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Environmental Monitoring and Management Plan (EMMP)

Housing and Development Board (HDB) Singapore

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List of Acronyms

Acronym	Definition
ACMV	Air-conditioning and Mechanical Ventilation
APCP	Air Pollution Control Plan
BIA	Biodiversity Impact Assessment
BOD	Biochemical Oxygen Demand
BTNR	Bukit Timah Nature Reserve
CCNR	Central Catchment Nature Reserve
CCTV	Closed-Circuit Television
COD	Chemical Oxygen Demand
DIV	Dutch Intervention Values
ECB	Erosion Control Blanket
ECM	Earth Control Measure
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
EPMA	Environmental Protection and Management Act 1999
EPR	Environmental Performance Report
EQO	Environmental Quality Objective
ERP	Emergency Response Plan
ERSS	Earth Retaining and Stabilizing Structure
ERT	Emergency Response Team
HDB	Housing and Development Board
LTA	Land Transport Authority
NEA	National Environmental Agency
NParks	National Parks Board
NSR	Noise Sensitive Receptor
PAC	Potential Area of Contamination
PIE	Pan Island Expressway
QECP	Qualified Environmental Control Professional
RRNP	Rifle Range Nature Park
SCDF	Singapore Civil Defense Force
SDS	Safety Data Sheets
SIDS	Surface Inlet Detection Sensors
SLA	Singapore Land Authority
SOP	Standard Operating Procedure
TBM	Tunnel Boring Machine
TPZ	Tree Protection Zone
TSS	Total Suspended Solids

1 Introduction

1.1 Project Description

1.1.1 Project Background

Singapore Environmental Consultancy Services Pte. Ltd. (SECS; now part of Aurecon Singapore Pte Ltd) has been appointed by the Housing & Development (HDB), to carry out the development of Environmental Management and Monitoring Plan (EMMP) specifications for the proposed developments located in the former Turf Club (hereafter referred to as the "Project"). The former Turf Club area – which has largely been slated for residential development, to cater for housing needs (hereafter referred to as 'Turf Club) – is an approximately 176 hectares (ha) site located in between the Pan Island Expressway (PIE) and Dunearn Road (see Figure 1-1).

The Project development area is approximately 42.1 ha, which is situated between Central Catchment Nature Reserve (CCNR) and Rifle Range Nature Park (RRNP), which are two vital green spaces contributing to Singapore's overall ecological connectivity. At present, the Project site features freshwater streams and forested areas. The proposed development to be constructed within the Turf Club Project area, involving site clearances, earthworks, construction of drains, road works, sewer, drain and road related facilities (e.g. bus shelters), construction and demolition works at the same time. The overall works for the Project are separated into two main stages of work: Stage 1 – for land clearance and infrastructure development; Stage 2 – for residential development.

An Environmental Impact Assessment (EIA) (full EIA is available online **here**) was previously conducted for the 176 ha site, by AECOM in 2024. A Recommended Area of Conservation (RAC) was proposed in the EIA and has been adopted for the Project and this EMMP. Taking into account the ecological sensitivity of these areas, including the proximity of the Project site to residential areas and educational institutions, this EMMP therefore provides: (i) recommendations for mitigation measures to be implemented to reduce ecological and human impacts; and (ii) provide specific monitoring measures with associated environmental quality objectives (EQOs) to assess the effectiveness of said mitigation measures. The adherence to, and implementation of said measures are vital to ensure that the construction activities will be conducted with minimal impacts to the surrounding ecological and human sensitive receptors.

Figure 1-1 Project Study Area

1.2 EMMP Objectives & Scope

1.2.1 EMMP Objectives

A preliminary EMMP has been proposed as part of the EIA for the Project. This document is intended to reiterate and outline the EMMP proposed in the EIS, including the recommended mitigation measures and monitoring regime for the different stages of the intended Project. The recommendations from the EIA were adapted with the aim of developing a suite of robust monitoring and mitigating measures in this detailed EMMP presented here.

This contract specific EMMP was developed for the Turf Club development to provide management and monitoring requirements for biodiversity, surface water quality and groundwater quality and levels, air quality, airborne noise, vector control and waste management, specifically for the Stage 1 development – which involves land clearance and preparation works – and also to ensure that environmental protection measures fulfil regulatory requirements. The roles and responsibilities of all relevant stakeholders (e.g., Environment Control Officer, EMMP Consultant, Arborist, Vector Control Operator, QECP) during the EMMP implementation throughout the Project are also detailed in this document.

Environmental monitoring will involve conducting compliance inspections for the specified mitigation measures and gathering data on environmental quality. These activities aim to ensure that the project does not lead to any significant long-term environmental effects. An environmental monitoring checklist has been created as part of the Environmental Management and Monitoring Plan (EMMP) to track and document its on-site implementation. A monthly Environmental Performance Report (EPR) will be submitted to the Authorities during the construction phase. This report will include all monitoring results, such as compliance checks and environmental quality data, as well as a summary of the actions taken to implement the EMMP.

This EMMP shall be a live document that will be updated as and when the need arises, to revise and amend monitoring and mitigation measures, or a change in Project details as a result of unforeseen or unavoidable circumstances. Detailed addendums to this EMMP will be drafted and submitted for each stage of works (e.g., Stage 1 – earthworks and clearance, and Stage 2 – infrastructure and building works), providing an outline of all stage specific measures and plans where they differ, or otherwise furnish new information from what has already been described and recommended in this EMMP.

In summary, the EMMP serves the following objectives:

- Define roles and responsibilities for environmental management;
- Provide a framework/guiding document for the Contractor and site users to track, document and monitor environmental compliance with statutory and contractual requirements, and to ensure full EMMP compliance is achieved;
- Ensure all construction activities are conducted in a manner consistent with the laws and regulations, including applicable regulatory approval conditions from relevant authorities and agencies;
- Ensures proper and effective mitigation measures are taken with proper monitoring during the construction phase;
- Set out the monitoring frequency and procedures for environmental monitoring;
- Define reporting and submission requirements; and

- Establish emergency response procedures for environmental incidents, including road kills, trapped animals found on site, and ensure effective corrective actions are taken.

Additionally, it is recommended for physical and/or digital copies of the EMMP specification to be kept on-site for reference purposes at all times.

1.2.2 EMMP Scope

The main scope of works with regards to the EMMP generally include the following items, with the responsibilities between the EMMP Consultant and Contractor segregated accordingly.

EMMP Consultant Scope

- Proposal of an Environmental Monitoring and Management Plan (EMMP) to guide the proposed development based on environmental studies done for the Project, full compliance with codes and legislations, reference from relevant guidelines, and consultations with Regulatory Agencies and Nature Groups;
- Preparation of a Fauna/Wildlife Response and Rescue Plan
- To establish mitigation and/or compensation actions to address impacts resulting from the Project for all stages of project implementation, and to manage, monitor, assure, and confirm that impacts of the Projects do not exceed the stipulated Environmental Quality Objectives (EQOs);
- The EQOs are as follows:
  - No harm or significant disturbance to wildlife
  - No significant water quality impact
  - No significant impact on the aquatic plants, animals or hydrophytes located within the potential impact area
  - No significant impact on stream / aquatic habitat within the potential impact area
  - No significant impact on water intakes within the potential impact area
- To define a procedure to minimise and control dust, exhaust emissions, fumes, etc. generated at construction sites; and tolerable limits;
- To outline water pollution, construction waste management control and mitigation plans, and all other relevant mitigation plans;
- To prepare, submit, and present to National Parks Board (NParks), HDB, and other relevant Authorities; and obtain approvals on the EMMP Plan from the Regulatory Agencies;
- Preparation and submission of EMMP Report;
- To ensure implementation of environmental management measures by auditing/inspecting HDB's appointed Main Contractor throughout the Project works, and document the environmental compliance reporting; and
- To prepare, submit, and present monthly EMMP Reports throughout the construction works;
- To carry out bi-weekly site inspections during the construction stage, and keep a record of any findings, potential or actual incidents, and non-conformances (if any);
- To conduct briefings and trainings to the Main Contractor and subcontractors throughout the construction works;
- Preparation and submission of Post-construction EMMP Close-off Audit Report.

Contractor Scope

- To carry out site preparation/clearance, infrastructure and/or BTO construction works
- To fully comply with all codes and legislations stipulated in this EMMP, and by Regulatory Agencies
- To engage an EMMP Specialist team to carry out Project-related works, and ensure compliance with EMMP measures. This EMMP Specialist team composition includes but is not limited to:
  - Project Manager
  - Contractor's ECO / EMMP In-Charge
  - EMMP Specialist (comprising fauna, flora and arboriculture specialists)
  - QP, QECP & ECMO etc.
- To procure and deploy all necessary equipment and personnel to carry out stipulated EMMP surveys, monitoring, and mitigation measures
- To ensure that the EMMP Specialist team works with the EMMP Consultant to implement the monitoring regime and mitigation measures described in this EMMP, specifically:
  - Baseline fauna survey and subsequent monthly monitoring
  - Baseline flora survey and subsequent monthly monitoring
  - Baseline arboriculture survey and subsequent monthly monitoring
  - Baseline hydrological and surface water quality survey and subsequent monthly monitoring, including monthly monitoring at all ECM discharge points
  - Baseline air quality survey and subsequent monthly monitoring
  - Baseline airborne noise survey and subsequent monthly monitoring
  - Monthly waste management monitoring
  - Monthly vector control monitoring
  - Conducting regular site inspections and verify that EMMP mitigation measures are in place
- To provide monthly data of all monitoring parameters, as well as the status of mitigation measures, site conditions, and non-compliances to the EMMP Consultant for the monthly EMMP report
- To facilitate briefings and trainings when conducted by the EMMP Consultant, to the Main Contractor's workers and subcontractors throughout the construction works – including the provision of equipment and facilities that are conducive for the briefing

1.3 EMMP Report Structure

The structure of the report is as follows:

- Section 1 – Introduction of the Project, the objectives and scope of the EMMP, as well as its report structure
- Section 2 – Summary of Environmental Impact Assessment (EIA) details the key baseline findings, assessed impacts, proposed mitigation measures and Recommended Area for Conservation (RAC)
- Section 3 – The Proposed Construction Activities and Timeline outlines the project's components, the overall schedule for construction, and the suggested activities for each phase
- Section 4 – Applicable Environmental Legislation details the key legislative requirements pertinent to the Project
- Section 5 – Environmental Roles and Responsibilities outlines the organisation chart of the key personnel involved in the EMMP as well as their roles and responsibilities
- Section 6 – Environmental Management and Monitoring Plan for Stage 1 details the EMMP programme during Stages 1 for biodiversity, hydrology, surface water, groundwater, air quality, airborne noise, , vector control and waste management
- Section 7 – EMMP Table Summary for Stage 1 provides an overview of the monitoring regime and mitigation measures to be implemented, as well as the responsible parties
- Section 8 – The Emergency Response Plan outlines the plans' objectives, essential contacts for environmental incidents, and response strategies for wildlife, drainage, surface water and groundwater, as well as air quality, and airborne noise.
- Section 9 – Reporting and Communication Plans outlines the key plans and schedule for reporting and communications

2 Summary of Environmental Impact Assessment

2.1 EIA Objective

An environmental impact assessment (EIA) was conducted by AECOM in 2024, under appointment by the Urban Redevelopment Authority (URA). The aim of the EIA is to assess any potential environmental impacts that may arise from the construction and operation of the proposed development within the Former Turf Club Area (henceforth known as the 'Project Site'). Previous studies done by AECOM under the Land Transport Authority (LTA) overlaps with this Study, and as such data from those studies were also referenced. A summary of the baseline survey findings will be presented in the following chapters.

2.2 EIA Study Area

The Former Turf Club covers an area of 176.4 ha and has been slated for development. It is located in the central region of mainland Singapore. Near the site to the east is the Central Catchment Nature Reserve (CCNR), Singapore's largest nature reserve and one of the main water catchments. The Bukit Timah Nature Reserve is also nearby to the northwest. The Project Site bounded by the Pan Island Expressway (PIE) to the north, Eng Neo Avenue to the east, Dunean Road to the south, residential developments to the west, and educational institutions (Chatsworth International School) and Clubs (Swiss Club and the British Club) to the northwest. The Study Area is demarcated into six (6) sites, labelled Sites A to F (Figure 2-1).

Legend

- EIA Study Area
- Site Demarcation
- Project Site

N

Rev.	Date	By	Description	Chk'd	App'd
-	MAY 2024	HBS	Turf Club EIA	LAL	JAG

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Project Title :
CONTRACT URA/T/22/031
ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR FORMER TURF CLUB AT BUKIT TIMAH

Figure Title :
Project Site and EIA Study Area

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Figure 2-1 Project Site and EIA Study Area (AECOM, 2024)

2.3 Summary of EIA Baseline Findings

2.3.1 Habitat Classification

The Study Area consists of six (6) sites, labelled Sites A to F (Figure 2-1 and Figure 2-2). Site E mainly consists of urbanized land which largely have been vacated since the end of 2023, with the remaining five (5) Sites being forested patches. Habitat classification definitions in this section takes reference from the National Parks Board (NParks) latest Biodiversity Impact Assessment (BIA) Guidelines V2, released in May 2024.

Table 2-1 Absolute (ha) and Relative (%) Sizes of Each Vegetation Type

Habitat Type	Site A		Site B		Site C		Site D		Site E		Site F	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Native-dominated Secondary Forest	1.9	4.9	2.9	16.5	6.2	33.0	0.6	11.1	4.2	4.0	1.0	12.2
Abandoned-land Forest	9.5	24.4	8.3	47.2	2.9	15.4	1.7	31.5	6.2	5.9	2.5	30.5
Exotic-dominated Secondary Forest	15.0	38.6	-	-	-	-	1.8	33.3	4.3	4.1	1.6	19.5
Scrubland	10.3	26.5	2.7	15.3	7.8	41.5	1.2	22.2	1.1	1.1	2.0	24.4
Urban Vegetation	1.1	2.8	1.5	8.5	1.8	9.6	-	-	47.9	45.8	1.1	13.4
Non-vegetated	0.8	2.1	1.9	10.8	0.1	0.5	0.1	1.9	40.1	38.5	-	-
Waterbody	0.3	0.8	0.3	1.7	-	-	-	-	0.3	0.3	-	-
Total Area	**38.9**	100.0	**17.6**	100.0	**18.8**	100.0	**5.4**	100.0	**104.1**	100.0	**8.2**	100.0

The Study Area is predominantly non-vegetated and urban vegetation, exceeding 50% of the total area. A notable finding is the existence of a rich native-dominated secondary forest, with the largest patch in Site C and smaller fragments at other sites. Overall, native forest constitutes nearly 10% of the total area. Other habitat types identified include abandoned-land forest, exotic-dominated secondary forest, scrubland, and waterbodies.

Site A

Site A is the second largest site (38.9 ha) and is situated to the east of the Project, largely in Eng Neo Avenue Forest. It is made up of five (5) vegetation types (Table 2-1) Exotic-dominated Secondary Forest (Albizia Dominated Forest) making up majority of the vegetation type at 15.0 ha. A single, naturalized forested stream (D/S14 in the EIA) runs along the east, with an anaerobic pond (0.3 ha) sitting in the middle of Site A.

Site B

Site B (17.6 ha) covers the forested areas in between Turf Club Road and Fairways Drive, and consist of six (6) habitat types. The largest vegetation type is Abandoned-land Forest (Table 2-1), which takes up nearly half of Site B at 8.3 ha. There are two (2) naturalized streams (D6 and D7 in the EIA) which runs along the west and east edges of Site B, with a concrete drain connecting upstream of D6 and a waterlogged/swampy ground located in the north of D7.

Site C

Site C (18.8ha) comprises of the forested areas bordering the British Club and Swiss Club, which mainly consists of Scrubland (7.8 ha) and Native-dominated Secondary Forest (6.2 ha). There are no water features present in Site C.

Site D

Site D is the smallest site at 5.4 ha and is represented by the forested area within Turf Club Road. It comprises of four (4) vegetation types (Table 2-1), with the largest being Exotic-dominated Secondary Forest (1.8 ha) throughout the site. The remaining portion of Site D is made up of infrastructure (0.1 ha) located in the northwest.

Site E

Site E is the largest site (104.1 ha) and is made up of five (4) vegetation types (Table 2-1), with the dominant vegetation type being urban vegetation (47.9 ha). This mainly occurs as turf and other planted vegetation in the golf course and Grandstand. There are two (2) ponds in the golf course (0.3 ha).

Site F

Site F is the forested area in between Eng Neo Ave and Linden Drive and consists of five (5) vegetation types (Table 2-1). Much of the vegetation present consists of Abandoned-land Forest (2.5 ha), with Scrublands occurring in large patches across the site (2.0 ha). There were non-vegetated areas nor water bodies found within Site F.

Figure 2-2 Habitat Map and Locations of Vegetation Plots (AECOM, 2024)

2.3.2 Flora

Species of Conservation Significance

The flora study recorded 591 species and 55 species groups (i.e., plants that could not be identified to species with certainty), belonging to at least 132 families. 177 species were considered of conservation significance, of which majority of individuals were found in Sites A, B, C, and F (Figure 2-3). Notable recorded species of conservation significance for each site are presented in below.

Table 2-2 Notable Species of Conservation Significance Found in each Habitat Type

Habitat Type	Site	National Conservation Status (SRDB3)	Species	Remarks
Native-dominated Secondary Forest	A	Critically Endangered	*Prunus arborea* var. *stipulacea*	Tree
			Piper baccatum	Climber
		Vulnerable	*Calophyllum tetrapterum* var. *tetrapterum*	Tree
	B	Critically Endangered	Actinodaphne maingayi	Tree
			Baccaurea pyriformis	Tree
			Aporosa nigricans	Tree
			Asplenium nitidum	Fern
		Endangered	*Ficus glandulifera*	Tree
			Ficus kerkhovenii	Strangler
		Vulnerable	*Xylopia malayana*	Tree
			Elaeocarpus ferrugineus	Tree
			Bulbophyllum vaginatum	Orchid
	C	Critically Endangered	*Daphniphyllum griffithianum*	Tree
			Parastemon urophyllus	Tree
	D	Vulnerable	*Macaranga griffithiana*	Tree
	E	Endangered	*Calophyllum inophyllum*	Tree
			Ficus virens	Strangler
		Vulnerable	*Calophyllum tetrapterum* var. *tetrapterum*	Tree
			Aporosa benthamiana	Tree
	F	Critically Endangered	*Piper baccatum*	Climber
			Xanophyllum eliipticum	Tree
		Endangered	*Calophyllum rubiginosum*	Tree
			Knema conferta	Tree
			Gymnacranthera farquhariana	Tree
		Vulnerable	*Horsfieldia polyspherula* var. *polyspherula*	Tree
			C. tetrapterum var. *tetrapterum*	Tree
			Aporosa benthamiana	Tree
			Knema communis	Tree
Abandoned-land Forest	B	Critically Endangered	*Asplenium nitidum*	Fern
		Vulnerable	*Bulbophyllum vaginatum*	Orchid
			Calophyllum tetrapterum var. *tetrapterum*	Tree
			Litsea umbellata	Tree
	C	Vulnerable	*Litsea umbellata*	Tree
			Chassalia curviflora	Tree
	E	Critically Endangered	*Cyclea laxiflora*	Climber
		Endangered	*Ficus kerkhovenii*	Strangler
		Vulnerable	*Ficus vasculosa*	Strangler
	F	Critically Endangered	*Xanthophylum ellipticum*	Tree
		Vulnerable	*Horsfieldia polyspherula* var. *polyspherula*	Tree

Habitat Type	Site	National Conservation Status (SRDB3)	Species	Remarks
Exotic-dominated Secondary Forest	F	Vulnerable	*Horsfieldia polyspherula* var. *polyspherula*	Tree
Scrubland	F	Vulnerable	*Horsfieldia polyspherula* var. *polyspherula*	Tree
Urban Vegetation	E	Endangered	*Ficus virens*	Strangler
			Ficus kerkhovenii	Strangler
		Vulnerable	*Litsea umbellata*	Tree
			Bulbophyllum vaginatum	Orchid
			Goniophlebium percussum	Fern
	F	Endangered	*Plegmariurus phlegmaria*	Fern

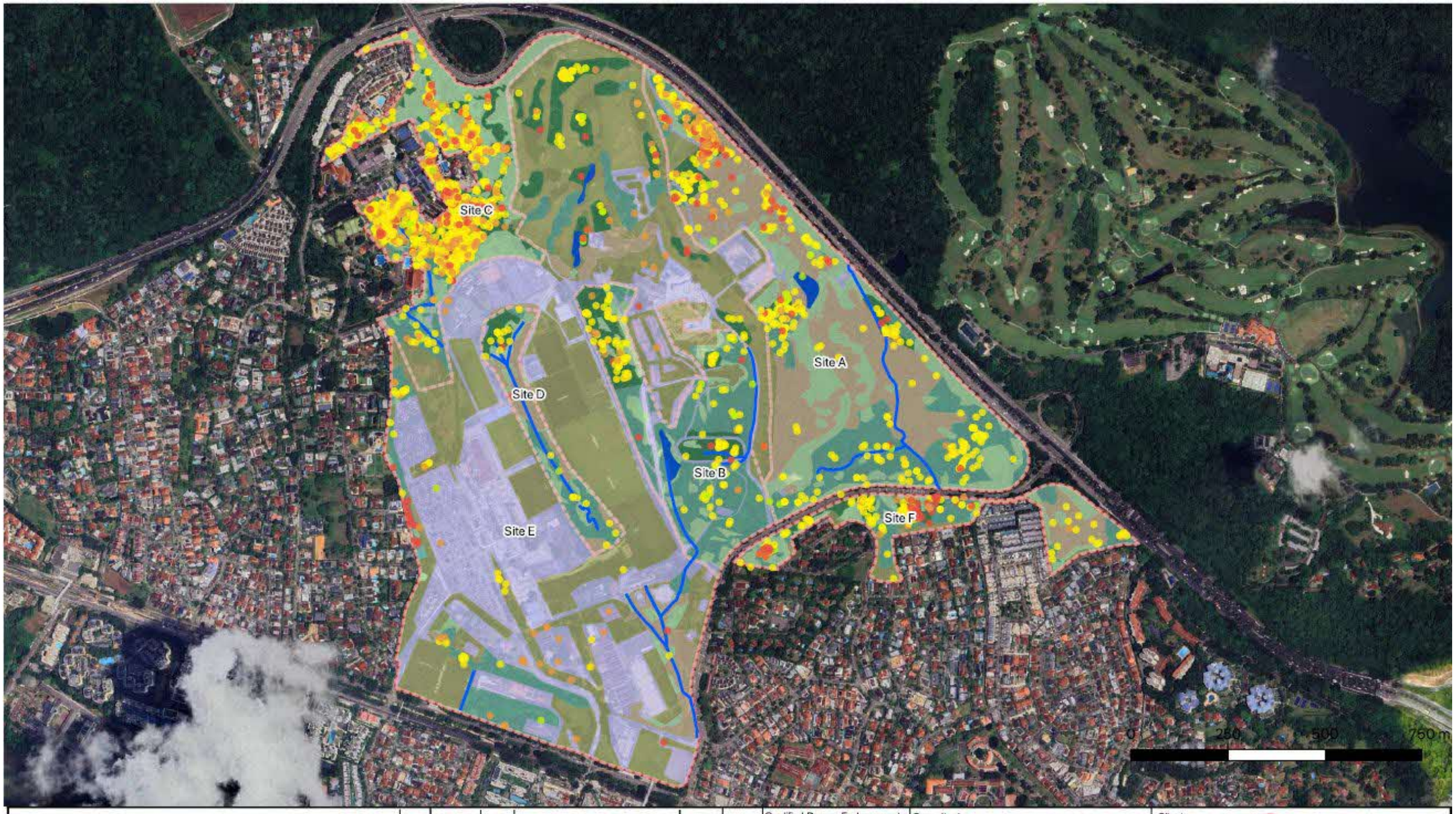


Figure 2-3 Distribution of Plant Specimens of Conservation Significance (AECOM, 2024)

Large Plant Specimens and Plant Specimens of Value

A total of 553 large plant specimens, comprising 41 species were recorded in the Project Site. The distribution of large plant specimens is presented in Figure 2-4 below. Site B had the biggest number of large plant specimens (129 individuals). The largest specimens recorded in the Project Site was found in Site E – *Ficus microcarpa* individuals with spreads of up to 20 m.

