as the “Project”). This Project will have a water production capacity of 135,000 cubic meters (m³) per day with provision for future expansion to the ultimate capacity up to 270,000 m³ per day when necessary.

In November 2015, WSD commissioned the study “*First Stage of Desalination Plant at Tseung Kwan O – Investigation, Design and Construction*” (Agreement No. CE 8/2015 (WS)) for the investigation, design and construction studies of the Project.

The Project requires an Environmental Permit (EP) from the Hong Kong SAR Government. In relation to this, WSD has prepared an Environmental Impact Assessment (EIA) Report which was submitted to the Director of Environmental Protection (DEP) on 27 May 2015 and was subsequently approved on 4 November 2015 (Register No.: AEIAR-192/2015). The EP (EP-503/2015) for the construction and operation of the Project was granted on 4 December 2015.

Condition 2.7 of the EP of the Project specifies that an Updated Vegetation Survey for Slope Mitigation Works shall be carried out to reduce ecological impact on plant species of conservation importance, including but not limited to *Marsdenia lachnostoma*, due to the slope mitigation works of the Project. The Updated Vegetation Survey for Slope Mitigation Works shall be completed before the commencement of site clearance works for the slope mitigation works.

An Updated Vegetation Survey (hereinafter “the Assignment”) to be carried out in accordance with the requirements of *Condition 2.7* of the EP is consequently required.

1.2 OBJECTIVE & SCOPE OF THIS ASSIGNMENT

The main purpose of this Updated Vegetation Survey is to gather up-to-date ecological information in the proposed location of the slope mitigation works within the Clearwater Bay Country Park area for the Project under Agreement No. CE 8/2015 (WS).

According to *Condition 2.7* of EP, the Updated Vegetation Survey shall include:

- details of updated vegetation survey including the survey methodology, duration and schedule;

- findings of the updated vegetation survey, particularly on species, numbers and locations of the plants species of conservation importance including but not limited to *Marsdenia lachnostoma*, identified within the works area of slope mitigation works.
- recommended protection and mitigation measures for the plant species of conservation importance as identified in the updated vegetation survey; and
- if transplantation is eventually proposed for the plant species of conservation importance, the transplantation proposal shall include the locations of reception sites for transplanted plants, methodology of transplantation and detailed schedule for post-transplantation monitoring and maintenance requirements.

1.3 PURPOSE OF THE REPORT

According to Condition 2.7 of EP, the Updated Vegetation Survey Report shall be prepared by the Qualified Ecologist as appointed under Condition 2.3 and 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 (Register No. AEIAR-192/2015).

The Updated Vegetation Survey of Slope Mitigation Works (“the Report”) summarizes the survey methodology and the findings of surveys between May and December 2016. Based on the survey findings, recommended mitigation measures are proposed to conserve the recorded plant species of conservation importance as identified in the Updated Vegetation Survey.

All recommended mitigation measures as set out in the approved Vegetation Survey Report shall be fully and properly implemented on site during the construction stage. No site clearance works for the slope mitigation works of the Project shall be allowed prior to the approval of the Vegetation Survey Report, as well as completion of any protection/mitigation works or transplantation.

1.4 STRUCTURE OF THIS REPORT

Following this introductory section, the remainder of this *Final Report* is presented as follows:

- *Section 2* presents the methodologies for the Updated Vegetation Survey of Slope Mitigation Works as agreed by AFCD;
- *Section 3* describes the findings of the surveys completed between May and December 2016; and

- *Section 4* presents the potential impacts and recommended mitigation measures for the plant species of conservation importance as identified in the surveys.

2.1 INTRODUCTION

The survey methodology of this Assignment has made reference to the technical guidelines of ecological assessment in *Annex 16 of EIAO-TM* and the relevant Guidance Notes (*GN 7/2010* and *GN 10/2010*) as well as the requirements stipulated in *Condition 2.7 of EP-503/2015*.

Based on the desktop review and findings from the EIA Report, an updated vegetation survey is proposed to be conducted in the wet and dry seasons for a duration of at least 6 months between May and December 2016 to provide up-to-date information on existing condition of terrestrial ecological profile within the Study Area, which is 500 m from the slope mitigation works area ("Works Area") (*Figure 2.1*) ⁽¹⁾. Study boundary is drawn up with due consideration of the diversity of habitats and presence of species of conservation importance within the terrestrial habitats of the Study Area, in particular the Works Area within the Clearwater Bay Country Park.

2.2 HABITAT & VEGETATION SURVEY

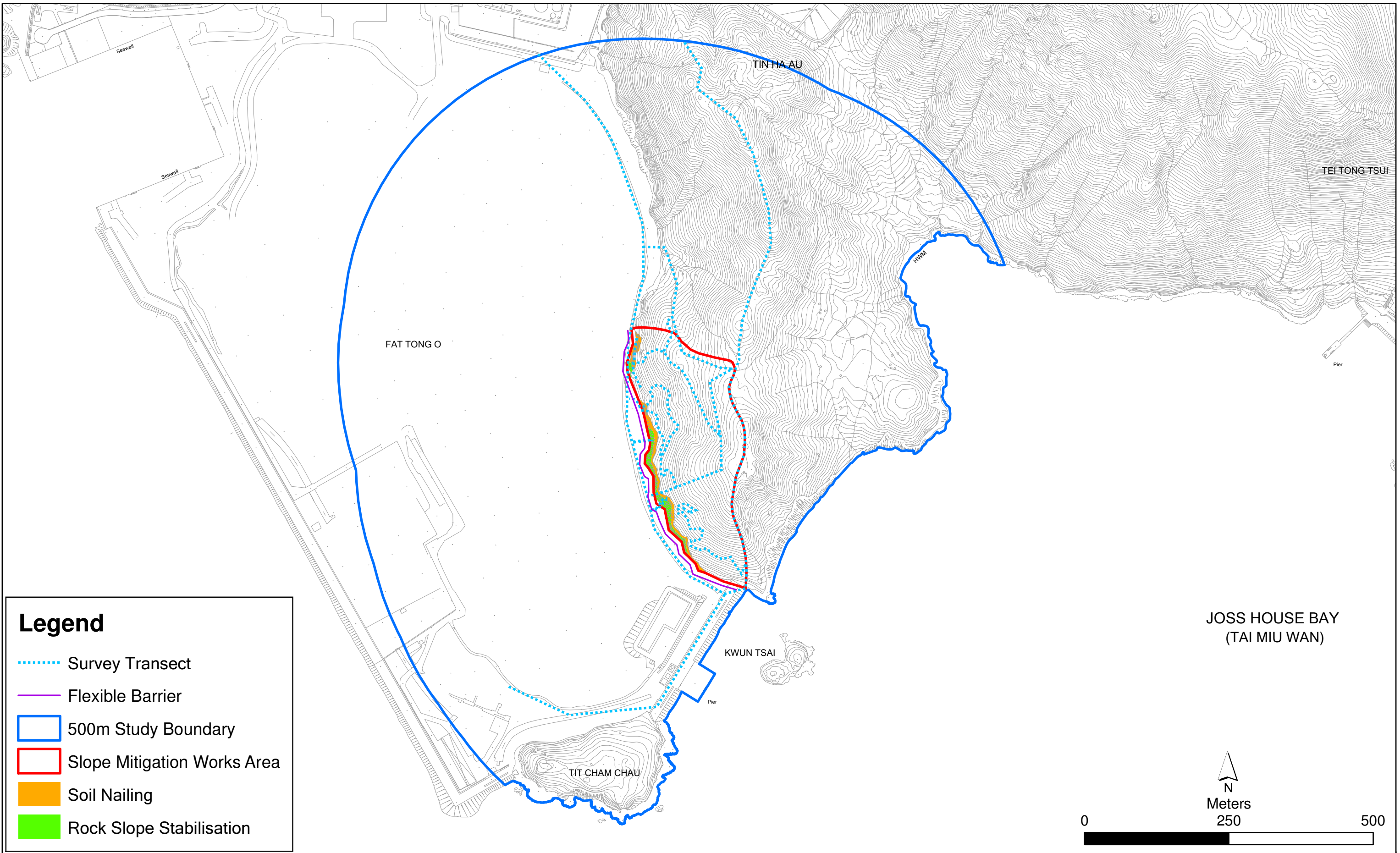
Field surveys focusing on habitat and vegetation within the Study Area were conducted to establish the general terrestrial ecological profile of the Study Area and Works Area.