Depending on each site, the dominant large tree species differs as follows:

- Site A: 58 of 115 specimens are Albizia trees (*Falcataria falcata*).
- Site B: 78 of 129 specimens belong to 15 species, majority of which are rain trees (*Samanea saman*) with 24 specimens.
- Site C: 10 of 47 specimens are tembusu trees (*Cyrtophyllum fragrans*).
- Site D: 21 of 52 specimens are Albizia trees (*Falcataria falcata*), with six (6) large specimens of Critically Endangered *Peltophorum pterocarpum* recorded
- Site E: 99 of 112 specimens belong 16 species, majority of which are tembusu trees (*Cyrtophyllum fragrans*) with 24 specimens.
- Site F: 21 of 20 specimens belong to three (3) species, majority of which are Albizia trees (*Falcataria falcata*) with nine (9) specimens.

A total of 22 plant specimens were identified to be specimens of value, as they contribute to ecosystem functions by providing habitats for fauna (location of specimens are in Figure 2-5). The breakdown of each the specimens found in each site are as follows:

- Site A: Two (2) separate Albizia trees (*Falcataria falcata*) had raptor nest observed. Nine (9) bamboo clusters (*Bambusa vulgaris*) were identified as potential roost sites for bamboo bats (*Tylonycteris* sp.).
- Site B: One (1) bamboo specimen (*Bambusa vulgaris*) was located among a larger cluster of bamboos, which were found to be the roost sies of bamboo bats during roost emergence surveys and thus is a potential roost site as well.
- Site C: One (1) bamboo specimen (*Bambusa vulgaris*) was identified as a potential roost sites for bamboo bats.
- Site D: One (1) Albizia tree (*Falcataria falcata*) hosted Goffin's cockatoos (*Tanimbar corella*).
- Site E: One (1) bamboo specimen (*Bambusa vulgaris*) was identified as a potential roost sites for bamboo bats, and three (3) red sealing wax palms (*Cyrtistachys renda*) – a locally critically endangered native palm – could be considered for conservation and integration into future design.
- Site F: Four (4) bamboo specimens (three *Bambusa vulgaris* and one *Thyrsostachys siamensis*) were identified as potential roost sites for bamboo bats.

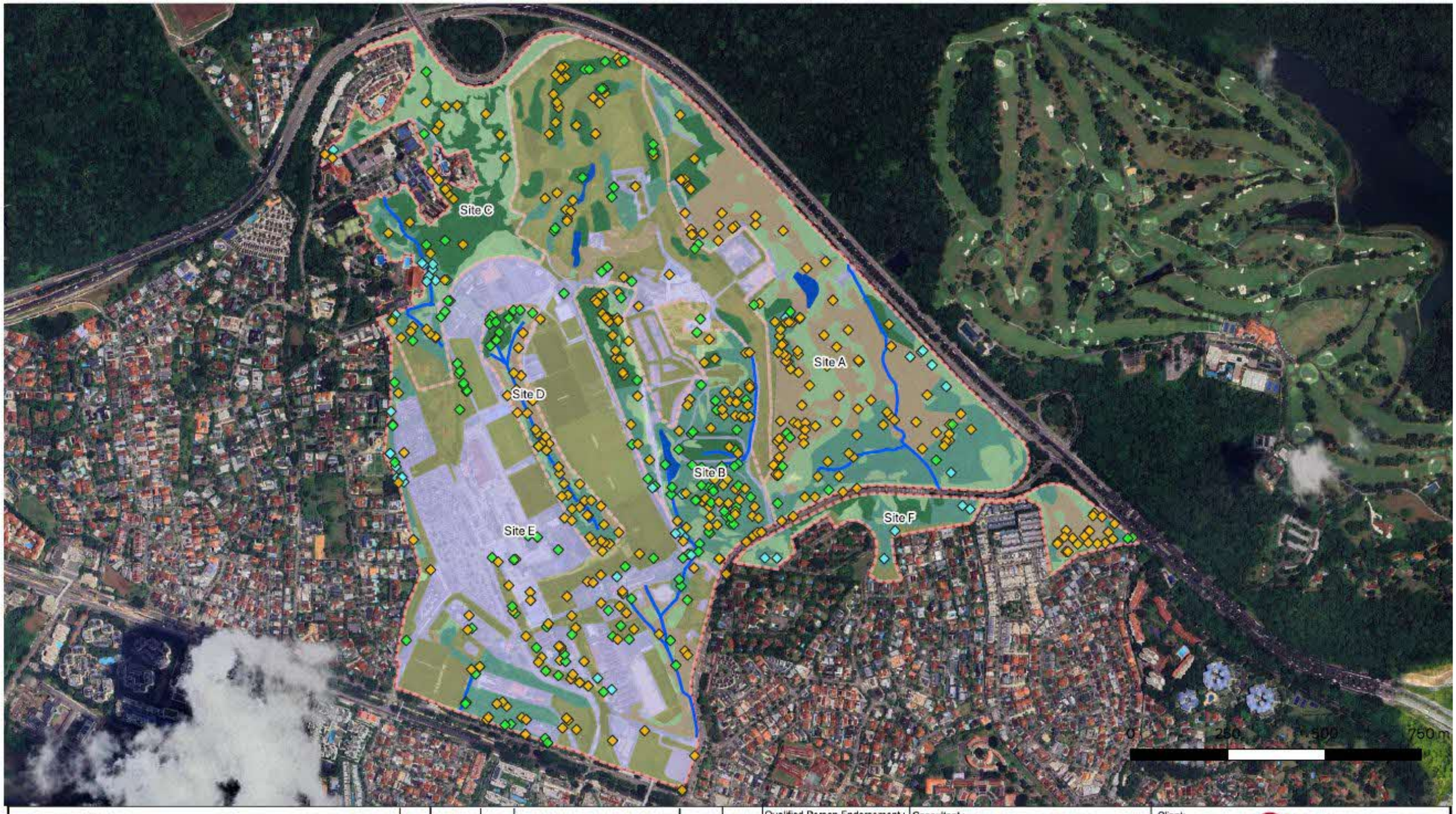


Figure 2-4 Distribution of Large Plant Specimens (AECOM, 2024)

Figure 2-5 Distribution of Other Plants Specimens of Value (AECOM, 2024)

2.3.3 Fauna

A total of 407 fauna species (see Table 2-3) from selected vertebrate and invertebrate groups were recorded across the study area from 2019 to 2024.

Table 2-3 Summary of Terrestrial and Aquatic Fauna Species

Taxon	Number of Species	Percentage Composition of Fauna Surveyed	Conservation Significant Species
Bees	27	6.63%	0
Stinging Wasps	36	8.85%	0
Dragonflies	34	8.35%	1
Damselflies	12	2.94%	2
Butterflies	101	24.82%	0
Freshwater Decapod Crustaceans	9	2.21%	0
Freshwater Fish	14	3.44%	1
Amphibians	11	2.72%	0
Reptiles	27	6.63%	0
Birds	111	27.27%	15
Non-volant Mammals	15	3.68%	3
Bats	10	2.46%	2
Total	**407**	100%	**25**

Various species of conservation significance (with local or global status of VU and higher) were observed in the study area (Figure 2-6). A higher number of CS species were recorded in Site A, likely due to its larger size and intact natural habitats. The globally threatened Straw-headed bulbul (*Pycnonotus zeylanicus*) and Sunda Pangolin (*Manis javanica*) were found throughout the site. It should be noted that Site C recorded 15 Sunda colugo (*Galeopterus variegatus*) sightings, the highest across the study area.

Table 2-4 Fauna of Conservation Significance Recorded in Project Study Area

No.	Species name	Common Name	Local Status (RDB3)	Global Status (IUCN)	Site of Records
Birds					
1	*Ardea purpurea*	Purple heron	Endangered	Least Concern	A
2	*Collocalia affinis*	Plume-toed swiftlet	Vulnerable	Least Concern	A, C, E, F
3	*Copsychus malabaricus*	White-rumped shama	Endangered	Least Concern	F
4	*Copsychus saularis*	Oriental magpie-robin	Vulnerable	Least Concern	A, D, E
5	*Corvus macrorhynchos*	Large-billed crow	Vulnerable	Least Concern	D
6	*Ketupa ketupu*	Buffy fish owl	Vulnerable	Least Concern	E
7	*Lanius cristatus*	Brown shrike	Vulnerable	Least Concern	A, E
8	*Nisaetus cirrhatus*	Changeable hawk-eagle	Vulnerable	Least Concern	A, E, F
9	*Psittacula longicauda*	Long-tailed parakeet	Near Threatened	Vulnerable	A, B, C, D, F
10	*Ptilinopus jambu*	Jambu fruit dove	Vulnerable	Near Threatened	C
11	*Pycnonotus brunneus*	Asian red-eyed bulbul	Vulnerable	Least Concern	C
12	*Pycnonotus zeylanicus*	Straw-headed bulbul	Endangered	Critically Endangered	All
13	*Strix seloputo*	Spotted wood owl	Vulnerable	Least Concern	B
14	*Treron curvirostra*	Thick-billed green pigeon	Vulnerable	Least Concern	A

15	*Zosterops simplex*	Swinhoe's white-eye	Vulnerable	Least Concern	A, B, E, F
Butterfly					
1	*Astictopterus jama jama*	Forest hopper	Endangered	Not Listed	A, B, D, E, F
2	*Troides helena cerberus*	Common birdwing	Vulnerable	Not Listed	A, B, D, E, F
Fish					
1	*Betta imbellis*	Crescent betta	Endangered	Least Concern	A
Mammal					
1	*Eonycteris spelaea*	Cave nectar bat	Vulnerable	Least Concern	A
2	*Lutrogale perspicillata*	Smooth-coated otter	Endangered	Vulnerable	E
3	*Macaca fascicularis*	Long-tailed macaque	Least Concern	Endangered	All
4	*Manis javanica*	Sunda pangolin	Critically Endangered	Critically Endangered	A, B, C, E, F
5	*Tylonycteris* sp.	Unidentified bamboo bat	Vulnerable	Least Concern	A
6	*Unidentified Sciuridae (flying)*	Flying squirrel	Endangered	Least Concern	A
Odonata					
1	*Ceriagrion chaoi*	Fiery coraltail	Vulnerable	Least Concern	A

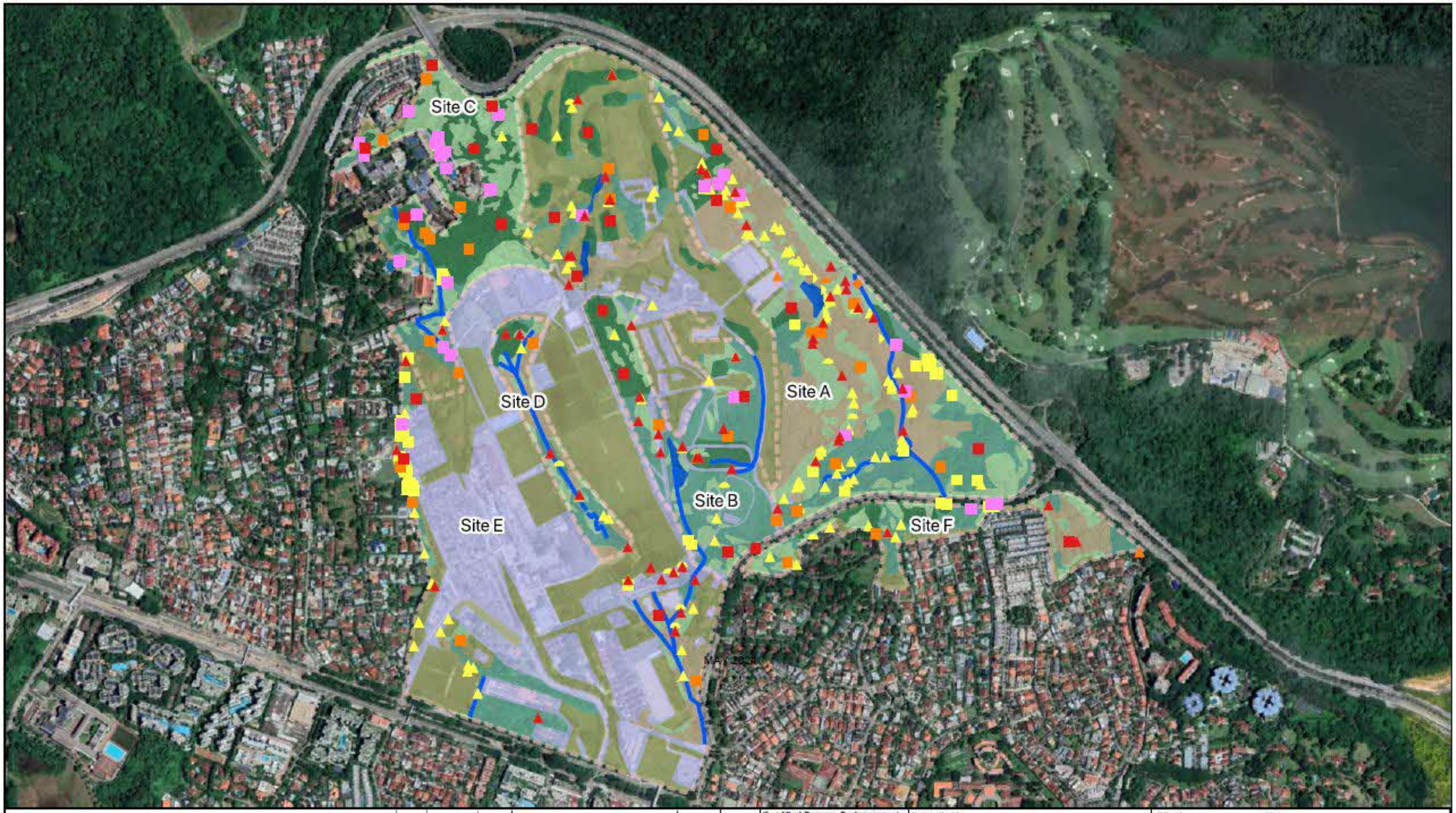


Figure 2-6 Distribution of Fauna of Conservation Significance (AECOM, 2024)

2.3.4 Surface Hydrology and Water Quality

All water courses within the Project Site were sampled, with two (2) dry and one (1) wet weather conditions. Dry conditions are defined as conditions after a continuous 48-hour period of no-rain, and wet weather conditions are defined as a rainfall event having more than 10 m of rainfall, with samples to be collected within three (3) hours after the rain stops. 35 sampling stations were identified and are presented in Figure 2-7 below.

Sampling was conducted from 25 July 2023 to 23 January 2024. In-situ measurements were taken using a calibrated multi-parameter probe. Ex-situ grab sampling samples were analysed by an accredited laboratory (Marchwood Laboratory Services Pte Ltd). The baseline water quality results were compared to the National Environmental Agency's (NEA) Environmental Protection and Management Act (EPMA) (Trade Effluent) Regulations limits, with selected parameters compared to water quality criteria for aquatic life from other countries. The parameters tested for are shown below.

Table 2-5 EIA Water Quality Testing Parameters

Testing Parameters		
▪ Temperature	▪ Aluminium as Al	▪ Manganese as Mn
▪ pH	▪ Antimony as Sb	▪ Mercury as Hg
▪ Conductivity	▪ Arsenic as As	▪ Molybdenum as Mo
▪ Turbidity	▪ Barium as Ba	▪ Nickel as Ni
▪ Total Dissolved Solids (TDS)	▪ Beryllium as Be	▪ Selenium as Se
▪ Dissolved Oxygen (DO)	▪ Boron as B	▪ Silver as Ag
▪ Total Nitrogen (TN)	▪ Cadmium as Cd	▪ Tin as Sn
▪ Total Phosphorus (TP)	▪ Chromium as Cr (trivalent and hexavalent)	▪ Zinc as Zn
▪ Nitrate as NO_3-N	▪ Copper as Cu	▪ Cyanide as CN^-
▪ Total Ammonia Nitrogen (TAN)	▪ Iron as Fe	▪ Sulphide as S^{2-}
▪ Phosphate as PO_4-P	▪ Lead as Pb	▪ Enterococcus
▪ Total Suspended Solids (TSS)		
▪ Total Organic Carbon (TOC)		

Site A generally has good water quality, but phosphorus, aluminium, iron, and manganese exceed the limits. Pond D4 within the site has low dissolved oxygen (DO) and high total organic carbon (TOC), likely attributed to decomposing organic matter in the pond.

The roadside drain D6 in Site B has good water quality, but the naturalised Stream D7 has relatively poorer water quality. Arsenic exceedances were recorded upstream of D7 in dry weather, likely due to anthropogenic sources near the study site.

Site C has good water quality in dry weather, but low DO and high iron was recorded in earth drain D14. During wet weather, copper, nickel, and lead exceedances were record – likely from the urban infrastructures nearby. The aluminium and iron exceedances detected in Site C are likely due to natural leeching from the soil.

Site D has generally good water quality in dry weather, but during wet weather the high sediment runoff from steep slopes in the ravine likely caused high total suspended solid (TSS) levels.

Site E generally has high phosphate levels throughout the site, except for the golf course ponds (D8 and D9) and the roadside drains (D10 and D13). This is coupled with high total phosphorus levels. Aluminium and iron exceeded the limits at some locations, likely due to natural leeching from the soil. DO is low at predominantly stagnant waterbodies, especially in dry weather.

Watercourses in Site F are generally of good water quality, but exceedances in arsenic, iron, and phosphate were recorded in dry and wet weather. There were also exceedances in aluminium during dry weather.

Legend

- Site Demarcation
- EIA Study Area
- Project Site
- Waterbodies

Water quality sampling locations

- Dry and wet
- Wet

Watercourses

- Surface
- Underground

N

Rev.	Date	By	Description	Chk'd	App'd
-	MAY 2024	HBS	Turf Club EIA	LAL	JAG

Qualified Person Endorsement : NA

URA Endorsement : NA

Consultant : AECOM

Client : Urban Redevelopment Authority

Project Title :
CONTRACT URA/T/22/031
ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR FORMER TURF CLUB AT BUKIT TIMAH

Figure Title :
Watercourses and sampling locations within/surrounding the Study Area

Designed	Checked	Approved
HBS	LAL	JAG
	Drawn: HBS	Date: MAY 2024

Figure No. : 8 - 1 | Rev. : - | Sheet : 1 of 1

CAD File Name : NA | A3

Figure 2-7 Watercourses and Sampling stations within the Study Area (AECOM, 2024)

2.3.5 Soil and Groundwater

Three (3) boreholes were drilled (Figure 2-8) and nine (9) soil samples were collected on 1 November 2022. The soil profile generally consisted of clayey silt, with layers of silt and silty sand. Soil samples were then analysed for parameters listed in the Dutch Environmental Guidelines Soil Remediation Circular as well as for sulphides. The laboratory analysis reported the following parameters above their respective levels of laboratory reporting limits: metals, total petroleum hydrocarbons (TPH), fluoranthene, and phthalates (dibutyl phthalate and di(2-ethylexy) phthalate). All of the parameters were below their respective Dutch Intervention Values (DIV).

Groundwater was encountered during the drilling of boreholes, but no samples were taken. Information was instead obtained from 17 monitoring wells from the EIA for the Study Area under the LTA CRL2 project, which reported detections of metals and TPH. Two monitoring wells exceeded the DIV for lead (RC/30204 at 75.2µg/L and RC30205 at 95.4µg/L, but these wells are located near the CR15 area, which is not part of the Project Site. The sources for the compounds detected in groundwater samples are likely not from the recent activities as the current land use of the site is considered as non-pollutive. It is likely that the TPH detections are from historical activities, with metals from leeching from the soil.

2.3.6 Air Quality

Parameters monitored for this project includes PM_{10} and $PM_{2.5}$. Baseline air quality monitoring combined data from primary baseline monitoring (EA01 – EA03 and AQ01 – AQ08 in Figure 2-9) and secondary data (LA01 in Figure 2-9) from a previous Environmental Impact Study (EIS) in Windsor and Eng Neo Avenue Forest under LTA (2022a). Air quality monitoring was conducted for one (1) week, for 5-minute interval data logging. Monitoring stations were placed more than 1 m away from any buildings or structures and not shaded by structures or trees to ensure adequate airflow, and 1.8 m from ground level.

The air quality monitoring results were compared against the Singapore Long Term Air Quality Targets. The levels of PM_{10} and $PM_{2.5}$ at all monitoring stations were generally below the targets, except for exceedances in Site E and F (AQ01, AQ04, AQ05, and AQ07) for the Max 24- hour average of $PM_{2.5}$. AQ07 and AQ01 are situated along the Pan Island Expressway (PIE), while AQ04 and AQ05 are near an existing construction site in Site B, extending into Site E – these could be the cause of the exceedances recorded.

Legend

- Borehole locations
- Project Site
- Site Demarcation
- EIA Study Area

N

Rev.	Date	By	Description	Chk'd	App'd
-	MAY 2024	SNZY	Turf Club EIA	LAL	JAG

Qualified Person Endorsement : NA

URA Endorsement : NA

Consultant : AECOM

Client: URBAN REDEVELOPMENT AUTHORITY

Project Title :

CONTRACT URA/T/22/031 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR FORMER TURF CLUB AT BUKIT TIMAH

Figure Title :

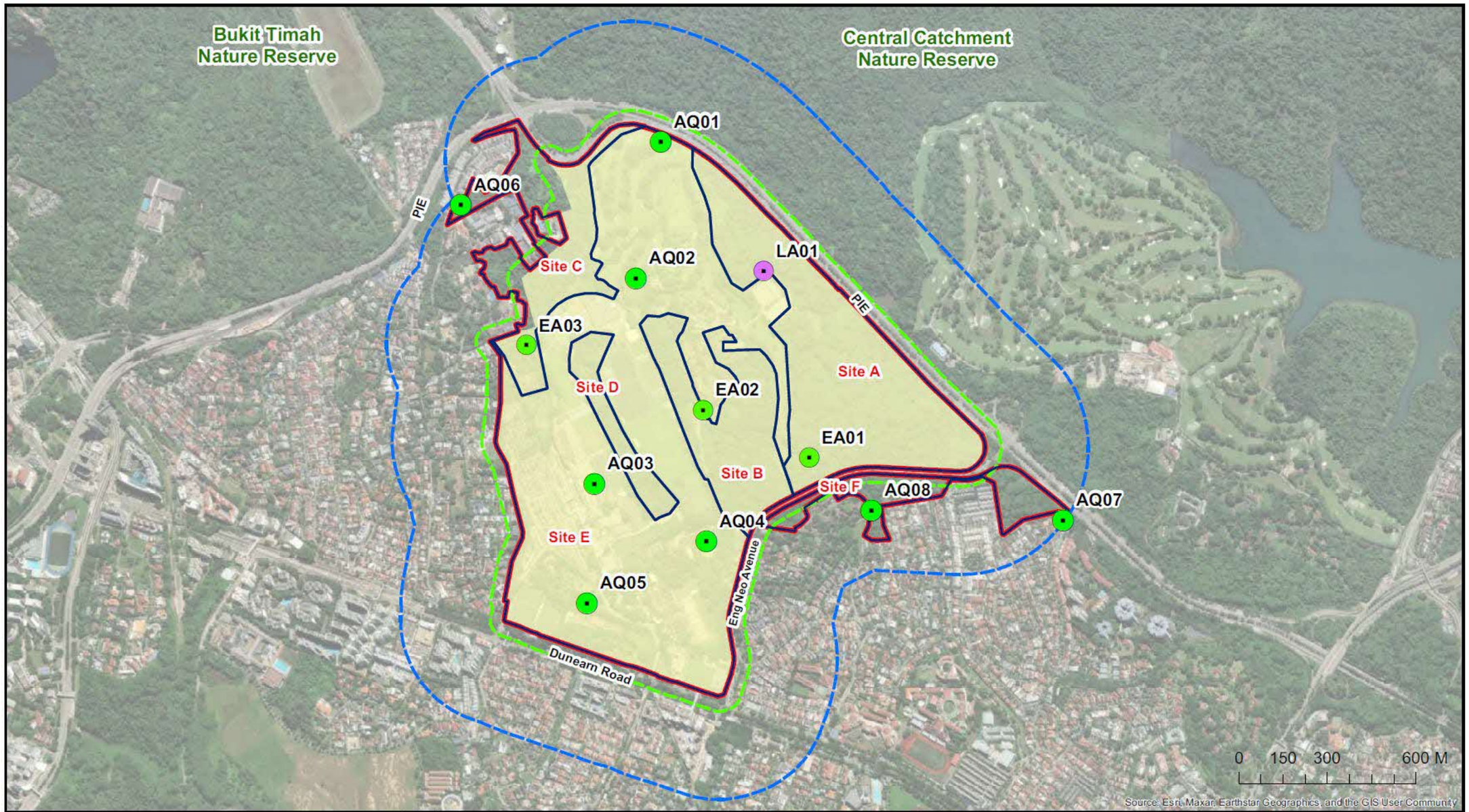
Location of boreholes

Designed	Checked	Approved
SNZY	LAL	JAG
	Drawn: SNZY	Date: MAY 2024

Figure No. : 9 - 2 | Rev. : - | Sheet : 1 of 1

CAD File Name : NA | A3

Figure 2-8 Location of Boreholes (AECOM, 2024)



Legend

- Baseline Air Monitoring Location
- Baseline Air Monitoring Location from Previous Study [R-4]
- Air Quality Study Area - Ecology
- Air Quality Study Area - Human
- Site Demarcation
- EIA Study Area
- Project Site

N

Rev.	Date	By	Description	Chk'd	App'd
-	MAY 2024	LLG	Turf Club EIA	LAL	JAG

Qualified Person Endorsement : NA

URA Endorsement : NA

Consultant : AECOM

Client: URBAN REDEVELOPMENT AUTHORITY

Project Title :
CONTRACT URA/T/22/031 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR FORMER TURF CLUB AT BUKIT TIMAH

Figure Title :
Baseline Air Quality Monitoring Locations

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	Drawn LLG	Date MAY 2024	CAD File Name : NA		A3

Figure 2-9 Baseline Air Quality Monitoring Locations (AECOM, 2024)

2.3.7 Airborne Noise

A total of 11 noise monitoring stations were placed within the study area (NN01 – NN11 in Figure 2-10), with noise monitoring conducted for a period of one (1) week between mid Aug 2023 to early October 2023. Data from an additional five (5) noise monitoring stations from a previous URA EBS (2022d) was also referenced to (NM01 – NM05 in Figure 2-10). The L_{Aeq} was recorded at 12 hour, 1 hour, and 5 min intervals for all stations.

The criteria applied for identification of Noise Sensitive Receptor (NSR) are based on EPM (Control of Noise at Construction Sites) Regulation 2008 which are listed below:

- (a) Hospitals, schools, institutions of higher learning, homes for aged sick, etc.
- (b) Residential buildings located less than 150 m from the construction site
- (c) Buildings other than those in (a) and (b) above

As such, sensitive noise receptors identified near the project site includes schools, residential buildings, and fauna within the forest.

Generally, noise levels captured at Sites B, C, D, and F did not exceed 60 dB(A). At Site A, NM02 recorded noise levels above 60 dB(A), likely due to the traffic along the Pan Island Expressway (PIE). The other monitoring points (NM01 and NM09) were below 60 dB(A). At Site E, NN01 and NN05 experienced noise levels above 60 dB(A), which can be attributed to higher traffic levels along the PIE for NN01, while NN05 was likely impacted by traffic from Dunearn Road, Bukit Timah Road, and Eng Neo Avenue. Other locations within Site E (NN02, NN04, and NN08) recorded levels below 60 dB(A).

Legend

- Monitoring Location's from Previous Studies [R-2, R-3]
- Airborne Noise Monitoring Locations
- Airborne Noise Study Area (150m)
- Site Demarcation
- EIA Study Area
- Project Site

N

Rev.	Date	By	Description	Chk'd	App'd
-	MAY 2024	SHA	Turf Club EIA	LAL	JAG

Qualified Person Endorsement : NA

URA Endorsement : NA

Consultant : AECOM

Client: URBAN REDEVELOPMENT AUTHORITY

Project Title :
CONTRACT URA/T/22/031 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR FORMER TURF CLUB AT BUKIT TIMAH

Figure Title :
Baseline airborne noise monitoring locations within/surrounding the Study Area

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Figure 2-10 Baseline Airborne Noise Monitoring Locations Within/surrounding the Study Area (AECOM, 2024)

2.4 Summary of Impact Assessment

2.4.1 Impact Significance Assessment Methodology

Environmental Impacts are evaluated based on their significance, which is a measure of the weight that should be given to each impact in decision making and if it warrants impact management. The following two (2) factors are then assessed in the Impact Assessment Matrix () to formulate the Impact Significance:

- Impact Consequence: The consequence of an impact is a function of a range of considerations including impact spread, impact duration, impact intensity, and nature, legal, and guideline compliance.
- Likelihood of occurrence: The likelihood of the impact occurring in the life of the project.

Table 2-6 Impact Significance Assessment Matrix (AECOM, 2024)

Consequence / Likelihood	Imperceptible	Very Low	Low	Medium	High
Unlikely/ Remote	Negligible	Negligible	Negligible	Negligible	Negligible
Less Likely/ Rare	Negligible	Negligible	Minor	Minor	Minor
Possible/ Occasional	Negligible	Minor	Minor	Moderate	Moderate
Likely/ Regular	Negligible	Minor	Moderate	Moderate	Major
Certain/ Continuous	Negligible	Minor	Moderate	Major	Major

Positive impacts are classified under a single category. Impacts assessed as ‘negligible’ or ‘minor’ do not require additional management or mitigation measures, and are deemed as ‘Insignificant’. Impacts which are moderate or major require adoption of management or mitigation measures to minimise or reduce the impact to an acceptable level, and as such major impacts are deemed ‘Significant’ and moderate impacts are ‘Relatively Significant’.

An ‘Acceptable Level’ is the reduction of a major impact to a moderate one after management or mitigation measures are in place. Reduction for moderate impacts should be done on the basis that the impact has been reduced to a level that is as low as reasonably practicable, as it is not always practical to reduce moderate impacts to minor ones in consideration of the cost-effectiveness of an approach. Residual impact assessment shall be conducted for parameters where impact from the activity is identified to be significant and additional mitigation measures are recommended, and assessment of residual impacts follow the similar risk approach as outlined above. Positive impacts were not accessed for significance.

2.4.2 Impact Assessment Findings

A summary of the impact assessments from AECOM (2024) are presented in and below, according to the construction and operational phases. It should be noted that impact significances which have a rating of negligible or minor have no residual impact assessments done.

Table 2-7 Summary of Impact Assessments – Construction Phase (AECOM, 2024)

Environmental Aspect			Construction Phase		
			Impact Significance Before Mitigation	Key Mitigation Measures	Impact Significance After Mitigation
Biodiversity	Habitat	Loss of habitat	Moderate – Major	• Avoid native-dominated secondary forest if possible. • Maintain hoarding integrity to prevent vegetation clearance beyond Project Site, and to restrict entry into retained forest areas.	Moderate – Major
		Habitat degradation	Negligible – Minor		Negligible – Minor
		Formation of edge effects	Minor – Moderate		Negligible – Minor
	Flora		Minor – Major	• Avoid plant removal, or transplant if unavoidable.	Negligible
	Fauna	Loss of or reduction in habitat or food source	Moderate – Major	• Create ecological connectivity within the project area and nearby green networks to allow fauna affected by the development to move. • Avoid night works and incorporate lighting strategies to reduce light disturbances. • Construct connectivity structures. • Conduct pre-felling inspection, biodiversity awareness training, and establish a wildlife response plan.	Minor – Major
		Accidental injury or mortality	Moderate		Minor
		Human disturbance	Negligible – Moderate		Negligible – Minor
		Human-wildlife conflict	Negligible – Moderate		Minor
		Light disturbance	Moderate – Major		Minor
		Loss of/ reduction of ecological connectivity	Negligible – Moderate		Minor
Hydrology and Surface Water Quality	Hydrology	Stormwater runoff generation (Human)	Negligible	• Redirect clean water into retained ecologically sensitive watercourses/ bodies with significant catchment loss (i.e. pond D4, naturalized stream D7, and earth drain D14).	-
		Stormwater runoff generation (Ecology)	Minor – Major		Minor
	Surface Water Quality	Stormwater runoff generation (Human)	Negligible		-
		Stormwater runoff generation (Ecology)	Negligible – Moderate		Negligible – Moderate
		Chemical substances (Human)	Negligible		-
		Chemical substances (Ecology)	Negligible – Major		Negligible – Moderate
		Domestic wastes (Human)	Negligible		-

		Domestic wastes (Ecology)	Negligible – Minor	• Prohibit any discharges from construction site into retained ecologically sensitive watercourses/ bodies (i.e. D1, D4, D7, D14, and D15). • Build a berm structure or equivalent at the upstream of tributary of natural stream D1 and earth drain D14 prior to construction works (e.g. backfilling). • Complete drain diversion construction prior to connection with naturalised stream D7. • Provide silt curtains or equivalent when connecting naturalized stream D7 to the drain diversion. • Coverage of all bare/ erodible surfaces are to be done as soon as possible when works are complete or at the start of heavy rain and cessation of works are necessary – tarp or other coverage material should always be on standby next to bare soil.	-
		Construction wastewater (Human)	Negligible		-
		Construction wastewater (Ecology)	Negligible – Major		Negligible – Moderate
		Solid wastes (Human)	Negligible		-
		Solid wastes (Ecology)	Negligible – Major		Negligible – Moderate
Soil and Groundwater	Soil and groundwater contamination due to seepage of contaminants originating from excavated soil, extracted groundwater, chemicals, and waste stored on the site.		Negligible – Minor	-	-
Air Quality	Dust emissions generated by earthworks processes and construction of new structures, as well as from the transport of dust and dirt by dumper trucks (trackout)		Moderate – Major	• Implement dust control measures e.g. dust screens. • Install hard surfaced haul routes. • Only use cutting, grinding, and sawing equipment with dust suppression water spray mechanisms. • Erect hoarding around dusty activities and site boundary – minimum of 1.8 m height in line with BCA guidelines. • Install signposts of maximum speed-limit of 25 km/hr on paved roads and 15 km/hr on unpaved roads and work areas. • No burning of waste allowed on site. • Revegetate earthworks and exposed areas/ soil stockpiles.	Minor
Airborne Noise	Ecological Receptors		Moderate – Major		Moderate – Major

	Human Receptors	Negligible – Major	• AECOM stated that due to limited information, it is not possible to ascertain the noise reduction provided by noise barriers. AECOM recommends the Developer to: o Conduct a boundary noise impact assessment o Perform installations of ACMV systems at later stages of the Project development o Monitor at the operational stage for non-industrial buildings with ACMV systems in accordance with NEA regulations.	Negligible – Major

Table 2-8 Summary of Impact Assessments – Operational Phase (AECOM, 2024)

Environmental Aspect			Operational Phase		
			Impact Significance Before Mitigation	**Key Mitigation Measures**	**Impact Significance After Mitigation**
Biodiversity	Habitat	Habitat degradation	Negligible – Moderate	• Put up signages to remind the public not to release exotic plants or stray off trails.	Negligible – Minor
		Introduction of exotic species	Minor – Major		Negligible – Minor
		Change in microclimate conditions	Minor – Moderate		Minor – Moderate
	Flora		Not assessed	N.A.	Not assessed
	Fauna	Accidental injury or mortality	Minor – Moderate	• Incorporate-bird friendly building designs. • Construct connectivity structures. • Set up road calming measures near the retained forest areas. • Plant flowering shrubs along streets and parks. • Set up signages for park etiquette. • Restrict park opening hours. • Conduct random patrols to deter poaching. • Include macaque proofing into building designs, such as a 6 m buffer between the building façade and tree lines or other potential climbing structures. Macaque proof bins should also be used as part of the waste management plans. • Otter-proof housing premises using adequate fencing, particularly in areas with fishponds.	Minor – Moderate
		Human disturbance	Negligible – Moderate		Minor – Moderate
		Human-wildlife conflict	Negligible – Moderate		Minor – Moderate
		Light disturbance	Moderate – Major		Minor
		Loss of/ reduction of ecological connectivity	Negligible – Moderate		Minor – Moderate
		Poaching	Negligible – Moderate		Negligible – Minor
	Hydrology	Altered stormwater runoff (Human)	Minor		-

Hydrology and Surface Water Quality		Altered stormwater runoff (Ecology)	Minor – Major	• Redirect clean water into retained ecologically sensitive watercourses/ bodies with significant catchment loss (i.e. pond D4, naturalized stream S7, earth drain D15) to increase flow into these watercourses/ bodies. if possible, the water can be from ABC Water Design Features.	Minor
	Surface Water Quality	Stormwater runoff contamination (Human)	Negligible		
		Stormwater runoff contamination (Ecology)	Negligible - Minor		Minor
		Improper Management of Liquid and Solid Wastes (Human)	Minor		-
		Improper Management of Liquid and Solid Wastes (Ecology)	Minor		-
Soil and Groundwater	Soil contamination due to seepage and leakage of contaminants originating from generated waste and chemicals stored and/ or used on the site		Negligible - Minor	-	-
Air Quality	Gaseous and particulate emissions from vehicle exhaust due to the increased traffic		Minor	-	-
Airborne Noise	Ecological Receptors		Negligible - Minor	-	-
	Human Receptors		Negligible - Minor	-	-

2.5 Recommended Areas of Conservation

Based on the EIA findings summarised above, it is crucial to maintain ecological connectivity within the Project Area and with nearby forested areas, particularly CCNR, Rifle Range Park and BTNR. By ensuring ecological connectivity within these areas, a consistent dispersal of threatened flora and fauna would be maintained, thereby further enhancing the ecological integrity and viability of RACs in the Project Area, as well as the surrounding green networks.

Areas of high conservation value were identified within the EIA study area, and were designated as Recommended Areas of Conservation (RAC), as shown in Figure 2-11 and Figure 2-12. Further, the EIA pinpointed all habitats, including plants and fauna with high ecological value, within the worksite and within 30m from the proposed worksite area as sensitive habitat receptors. It can be seen that the RAC described in the EIA primarily sits on the periphery of the Project Area (Figure 2-1). Should there be a need to develop within the RAC, the development should be planned for less sensitive habitats such as scrublands and forest with less or no flora and fauna of conservation significance. The EIA also recommended for a buffer of at least 50m from waterbodies, where applicable and feasible.

Additionally, with reference to this project, the EIA recommended for a nationally Endangered *Ficus kerkhovenii* strangler (situated within Site B of the EIA, and Parcel A4 of this EMMP) to be retained (see Figure 1-1). A TPZ of radius 15 m was recommended to be set up around the large *Ficus kerkhovenii* strangling fig, which had 14 m spread recorded.

Legend

- EIA Study Area
- Heritage/Community Clusters
- Residential with supporting amenities
- Retained Buildings
- Retained Forest with Trails
- Urban Vegetation
- Pedestrian Routes/Green Fingers
- Transport Network
- MRT Entrance
- MRT

N

Rev.	Date	By	Description	Chk'd	App'd
-	MAY 2024	HBS	Turf Club EIA	LAL	JAG

Qualified Person Endorsement : NA

URA Endorsement : NA

Consultant : AECOM

Client: URBAN REDEVELOPMENT AUTHORITY

Project Title : CONTRACT URA/T/22/031 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR FORMER TURF CLUB AT BUKIT TIMAH

Figure Title : Proposed preliminary land use plan of the Project Site

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
HBS	LAL	JAG	3 - 2	-	1 of 1
	Drawn HBS	Date MAY 2024	CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

Figure 2-11 Preliminary Land Use Plan (AECOM, 2024)

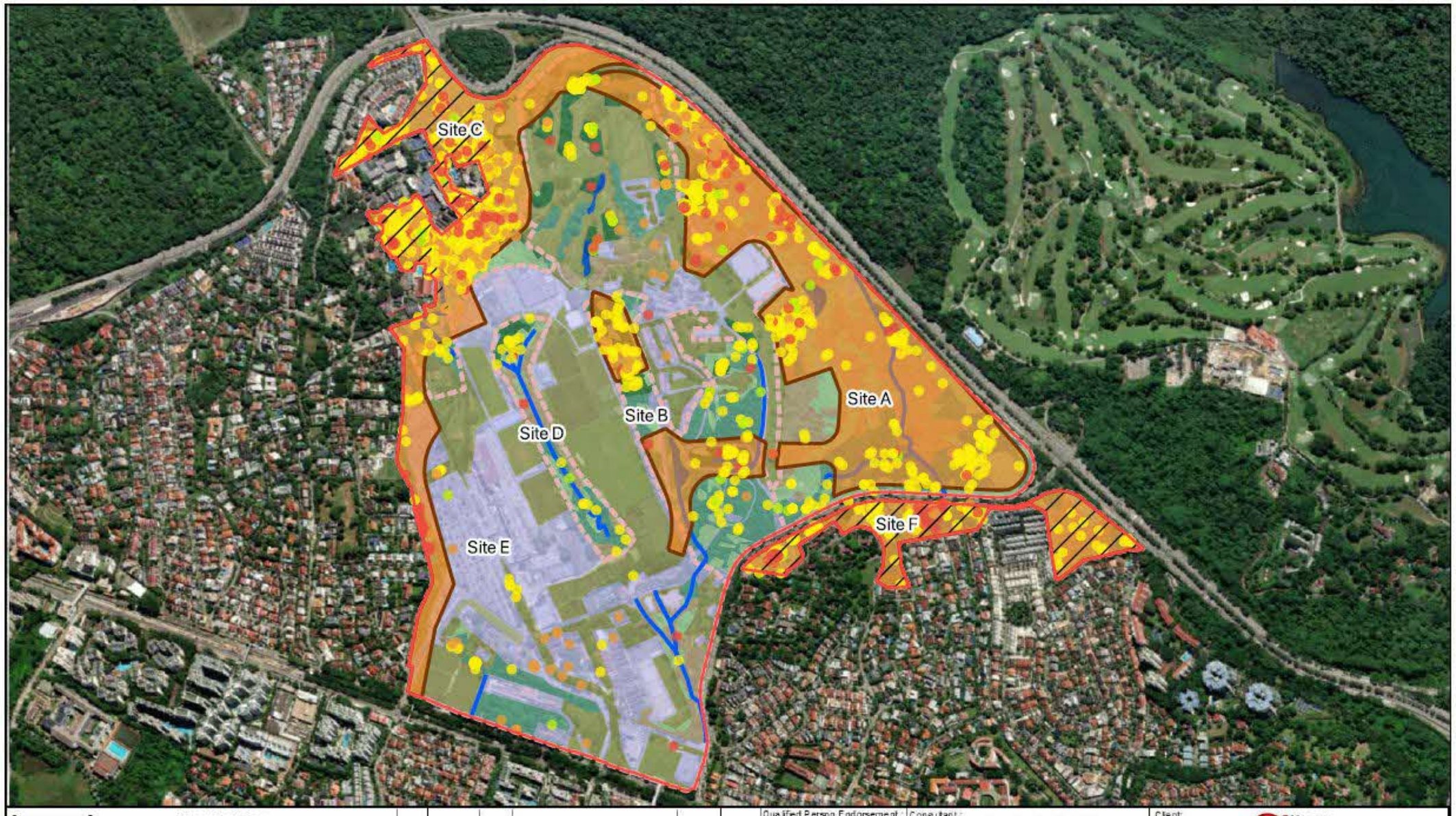


Figure 2-12 Recommended Areas of Conservation (AECOM, 2024)

3 Proposed Construction Plan & Timeline

The works for this Project are split into two (2) main stages – Stage 1 will cover the advance works that include soil investigation works, cable detection, pre-condition survey, baseline re-establishment survey, hoarding installation, site access formation, site clearance and earthworks, whilst Stage 2 will cover infrastructure and building works. The information in this section is extracted from the AECOM 2024 EIA and is thus preliminary and subject to changes. The Construction Master Programme for both stages will be provided by the appointed contractor(s). Additionally, it is to be noted that the planned earthworks programme (Stage 1) and sequence of works are subject to inputs and finalised schematic from other agencies, specifically LTA's final road scheme, HDB's final parcellation of the Project boundary, as well as PUB's review and approval of the final drainage scheme (Figure 3-1). As significant cut-and-fill works are expected for the Project, soil investigation (SI) works will be required. The notional site utilisation plan has also been presented in Figure 3-2 and Figure 3-3 for reference.