A habitat map showing the Study Area was compiled based on the government latest aerial photos and findings from the approved EIA report (Register No.: AEIAR-192/2015), with aid of field ground truthing. Representative areas of each habitat type and the proposed Works Area were surveyed on foot.

According to the approved EIA Report (Register No.: AEIAR-192/2015) and *Condition 2.7* of the Environmental Permit (EP) (EP-503/2015), the Updated Vegetation Survey was carried out at the slope mitigation areas within the Clearwater Bay Country Park in order to assess the existing condition and identify the location of each individual of *Marsdenia lachnostoma* and other plant species of conservation importance that may be directly affected by the slope mitigation works.

As part of the Updated Vegetation Survey, plant species within each habitat type of the Study Area were identified, and their relative abundance was recorded with special attention to rare or protected species. Species, number and locations of plant species of conservation importance, including but not limited to *Marsdenia lachnostoma*, were recorded in accordance with

(1) Surveys have been done along all identified accessible paths throughout the site (verification by ground-truthing), including survey transects conducted in the previous EIA study. Survey over the slope, especially at the horizontal interface between mixed woodland in the slope toe and the shrubland and hillside grassland mosaic, was conducted along the temporary accesses which only available since July 2016.



requirements stated in the *EP Condition 2.7*. Since there are multiple above-ground shoots or rhizomes for each individual of scandent shrubs and herbaceous plants, each plant species of conservation importance are counted in terms of group, which refers to cluster of individuals growing together at the same location. Nomenclature and conservation status of the plant species followed those documented in the AFCD's biodiversity database as well as Xing et al., (2000) ⁽¹⁾, Wu and Lee (2000) ⁽²⁾, Siu (2000) ⁽³⁾, Yip et al., (2010) ⁽⁴⁾ and Hong Kong Herbarium (2016) ⁽⁵⁾.

2.3 SURVEY EFFORT

The entire surveying period for this Assignment is from May to December 2016. Over this period, a total of seven surveys have been conducted in accordance with the approved survey methodology ⁽⁶⁾. The overall survey programme is summarized in *Table 2.1*.

Table 2.1 *Programme of the Updated Vegetation Survey*

Season	Wet					Transition	Dry	
Month	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Day-time								
Habitat & Vegetation	18/5	22/6	22/7	22/8	20/9		29/11	23/12

Note:
Survey dates are presented in the shaded cells.

- (1) Xing FW, Ng SC, Chau LKC (2000) Gymnosperms and angiosperms of Hong Kong. *Memoirs of the Hong Kong Natural History Society* 23: 21-136
- (2) Wu SH, Lee TC (2000) Pteridophytes of Hong Kong. *Memoirs of the Hong Kong Natural History Society*: 23:5-20
- (3) Siu LPG (2000) Orchidaceae of Hong Kong. *Memoirs of the Hong Kong Natural History Society*: 23:137-148
- (4) Yip JY., Yip JKL, Liu EKY, Ngar YN and Lai PCC (2010) A Floristic Survey of Marshes in Hong Kong. *Hong Kong Biodiversity. Agriculture, Fisheries and Conservation Department Newsletter*, 19: 7-16.
- (5) Hong Kong Herbarium (2016) Available at: <http://herbarium.gov.hk/Introduction.aspx>
- (6) The methodology was submitted to AFCD for review and comment via email on 4 March 2016. Subsequently, AFCD replied with no further comment on the methodology on 21 April 2016

3.1 HABITAT & VEGETATION

A total of six habitats were identified in the Study Area, including mixed woodland, shrubland and hillside grassland mosaic, urbanised/ disturbed area, wasteland, watercourse and marine habitats (including rocky shore, sandy shore and seawall, which are outside of the scope of this Assignment). A map showing the terrestrial habitat types is presented in *Figure 3.1*. The total area of terrestrial habitat is summarised in *Table 3.1* and the representative photos of identified terrestrial habitats are shown in *Figure 3.1*.

A total of 139 plant species were recorded between May and December 2016 within the study area. Of the 139 plant species recorded, two were considered as plant species of conservation importance, including Hairy-throat Condorvine *Marsdenia lachnostoma* and Balloon Flower *Platycodon grandiflorus*. Only *Marsdenia lachnostom* was found within the Works Area and within the shrubland and hillside grassland mosaic habitat. Location of the identified plant species of conservation importance are shown in *Figure 3.2* and their representative photos are presented in *Figure 3.3*. Full list of the plant species recorded between May and December 2016 is provided in *Annex A*.

Table 3.1 *Estimated Habitat Area within the Study Area and Proposed Works Area*

Habitat	Area within the Study Area		Area within the Works Area	
	hectares (ha)	% total	hectares	% total
Mixed woodland	~ 1.2	1.2%	~ 0.3	5%
Shrubland and hillside grassland mosaic	~ 43.1	44.1%	~ 5.6	95%
Urbanised / disturbed area	~ 44.3	45.3%	0.0	0%
Wasteland	~ 8.1	8.3%	0.0	0%
Watercourse	~ 1.0 (length = 1.6km)	1.0%	0.0	0%
Total	~ 97.7	100%	~ 5.9	100%

3.1.1 Mixed Woodland

Mixed woodland of about 1.2 ha in size was recorded within the Study Area. It was found at the toe of the Works Area and in close proximity with shrubland and hillside grassland mosaic.

The habitat had a canopy height of between 8 - 10 meters. The mixed woodland was composed of a low diversity of exotic tree species including *Acacia auriculiformis* and *Leucaena leucocephala*, and native trees including *Celtis sinensis*, *Ficus hispida*, *Litsea glutinosa*, *Schefflera heptaphylla*, and *Sterculia lanceolata*. Understorey of the woodland was occupied by young tree