It is to be noted that as the soil investigation works are an additional scope, Surbana Jurong has made a separate Form A submission to NParks for review and approval. Soil investigation works have nonetheless been accounted for in this EMMP.

The tentative timeline for this Project is as follows:

- Stage 1 – Approximately 34 months
- Stage 2 – Approximately 55 months

3.1 Stage 1 – Expected Work Activities & Potential Risks and Impacts

Specific construction activities at Stage 1 with regards to environmental aspects are presented in Table 3-1 below. The associated potential risks and impacts with the activities are also stated.

Table 3-1 Stage 1 Activities and Associated Environmental Impacts

Process / Activity	Impacts / Pollution
Site Clearance and Preliminary Works	
Delivery of materials (e.g. steel plates, scaffolding, hoarding boards, etc.)	• Dust emission • Noise pollution
Pre-condition survey, baseline re-establishment surveys and soil investigation works	• Dust emission • Noise pollution • Soil erosion • Loss of habitat and tree cover • Movement of wildlife to new areas may lead to roadkill / Wildlife mortality • Human-wildlife interaction – animals may stray into nearby populated areas to seek new foraging grounds • Silty discharge; increased runoff volume, rate, and duration
Site clearance and removal of vegetation (trees, shrubs, etc.)	
Hoarding installation and site access works	
Demolition of existing structures and accompanying infrastructures which are not intended to be retained (Figure 3-1)	
Hacking of minor and major structures	

Process / Activity	Impacts / Pollution
Removal of abandoned steel elements and debris (e.g. damaged windows, doors, internal & external building furniture, etc.)	• Dust emission • Noise pollution • Soil erosion • Generation of construction waste
Removal of foundation, soils, and debris	
Earthworks	
Soil dewatering (i.e. groundwater extraction and pumping of rainwater)	• Dust emission • Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Soil excavation, cut and fill	
Soil levelling to obtain planned platform levels	
Soil excavation for foundations	
Utilities Diversion	
Construction of access temporary roads and other infrastructure required for construction activities (e.g. site office, workers dormitory, etc.)	

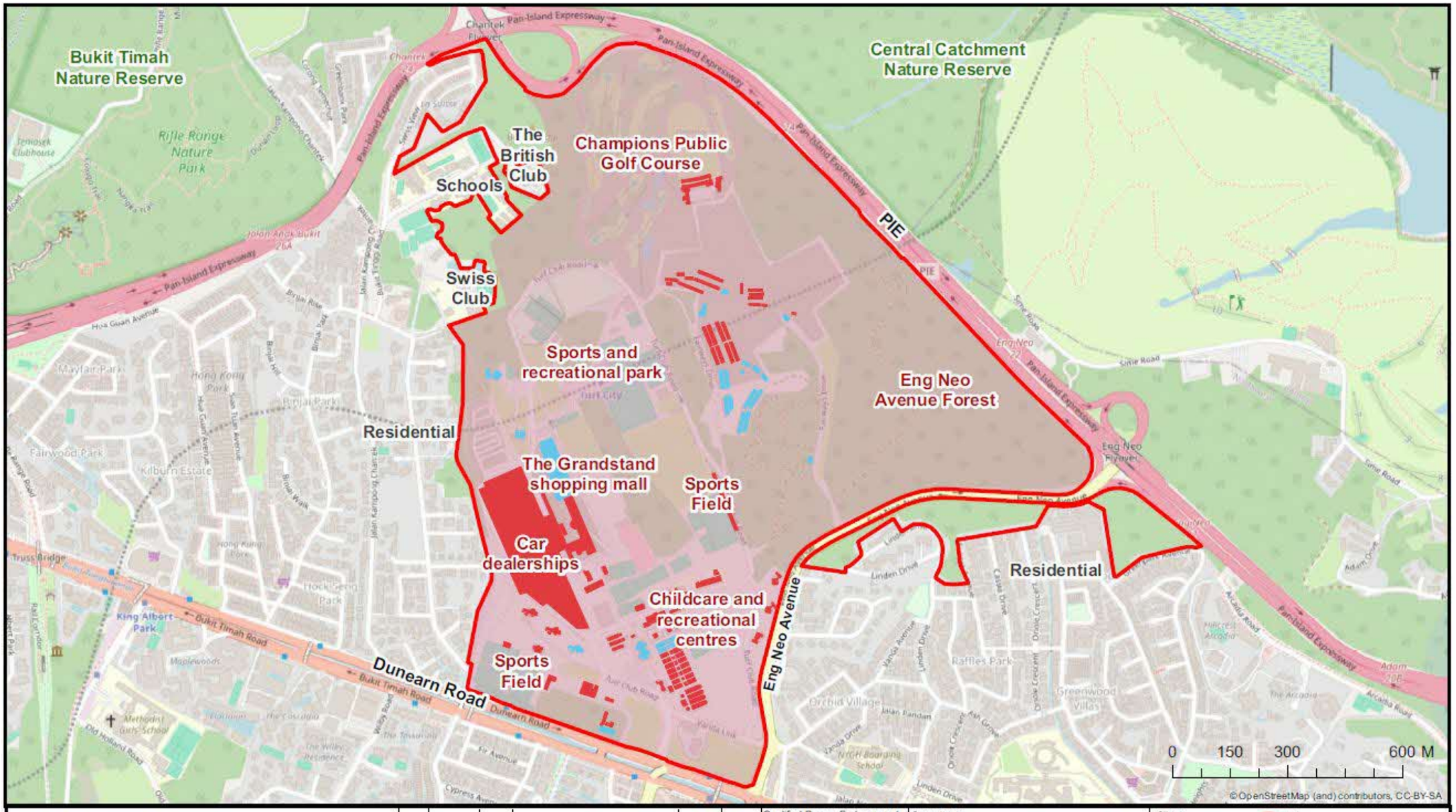
3.2 Stage 2 – Expected Work Activities & Potential Risks and Impacts

Specific construction activities at Stage 2 with regards to environmental aspects are presented in Table 3-2 below. The associated potential risks and impacts with the activities are also stated. It is to be noted that the finalised construction programme, layout and site utilisation for Stage 2 works will be updated for this EMMP in an addendum at a later stage.

Table 3-2 Stage 2 Activities and Associated Environmental Impacts

Process / Activity	Impacts / Pollution
Foundation and Earthworks	
Soil Excavation, cut and fill	• Dust emission • Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Site levelling to obtain planned platform levels	
Soil boring works	
Stage excavation	
Utility laying	
Construction of drainage and sewage infrastructure	
Stage excavation with walers and struts	
Installation of bore casings	
Installation of rebar cage and tremie pipe	
Concreting works – construction of piles and pile caps	
Pile head hacking/removal	

Process / Activity	Impacts / Pollution
Soil dewatering	• Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Spoil and slurry removal	
Delivery and erection of construction machinery (i.e. crawler crane for lifting operations and boring rig for soil drilling)	• Dust emission • Noise pollution
Delivery of steel sections	
Hoisting of walers and struts	
Hot works – welding of steel beams, brackets, etc.	• Noise pollution • Construction waste
Superstructure Works (Prefabrication Installation)	
Soil dewatering	• Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Spoil removal	
Establishment of power supply (for site equipment)	
Excavation below ground surface	• Dust emission • Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Rebar handling and positioning	• Dust emission • Noise pollution
Hoisting of falsework	
Setting up and tearing down scaffolding	
Formwork construction and cleaning before casting	• Dust emission • Noise pollution • Changes in illumination
Casting of concrete	
Finishing works (e.g. plastering, waterproofing, tiling, etc.)	• Noise pollution • Water Pollution
Landscaping Works	
General landscaping activities	• Dust emission • Noise pollution • Water Pollution • Silty discharge, increase runoff volume, rate, and duration
Construction of landscape amenities/ constructions (e.g. gazabos, pathways, etc.)	
Removal of Temporary Structures and Reinstatement	
Removal of Earth Retaining and Stabilizing Structures (ERSS)	• Dust emission • Noise pollution • Water Pollution • Silty discharge, increase runoff volume, rate, and duration
Reinstatement of the area to original (or required) condition	• Dust emission • Noise pollution



Legend

- EIA Study Area
- Project Site

Demolished/Retained

- Demolished
- Retained

N

Rev.	Date	By	Description	Chk'd	App'd
-	MAY 2024	HBS	Turf Club EIA	LAL	JAG

Qualified Person Endorsement : NA

URA Endorsement : NA

Consultant : AECOM

Client: URBAN REDEVELOPMENT AUTHORITY

Project Title :
CONTRACT URA/T/22/031 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR FORMER TURF CLUB AT BUKIT TIMAH

Figure Title :
Existing structures to be demolished or retained

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HBS	LAL	JAG	3 - 5	-	1 of 1
	Drawn HBS	Date MAY 2024	CAD File Name : NA		A3

Figure 3-1 Stage 1 Existing Structures to be Demolished and Retained (AECOM, 2024)

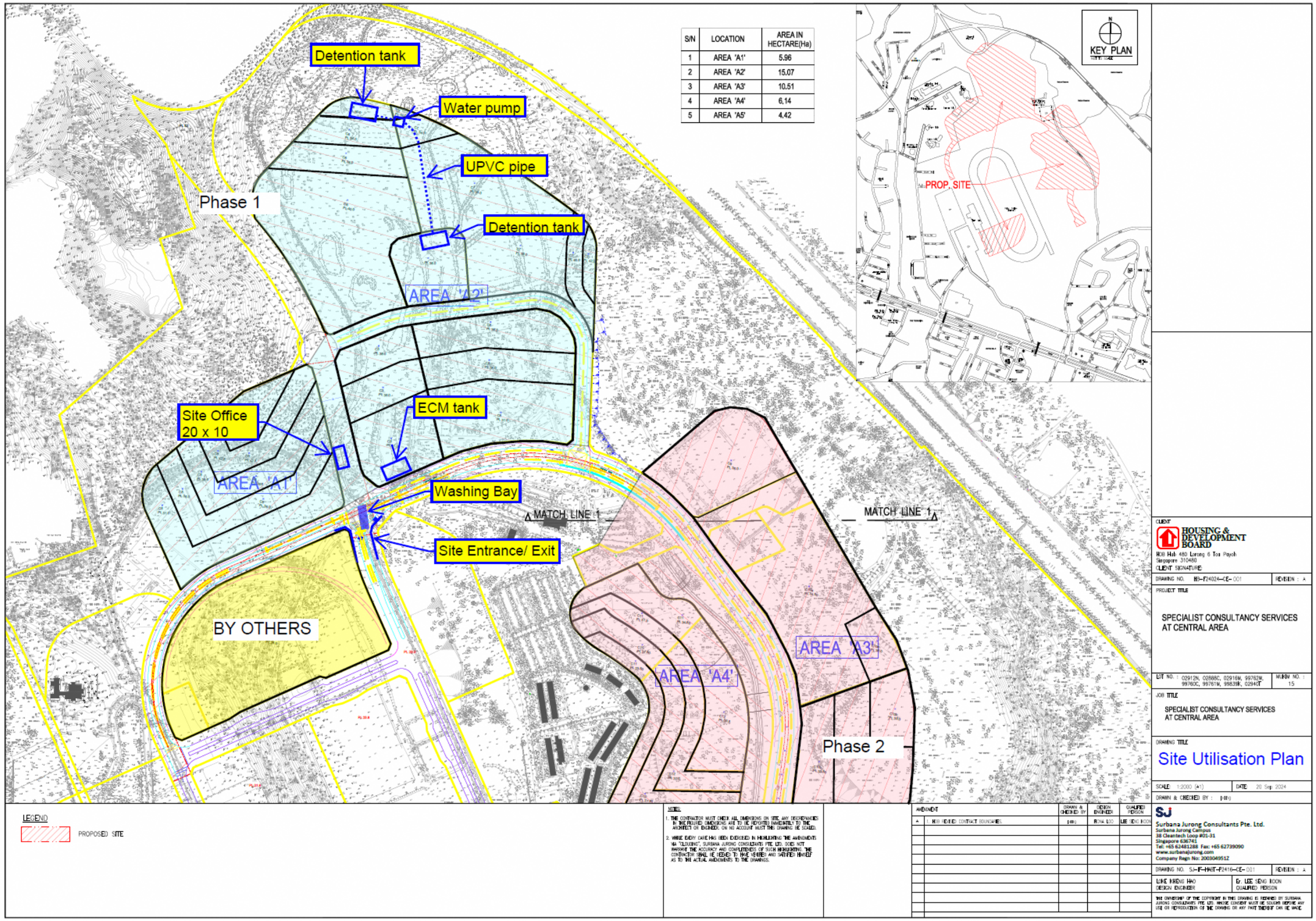


Figure 3-2 Indicative Site Utilisation Plan for Project (Part 1; Source: HDB-SJ)

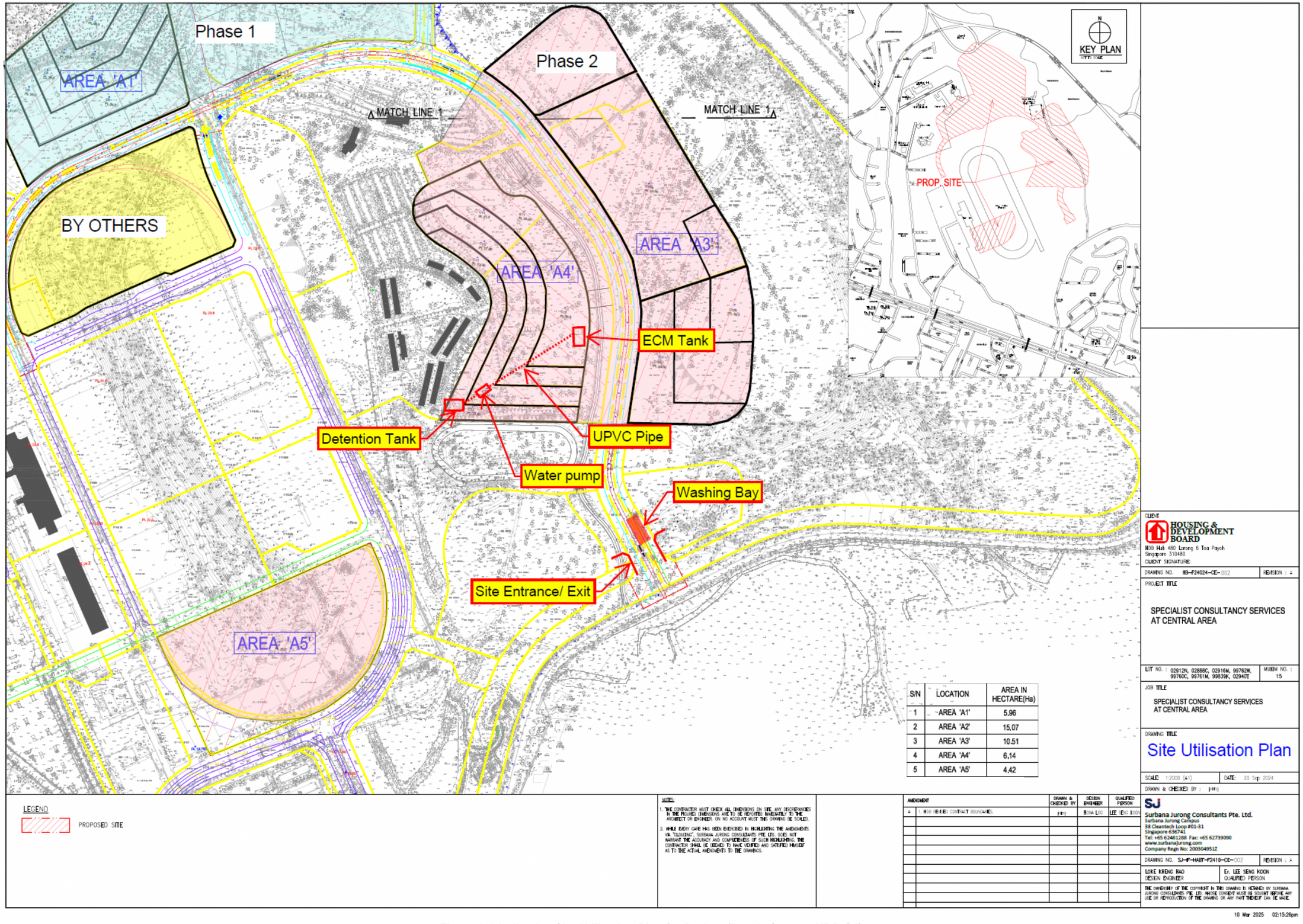


Figure 3-3 Indicative Site Utilisation Plan for Project (Part 2; Source: HDB-SJ)

4 Applicable Environmental Legislation

This section outlines the legislations and guidelines in Singapore relevant to the implementation of the EMMP.

4.1 Summary of Environmental Legislation

The following sections provides the legislative framework for the control of environmental pollution and biodiversity protection measures. The scope covers biodiversity protection, air pollution, water pollution, land pollution, noise pollution, and hazardous substances control. Section 10 of the Wildlife Act stipulates the requirement for an EMMP. Some sections which play an important part are those related to noise from construction and other works, trade effluent discharge limits into watercourse, prevention of pollution from construction site, and the pollution control studies. The Acts, subsidiary regulations, action plans, and guidelines relevant to environmental protection are summarised in Table 4-1 below:

Table 4-1 Summary of Environmental Acts, Subsidiary Regulations, Action Plans and Guidelines

Environmental Aspects	Relevant Local Acts / Regulations / Action Plans	Acronyms	Jurisdiction/ Enforcement Agencies
Air Pollution	Environmental Protection and Management (Vehicular Emission) Regulation 2008	EPMA (Vehicular Emission)	NEA
	Environmental Protection and Management (Air Impurities) Regulation 2008	EPMA (Air Impurities)	
	Environmental Protection and Management (Off-Road Diesel Engine Emissions) Regulation 2012	EPMA (Off-Road Diesel Engine Emission)	
	Environmental Protection and Management (Prohibition on the Use of Open Fires) Order 2008	EPMA (Prohibition on the Use of Open Fires)	
	Singapore Ambient Air Quality Targets	-	
Water Pollution	Environmental Protection and Management (Trade Effluent) Regulations 2008	EPMA (Trade Effluent)	PUB
	Sewerage and Drainage Act (and its subsidiary legislation) 2001	Sewerage and Drainage Act	
	Public Utilities (Reservoir and Catchment Areas) Regulations 2006	Public Utilities Act	
Noise Pollution	Environmental Protection and Management (Control of Noise at Construction Sites) Regulations 2008	EPMA (Control of Noise at Construction Sites)	NEA
	Environmental Pollution Control (Control of Noise at Construction Sites) (Amendment) Regulations 2007	Environmental Pollution Control Act	
Waste Management	Environmental Public Health Act	EPHA	NEA
	Environmental Public Health (Toxic Industrial Waste) Regulation 2000	EPH (Toxic Industrial Waste)	
	Environmental Public Health (General Waste Collection) Regulations 2000	EPH (General Waste Collection) Regulations	
Vectors	Infectious Diseases Act 2020	IDA	NEA
	Control of Vectors and Pesticides Act 2002	CVPA	
	Environmental Public Health (Employment of Environmental Control Officers) (Amendment) Orders 2021	EPH (Employment of Environmental Control Officers)	
Biodiversity	Parks and Trees Act 2020	Parks and Trees Act	NParks
	Wildlife Act 2020	Wildlife Act	
	National Biodiversity Strategy and Action Plan	NBSAP	
	Nature Conservation Masterplan	-	
	NParks Biodiversity Impact Assessment Guidelines	-	

4.2 Specific Environmental Legislation

The specific legislation requirements on the various environmental aspects relevant to the Project are presented in the following sub-sections. They include six sub-sections: Biodiversity, Air Pollution, Water Pollution, Noise, Waste Management, and Vectors.

4.2.1 Biodiversity

The main legislation relevant to the protection, preservation and management of biodiversity within Singapore are the Parks and Trees Act 2020, Planning Act 2020 and the Wildlife Act 2020, which was originally the Wild Animals and Birds Act 1985, with specific amendments. This is reinforced by Singapore's various commitments and guidelines aimed at promoting biodiversity conservation, such as the National Biodiversity Strategy and Action Plan (NBSAP) in 2009 and updated in 2019 based on the Convention on Biological Diversity Strategic Plan, and the Aichi Targets for 2011-2020.

Tree Conservation Area (TCA) and Heritage Road

The *Tree Conservation Area (TCA) and Heritage Road Act* provides for the planting, maintenance and conservation of trees and plants within different designated zones/areas within Singapore. Such protected spaces include National Parks, Nature Reserves, Tree Conservation Area (TCA), and Heritage Road Green Buffer.

Wildlife Act

The *Wildlife Act* has been in effect since June 1, 2020. Table 4-2 provides a summary of the relevant sections to this Project based on the current version. All site personnel will be briefed on the relevant legal requirements and penalty from the Wildlife Act during the Biodiversity Awareness Briefing, prior to work at site.