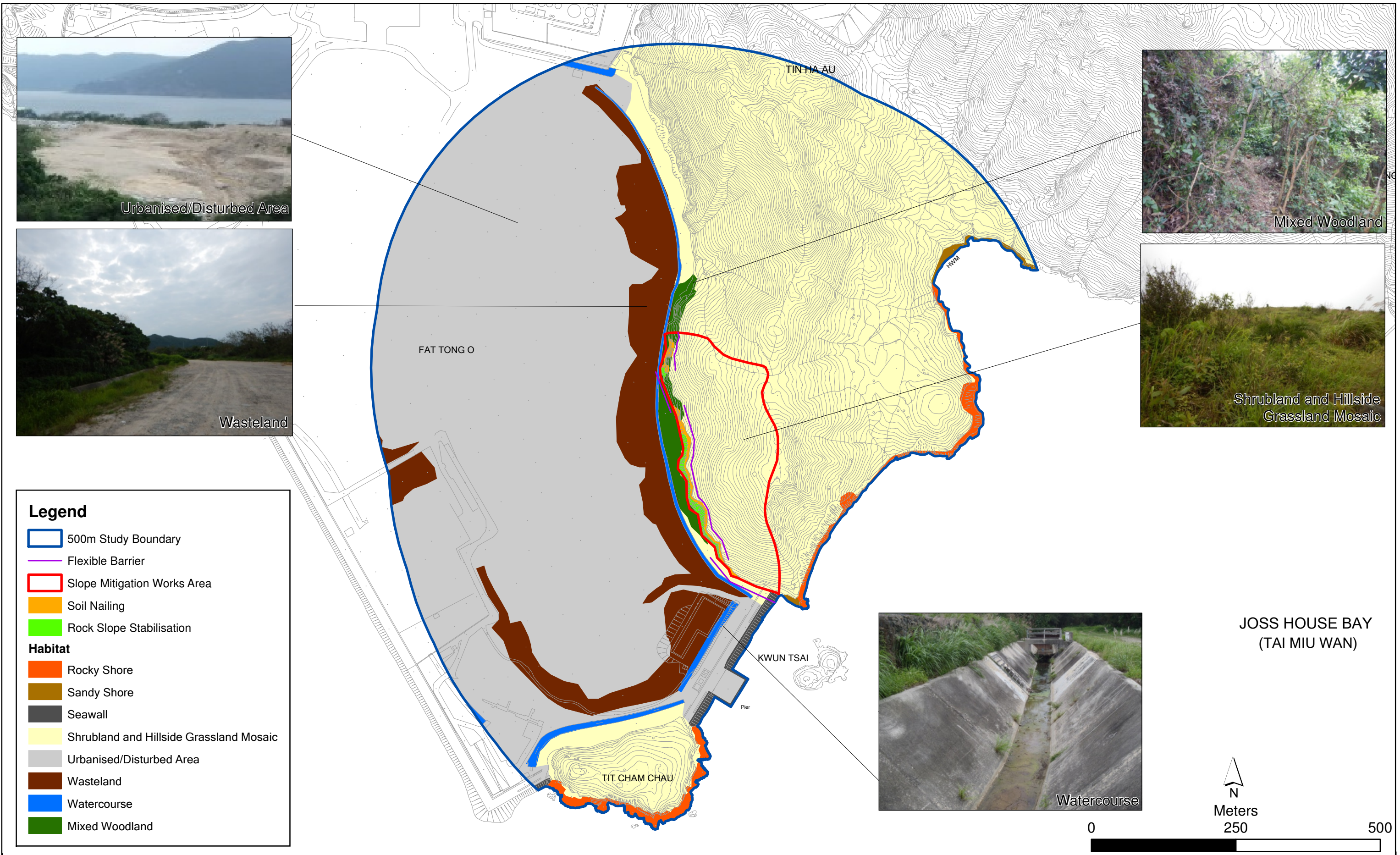


Figure 3.1

Habitat Map With Respect to Original Slope Mitigation Works Design

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Date: 12/5/2017

Environmental
Resources
Management



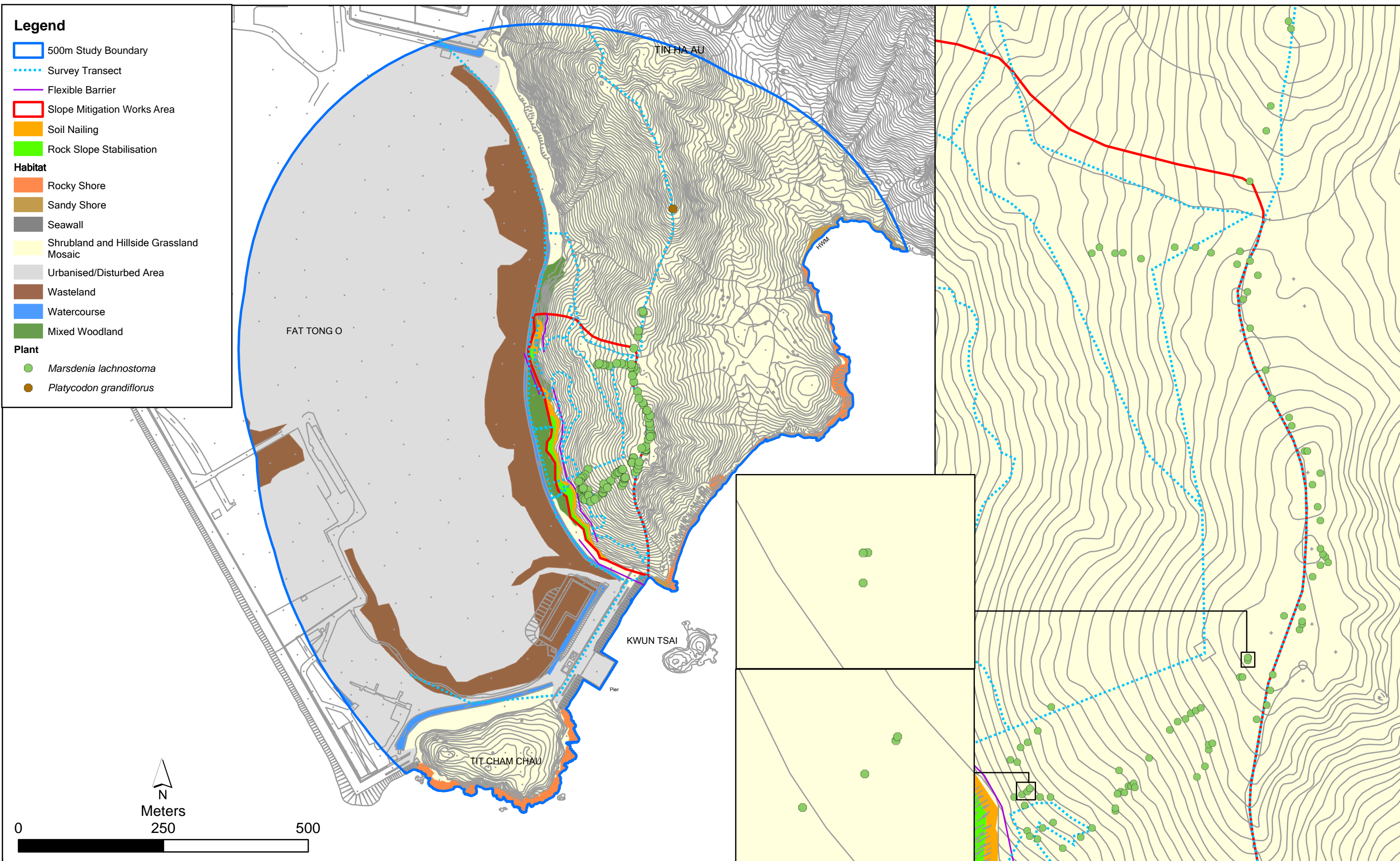


Figure 3.2
 Study Area for Updated Vegetation Survey - Species of Conservation Importance (Original Slope Mitigation Works)



Marsdenia lachnostoma



Platycodon grandiflorus

seedlings, shrubs and herbaceous vines, including *Alocasia macrorrhizos*, *Alpinia zerumbet*, *Ficus hirta*, *Lophatherum gracile*, *Miscanthus floridulus*, *Mussaenda pubescens*, *Psychotria asiatica* and exotic *Mikania micrantha*. No plant species of conservation importance was identified in this habitat.

3.1.2 Shrubland and Hillside Grassland Mosaic

Natural shrubland and hillside grassland mosaic is the second largest habitat in terms of area within the Study Area (approximately 43.1 ha, comprising 44.1% of the total Study Area). This habitat is simple in community structure and scattered with sparse trees/ tall shrubs. Common shrubland species recorded in this habitat included *Litsea glutinosa*, *Rhodomyrtus tomentosa*, with understorey comprised of *Dicranopteris pedata*, *Embelia laeta* and *Gnetum luofuense*. Two species of conservation importance, *Marsdenia lachnostoma*, *Platycodon grandiflorus*, were recorded in this habitat, and only *Marsdenia lachnostoma* recorded within the Works Area.

3.1.3 Urbanised/ Disturbed area

Urbanised/ Disturbed area, the largest habitat in terms of area within the Study Area, included existing landfill, fill bank, roads, and other existing developments. Plant species recorded were mainly composed of low diversity of herbaceous plants namely *Imperata cylindrica* and weedy vegetation including *Bidens alba*.

3.1.4 Wasteland

Wasteland was recorded along the fringe of the Project Site outside of the Works Area and as patches inside the existing fill bank. This habitat was densely vegetated with herbaceous plants including *Miscanthus floridulus* and *Alternanthera paronychioides* and weedy vegetation including *Leucaena leucocephala*, *Bidens alba* and *Mikania micrantha*.

3.1.5 Watercourse

Watercourse identified within the Study Area is a man-made channel and ditches without riparian vegetation community.

3.1.6 Plant Species of Conservation Importance

Within the Study Area, a total of two plant species of conservation importance were recorded, including Hairy-throat Condorvine *Marsdenia lachnostoma* and Balloon Flower *Platycodon grandiflorus*.

Throughout the surveys between May and December 2016, a total of 94 groups of *Marsdenia lachnostoma* and 1 group of *Platycodon grandiflorus* were recorded (Figure 3.2). Most of them are located within the slope mitigation works area, except for the *Platycodon grandiflorus* and 4 groups of *Marsdenia lachnostoma*.

Hairy-throat Condorvine *Marsdenia lachnostoma* is an endemic plant of Guangdong that is listed in the Rare and Precious Plants in Hong Kong and listed as “Critically Endangered” in China Plant Red Data Book ⁽¹⁾ ⁽²⁾. Locally it is only distributed in shrublands and young woodlands with sparse tree canopy in North Point, Ma On Shan, Sai Kung and Tung Lung Chau. The 94 groups of *Marsdenia lachnostoma* were all recorded at the shrubland and hillside grassland mosaic within the Works Area.

Balloon Flower *Platycodon grandiflorus* was recorded in the current survey, which is in line with the record in the approved EIA report (AEIAR-192/2015). This plant species is a restricted species found only in sunny grassy slopes and shrublands of Hong Kong ⁽¹⁾. Populations of this plant species are only recorded in Hong Kong Island, Castle Peak and Long Ke, where a Site of Special Scientific Interest (SSSI) was designated in Castle Peak since 1980 to protect a population of this plant species. Balloon Flower is protected under Cap. 96 locally for conservation and to avoid further exploitation due to its medicinal and ornamental value. During the survey in September 2016, six (6) groups of Balloon Flower were recorded flowering with immature fruits on an exposed ridge close to point count location P7, where is a shrubland and hillside grassland mosaic habitat outside of the Works Area.

3.2 SPECIES OF CONSERVATION IMPORTANCE WITHIN THE WORKS AREA

During the surveys between May and December 2016, one plant species and seven fauna species recorded within the Works Area are of conservation importance, and they are summarised in *Table 3.2*.

Table 3.2 Plant Species of Conservation Importance Recorded Within the Works Area

Name	Locations	Protection Status ⁽²⁾	Distribution	Rarity	Location along Direct Footprint of Proposed Flexible Barrier, Soil Nailing and Rock Slope Stabilisation Area
Hairy-throat Condorvine <i>Marsdenia lachnostoma</i>	Shrubland and hillside grassland mosaic	Listed as “Critically Endangered” in the Rare and Precious Plants of Hong Kong and “Critically Endangered” in China Plant Red Data Book	Shrubland	Very rare	Near flexible barrier at Location P3

(1) <http://herbarium.gov.hk/PublicationsPreface.aspx?BookNameId=1&ContentId=73&SectionId=3>

(2) Hong Kong Plant Database. [Available from: http://herbarium.gov.hk/Search_Form.aspx]

The Updated Vegetation Survey of Slope Mitigation Works were carried out between May and December 2016 in accordance with the approved methodology set out in *Section 2*.

One plant species of conservation importance was found within the Works Area, namely Hairy-throat Condorvine *Marsdenia lachnostoma*. It was distributed within the shrubland /hillside grassland mosaic habitat within the Works Area. It is worth noting that several groups of *Marsdenia lachnostoma* were recorded in the close proximity of the proposed flexible barrier as shown on *Figure 3.2*.

4.1 POTENTIAL IMPACTS TO THE PLANT SPECIES OF CONSERVATION IMPORTANCE BASED ON ORIGINAL SCHEME

The original proposed slope mitigation works including installation of flexible barriers, boulder stabilisation and rock slope stabilisation was proposed to be carried out within the mixed woodland and shrubland-grassland mosaic habitat along the toe of natural terrain within the Clearwater Bay Country Park area and its close proximity. The flexible barriers were originally proposed to be located at the east of the rock slope stabilisation to preserve all recorded flora species of conservation importance and minimise potential impacts to the existing vegetation as far as possible. However, the proposed temporary fencing is located in proximity of several groups of *Marsdenia lachnostoma*, and may cause impact to the woodland and shrubland-grassland mosaic habitat in Clearwater Bay Country Park:

- Permanent loss or temporary disturbance of the woodland and shrubland-grassland mosaic habitat; and,
- Permanent loss or temporary disturbance of *Marsdenia lachnostoma* .

In order to further minimise the potential impacts, a revised scheme of slope mitigation works has been proposed, as detailed in *Section 4.2* below.

4.2 REVISED SCHEME OF SLOPE MITIGATION WORKS

The survey findings showed that several groups of *Marsdenia lachnostoma* were recorded in the close proximity of the proposed flexible barrier. Therefore, the design of the slope mitigation works, in particular the alignment of flexible barrier, is further adjusted such that no plant species of conservation importance will be affected and tree felling is also avoided. The schemes of slope mitigation works, as shown in *Figure 4.1*, include:

- (i) Boulder removal/ break-off works for 15 unstable boulders identified on the natural terrain within the Clearwater Bay Country Park area;
- (ii) Rock slope stabilisation along the toe of natural terrain within the Clearwater Bay Country Park area; and,

- (iii) Flexible barrier at 7m away from the slope toe of the Clearwater Bay Country Park.

4.2.1 *Boulder Removal*

A total of 15 high risk and potentially unstable boulders (ranged between 1.0m – 2.5m in diameter) located at the toe and near the hill top of natural terrain within the Clearwater Bay Country Park will be removed or broken-off in place (*Figure 4.1*). Unstable boulder capable for removal will be lifted up and removed by mobile crane directly. Where removal of boulder is not feasible, the unstable boulder will be broken off into small pieces (about 300mm) in place manually by hand-held electrical jack hammer. Boulder pieces will then be deposited in place or transported off site. Five temporary elevated accesses of 600mm in width and with a total length of approximately 433m, ranging from 9m to 290m around the unstable boulder, will be provided. Temporary elevated access for boulder removal work (surround each boulder with 600mm width) for 15 nos. of boulders will also be provided (total area = 0.006 ha). Three unstable boulders are located at the close proximity of area with relatively higher density of the plant species of conservation importance *Marsdenia lachnostoma* in the shrubland and hillside grassland mosaic habitat to the southeast of location P3 (*Figure 4.2*). To avoid direct conflict between the boulder removal and nearby plant species of conservation importance, protection zones/ works exclusion zones will be established at least 1m radius from the identified plant species of conservation importance in order to preserve them on site. The protection zone (s)/ works exclusion zone(s) will be established prior to site clearance and throughout the construction period to separate the identified protected plant individuals from any potential works. The temporary working platform and temporary elevated access will also be designed to avoid its anchorage on the plant species of conservation importance. Potential ecological impact due to the site clearance and temporary elevated access is expected to low, as the impacts will be temporary and all species of conservation importance will be avoided with protection. Further mitigation measures are presented in *Section 4.3*. With proper implementation of the recommended mitigation measures, no unacceptable impact to the plant species of conservation importance is anticipated.