Table 4-2 Summary of Wildlife Act 2020

Activity	Applicable Section	Legal Requirement	Penalty
Feeding of wildlife	5A	*A person must not intentionally feed any wildlife in any place unless the person has the Director-General's written approval to do so*	*For a first offence, to a fine not exceeding $5,000* *For a second or subsequent offence, to a fine not exceeding $10,000*
Killing, trapping, taking or keeping of wildlife	5C	*A person must not intentionally kill, trap, take or keep any wildlife in any place unless the person has the Director-General's written approval to do so.*	*In the case where the offence is committed in respect of a protected wildlife, to a fine not exceeding $50,000 or to imprisonment for a term not exceeding 2 years or to both.*
Wildlife-related measures for development or works	10	*The Director-General may direct a person to implement, in respect of any development or works being carried out, or to be carried out, by or on behalf of the person, any wildlife related measure that the Director-General considers necessary to safeguard*	*A person who, without reasonable excuse, contravenes subsection (3) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $50,000 or to imprisonment for a term not exceeding 6 months or to both.*

4.2.2 Water Pollution

Water Quality

The Pollution Control Department (PCD) of National Environment Agency (NEA) is responsible for the control of water pollution, hazardous substances, and toxic industrial wastes in Singapore. The main legislative instruments governing water pollution are the *EPMA (Part V – Water Pollution Control)*, the *EPMA (Trade Effluent)* and the *Sewerage and Drainage Act*. The Director-General of Environmental Protection is responsible for the implementation and administration of the EPMA regulations, while PUB is responsible for the administration of the Sewerage and Drainage Act. The provisions given under each of these Acts or Regulations are described below, whilst a summary of allowable limits for trade effluent discharge applicable to a watercourse is presented in Table 4-3 below. EPMA (Part V – Water Pollution Control) 2008 includes the following measures to protect water bodies from pollution:

- Penalties for the discharge of polluting matter into inland waters;
- Licensing requirements for the treatment and discharge of trade effluent, oil, chemical, sewage or other polluting matters; and Licensing is only applicable for storage, removal and disposal of toxic industrial waste and trade effluent:
- Measures to be undertaken to prevent water pollution due to storage or transportation of toxic substances or other polluting matters.
- A written permission is required from the Director-General for any person who discharges, or causes or permits to be discharged, any trade effluent, oil, chemical, sewage or other polluting matters into any drain or land.

The *EPMA (Trade Effluent)* Regulations establish regulatory control over industrial, trade premises and other activities that may have adverse impacts on water quality. The Regulations provide details on trade effluent quality standards for discharge of trade effluent into watercourses or land but does not cover the discharge of trade effluent into the public sewer system (as it is covered under the Sewerage and Drainage (Trade Effluent) Regulations). The Regulations state that no trade effluent shall be discharged into watercourses or land without obtaining NEA permission. Trade effluent standards and permitting requirements are stipulated in the Regulations and all trade effluent must be treated to the stipulated standards prior to discharge, with standards being applied depending on the watercourse being discharged into. Controlled watercourses have particularly stringent standards, as these are located within water catchment areas.

The *Public Utilities* (Reservoirs, Catchment Areas and Waterway) Regulations may also be referred to for the definitions of water catchment areas, and activities prohibited within Catchment Area Parks.

Table 4-3 Allowable Limits for Trade Effluent Discharge

S/N	Items of Analysis	Watercourse	Controlled Watercourse
		(Units in milligram per litre or otherwise stated)	
1	Temperature of discharge	45ºC	45ºC
2	Colour	7 Lovibond Units	7 Lovibond Units
3	pH Value	6- 9	6- 9
4	BOD (5 days at 20°C)	50	20
5	COD	100	60
6	Total Suspended Solids	50	30
7	Total Dissolved Solids	-	1000
8	Chloride (as chloride ion)	-	250
9	Sulphate (as SO_4)	-	200
10	Sulphide (as sulphur)	0.2	0.2
11	Cyanide (as CN)	0.1	0.1
12	Detergents (linear alkylate sulphonate as methylene blue active substances)	15	5
13	Grease and Oil	10 (Total) 10 (Hydrocarbons)	1 (Total)
14	Arsenic	0.1	0.01
15	Barium	2	1
16	Tin	-	5
17	Iron (as Fe)	10	1
18	Beryllium	-	0.5
19	Boron	5	0.5
20	Manganese	5	0.5
21	Phenolic Compounds (expressed as phenol)	0.2	Nil
22	*Cadmium	0.1	0.003
23	*Chromium (trivalent and hexavalent)	1	0.05
24	*Copper	0.1	0.1
25	*Lead	0.1	0.1
26	*Mercury	0.05	0.001
27	*Nickel	1	0.1
28	*Selenium	0.5	0.01
29	*Silver	0.1	0.1
30	*Zinc	1	0.5
31	*Metals in Total	1	0.5
32	Chlorine (Free)	1	1
33	Phosphates (as PO_4)	5	2
34	Calcium (as Ca)	-	150
35	Magnesium (as Mg)	-	150
36	Nitrate (as NO_3)	-	20

Note:

1 Controlled Watercourse refers to a watercourse from which water supplied by PUB under the Public Utilities Act is obtained but does not include a watercourse from which water is pumped into a main of the PUB.

2 *Where two or more of the metals listed in the table are present in the trade effluent, the total concentration of the metals shall not exceed: (i) 1 milligram per litre, if discharged into watercourse other than controlled watercourse; and (ii) 0.5 milligrams per litre, if discharged into controlled watercourse.

3 "-" No specified maximum concentrations under the Regulations.

Construction Surface Water Runoff

Under the requirements stipulated by PUB in the *Sewerage and Drainage Act*, effective Earth Control Measures (ECM) shall be implemented at all construction sites to prevent silty discharge from construction sites.

Before commencement of construction and earthworks, Contractors are required to engage a Qualified Erosion Control Professional (QECP) to plan, design, supervise and review a system of earth control measures (ECM) to meet the requirements cited in the Code of Practice on Surface Water Drainage and to comply with the Sewerage and Drainage Act. The QECP is required to submit the detailed ECM proposal, on behalf of the site owner/ developer to the Public Utilities Board (PUB), prior to the commencement of works.

4.2.3 Air Pollution

Ambient Air

Singapore announced in 2012 that it was adopting ambient air quality targets for ozone, nitrogen dioxide, sulphur dioxide, particulate matter and carbon monoxide, based on the World Health Organization (WHO) Air Quality Guidelines for the prevention of public health impacts by air pollution. The goal is to achieve the ambient air quality targets by 2020. The National Environment Agency (NEA) also makes reference to the United States Environmental Protection Agency (USEPA) National Ambient Air Quality Standards (NAAQS) for reporting Singapore's ambient air quality status. This includes the relevant ambient air quality targets that may be affected based on the Project's construction activities (such as the use of diesel generators and construction vehicles) are CO, NO2, PM10 and PM2.5. As a result, Table 4-4 outlines Singapore's Ambient Air Quality Targets (SAAQT) for 2020.

Table 4-4 Singapore Ambient Air Quality Targets for 2020

Pollutant	Averaging Period	Target by 2020	Units
SO_2	24-hour	50	$\mu g/m^3$
	Annual	15	$\mu g/m^3$
NO_2	I-hour	200	$\mu g/m^3$
	Annual	40	$\mu g/m^3$
O_3	8-hour	100	$\mu g/m^3$
$PM_{2.5}$	24-hour	37.5	$\mu g/m^3$
	Annual	12	$\mu g/m^3$
PM_{10}	24-hour	50	$\mu g/m^3$
	Annual	20	$\mu g/m^3$
CO	8-hour	10	mg/m^3
	I-hour	30	mg/m^3

Industrial Emissions

The Pollution Control Department (PCD) of the NEA (under the Ministry of Sustainability and the Environment) is responsible for the prevention and control of air pollution in Singapore. Pursuant to the EPMA 2008, the Minister for the Environment has appointed a "Director-General of Environmental Protection" to assist in the implementation and administration of the Act and its regulations.

The EPMA (Part IV – Air Pollution Control) 2008 together with the EPMA (Prohibition on the Use of Open Fires), EPMA (Vehicular Emissions), EPMA (Air Impurities), and the EPMA (Off-Road Diesel Engine Emissions) regulate the emission of air pollutants from industrial or trade premises.

Vehicular emissions control is regulated against the EU Directive 98/69/EC-B (2005) Exhaust Emissions Limits for passenger cars and light commercial vehicles and the EU Directive 1999/96/EC-B1 (2005) Exhaust Emission Limits for heavy duty vehicles. The regulations stipulate standards for exhaust gas emissions from diesel-powered motor vehicles and are presented below in Table 4-5 below.

Table 4-5 Exhaust Emission Limits from Diesel Powered Motor Vehicles

For Diesel-Powered Motor Vehicles Registered in Singapore on or after 1st January 2001, and Before 1st October 2006	
Class of Vehicle	Standard for Exhaust Emission
(a) Passenger car	EC Directive 96/69/EC
(b) Light commercial vehicle with gross vehicle weight not exceeding 3.5 tons	EC Directive 96/69/EC
I Heavy duty vehicle with gross vehicle weight exceeding 3.5 tons	EC Directive 91/542/EEC stage 11
For Diesel-Powered Motor Vehicles Registered in Singapore on or after 1st October 2006	
Class of Vehicle	Standard for Exhaust Emission
(a) Passenger car	EC Directive 96/69/EC-B (2005)
(b) Light commercial vehicle with gross vehicle weight not exceeding 3.5 tons	EC Directive 96/69/EC-B (2005)
I Heavy duty vehicle with gross vehicle weight exceeding 3.5 tons	EC Directive 1999/96/EC-B1(2005)

4.2.4 Noise Pollution

Operating under the *EPMA (Part VIII – Noise Control) 2008,* the *EPMA (Control of Noise at Construction Sites)* sets acceptable noise limits for construction activity within Singapore, including corrections based on ambient background noise levels. The accepted construction noise levels provided in Table 4-6 below are recommended to be followed for any construction works.

Table 4-6 Maximum permissible noise levels for construction work commenced on or after 1 October 2007 (Sunday and Public Holiday)

Type of Affected buildings	**7am - 7pm**	**7pm - 10pm**	**10pm - 7am**
(a) Hospital, schools, institutions of higher learning, homes for aged sick, etc	60 dBA (Leq* 12 hrs)	50 dBA (Leq* 12 hrs)	
	75 dBA (Leq 5 mins))	55 dBA (Leq 5 mins)	
(b) Residential buildings located less than 150m from the construction site	75 dBA (Leq 12 hrs)	-	
	75 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)	
(c) Buildings other than those in (a) and (b) above	75 dBA (Leq 12 hrs)	65 dBA (Leq 12 hrs)	
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	

In addition to the maximum permissible noise limits, Contractors must also comply with rules on the prohibition work on Sundays and Public Holidays for construction sites located within 150 m of residential premises and near to noise sensitive premises as follows:

- Construction sites established from September 1, 2011, onwards will not be allowed to carry out construction activities from 10 p.m. on Saturday to 7 a.m. on the following Monday, as well as from 10 pm on eve of a public holiday to 7 a.m. on the day after the public holiday.

The Singapore Standard CP 49:1998 (Code of Practice for Noise Control on Construction and Demolition Sites) was developed by SPRING Singapore in 1998 to complement the *EPMA (Control of Noise at Construction Sites) Regulations*. There is no specific regulation for vibration impact assessment in Singapore. The German Standards (DIN) 4150-2:1999 (Structural Vibration – Human Exposure to Vibration in Buildings) and DIN 4150-3:1999 (Structural Vibration – Effects of Vibration on Structures) are used as references for vibration impact assessments.

As per the abovementioned legislations, if there are other sources of noise affecting the measurement of noise emitted from the construction site, the maximum permissible noise levels for construction sites are supposed to be adjusted by the addition of a correction factor to account for the existing background noise levels in the area. The correction factor corresponds to the difference between the relevant permissible level, and the background noise level and is presented in Table 4-7. The differences in the noise levels are then added to the higher of the two noise levels (background noise/ criteria as appropriate) to give the applicable noise criteria for the specified construction area.

Table 4-7 Maximum Permissible Noise Limits for Construction Works

Difference between Permissible & Background Noise Levels (dB(A))	Correction Factor to be Added to the Higher of the Two Noise Levels, (dB(A))
Below 2	3
2 to 4	2
4 to 10	1
10 and above	NIL

4.2.5 Waste Management

Environmental Public Health Act (EPHA) 2020

The *Environmental Public Health Act (EPHA) 2020* contains specific provisions relating to industrial waste and its disposal. The Commissioner for Public Health may require the owner or occupier of any workplace to furnish information on the amount, type and nature of any industrial waste found on his premises. The owner or occupier may also be required to treat the industrial waste at their own expense before disposal.

EPH (Toxic Industrial Waste) specifies wastes which are classified as TIW and regulates their handling, transport and disposal. The COPPC provides recommended control measures for industries and trade premises in handling, transport and disposal of TIW. Factories are required to install in-house treatment facilities to recycle and reuse their TIW or to treat their TIW for safe disposal. However, factories may apply for clearance from the PCD of NEA to engage licensed TIW collectors to collect their wastes for recycling or treatment for safe disposal.

The *EPH (General Waste Collection)* governs the collection and disposal of general waste. All waste collectors must be licensed and listed by the NEA. Wastes are classified into three types (bulky wastes, putrefiable waste, sludge) and disposed of differently in particular vehicles, e.g., sludge and latrine waste from aircraft and portable toilets must be transported in tanker trucks. All wastes must be disposed of only at disposal facilities or incineration plants. The collector must keep proper records including the place and frequency of collection, place of disposal, type and tonnage of waste collected and disposed of, and the vehicle used. Collectors must ensure that the refuse or waste is not dropped, scattered or spilled into any public place.

4.2.6 Vector Control

NEA Guidelines on Rainwater Collection System and Mosquito Prevention (2011)

The NEA Guidelines on Rainwater Collection System and Mosquito Prevention (2011) provide recommendations for effectively collecting and managing rainwater while preventing mosquito breeding. They emphasize proper design, filtration, and maintenance of harvesting systems to ensure water quality and prevent stagnation. By following these guidelines, users can achieve efficient rainwater collection and effective mosquito control, promoting public health.

Control of Vectors and Pesticides Act 2002

The Control of Vectors and Pesticides Act 2002 is legislation aimed at regulating the handling, distribution, and use of pesticides to control vector populations, such as mosquitoes, that pose health risks. The Act establishes a framework for the registration of pesticides, ensuring they are safe and effective for public health. It includes provisions for licensing and monitoring of pest control operators, as well as guidelines for public awareness and safety measures. Overall, the Act seeks to safeguard public health and the environment while managing vector control effectively.

Environmental Public Health Act (EPHA) 2002

The Environmental Public Health Act (EPHA) 2002 is legislation aimed at promoting and protecting public health and the environment in relation to environmental hazards. It establishes frameworks for the regulation of environmental health issues, including waste management, sanitation, pollution control, and vector management. The Act empowers authorities to enforce health standards, conduct inspections, and implement public health initiatives to mitigate risks and ensure community well-being. Overall, it seeks to create a healthier living environment for the public.

5 Environmental Roles and Responsibilities

The responsibilities of the parties involved in the EMMP are as follows:

- Ensure that the EMMP is designed, implemented and maintained throughout the construction phase in accordance with the regulations and requirements drawn by the relevant authorities;
- Implement the procedures on monitoring and measure the effectiveness of mitigation undertaken, via monthly monitoring of terrestrial fauna, water quality, air quality and noise; and
- Implement corrective or preventive action measures to eliminate non-compliance and incidences, including environmental pollution issues.

The following sub-sections lists the parties involved and their roles in the EMMP, with the Project Organizational Chart in Figure 5-1.

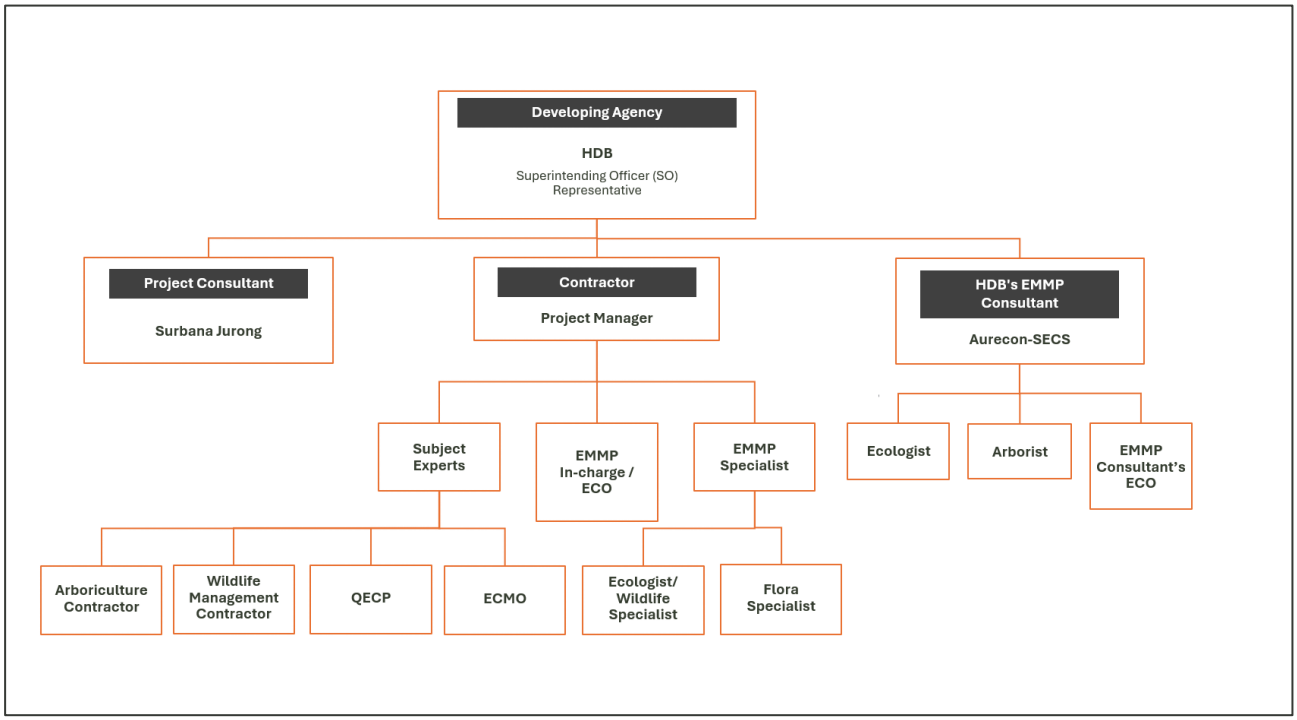


Figure 5-1 Environmental Management Organization Chart

5.1 Developer

The developer for this Project is the Housing and Development Board (HDB) and Surbana Jurong (SJ) is the project consultant for HDB. HDB and SJ shall regularly liaise with the Contractor's Project Manager to review the effectiveness of measures implemented and compliances status during the implementation. The point of contacts for the developer and associated consultant are the HDB Project Coordinator/Director and Consultant Project Engineer.

5.2 EMMP Consultant

The EMMP Consultant provides technical knowledge on the mitigation and monitoring measures pertaining to EMMP. The responsibilities of the EMMP Consultant are as follows:

- To monitor the implementation of the EMMP by all parties and provide oversight;
- Provide a solution if any environmental issue and/ or non-compliance arises and ensure that rectification is carried out to the satisfaction of Client and Technical Agencies (TAs);
- Ensure that the project team, subcontractors and site personnel understand and implement the EMMP requirements;
- Provide input for environmental mitigation measures and monitoring requirements prior to any physical works;
- To advise all parties (e.g., Project Manager, Environmental Control Officer, Environmental Checker, Site Engineers, Site Supervisors, Subcontractors etc.) on matters related to environmental management and promote awareness within the site;
- Ensure the preparation and timely submission of EMMP to the Contractor, Agency and TA;
- To ensure the monthly environmental inspection and reporting is carried out and submitted to SJ, HDB and NParks; and
- To liaise with Agency/TA on environmental matters.

5.2.1 Ecologist

An Ecologist is engaged under the EMMP Consultant. The responsibilities of the Ecologist in this Project includes but are not limited to the following:

- To prepare Project site specific fauna management plan as part of EMMP, utilizing the EMMP framework recommended in the EIA Report and assist Contractor in obtaining authority approval;
- To conduct pre-fell check and prepare wildlife management protocols as necessary during site clearance stage;
- To provide advice and training to site personnel throughout the construction duration;
- To visit the Project site regularly to carry out inspection related to fauna EMMP requirements;
- To assist the Contractor's Animal Management Specialist to identify, rescue, and manage any wildlife in and around the Project site that will affect the development;
- To assist in reporting requirements of EMMP during construction phase; and
- To liaise with NParks on addressing any comments or requirements related to wildlife implementation measures.

5.2.2 Arborist

An Arborist will be engaged under the EMMP Consultant for the Pre-Construction phase of the Project. The responsibilities of the Arborist in this Project include but are not limited to:

- To conduct Monthly Inspections & Monitoring to ensure that NParks' specification and requirement of Tree Protection Zone (TPZ) are adhered to and adopt ISA TRAQ Level 1 for tree assessment
  - Tree physiological health condition
  - Highlight concerned defects.
  - To ensure that NParks specification and requirement for Tree Protection Zone (TPZ) are adhered.
- Furnish monthly report on tree condition, TPZ condition, and recommend any mitigating/remedial measure(s) necessary for the trees based on the site inspection
  - The assessment & recommendation of the tree condition and TPZ conditions shall be presented in table format

- Current month tree photograph (overall & tree base) is juxtaposed with previous month tree photograph.

- To advise and implement specific measures in the case of tree pruning prior to clearance, tree injury, and construction activities affecting tree roots;
- To identify any flora species of conservation significance prior to site clearance;
- To provide checks on and submit to the S.O. plan of Tree Protection Zone (TPZ); and
- To liaise with NParks on addressing any comments or requirements related to arboriculture implementation measures during the pre-construction phase.
- To work with the Contractor's Flora Specialist and Arboriculture Contractor for matters related to flora and arboriculture

5.2.3 EMMP Consultant's ECO

An Environmental Control Officer (ECO) will be stationed full time on site during construction stage. The responsibilities of the ECO are as follows:

- To ensure the Contractor's adherence to all legal, environmental requirements (listed in Chapter 4);
- Perform the role of secondary ECO (with respect to the Contractor's ECO) stipulated in the Code of Practice for Environmental Control Officers;
- To monitor the EMMP implementations on-site by the Contractor and recommend any monitoring and mitigation amendments to the plan where necessary to the EMMP Consultant;
- To assist the Contractor's Project Manager in undertaking the Project in an environmentally sustainable manner;
- Train and educate all site personnel to work in a manner that respects the surrounding environment;
- Continually identify, report, and record potential and present environmental issues on-site to the EMMP Consultant;
- Limit or stop any activities if environmental issues are identified until rectified;
- Report any environmental incidence to the Contractor's Project Manager, EMMP Consultant and SJ, and provide support to address the incidence;
- Inform Contractor's Project Manager, HDB, SJ, PUB, NParks, NEA, and EMMP Consultant in the event of an environmental emergency (e.g. oil/chemical spill);
- Conduct environmental site inspections; and
- Conduct environmental performance audits.

5.3 Contractor

The Contractor shall provide sufficient manpower and resources to implement the requirements of the EMMP. Appropriate personnel shall be appointed by the Contractor to look after all implementations and reporting. The general responsibilities of the appointed Contractor's EMMP Specialist team for this Project is detailed in the following paragraphs.

5.3.1 Project Manager

The Contractor's Project Manager is the team leader responsible for the implementation of the EMMP. The Contractor is also required to regularly liaise with the appointed EMMP Consultant for monthly monitoring and site inspection

- To ensure implementation of all EMMP mitigation measures and monitoring procedures;
- To comply with environmental legislation and contractual requirements applicable to this Project;
- To carry out planning on all project activities throughout project planning, budgeting, execution and completion of EMMP;
- To provide solutions regarding significant construction matters if their subordinates are unable to decide;
- To monitor and measure the timely completion of the Project;
- To liaise with the EMMP Consultant and SJ on environmental matters; and
- Keep track of project costs and expenditures, including implementation of EMMP to ensure that any control measures implemented will meet the Project budget.
- To ensure all team members, including subcontractors, are briefed and aware of the conditions stated in the NParks S10 letter.

5.3.2 Contractor's EMMP Specialist

The requirements, duties and responsibilities of the EMMP Specialist engaged by the Contractor include:

- Coordinate with the EMMP Consultant's team, Qualified Erosion Control Personnel (QECP) and all other key personnel if necessary to ensure that the EMMP is implemented as per specifications and in accordance with the relevant regulations.
- Coordinate with the Contractor for the collection of all necessary monthly biodiversity and physical monitoring data (e.g., fauna, flora, arboriculture, noise, air quality and water quality, etc).
- Conduct fortnightly site visits to monitor the implementation of the mitigation measures listed in the EMMP.
- Submit monthly environmental monitoring reports for all necessary monthly biodiversity and physical monitoring data (e.g., fauna, flora, arboriculture, noise, air quality and water quality, etc); summarising the results of the EMMP implementation for that month; For the EMMP Consultant's submission of the monthly Environmental Performance Reports (EPRs)

5.3.3 Contractor's Ecologist/Wildlife Specialist

- To facilitate and implement the fauna management plan described in the EMMP
- To conduct fauna monitoring surveys as per the methodology and techniques specified in this EMMP, unless otherwise specified by NParks
- To work with the EMMP Consultant's team and Animal Management Specialist, for any issues pertaining to wildlife
- To conduct regular site inspections to ensure proper implementation of fauna management and mitigation measures by the Contractor

5.3.4 Contractor's Flora Specialist

- To facilitate and implement the flora management plan described in the EMMP
- To conduct flora monitoring surveys as per the methodology and techniques specified in this EMMP, unless otherwise specified by NParks
- To work with the EMMP Consultant's team and Animal Management Specialist, for any issues pertaining to flora
- To conduct regular site inspections to ensure proper implementation of flora management and mitigation measures by the Contractor

5.3.5 Contractor's Arboriculture Contractor

The requirements, duties and responsibilities of the Arboriculture Contractor engaged by the Contractor include:

- Arboriculture Contractor to liaise with NParks, EMMP Consultant and Developer on matters related to arboriculture, and to prepare monthly reports (if relevant), to be submitted to EMMP Consultant for the submission of the monthly Environmental Performance Reports (EPRs)
- Arboriculture Contractor to be listed either under Contact List of NParks Term Contractor or Landscape Company Register list under Centre of Urban Greenery and Ecology (CUGE)
- Performs arboriculture and/or horticultural operation works such as pruning, tree removal, turfing, etc

5.3.6 Contractor's ECO (EMMP In-Charge)

The requirements, duties and responsibilities of the Environmental Control Officer (ECO) engaged by the Contractor include:

- Ensures the Contractor's adherence to all legal, environmental requirements (listed in Chapter 4)
- Performs the role of ECO stipulated in the Code of Practice for Environmental Control Officers
- Possess relevant certifications to effectively implement EMMP requirements (e.g. Joint ITE-NEA Certificate in Pest Management for ECO or equivalent)
- Acts as the EMMP In-Charge and leads the implementation and reporting requirements of the EMMP during construction phase
- Responsible for managing all environmental issues arising from the construction work which includes monitoring and ensuring the implementation and management of change of the EMMP, the environmental performance of the project, investigation of incidents, inspections of site and implementing corrective/ preventive measures
- Conducts all the necessary EMMP monitoring and fulfils associated reporting requirements
- Carries out daily compliance checks on all environmental aspects as per EMMP requirements
- To execute fauna response and rescue protocol when fauna is found on-site
- Conducts daily toolbox meetings with construction workers including subcontractors
- Monitors ECM performance and coordinates with the QECP on specific issue
- Coordinates with the EMMP Consultant team/EMMP team members for advice on specific issues related to EMMP implementation

- Submits monthly Site Environmental Control Reports (SECR) and other relevant reports before the end of each month to the EMMP Consultant for the submission of the monthly Environmental Performance Reports (EPRs)

5.3.7 Qualified Erosion Control Professional (QECP)

The requirements, duties and responsibilities of the Qualified Erosion Control Professional (QECP) engaged by the Contractor include:

- To prepare, submit, and obtain approval for Earth Control Measures (ECM) Plan from PUB prior to Contractor starting work; and
- Verifies the ECM Plan implementation as per the approved design
- To ensure that the Contractor implements the ECM in compliance with the ECM Plan, via monthly site inspections.
- Recommends contingency plans and additional measures if implemented measures are ineffective

5.3.8 Earth Control Measures Officer (ECMO)

The requirements, duties and responsibilities of the Earth Control Measures Officer (ECMO) engaged by the Contractor include:

- To Implements all ECM requirements in compliance with the ECM Plan approved by PUB

5.3.9 Animal Management Specialist/Wildlife Management Contractor

The requirements, duties and responsibilities of the Animal Management Specialist/Wildlife Management Contractor engaged by the Contractor include:

- Listed under NParks' Public Registry of Certified Animal Management Specialists
- Identifies rescues and manages any trapped and/or injured wildlife at the project site.
- Traps and removes any wild boar spotted within the project site at any time during the project.
- Translocate beehives (if any) within the project site at any time during the project.
- Safeguards the welfare or safety of wildlife removed from the site.
- Liaises with NParks on appropriate areas for translocation of wildlife within the project site

6 Environmental Monitoring and Mitigation Plan (EMMP) for Stage 1

6.1 Summary of Environmental Monitoring and Reporting

The proposed mitigation and monitoring portion of this detailed EMMP has been developed in Table 6-1 to provide a holistic framework for the management of environmental impacts during pre-construction, construction and post-construction stages. This includes measures to reduce potential impacts from excessive noise, light, particulate matter, or pollution arising from the development of the area, and to ensure the wildlife and surrounding sensitive receptors are protected.

Table 6-1 Summary of Management and Monitoring Plans

Parameter	Monitoring/Mitigation	Section
Pre-construction		
Biodiversity	Wildlife Shepherding (including during SI and access road works) – Pre-felling Inspections prior to tree felling – Prohibition of additional clearance or tree felling for site access and set-up to worksite, unless otherwise permitted and/or necessary – Drilling rigs, mobilisation and demobilisation activities shall be kept minimally 5m away from trees (>1.0m in girth), to protect roots and tree structures Biodiversity Awareness Trainings – To ensure all personnel are aware of the do's and don'ts pertaining to wildlife encounters Installation of Hoardings – To prevent unauthorised encroachment outside of project boundary Installation of ECMs – To minimise surface runoff and erosion – To ensure proper wastewater treatment before discharge into public watercourses – To prevent and minimise pollution of waterways	6.3.1
	Flora/Arboriculture Management Plan	6.3.2
Water Quality	Baseline Water Quality	6.3.3
Air Quality	Baseline Air Quality	6.3.4
Airborne Noise	Baseline Airborne Noise	6.3.5
Construction		
Biodiversity	Monthly Monitoring of Terrestrial Fauna	6.4.1
	Monthly Arboriculture Inspection	6.4.2
Water Quality	Monthly Monitoring of Water Quality	6.4.4

Airborne Noise	Monthly Monitoring of Noise Level	6.4.6
Air Quality	Monthly Monitoring of Air Quality	6.4.5
Visual Site Inspection	Monthly Visual Site Inspection	6.4.8
Post-construction		
General	Close-off Audit Report	6.5.1

6.1.1 Monitoring Schedule

Routine monitoring will be conducted throughout the duration of works. During site clearance, Aurecon will closely monitor the progress of vegetation clearance done and conduct pre-fell check on a weekly basis. Once site clearance works are completed, monitoring frequency will be reduced to monthly and visual site inspections will be conducted. Post-construction monitoring will also be done for terrestrial fauna and water quality. Refer to Table 6-2 for the monitoring schedule.

Table 6-2 Monitoring Schedule

Monitoring	Frequency	Responsible Party
Pre-construction		
Pre-felling Inspection	During SI works and site access works, and subsequently weekly during site clearance	Aurecon / Ecologist
Baseline Arborist Survey	Once-off	Aurecon / Ecologist
Baseline Fauna Survey	Once-off	Contractor
Baseline Flora Survey	Once-off	Contractor
Baseline Noise Sampling	Seven (7) consecutive days	Contractor
Baseline Air Quality Sampling	Seven (7) consecutive days	Contractor
Baseline Water Quality Sampling	Once-off in accordance with Project boundary	Contractor
Baseline Stream Hydrology Survey	Once-off	Contractor
Construction		
Biodiversity		
Fauna / Wildlife	Monthly site inspection for trapped fauna and implementation of proposed biodiversity mitigation measures (refer to Section 6.2.1)	Aurecon / Ecologist
Arboriculture	Monthly inspection of tree health and TPZs (refer to Section 6.2.2)	Arborist
Physical Parameter		
Water Quality (visual inspection & TSS monitoring)	Monthly/Continuous (refer to Section 6.2.2)	Contractor
Noise Monitoring	Continuous (refer to Section 6.3.5)	Contractor
Waste Management (visual inspection)	Monthly (refer to Section 6.2.6)	Contractor
Post-construction		
Closed-off Audit Report	During final month of Project, when all works are completed A total of four (4) Closed-off Audit Report shall be furnished upon the completion of each stage of works (i.e., infrastructure and building works)	Aurecon

6.1.2 Information Management System / Dashboard

Field Force Mobile Application

Collection of accurate, complete, and reliable field data is essential for a variety of project works including construction and infrastructure management. Traditional methods such as pen-and-paper can be time-consuming, lack validation methods, and introduces opportunities for data entry errors, compromising data integrity, and increasing labour cost. With advancements in digital technology, we can accelerate and enhance out speed and quality of field data collection.

FieldForce is a digital data collection method powered by GeoMobile, which enables the efficient execution of data dependent projects by enhancing the way information is gathered and processed in the field. The tool leverages ESRI's GeoMobile and Survey123 technology stack, allowing bespoke digital forms to be tailored to the unique needs of each project. This customisation allows field teams to quickly capture relevant data through mobile devices, streamlining the data collection process, reduce handling errors and reducing the chance of data loss.

What sets this solution apart is real-time capabilities, as data is rapidly assembled from teams in the field and is quickly available for analysis and validation. This empowers decision makers such as HDB and other relevant stakeholders with up-to-date insights presented through the web-GIS Portal bridging the gap between field operations and stakeholder awareness.

Web-GIS Portal

The web-GIS portal is part of the dashboard and will assist HDB and relevant stakeholders in monitoring essential environmental parameters on the project site. The underlying principle for this to work is digitizing and converting all monitoring points and relevant data into geospatial format, which can then be developed into map layers for easier visualisation. The data input can be done manually or integrated with the previously mentioned ForceField application. The steps for online map development are as follows:

Digitise and Converting Fundamental Environmental Quality Data

The location of sensors or sample points will be captured in various formats such as .csv or excel tables. The data will be generated into spatial data (.dwg and .kmz) using the given coordinates and converted into a spatial data layer or shapefile (.shp). Both processes will be done in the ArcGIS Pro software.

Each data layer will be designed accordingly to ensure that data layers consist of essential information such as ID, name, category, and parameter values. At least one data layers will be created for each monitored parameter, with other supporting layers such as land use, topography, and surrounding receptors added to allow for a better understanding of the impact by the Project.

Geovisualise Data and Develop Map Layer in ArcGIS Pro

Map layers will be developed in ArcGIS Pro using the data layers created. A dedicated map layer will be created for each data layer to be used for each sub-module later. One combined map layer will also be created to be used for the Dashboard that will display all the summarised information. Display settings such as symbology and labelling will be set up during the creation of these layers.

Publish Map Layers to ArcGIS Online

The produced map layers will then be exported to ArcGIS Online through “Share as Web Map” tools in ArcGIS Pro. This step uploads the produced map layers containing the monitoring point data layers to the web environment.

Develop EMMP WebGIS Portal using ArcGIS Dashboard

The EMMP Portal and webpages will be developed and customised using ArcGIS’s Experience Builder. Each uploaded map layer will be embedded into a webpage, dedicated to each parameter monitored. Each webpage will have the functionality to display information based on filtering by category, searching by name, showing graphs, and the ability to switch the base map. These functions will be customized using the existing template in ArcGIS Experience Builder and the ArcGIS Dashboard, with the possibility for API establishment to link to pages, and process data from the noise monitoring equipment.

An overview of the development of the web-GIS Portal is shown below in Figure 6-1.

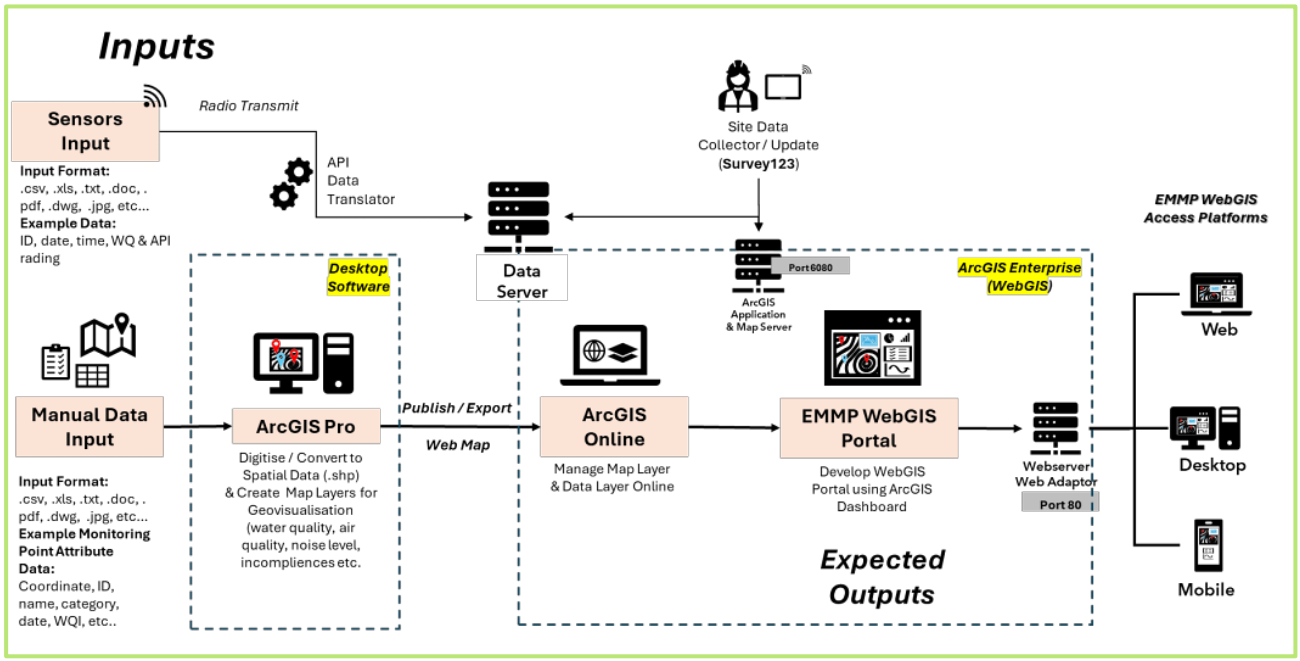


Figure 6-1 Conceptual web-GIS Portal Development Process

6.1.3 Monthly EMMP Reporting

The EMMP Consultant shall prepare Monthly EMMP Reports (also referred to as Environmental Performance Report ‘EPR’) and submit to SO Rep, HDB and relevant Agencies by the 3rd working day of each month, to report on different aspects of the EMMP implementation in the preceding month for the whole Project construction phase, unless otherwise instructed by the Employer / SO Rep.

The contents of the Monthly EMMP Reports shall include

- (a) Projects monitored and inspected for the prevailing month;
- (b) Types of relevant mitigation and management works implemented corresponding to the specific project stage/activities;
- (c) Performance of the mitigation and management works;

- (d) Environmental and biodiversity monitoring results and findings, corresponding to the specific project stage/activities;
- (e) Incidents on site including incident investigation, root cause and corrective actions;
- (f) Assessment of results against environmental standards; and
- (g) Further recommendations and corrective measures and / or remedy or restoration or compensation actions, if any.

6.2 Summary of Environmental Tolerance Limits and Quality Objectives (EQOs)

The allowable amount of released environmental parameters will take reference from the tolerance limits stipulated in this EMMP, the past EIA, and the latest Regulatory Agencies' requirements. The impacts on the various environmental receptors will then be classified according to the following levels shown in Table 6-3 below.

Table 6-3 Summary of Impact Level Classifications on Environmental Receptors

Impact Level	Description
No Impact	Changes are below the level of model reliability or are significantly below recognised tolerance levels, so that no change to the quality or functionality or a receptor will occur.
Slight Impact	Changes can be resolve by the numerical models but are unlikely to be detectable in the fields, for example, a change in living status. Typically, slight impacts are associated with changes that cause stress, but not mortality to stream/aquatic ecosystems. Slight impacts may be recoverable once the stress factor is removed.
Minor Impact	Changes are identified by the predictive tools at a level where change (e.g. mortality) can be expected to be identifiable in the field. Changes are limited in spatial extent and are unlikely to have any secondary consequences.
Moderate Impact	Changes are at a level that can be classified as locally significant and may results in secondary impacts. From a physical perspective, a moderate impact would typically require a change in operating procedure for the continued safe use of an existing facility.
Major Impact	Changes are often related to a complete loss of local habitat with consequent secondary impacts on liked ecosystem processes. From a physical perspective, a major impact would typically be associated with an impact that prevented the use of an existing facility.

6.2.1 Tolerance Limits

The respective tolerance limits EQOs prescribed for each monitoring parameter will be detailed in their respective sections. The general qualitative tolerance limits proposed for each parameter are as shown:

- Suspended sediment impact on aquatic plants, animals, or hydrophytes;
- Sedimentation impact on aquatic plants, animals, or hydrophytes;
- Suspended sediment impact on stream / aquatic habitat;
- Sedimentation impact on stream / aquatic habitat;
- Noise and dust impact on animals / aquatic habitat, or hydrophytes;
- Minimum amount of water flow required to maintain the stream's current condition; and to support existing aquatic biodiversity.

6.2.2 Environmental Quality Objectives

The respective tolerance limits and/or EQOs prescribed for each monitoring parameter will be detailed in their respective sections. The general qualitative environmental quality objectives (EQOs) are summarised below:

- No harm or significant disturbance to wildlife
- No significant water quality impact
- No significant impact on the aquatic plants, animals or hydrophytes located within the potential impact area
- No significant impact on stream / aquatic habitat within the potential impact area
- No significant impact on water intakes within the potential impact area

6.3 EMMP for Pre-Construction Phase

Advance works as detailed in Table 3-1, monitoring and mitigation detailed in Table 6-1 shall be implemented and adhered to during this initial phase. Primarily for site clearance and tree felling for soil investigation, access road and site office setup, hoarding and ECM installation works shall be conducted prior to the main site clearance. The proposed mitigations for the aforementioned advance works are detailed in Section 6.3.1, followed by the general mitigation measures pertaining to fauna during site clearance in Section 6.3.2.

6.3.1 Measures for Advance Works

Soil Investigation

The purpose of Soil Investigation (SI) works is to obtain geotechnical information on the subsurface condition, which is crucial for ascertaining subsurface soil composition, groundwater levels, penetration resistance etc. for advanced and in-depth engineering analyses. For information and illustration purposes, a map of the indicative SI borehole locations and proposed access routes are shown in Figure 6-3 below. The Qualified Personnel (QP) in charge of SI works is SJ, who has submitted a separate Form A to NParks. The detailed methodology shall be appended to this EMMP at a later juncture, when available. Nonetheless, the following biodiversity mitigation measures are proposed as shown in Table 6-4 below. Should site clearance and tree felling works be unavoidable and necessary, the following mitigation measures described in Section 6.3.2 shall be referenced and adhered to.

Table 6-4 Mitigation Measure for Soil Investigation and Advance Works

Mitigation Measure	Description
Biodiversity	▪ Where practicable and feasible, the least intrusive path, existing roads, pathways and/or trails will be undertaken during SI and advance works (e.g., perimeter hoarding), ensuring minimal disturbance to surrounding biodiversity. ▪ All effort shall be made to ensure borehole locations are kept within the project boundary, ideally within developed areas (e.g. recreational land or turfed areas). Entry into forested areas shall be prohibited during this stage. ▪ Borehole locations and the worksite footprint shall be kept minimally 5m away from trees with >1m girth, to protect the integrity of tree structures and its root systems. ▪ Minimal or no additional site clearance shall be conducted for the proposed borehole locations. Where necessary, undergrowth clearance and pre-clearance

Mitigation Measure	Description
	inspections shall be conducted to facilitate formation of access routes to borehole locations. ■ Access paths and the overall routes shall be clearly demarcated (including the path widths) to prevent unauthorised encroachment into the forested areas. ■ Where applicable and practicable, mini excavator(s) and portable drilling rig(s) of small statures shall be employed to minimise disturbance to surrounding habitats during advance works. ■ Soil investigation works and related ancillary works shall only be conducted during daylight hours and only during workdays.
Noise Management	■ SI work sites shall be clearly demarcated with portable hoarding and enclosed with acoustic barriers/screens. ■ The noise from the operation of the drilling rigs shall be further mitigated by deploying noise blankets enclosing the rig, as well as addition noise insulating materials (e.g. wooden boards or noise insulation foam) where necessary (see for Figure 6-2 example).
Waste Management	■ All waste arising from the SI works (be it solid or liquid, construction, drilling or human/food waste), such as slurry, shall be kept in proper containment structures and disposed of properly by licensed waste disposal contractors. ■ There shall be no discharge of slurry or disposal of waste within or around the SI work areas. ■ Sandbags and/or silt fencing shall be deployed around the perimeter of the worksite(s) to prevent discharge of waste into surrounding area. ■ Food and drinks shall be consumed outside of the worksite and in proper designated zone(s).