4.2.2 *Rock Slope Stabilisation*

Rock slope stabilisation, including the use of Rock bolt, buttress/ dentition and wire mesh, will be undertaken to stabilize the toe of natural rock slope at the shrubland and hillside grassland mosaic habitat (a total area of 0.12 ha) and small portion of mixed woodland (about 0.08 ha) within the Clearwater Bay Country Park (*Figure 4.2*). The rock slope stabilisation works are described in *Table 4.1* and indicated on *Figure 4.1*. The rock stabilisation works has been adjusted such that no tree felling will be required and plant species of conservation importance will be affected. Two temporary working platforms for rock slope works (~0.02ha and ~0.26ha respectively) will be provided. Landscaping works will be provided in form of hydroseeding and/or planting shrub seedlings to reinstate vegetation loss and disturbance at the area of rock slope stabilisation (see *Section 4.3*). Stone facing to

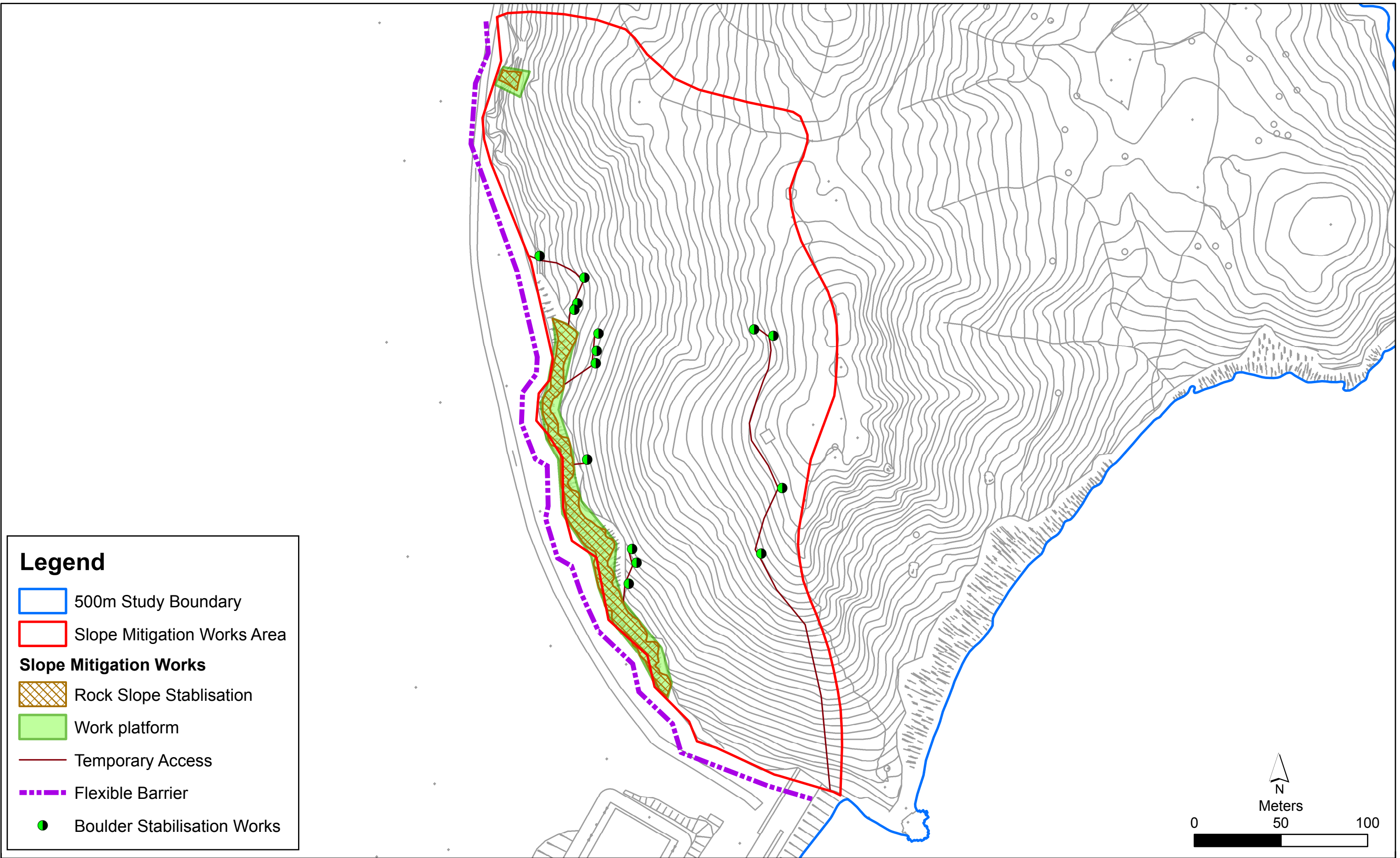


Figure 4.1

Revised Scheme of Slope Mitigation Works

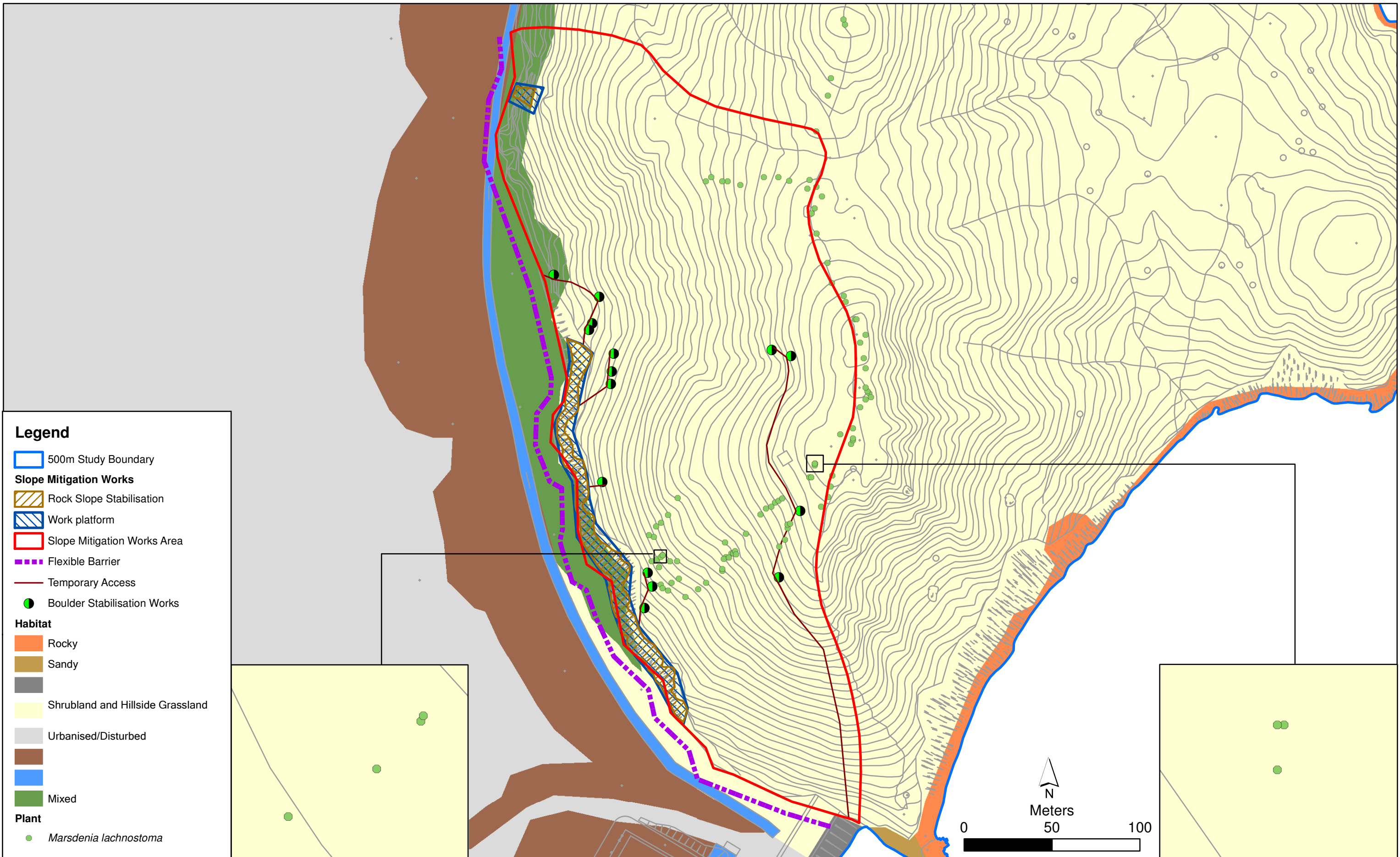


Figure 4.2

Species of Conservation Importance in the Revised Scheme of Slope Mitigation Works

constructed concrete surfaces (such as buttress wall and dentition) at the rock slope will be provided to restore the natural finishes of the slopes. No unacceptable impact to the habitat loss and disturbance from rock slope stabilisation is anticipated.

Table 4.1 *General Scope of Rock Slope Stabilisation Works*

Type of Rock Slope Stabilisation Works	Description	Surface Area/ Quantity within the Rock Slope Stabilisation Works
Rock bolt	Drilling works will be involved with each drillhole of size around 200mm. Each of completed rock bolt head will be 400mm x 400mm.	A total of 53 rock bolts
Buttress/ Dentition	Buttress involves dowel bar construction by drilling and sprayed concrete to backfill the slot	Buttress will be constructed at four locations comprising a total area of 300 m ² within the mixed woodland. Dentition will be constructed at two locations comprising a total area of 40 m ² .
Wire mesh	Wire mesh (about 250m in length; mesh size of 2.2mm in diameter) will be installed along the toe of rock slope by mobile crane and construction of steel hook anchor on surface (16mm diameter x 300mm anchor head or 25mm diameter x 1000mm anchor head).	Wire mesh covers a total of 7,800m ² of rock slope surface within the shrubland and hillside grassland mosaic habitats and small portion of mixed woodland

4.2.3 *Flexible Barrier*

As a relatively high density of plant species of conservation importance were located near the toe of the natural terrain within the Clearwater Bay Country Park, the flexible barrier (about 500m long and 4m high) has been adjusted to construct in bays at the mixed woodland with a setback of at least 7m from the toe of the Clearwater Bay Country Park (*Figure 4.2*). The locations and footprint of the proposed flexible barrier have been adjusted to avoid tree felling and no plant species of conservation importance will be affected.

Localised trimming of the ground vegetation within the works areas of the flexible barrier will be needed. Due to the flexible barrier will be located in or nearby disturbed habitat, and footprint of vegetation clearance and would be localised and very limited, potential unacceptable ecological impacts resulting from the possible vegetation clearance and minor excavation is not anticipated.

4.3 RECOMMENDED MITIGATION MEASURES

Apart from the mitigation measures stated in the approved EIA Report, addition measures to further minimise the potential impacts on loss/ disturbance of habitat and the plant species of conservation importance in the close proximity of the slope mitigation works during pre-construction and construction phases are presented as follows:

4.3.1 Avoidance

- The locations of plant species of conservation importance have been mapped and subsequently taken into account for setting the alignment of the flexible barriers and no species of conservation importance will be close to the proposed alignment (see *Section 4.2.3* and *Figure 4.2*). The alignment of flexible barrier along the slope toe area will be constructed at least 7m away from the toe of Clearwater Bay Country Park. As such, the proposed flexible barrier will not affect plant species of conservation importance. Tree felling is also avoided.
- Prior to the commencement of construction works, the location and condition of plant species of conservation importance along the direct footprint of the slope mitigation works shall be conducted by a qualified plant ecologist. Protection zones/ works exclusion zones will then be established at least 1m radius from the identified plant species of conservation importance in order to preserve them on site. The protection zone (s)/ works exclusion zone(s) will be established prior to site clearance and throughout the construction period to separate the identified protected plant individuals from any potential works. Protection fences of at least 1m height with 1m radius will be established to surround plant species of conservation importance identified in the survey in group or individually. A sign identifying the protection zone (s)/ works exclusion zone(s) shall be attached to the fence and flagging tape shall be attached to the identified groups or individuals to visualize their locations. Upon completion of the works, the species of conservation importance that will be potentially affected by the construction works will be revisited to assess the condition.
- Introduction and training will be provided to all site staff to ensure that every staff will fully understand the preservation method and the location of the identified species of conservation importance.
- The Environmental Team shall monitor the condition of plant species of conservation concern within the protection zone(s)/ works exclusion zone(s) during the construction period on a monthly basis. The monthly monitoring report, as part of the Environmental Monitoring & Audit (EM&A) Report, shall include representative photographic record to present the updated conditions of the plant specimens.

4.3.2

Minimization

- The survey findings showed a relatively high density of *Marsdenia lachnostoma* at the southern portion of the Works Area (i.e. near point count location no. P3), where boulder removal and rock slope stabilisation works will be carried out. The footprint of slope mitigation works will be minimised during the construction as far as practicable. For example, working platform and temporary elevated access to be erected in front of the coastal slope will be temporary in nature and anchorage will be designed to avoid the plant species of conservation importance.
- Where vegetation clearance and/or trimming is required, a qualified ecologist/ arborist will be appointed to provide on-site supervision and monitoring of any vegetation clearance and tree trimming works to ensure no trees' canopy or tree roots will be adversely impacted due to malpractice of vegetation clearance and trimming. AFCD's consent should be granted before conducting any vegetation clearance and/ or trimming within country park area.
- Standard good site practice will considerably reduce any potential disturbance from slope works, including habitats within the Clearwater Bay Country Park, in particular,
 - All construction materials shall be stockpiled offsite to minimise the disturbance to areas in particular inside the country park area.
 - Construction activities will be restricted to the clearly demarcated slope mitigation works area.
 - The boulder works will be carried out by handheld tool to minimise the size of works area within the Clearwater Bay Country Park. No excavation work, tree felling and removal of vegetation should be allowed during boulder removal/ break-off work.

4.3.3

Restoration

- Landscaping works will be provided in form of hydroseeding and planting of native shrub seedlings (e.g. *Glochidion eriocarpum* and *Rhaphiolepis indica*) to reinstate vegetation in all temporarily disturbed areas where feasible, in particular rock slope stabilization. Stone facing to constructed concrete surfaces (such as buttress wall and dentition) at the rock slope will be provided to restore the natural finishes of the slopes. Given that the slope mitigation works area is in close proximity of mixed woodland, it is anticipated that the vegetation temporarily disturbed during construction phase will recover progressively by natural succession.
- Upon completion of the hydroseedling and planting of native shrub seedlings, the appointed landscape contractor shall carry out regular monitoring and appropriate maintenance (e.g. replacement for unsatisfactory plant specimens) for a 12-month establishment period.

An Updated Vegetation Survey were carried out between May and December 2016 in accordance with the approved survey methodology as presented in *Section 2*.

The terrestrial habitats identified within the 500 m Study Area include mixed woodland, shrubland and hillside grassland mosaic, urbanised/ disturbed area, wasteland and watercourse. All of the habitats are of very low or low ecological value, except for mixed woodland and shrubland/ grassland, of low to moderate and moderate ecological value, respectively. Apart from this, the slope mitigation works area is located within the Clearwater Bay Country Park, where is the recognized site of conservation importance.