Figure 6-2 Sample for Soil Investigation Worksite Setup (Source: TODAY)

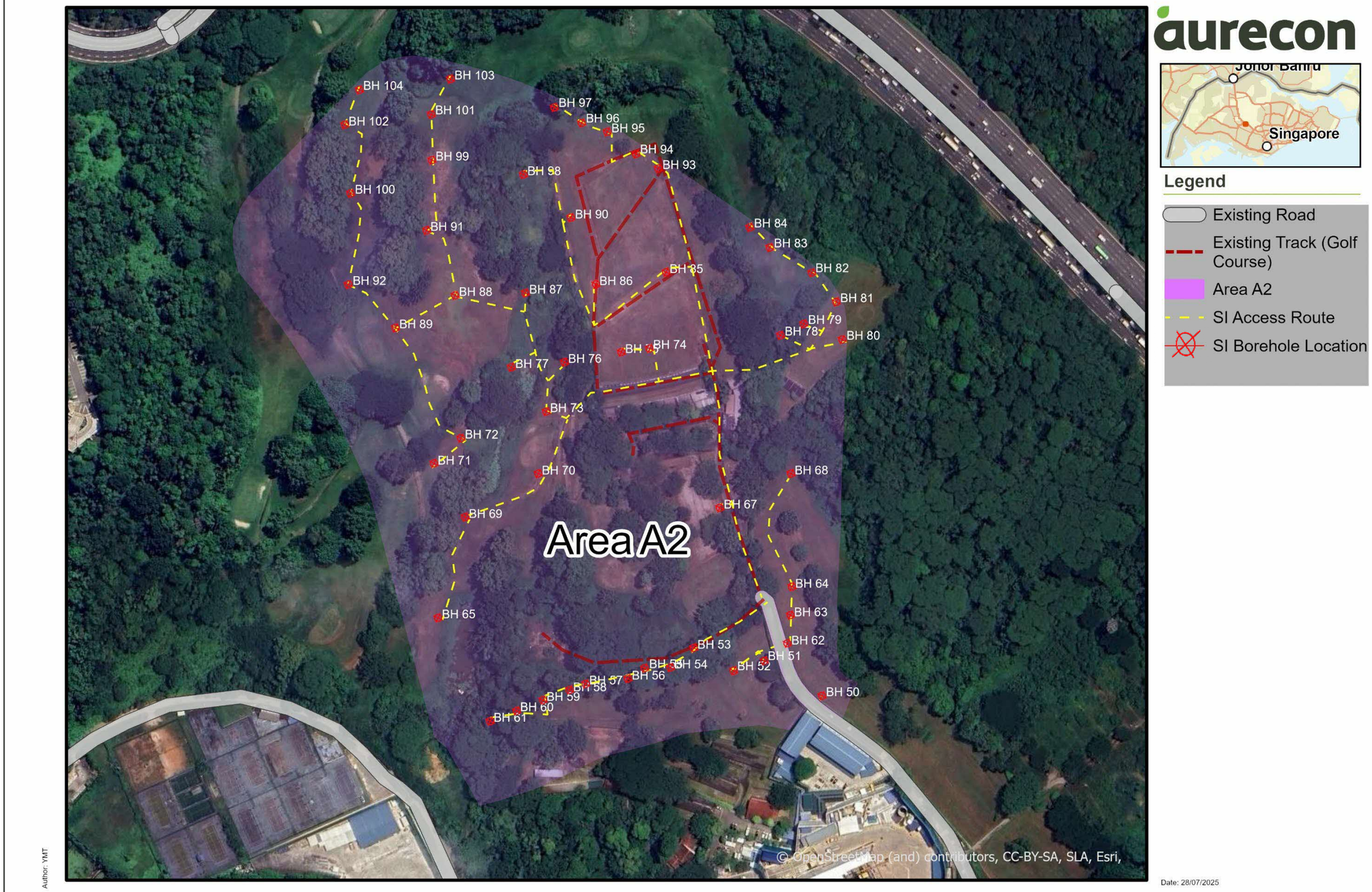


Figure 6-3 Indicative SI Locations and Proposed Access Routes

Site Access Works & ECM Setup

Where applicable and feasible, site access works (i.e. site office setup, access roads and perimeter/preliminary hoarding) and ECM setup (whether necessitating site clearance or not) shall adhere to the mitigation measures described above in Section 6.3.1, Table 6-4 and in Section 6.3.2. The detailed fauna management and mitigation measures are described in the following section below.

6.3.2 Fauna Management Plan

Given the significance of this area as a natural wildlife corridor, it is essential to minimize impacts on local fauna. Developing a Wildlife Response and Rescue Plan can mitigate these impacts and lower the risk of human-wildlife conflicts that could threaten safety. Wildlife management should begin before construction to safely move animals out of the work area, either through passive shepherding or active relocation. Additionally, a Wildlife Rescue and Response Plan should be implemented during construction to assist any animals that become trapped or injured on-site.

The Contractor shall also engage an NParks-certified Animal Management Specialist/Wildlife Management Contractor who can be promptly deployed upon the EMMP Specialist's recommendation to relocate fauna during the project. This specialist should be an approved third-party contractor authorized by the Director-General of Wildlife Management to perform activities regulated by the Wildlife Act.

Proposed Shepherding/Site Clearance Sequence

Upon consultation with HDB and SJ, a concurrent site clearance of parcels A1, A2 & A3 (including the access road), followed by A4, has been proposed. To facilitate the this, the preliminary hoarding has been expanded to ensure proper delineation and segregation of the parcels (Figure 6-2). The direction of the shepherding adheres to the suggestions by NParks during past consultations. The detailed wildlife shepherding plan, which includes the proposed sequence of works, can be referred to in Appendix A.

Fauna Management during Site Clearance

The objective of fauna management during site clearance is to effectively remove wildlife from the worksite before construction activities begin. This approach is crucial for preventing fauna entrapment, injury, and mortality, in particular animals such as snakes that may pose human-wildlife conflicts during the clearance process, with the aim of minimizing interactions between humans and wildlife.

Prior to commencing any work, the area designated for construction should be fully enclosed by hoarding to contain the worksite and protect surrounding habitats. An inspection of the hoarded area will be conducted to assess the presence of wildlife. This inspection should occur before any site clearance activities take place. The Wildlife Specialist shall carry out a thorough survey within the hoarded area specifically aimed at detecting any wildlife that may be trapped.

Once the area has been secured and inspected, site clearance activities should be carried out in a directional manner, moving towards a designated forested wildlife refuge area. This approach aims to encourage any remaining wildlife to vacate the worksite naturally due to the disturbances caused by the clearance activities.

Prior to the felling of any trees, additional pre-site clearance fauna inspections must be conducted to ensure that no fauna remain in the vicinity.

Hoarding Installation

The contractor is responsible for completing the installation of hoarding prior to the commencement of site clearance activities. The hoarding must adhere to the following specifications:

- The hoarding shall be a minimum of 2.4 m in height. Both sides of the hoarding should be painted white to enhance visibility for fauna, thereby minimizing the likelihood of accidental contact.
- In areas where internal hoarding is required to partition the site into smaller zones, the hoarding may be reduced to a height of 1.8 m.
- It is crucial that the hoarding panels are installed without any gaps, ensuring they form a continuous barrier. The base of the hoarding must extend at least 300 mm into the ground to deter burrowing animals from accessing the site.
- The mitigation measures described in Table 6-4 shall be referenced and adhered to as well. In particular:
  - The Contractor shall make all effort to ensure that the least intrusive path, existing roads, pathways and/or trails will be undertaken during SI and advance works (e.g., perimeter hoarding) – as well as to conduct minimal or no site clearance – thereby ensuring minimal disturbance to surrounding biodiversity.
- The sequence of the hoarding installation will be reviewed by the Ecologist or Wildlife Specialist to ensure that the disturbances caused by the installation do not drive fauna onto adjacent roads. The optimal installation order will be:
  - First, install hoarding adjacent to roadways;
  - Next, address areas that are furthest from identified wildlife refuge areas; and
  - Finally, complete the installation in the remaining sections of the site.
- Once the hoarding installation is complete, the Ecologist or Wildlife Specialist will conduct an inspection to assess the integrity of the hoarding. This inspection will confirm that the hoarding effectively prevents the entry and exit of fauna, ensuring that the site remains secure for the duration of the clearance and construction activities.
- The perimeter hoardings are positioned at the site boundary.

Pre-site Clearance Fauna Inspection

Prior to site clearance, the Wildlife Specialist is responsible for conducting thorough fauna inspections in areas designated for clearance, as well as for any subsequent removal, pruning, or trimming of vegetation and trees. The inspections will aim to fulfil the following objectives:

- The inspection will focus on identifying potentially active animal nests, hollows, burrows, and other nesting structures. It will also aim to detect any animals that may be at risk of being trapped, injured, or killed during site clearance. This includes recognizing animals that could potentially lead to human-wildlife conflicts, such as snakes. Each inspection will remain valid for a period of seven (7) days.
- The Wildlife Specialist will report and document all fauna observations made during inspections. Recommendations for mitigating measures will also be included based on these observations.
- In the event of wildlife encounters, the Wildlife Specialist will coordinate actions in accordance with the designated Wildlife Response Plan.

If fauna is found on vegetation slated for clearance, the affected vegetation will be marked with coloured tags

or tape. Wildlife will be allowed to vacate the area on their own prior to any clearance activities. In cases where eggs, chicks, or young animals are present in nests, these will also be allowed to fledge or leave the nests naturally before site clearance. The Wildlife Specialist will conduct follow-up checks to confirm that all faunas have departed prior to any vegetation removal. If it is impractical or unsafe for certain fauna to leave on their own (e.g., a venomous snake that cannot be safely captured), relocation efforts will be considered and executed by certified wildlife management contractors. This will be done in consultation with NParks and in alignment with the Wildlife Response Plan outlined in Section 8.3.

Should the Wildlife Specialist determine that there is a risk of injury or death to fauna – even in the absence of visible signs during the inspection (e.g., a bird nest but no observable activity) – the Wildlife Specialist will be present on-site during the removal of the affected vegetation. This presence will ensure the implementation of the Wildlife Response Plan as needed. To aid in inspections of nests, hollows, and structures, elevating equipment will be deployed where necessary.

The Wildlife Specialist is required to submit an inspection report within 24 hours of conducting the inspection. This report will include the following information:

- Date of the inspection;
- Tree tag number (or location coordinates if untagged);
- Observations made during the inspection;
- Recommended mitigation measures; and
- Photographic evidence of the findings.

Site Inspection

To ensure effective wildlife management and environmental protection during the construction phase, a structured site inspection regime will be implemented, comprising bi-weekly inspections by the EMMP Consultant and daily inspections by the Contractor.

The EMMP Consultant will conduct site inspections every two weeks to document findings related to the following key items:

- Degradation of adjacent sensitive habitats;
- Implementation of proper ECM measures;
- Food and waste management;
- Gaps in hoarding;
- Potential fauna entrapments; and
- Presence of injured/trapped/dead animals.

Daily inspections will be performed by the Contractor and Contractor's ECO on-site. These inspections will focus on the following critical items:

- Proper ECM measures;
- Food management practices; and
- Potential fauna entrapments.

Pre-felling Fauna Inspection

The main objective of the pre-felling fauna inspection is to prevent and mitigate fauna mortality during the clearing of the forest habitat. The key considerations for clearing of the forested land are in compliance with the National Parks Board (NParks) Technical *Note on Wildlife Shepherding and Pre-felling Fauna Inspection* (NParks, 2024c):

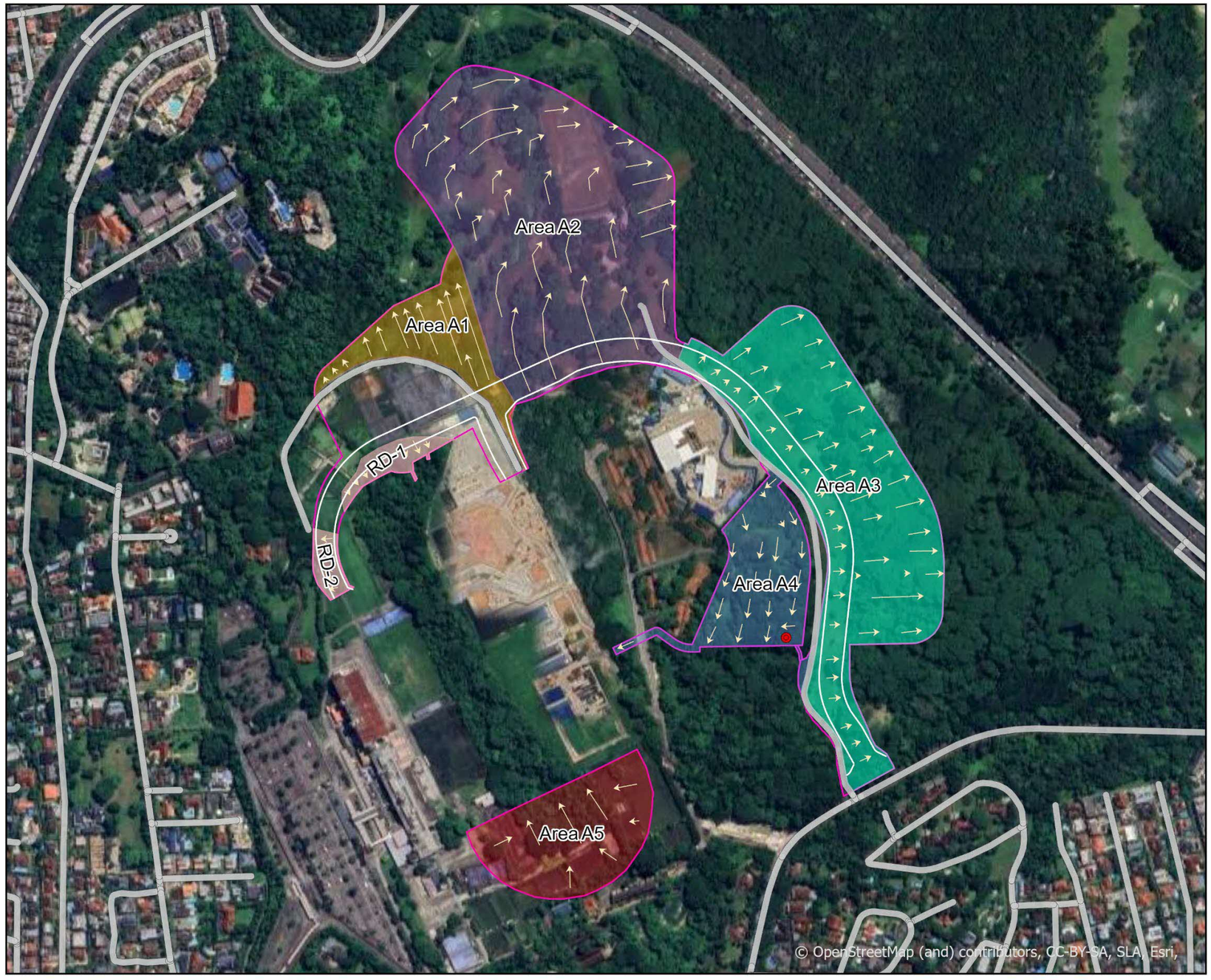
- Clearance shall be phased from the most disturbed area (usually the side nearest to roads or existing developments) towards the **least disturbed area** (where applicable and practicable);
- Clearance shall also take place from **high to low ground** (where applicable and practicable);
- An **unobstructed escape route** shall be designed to channel wildlife out of the development site; and
- Clearance of the development site can be broken up into **zones** (where applicable and practicable), where each zone is isolated from the next either by natural barriers that prevents animal movement or permanent hoarding structures.

The proposed site clearance and tree-felling will take into consideration the existing Project boundary, and obstacles (e.g. terrain) that might impede wildlife movement. The site clearance and tree-felling shall follow that of the proposed wildlife shepherding plan (Figure 6-2 and Appendix A). Notwithstanding, the hoarding plan (to be updated when Contractor has been onboarded) will highlight the hoarding layout, whilst Biodiversity Awareness Trainings [Appendix B] will be carried out before any clearance can commence. To ensure workers are reminded on the contents discussed during the Biodiversity Awareness Training, regular refreshers, such as during toolbox briefings will be conducted. The sequence of site clearance and tree-felling is divided into the following stages:

- Step 1: Biodiversity Awareness Trainings;
- Step 2: Installation of Hoardings;
- Step 3: Installation of ECMs;
- Step 4: Undergrowth Clearance; and
- Step 5: Tree Felling.

In summary, site clearance and tree-felling follow these steps:

- Biodiversity Awareness Training shall be conducted for all construction personnel.
- Put up perimeter hoardings, perimeter drains, ECMs, and silt fences around the site. This shall be set up to prevent wildlife from entering the road and Project area. A work area of 5m width is allocated for establishing the perimeter hoarding.
- Pre-felling inspections are conducted to identify any nests, burrows, and wildlife. If active nests are detected, further monitoring will be needed with a provision of a vegetative buffer. For animals that cannot be guided out safely, relocation may be considered. Abandoned nests or burrows with no discernible activities shall be removed ASAP to prevent animals from returning.
- Pre-felling inspections shall be conducted within seven (7) days prior to clearing.
- Clearing of the undergrowth vegetation (if applicable).
- Minimum three (3) days of buffer between clearance of undergrowth and the eventual clearance of trees (≥1 m girth).
- Clearance of trees (≥1 m girth). Close up of sections without any vegetation with temporary barriers.
- Upon completion of all site clearance, the perimeter hoarding shall be set up covering the full perimeter of the Project.



aurecon

Legend

- Site Boundary
- Proposed Road Development
- Shepherding Direction
- Existing Road
- Ficus kerkhovenii (TPZ)
- Clearance for Road Development

HDB Parcel

- Area A1
- Area A2
- Area A3
- Area A4
- Area A5

Author: YMT

Date: 28/07/2025

Scale: 1:8,109

0 40 80 160 Meters

Job No: P528629

Coordinate System: SVY21

P528629 - EMMP for HDB Central Area EMMP Report

Figure 6-4 Proposed Overall Wildlife Shepherding Plan

Step 1: Training

Training sessions on biodiversity awareness will be conducted prior to setting up of hoardings. The main objective of the training is to educate the workers and construction personnel on the site clearance and tree-felling procedures, types of wildlife they may encounter, and the dos and don'ts if an animal is sighted. After the initial training, annual refresher trainings will be conducted. Daily reminders on biodiversity awareness will be briefed during toolbox meetings as well. Personnel involved in site clearance and tree-felling works will also be briefed on how to handle encounters with wildlife.

Summary of the Training:

- This training is conducted for all staff working at the site (Contractor, sub-contractor etc). This shall be incorporated into the safety induction course, toolbox meetings, and communicated to the workers.
- Information on potential wildlife sightings and what to do when wildlife is encountered shall be put up and available at site office notice boards accessible by all workers.
- The training will include the dos and don'ts to minimise attracting wildlife (E.g., Proper housekeeping, no feeding of wildlife, or indiscriminate discarding of food items.).
- Injured or stranded wildlife shall not be provoked, caught or handled by anyone. Appointed licensed wildlife Contractors are to be contacted to handle relocation or removal of the animal.
- Supervisor or assigned workers moving in front of excavators during vegetation clearance shall undergo a detailed course by the ecologist/wildlife specialist on how to look out for animals in the undergrowth, burrows or trees.
- Refer to Appendix B for Biodiversity Awareness Training Deck.
- Refer to Section 9.2 for Wildlife Encounter Protocol
- Refer to Section 9.3 for Wildlife Response Plan

Training sessions will also be conducted to brief the relevant personnel involved on the EMMP, to ensure that they are clear on the mitigation measures in place. This includes site personnel and Contractors. The briefing will be conducted for workers who are involve in the following activities (where applicable):

- Wildlife encounter and site clearance;
- Installation of perimeter hoarding;
- ECM works;
- Cut and fill works;
- Demolition works;
- Sewer pipe jacking works;
- Approved night works; and
- Any other key activities, which might cause nuisance to the biodiversity.

During the construction phase, refresher trainings involving the aforementioned content shall be conducted every 6 months by the EMMP Consultant.

Step 2: Installation of Hoardings

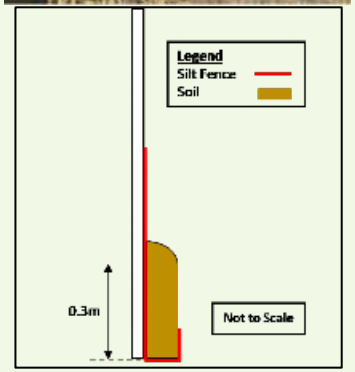
The hoardings shall take into consideration the existing hoardings around the development so as to prevent wildlife from being trapped. Two kinds of hoardings are typically utilised, perimeter hoardings which will be used to demarcate the construction boundary, and temporary barriers used as short-term hoardings in between shepherding sections (if applicable). Examples and specifications of each hoarding is included in Table 6-4 below. In general, hoardings shall be made of opaque, non-reflective materials.

The Contractor shall demarcate and peg the site boundary at least four (4) weeks prior to the start of site clearance. Perimeter hoardings will first be implemented around the Project site to prevent unnecessary vegetation damage outside the Project area. Installation of the perimeter drain, and appropriate placement of silt fences will occur after putting up the Perimeter Hoarding. This will minimise the impact to the necessary work area. A working space of not more than 5 m width (NParks requirement) along the boundary of the Project will be required for the setting up of the perimeter hoarding and drains, where applicable and practicable.

If access gates are to be installed, silt fence/covering shall be attached to the bottom of the gates as shown in Table 6-4 to reduce the gap between the gate and the ground. The gate shall also remain closed during site clearance, and whenever it is not in used. There shall be no opening greater than 50 mm for the access gate to prevent wildlife from entering through these openings, where applicable and practicable.

The notional Site Hoarding Plan will be along the boundary line provided in Figure 3-2 and Figure 3-3 above, and the finalized proposed hoarding plan and specifications will be included in the EMMP once the contractor has been onboarded. Pre-felling/site clearance inspections shall be carried out for these advance clearings (i.e. setting up of preliminary hoardings and ECMs) if there are trees along the proposed hoarding route.

Table 6-5 Hoarding Specifications

Perimeter Hoarding	Temporary Barriers	Access Gate(s)
Utilised to prevent wildlife from entering the construction site and preventing wildlife entering roads. Some existing requirements: ■ At least 1.8m or as per contract requirement in height (hoarding will eventually be replaced by noise barrier) ■ Sufficient counterweight to withstand impact ■ Embedded at least 300mm into the ground; or Concrete flooring / foundation ■ Smooth top edge ■ Opaque and non-reflective	Utilised for short-term boundary function. These may be temporary fixtures which can be moved to allow access or before perimeter hoardings are set up. For water barriers, there shall be no gap in between water barriers. Fence netting is applicable only for sections where terrain is challenging and not feasible for water barrier.	Access gate(s) should have bottom gap of no more than 50 mm To reduce gaps between access gates and the ground, rubber flaps can be installed as a mitigation measure
Examples:  	**Examples:**  	**Examples:** 

Step 3: Localised Site Clearance for Installation of ECM

Where applicable, a localised site clearance will be conducted prior to the installation of ECMs. The methods are similar to Step 5 and Step 6 below. The area required for site clearance is dependent on the size of the ECM ponds and tanks. The earth drains will require a working area of 4 m width. The route will be from the existing access road and extend all the way down from the earth drains towards the ECM facilities.