Based on the survey findings, the alignment of flexible barrier is further adjusted to locate outside of the Clearwater Bay Country Park to avoid direct conflict with plant species of conservation importance. In addition, mitigation measures to minimise the potential impact of habitat loss and disturbance to plant species of conservation importance have been proposed to manage the potential ecological impact to acceptable level. With the implementation of the proposed mitigation measures, no adverse residual impact due to the slope mitigation works is anticipated.

Annex A

Full List of Plant Species Recorded

Annex A1 Relative Abundance of Plant Species Recorded Within the Study Area

Note:

(1) Commonness as per Xing *et al.* Gymnosperms and angiosperms of Hong Kong. Memoirs of the Hong Kong Natural History Society (2000)

C = Common; VC = Very Common; P = Planted, VR = Very Rare, RA = Rare, RE = Restricted, NA = Not Applicable

(2) AFCD (2003) Rare and Precious Plants of Hong Kong

Listed in China Red Plant Databook (1992): LC = Least Concern; CR = Critically Endangered;

Cap. 96 = Listed in the Forests and Countryside Ordinance.

(3) Habitats: WL = Mixed Woodland, SG = Shrubland and Hillside Grassland Mosaic, UA = Urbanised/ Disturbed Area, WA = Wasteland and WC = Watercourse

(4) Relative abundance: 1 = scarce, 2 = common, 3 = abundant

Species Name	Chinese Name	Origin	Growth Form	Commonness ⁽¹⁾	Conservation Status ⁽²⁾	Habitat ⁽³⁾ ⁽⁴⁾					Slope Mitigation Works Area
						WL	SG	UA	WA	WC	
<i>Acacia auriculiformis</i>	耳果相思	Exotic	Tree	C, P		2			1		2
<i>Acacia confusa</i>	台灣相思	Exotic	Tree	C, P		1			1		1
<i>Acronychia pedunculata</i>	山油柑	Native	Tree	VC			1				1
<i>Adiantum flabellulatum</i>	扇葉鐵線蕨	Native	Herb	VC		1					1
<i>Adina pilulifera</i>	水團花	Native	Tree	VC		1					1
<i>Aeginetia indica</i>	野菰	Native	Herb	C		1					1
<i>Alangium chinense</i>	八角楓	Native	Tree	C		1					1
<i>Alocasia macrorrhizos</i>	海芋	Native	Herb	C		2			2		2
<i>Alpinia officinarum</i>	高良薑	Native	Herb	RE			3				3
<i>Alpinia zerumbet</i>	艷山薑	Native	Herb	VC		3					3
<i>Alternanthera paronychioides</i>	星星蝦鉗菜	Exotic	Herb	NA					3		3
<i>Alyxia sinensis</i>	鏈珠藤	Native	Climber	C		1					1
<i>Ampelopsis heterophylla</i>	牯嶺蛇葡萄	Native	Climber	C		2					2
<i>Aporosa dioica</i>	銀柴	Native	Tree	VC		2					2
<i>Archidendron clypearia</i>	猴耳環	Native	Tree	C		1					1
<i>Asparagus densiflorus</i>	非洲天門冬	Exotic	Climber	C		2	1				2
<i>Atalantia buxifolia</i>	酒餅筍	Native	Shrub	C		1					1
<i>Baeckea frutescens</i>	崗松	Native	Shrub	VC		1	2				1
<i>Bidens alba</i>	白花鬼針草	Exotic	Herb	VC		1	2	2	2		2
<i>Blechnum orientale</i>	烏毛蕨	Native	Herb	VC		1	1				1
<i>Boehmeria nivea</i>	苧麻	Exotic	Shrub	C				1	2		
<i>Breynia fruticosa</i>	黑面神	Native	Shrub	VC			1				1
<i>Bridelia insulana (Bridelia balansae)</i>	禾串樹	Native	Tree	C		1					
<i>Bridelia tomentosa</i>	土蜜樹	Native	Shrub	VC		1	1				1
<i>Cajanus scarabaeoides</i>	蔓草蟲豆	Native	Climber	C			1				1
<i>Casuarina equisetifolia</i>	木麻黃	Exotic	Tree	C				1	1		
<i>Cayratia corniculata</i>	角花烏蘘莓	Native	Climber	VC		1					1
<i>Celtis sinensis</i>	朴樹	Native	Tree	C, P		2	1				2

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(4) Relative abundance: 1 = scarce, 2 = common, 3 = abundant

Species Name	Chinese Name	Origin	Growth Form	Commonness ⁽¹⁾	Conservation Status ⁽²⁾	Habitat ^{(3) (4)}					Slope Mitigation Works Area
						WL	SG	UA	WA	WC	
<i>Cerbera manghas</i>	海杧果	Native	Tree	C					1		1
<i>Chloris barbata</i>	孟仁草	Native	Herb	VC				1	1		
<i>Choerospondias axillaris</i>	南酸棗	Native	Tree	C		1					1
<i>Cinnamomum camphora</i>	樟	Native	Tree	C, P		1					1
<i>Cleistocalyx nervosum</i>	水翁	Native	Tree	VC		1					1
<i>Cratogeomys cochinchinense</i>	黃牛木	Native	Tree	VC		1	1				1
<i>Cyclosorus acuminatus</i>	漸尖毛蕨	Native	Herb	VC		1	1		1		1
<i>Cyrtococcum patens</i>	弓果黍	Native	Herb	VC		2		1	1		2
<i>Dalbergia benthamii</i>	兩廣黃檀	Native	Climber	C		1	2				1
<i>Dalbergia hancei</i>	藤黃檀	Native	Climber	C		1	1				1
<i>Daphniphyllum calycinum</i>	牛耳楓	Native	Tree	C			1				1
<i>Desmos chinensis</i>	假鷹爪	Native	Shrub	C		1					1
<i>Dianella ensifolia</i>	山菅蘭	Native	Herb	VC			1				1
<i>Dicranopteris pedata</i>	芒萁	Native	Herb	C			3				3
<i>Elaeocarpus chinensis</i>	中華杜英	Native	Tree	C		1					1
<i>Elaeagnus loureirii</i>	羅氏胡頹子	Native	Climber/ Shrub	C			1				
<i>Embelia laeta</i>	酸藤子	Native	Climber	VC			3				3
<i>Emilia sonchifolia</i>	一點紅	Native	Herb	VC				1	1		
<i>Eriosema chinense</i>	雞頭薯	Native	Herb	C			2				2
<i>Eucalyptus citriodora</i>	檸檬桉	Exotic	Tree	C				1	1		
<i>Eucalyptus robusta</i>	大葉桉	Exotic	Tree	C				1	1		
<i>Eurya nitida</i>	細齒葉柃	Native	Shrub	VC		1	1				1
<i>Ficus hirta</i>	粗葉榕	Native	Shrub	C		2					2
<i>Ficus hispida</i>	對葉榕	Native	Tree	VC		3	1				3
<i>Ficus microcarpa</i>	細葉榕	Native	Tree	C		1			1		1
<i>Ficus subpisocarpa</i>	筆管榕	Native	Tree	C		1					1
<i>Ficus variegata</i>	青果榕	Native	Tree	C		1					1
<i>Ficus variolosa</i>	變葉榕	Native	Tree	VC		1					1
<i>Gahnia tristis</i>	黑莎草	Native	Herb	VC			1				1

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						WL	SG	UA	WA	WC	
<i>Garcinia oblongifolia</i>	嶺南山竹子	Native	Tree	VC		1					1
<i>Gardenia jasminoides</i>	梔子	Native	Shrub	VC		1	1				1
<i>Glochidion eriocarpum</i>	毛果算盤子	Native	Shrub	C			1				1
<i>Glochidion lanceolarium</i>	艾膠算盤子	Native	Tree	C			1				1
<i>Glochidion puberum</i>	算盤子	Native	Shrub	RE			1				1
<i>Gnetum luofuense</i>	羅浮買麻藤	Native	Climber	VC		1	2				2
<i>Gymnanthera oblonga</i>	海島藤	Native	Climber	C				1	1		1
<i>Helicteres angustifolia</i>	山芝麻	Native	Herb	VC			2				2
<i>Homalium cochinchinense</i>	天料木	Native	Tree	C		1	1				1
<i>Ilex asprella</i>	梅葉冬青	Native	Shrub	VC		1	1				1
<i>Ilex pubescens</i>	毛冬青	Native	Shrub	VC		1	1				1
<i>Imperata cylindrica</i>	大白茅	Native	Herb	C				3	3		3
<i>Ipomoea cairica</i>	五爪金龍	Exotic	Climber	VC				1	1		1
<i>Ipomoea nil</i>	牽牛	Exotic	Climber	C			1		3		3
<i>Itea chinensis</i>	鼠刺	Native	Shrub	VC		1					1
<i>Lantana camara</i>	馬纓丹	Exotic	Shrub	VC		1	1		1		1
<i>Leucaena leucocephala</i>	銀合歡	Exotic	Tree	C		3		1	3		3
<i>Ligustrum sinense</i>	山指甲	Native	Tree	C		1			1		1
<i>Liquidambar formosana</i>	楓香	Native	Tree	C		1					1
<i>Liriope spicata</i>	山麥冬	Native	Herb	VC		1	1				1
<i>Litsea glutinosa</i>	潺槁樹	Native	Tree	C		3	2				3
<i>Litsea rotundifolia</i>	豺皮樟	Native	Shrub	VC		1	1				1
<i>Lophatherum gracile</i>	淡竹葉	Native	Herb	VC		2			2		2
<i>Lygodium japonicum</i>	海金沙	Native	Herb	VC		1	2				2
<i>Macaranga tanarius</i>	血桐	Native	Tree	C		3		2	2		3
<i>Machilus velutina</i>	絨毛潤楠	Native	Tree	C		1					1
<i>Maesa perlaris</i>	鯽魚膽	Native	Shrub	C		1					1
<i>Mallotus paniculatus</i>	白楸	Native	Tree	C		3	2				3
<i>Marsdenia lachnostoma</i>	毛喉牛奶菜	Native	Climber	VR	CR		3				3

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<i>Melastoma sanguineum</i>	毛荳	Native	Shrub	C		1	1				1
<i>Melicope pteleifolia</i>	密茱萸	Native	Shrub	C		1					1
<i>Melodinus suaveolens</i>	山橙	Native	Climber	C		1					1
<i>Mikania micrantha</i>	薇甘菊	Exotic	Climber	C		2	2	1	2		3
<i>Millettia nitida</i>	亮葉崖豆藤	Native	Climber	VC		1	1				1
<i>Millettia speciosa</i>	美麗崖豆藤	Native	Climber	C		1	1				1
<i>Miscanthus floridulus</i>	五節芒	Native	Herb	C		2	3	1	3		3
<i>Morinda parvifolia</i>	雞眼藤	Native	Climber	VC			2				1
<i>Mussaenda pubescens</i>	玉葉金花	Native	Climber	VC		2	2				2
<i>Neyraudia reynaudiana</i>	類蘆	Native	Herb	C				2	3		3
<i>Oxalis corniculata</i>	酢漿草	Native	Herb	VC				1	1		1
<i>Oxalis corymbosa</i>	紅花酢漿草	Exotic	Herb	C				1	1		1
<i>Osbeckia chinensis</i>	金錦香	Native	Herb	C			1				1
<i>Paederia scandens</i>	雞矢藤	Native	Climber	VC		1	2		1		1
<i>Pallinhaea cernua</i>	鋪地蜈蚣	Native	Herb	VC			1				1
<i>Pandanus tectorius</i>	露兜樹	Native	Shrub	VC		1	1				1
<i>Panicum maximum</i>	大黍	Exotic	Herb	C			1	1	1		1
<i>Parthenocissus dalzielii</i>	爬牆虎	Exotic	Climber	P		1					1
<i>Passiflora foetida</i>	龍珠果	Exotic	Climber	C			1				1
<i>Phoenix hanceana</i>	刺葵	Native	Tree	C		2	1				2
<i>Phyllanthus cochinchinensis</i>	越南葉下珠	Native	Shrub	C		1	1				1
<i>Phyllanthus emblica</i>	餘甘子	Native	Tree	VC			2				2
<i>Platycodon grandiflorus</i>	桔梗	Native	Herb	RE	Cap.96; LC		1				
<i>Psychotria asiatica</i>	九節	Native	Tree	C		2	1				2
<i>Psychotria serpens</i>	蔓九節	Native	Climber	VC			2				2
<i>Pteris semipinnata</i>	半邊旗	Native	Herb	VC		3	1				3
<i>Pueraria phaseoloides</i>	三裂葉野葛	Native	Climber	VC		2	1				2
<i>Rhaphiolepis indica</i>	石斑木	Native	Shrub	VC			1				1
<i>Rhodomyrtus tomentosa</i>	桃金娘	Native	Shrub	VC		2	3				3

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<i>Rhus hypoleuca</i>	白背漆	Native	Shrub	C		2	2				2
<i>Rhus succedanea</i>	野漆	Native	Shrub	C		2	2				2
<i>Rubus reflexus</i>	鑷毛莓	Native	Climber	VC		1	1		1		1
<i>Sapium discolor</i>	山烏柏	Native	Tree	VC		1	1				1
<i>Sapium sebiferum</i>	烏柏	Native	Tree	C		2	1				2
<i>Schefflera heptaphylla</i>	鵝掌柴	Native	Tree	C		2	2				2
<i>Schima superba</i>	木荷	Native	Tree	C		1					1
<i>Smilax china</i>	菝葜	Native	Climber	VC		1	2				2
<i>Smilax glabra</i>	土茯苓	Native	Climber	VC		1	1				1
<i>Solena amplexicaulis</i>	茅瓜	Native	Climber	VC			2				1
<i>Sterculia lanceolata</i>	假蘋婆	Native	Tree	C		3	1				3
<i>Strophanthus divaricatus</i>	羊角拗	Native	Climber	C			1				1
<i>Syzygium jambos</i>	蒲桃	Exotic	Tree	C		1					1
<i>Syzygium levinei</i>	山蒲桃	Native	Tree	C		1					1
<i>Tadehagi triquetrum</i>	葫蘆茶	Native	Shrub	VC			1				1
<i>Tetracera asiatica</i>	錫葉藤	Native	Climber	VC		1					1
<i>Tylophora ovata</i>	娃兒藤	Native	Climber	C		1					1
<i>Viburnum odoratissimum</i>	珊瑚樹	Native	Shrub	VC		1					1
<i>Vitis balanseana</i>	小果葡萄	Native	Climber	RE			2				2
<i>Vitis bryoniiifolia</i>	襲菓	Native	Climber	RA			1				2
<i>Vitis rotundifolia</i>	綿毛葡萄	Native	Climber	C		1	1				1
<i>Wikstroemia indica</i>	了哥王	Native	Shrub	C			1				1
<i>Zanthoxylum avicennae</i>	筲欖花椒	Native	Tree	C		1					1
<i>Zanthoxylum nitidum</i>	兩面針	Native	Climber	VC		1	1				1
Total Number of Species:		139				93	80	19	32	0	130