Step 4: Installation of ECMs

Earth Control Measures (ECM) shall be implemented prior to site clearance to prevent silty discharge into the surrounding streams, roads and forests. A detailed ECM Plan (to be provided by the contractor when onboarded) will be prepared and endorsed by the Qualified Erosion Control Professional (QECP). The ECM Plan shall be approved by PUB prior to the site clearance.

Perimeter Earth Drain and Silt Fences are advised to be set up in tandem with the hoardings to minimize the working space required. The ECM shall only be set up after the hoardings have been set up. Holding Pond / Detention Tank shall have Water Barriers and subsequently a permanent fence with toe boards along the bottom of the fence will be set up to prevent wildlife from entering the pond/tank (Figure 6-3). If any animals are spotted in the holding pond, the approved wildlife management contractor will be informed. The site clearance for ECM Water Treatment Plan will be cleared from the roadside.

Figure 6-5 Overall Example of ECM Holding Pond with Surrounding Fence and Toe Boards

Step 5: Undergrowth Clearance (if applicable)

This step follows the typical site clearance methods recommended by NParks (2024c). Extra consideration is given to the wildlife in the habitat, and time is provided for the wildlife to move away from the areas to be cleared. Clearance will also be scheduled during daylight hours (8am to 6pm). Site clearance is thus conducted in systematic steps as follows:

- Each Site (A1 to A5), is subdivided into smaller subzones of 2500 m^2 to 3500 m^2, depending on the terrain and tree density per subzone (Figure 6-). Site clearance is to be done in the direction shown in Figure 6-, and can take place concurrently at different sites.
- Clearing of undergrowth is typically conducted manually or with a small excavator. Workers and operators shall generate noise (i.e., using a whistle or clapping of hands) or use a stick to disturb the surrounding vegetation and encourage the wildlife to move. This is done in a systematic manner, and towards the shepherding direction (if applicable).
- A worker will walk ahead of the excavator to scan the ground of any fauna - such as snakes in holes, bird nests, mammals in burrows, and other terrestrial animals. Workers shall alert the Ecologist/Wildlife Specialist if active nests and burrows are found. If no nest or burrows were detected on the ground, clearing of undergrowth and low-lying vegetation may commence.
- The clearing shall be done while avoiding the trees with 1 m girth and above. No trees with 1 m girth and above are to be felled during this process. The rate of clearance in each area will be predetermined based on the section identified. Markings (i.e., on the perimeter hoarding) can be adopted to demarcate the zones/sections. A maximum of two (2) excavators shall be used.
- Once the undergrowth is cleared, a buffer of three (3) full days is given for arboreal wildlife to migrate from the site. The day on which the undergrowth is completely cleared is considered as Day 1

Step 6: Tree Felling

Pre-felling fauna inspections can be conducted during the 3-day buffer period or prior to tree felling. The ecologist/ wildlife specialist shall check for the following:

- Crown of the tree for nest, tree trunk for crevices used by wildlife, or bees' nest on the tree trunk. The objective is to determine if there are any active roosting/nesting sites by birds. This allows for the establishment of sufficient buffer (if necessary) to ensure the nesting sites are protected until the young are able to leave.
- If animals are found to be trapped within the site and cannot be guided out safely, an approved wildlife management company (a registry is available at www.nparks.gov.sg/avs/animals/animal-related-businesses/animal-managementcompanies/public-registry-of-certified-animal-management-specialists) must be engaged to rescue the trapped wildlife (NParks, 2024c).
- If an active nest was found, it shall be monitored by an ecologist/wildlife specialist who will ensure that the nest has been vacated before clearance (NParks, 2024c).
- Assessed trees with active nests shall be flagged and labelled to indicate tree is to be retained temporarily. Tree number, location and photographs of tree and nest are to be reported in the weekly pre-felling report.
- Pre-felling inspections shall be conducted prior to tree felling. Clearing of trees shall be conducted within seven (7) days from the inspection. If more than seven (7) days have passed from the inspection and tree felling has not commenced, the inspection shall be carried out again.

After the three (3) days buffer has passed and no active nests are detected, trees can be felled. Temporary hoardings shall be put up after all the trees of each section has been cleared. This will prevent wildlife from re-entering the cleared sections and allow the Contractor to begin earthworks within the completed cleared section. As site clearance progresses, temporary hoarding placed between two cleared sections can be removed.

After the vegetation in all sections have been cleared (both undergrowth and trees), the temporary hoarding along the Project boundary shall be replaced with perimeter hoardings/noise barrier to prevent wildlife from re-entering. The Site will eventually be hoarded up entirely, as based on the Project boundary.

Notes:

- All works are to be within the Project boundary. No workers or machinery shall venture into forested areas outside the contract boundary. Working space used to erect the hoarding prior to site clearance shall only be 5 m.
- If there are any large trees encountered along the hoarding line, Contractors are to avoid the trees by going around the trees while keeping within the Project boundary and continue hoarding according to the Project boundary beyond that.
- Hoarding to be implemented around the Project site to prevent unnecessary vegetation damage outside the Project area. Similarly, vegetation outside the Project site shall not be damaged.
- Work around the immediate vicinity shall stop if animal is witnessed on site, dead or alive, until full investigation or relocation is completed. Refer to Section 9.2 of the EMMP for the wildlife encounter protocol.

Biodiversity Awareness Training

The Ecologist will carry out biodiversity awareness training and toolbox briefings to all site personnel prior to commencing work on-site, and regularly (every six months) throughout the duration of the construction phase.

The Ecologist will provide an account of common wildlife found on site and educate the staff on appropriate behaviour and procedures (e.g., dos and don'ts) to be taken when encountering wildlife. The Ecologist will also supply presentation materials for the main staff to conduct subsequent workshops with new staff on their own. The training and toolbox briefing will include (but not limited to):

- Ecological value of the project site and its surroundings
- Wildlife/Fauna types present within and around the site
- Strategies to protect biodiversity
- Site personnel's responsibilities towards biodiversity
- Fauna response and rescue plan
- The laws protecting wildlife in Singapore (e.g., no feeding nor killing or poaching of wildlife)
- Roadkill prevention
- Pre-felling inspection of trees for wildlife

The Ecologist will conduct 6-monthly fauna orientation workshop for all site personnel, who will undergo said training and maintain relevant documentation. The Wildlife Response Plan (in Section 9.3) procedure shall be followed if there is any sighting of entrapped wildlife. Similarly, the appointed ECO and the EMMP consultant shall be notified immediately. Subsequently, NParks will also be informed. Refer to Appendix B for the Biodiversity Awareness Training Deck.

Bamboo Bats

Existing bamboo clusters on site (if any) are known to be potential bamboo bat roosts. Therefore, the engagement of approved wildlife management company certified in handling mammals is required to check for the presence of active bamboo bat roosts prior to any bamboo felling works. If an active bat roost (as indicated by the presence of bamboo bats or sonogram records) is detected in a particular bamboo cluster, appropriate relocation measures should be taken. The following mitigation measures shall be undertaken for the bamboo clusters found within the Project Site:

- Prior to any site clearance and bamboo felling, the Ecologist / Wildlife Management Specialist will first conduct roost emergence surveys between 1900hrs – 2100hrs to ascertain the presence of bamboo bats.
- The presence of bamboo bats will be ascertained using a mixture of visual inspection and call recordings (if any) via bioacoustics monitoring devices (e.g., Echo Meter Touch 2 Pro or equivalent).
- If bamboo bats are absent, the bamboo clusters to be felled shall still undergo pre-felling fauna inspections by the Ecologist.
- Should any bamboo bats be detected, an NParks-approved wildlife management company certified in handling mammals will be engaged to conduct the rescue, release and/or translocation of said bats in affected bamboo cluster(s).
- Should any trapped or injured bamboo bat(s) be encountered, the Wildlife Encounter Protocol and Wildlife Response Plan (in Section 9.3) shall be activated.

- The Ecologist/Wildlife Management Specialist and NParks-approved wildlife management company shall work with NParks to determine the best course of action.

Mitigation Measures for Wildlife Connectivity

Due to planned road expansion along Eng Neo Avenue, there is an increased risk of roadkill for wildlife, particularly Sunda colugos and pangolins, both of which have been observed in the area during the EIA baseline study. The Sunda colugo requires a certain proximity of trees to be able to glide between spaces. AS such, the widening of the road could thereby reduce viable glide paths for colugos, and has previously resulted in pangolin roadkill – as reported by data from ACRES and the Singapore Pangolin Working Group. Consequently, it is crucial to support the movement of colugos and other ground-dwelling animals in light of this development (Figure 6-4).

The EIA recommended for culverts and colugo poles to be installed as part of roadkill mitigation. The recommendations from the EIA (AECOM, 2024) were extracted and shown below:

- Steep/vertical-walled canals or large drains, such as the one that runs under Eng Neo Avenue from Site A towards Site E (Figure 6-5; position 1), can be modified to potentially serve as a walkway for ground-dwelling mammals moving between these two Sites. The presence of obstacles to fauna movement (e.g. vertical dropoffs) along this canal is currently unknown.
- The detailed architecture of the canal should be examined to identify these obstacles, and strategies to address them (e.g. installation of ladders) can be formulated.
- Constructing an elevated wildlife friendly walkway above the high-water mark will allow wildlife to continue using these pathways when the water level in the drain is high (Figure 6-6)
- On top of the wildlife friendly passage, a culvert under Eng Neo Avenue (Figure 6-6), west of the canal is recommended to facilitate the movement of more ground dwelling animals across.
- The culverts can be constructed concurrently with the road widening works to provide for another fauna underpass crossing for small terrestrial ground dwelling mammals. Further technical studies are required for proper and effective implementation of this recommendation.
- Colugo poles (Figure 6-6) can also be installed along the road and road divider of the expanded road to decrease the glide path of colugos. Further details on the location and number of poles or culvert to be installed is to be further discussed with the aid of connectivity models.

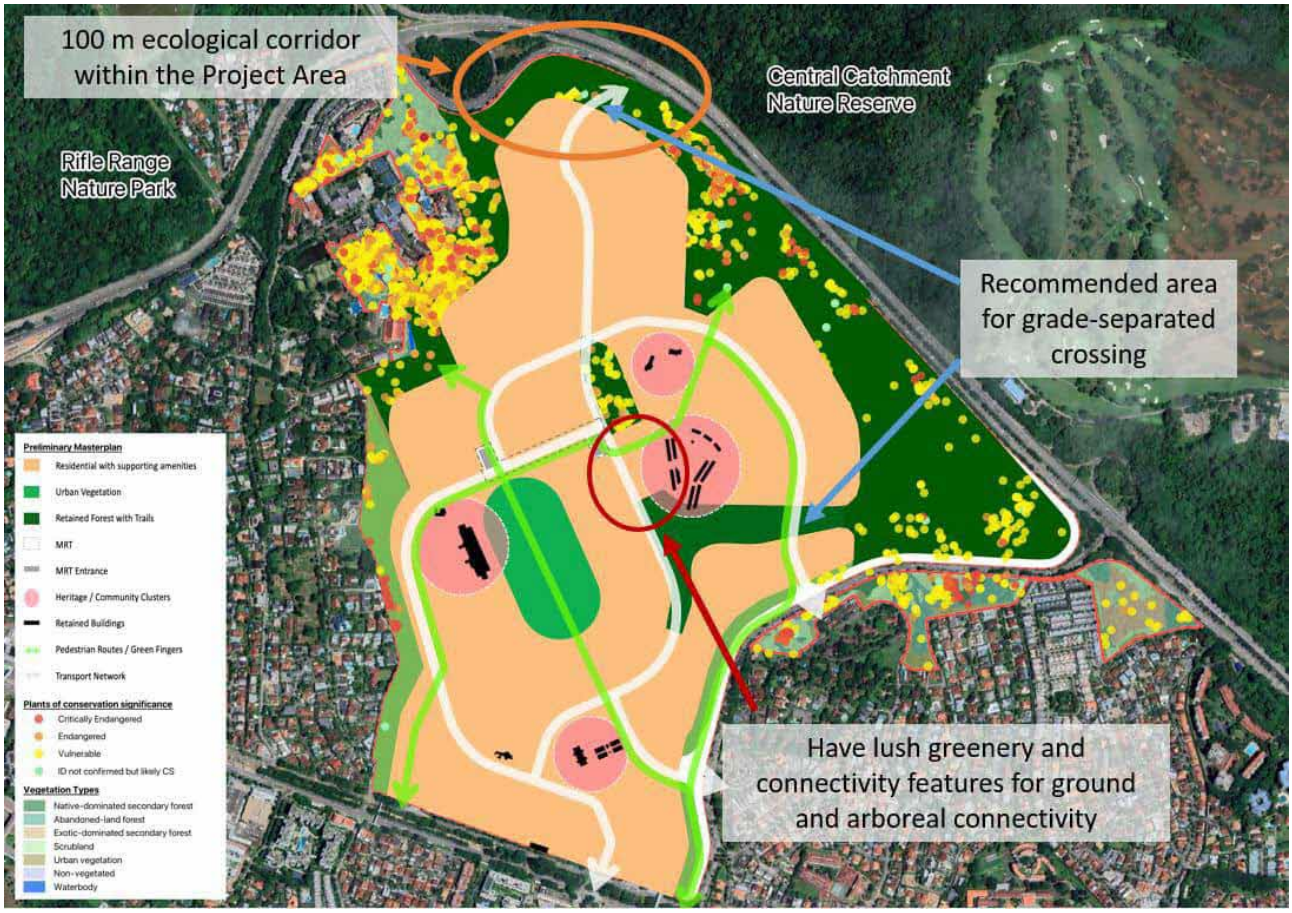


Figure 6-6 Recommended connectivity within Project Area (AECOM, 2024)

Figure 6-7 Suggested culvert location under Eng Neo Avenue (AECOM, 2024)

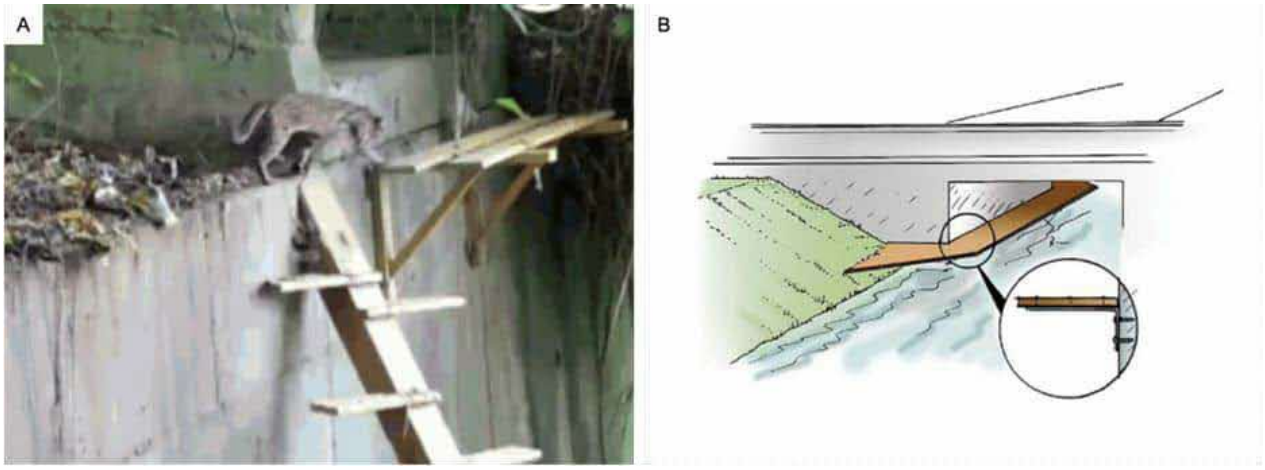


Figure 6-8 Examples of installations on canal walls to facilitate wildlife movement. (A) Ladder; (B) Elevated walkway above high-water mark (Kruidering et al., 2005; AECOM 2024)

Figure 6-9 Example of Colugo Pole (AECOM, 2024)

Lighting Management and Mitigation Measures

A standalone Light Management Plan (LMP) [Draft LMP provided in Appendix C] for ambient and task lights will be prepared at a later stage, and its objectives are provided below:

- Artificial lights will be managed so that fauna is able to undertake critical behaviours such as foraging, reproduction and dispersal outside of the project boundary; and
- Mitigate the impacts of artificial lighting on the surrounding environment as far as reasonably practicable.

During site clearance stage, only lighting for ECM facilities is required. Public Utilities Board (PUB) requires that construction sites (> 0.2 ha) implement 24-hour continuous CCTV monitoring at the discharge outlet at the public drain or canal to monitor the surface runoff discharge. Therefore, the discharge outlet will be illuminated with white light throughout the night to provide a clear image under dark conditions. The white light will be pointed only at the discharge outlet (Figure 6-8).

Figure 6-10 Example Day Time Image and Night Time Image of ECM Discharge Outlet

For ad hoc night works, task lighting will be utilised at specific areas to create a safe workspace, and the required illuminance will vary depending on the type of activity to be undertaken. The following measures will be adopted for ad hoc night works:

- Scheduling of activities during nightworks;
- Turn off all unnecessary lights outside working hours;
- Provide at least a 10 m width dark buffer zone from the hoardings (only at the edge between construction site and forest);
- Use portable LED spotlights;
- Shine only on the objects or areas intended – keep lights close to the ground, directed, and shielded to avoid light spills;
- Ensure that lights are tilted downwards, facing away from any forest, mounted below height of hoarding as much as possible.
- Install hoardings or shields to prevent spillage of light into sensitive habitats;
- Limit the hours of lighting – only be used during specific times at specific locations and portable units with manual switching should be provided; and
- Localised control of lighting – lights should not be centralised and must be able to be switched off when not required.

Other General Biodiversity Mitigation Measures

Apart from the above-mentioned measures, the Contractor shall also be responsible in implementing the other general biodiversity management measures which include:

- The Contractor shall implement and adhere to all mitigation measures recommended by the Arborist, Flora Specialist, and Ecologist, as far as practicable, and where feasible.
- The Contractor shall conduct daily visual inspections of the worksite for wildlife prior to the start of construction activities.
- The Contractor shall maintain and ensure the integrity of the worksite hoarding by repairing any reported damages/breaches on a timely basis.
- Upon encountering trapped/injured/dead/dangerous fauna, the Contractor shall respond in accordance with the Fauna Response and Rescue Plan.
- The Contractor shall ensure that all personnel and external visitors limit their movements and activities (including non-work activities such as resting and eating) to within the worksite boundary. There shall be strictly no movements into adjacent forested areas.
- Graphical representations of but not limited to the following shall be posted around the worksite:
  - No feeding of wildlife
  - No fishing
  - No littering
  - No food or drinks (outside designated eating areas)
  - No cutting of trees or plants
  - No smoking (outside designated smoking areas)
- The Contractor shall procure and deploy only 100% biodegradable erosion control blankets.
- The Contractor shall construct and maintain designated sheltered eating areas that are wildlife proof.
- The Contractor shall procure and deploy fully covered and wildlife-proof food storage areas including wildlife-proof refuse bins.
- The Contractor shall ensure that all pits, drains, ponds, trenches, tanks that are potential fauna entrapments are suitably covered (e.g., using plywood, mesh, tarpaulin) to prevent fauna from falling in.
- The Contractor shall conduct periodical checks and trim overhanging vegetation above the worksite hoarding to prevent arboreal fauna from entering the worksite (if applicable).
- The Contractor shall instil discipline and raise awareness amongst all personnel on measures and mitigations to prevent damage to retained and protected trees throughout construction by including reminders on tree conservation guidelines within their daily toolbox briefings to workers and crane/excavator operators.
- Exposed/unused land areas shall be returned to earth ground and properly treated by compaction, turfing, vegetation planting or sealing with bituminous materials, concrete or other suitable materials as soon as practicable after site clearance, as instructed by the development agency / SLA. Turfed land will also reduce surface runoff, sedimentation/siltation, and erosion to adjacent sites.

6.3.3 Flora/Arboriculture Management Plan

Site Clearance and Tree Felling

The Arborist will review the Contractor's method statement for site clearance, tree felling, and the establishment of TPZ to ensure it meets the required specifications. The method statements for site clearance

and tree removal shall incorporate directional felling techniques using a hinge and back cut. Trees should not be removed by pushing with an excavator or any other heavy equipment. Instead, cranes will be used to offset the tension on the trunks in the direction of the intended fall. In addition, any interlocking canopy branches must be pruned before the trees are felled.

When design changes have the potential to impact additional trees or those designated for retention, the Arborist will collaborate with the structural engineers to propose solutions that adhere to NParks' guidelines. Whenever feasible, cleared vegetation, especially in sloped areas, should be covered with 100% biodegradable, fauna-friendly ECBs to mitigate soil erosion. The bare ground will be revegetated promptly to stabilize the surfaces and reduce dust re-entrainment, as well as the risk of erosion of waste materials into watercourses.

Clearance activities on-site will be prohibited during rainfall or when storm events are forecast in the vicinity to protect the forest edge from wind throw. In cases where forest edges are vulnerable to wind, the Arborist will collaborate on implementing temporary measures, such as additional hoardings, to provide protection during storm events. Careful consideration will be given to the removal of trees in riparian zones to minimize impacts on the bed and banks of waterways. Whenever possible, saplings, seeds, and seed banks will be preserved within the soil profiles for future forest restoration efforts. Furthermore, horticultural waste will be removed on the same day it is generated to mitigate the risk of fauna taking refuge in the cleared debris if it is left overnight.

In summary:

- Tree felling method statements, where feasible, shall involve directional felling methods that utilize hinge and back cutting.
- Tree removal via pushing by excavator shall not be permitted, unless stated otherwise by technical and/or development agencies.
- Where necessary, cranes shall be deployed offset trunk tension with reference to the felling direction.
- Trees exhibiting interlocking canopies shall be pruned prior to felling.

Tree Mapping and Assessment

The ISA-certified Arborist shall carry out tree inspection works for trees within 5m of the Project Area boundary. The Arborist will first conduct a tree inception survey before construction starts to establish a baseline for trees within the Project Area, adopting ISA TRAQ Level 1 Assessment. All trees with a girth of 1m and above will be assessed, and any smaller trees with 0.3m girth and above of high conservation value (vulnerable status and above according to SRDB3).

The Arborist shall conduct the tagging of trees (with unique identifiers) within the overall work boundary, as well as trees situated along construction access roads. The GPS coordinates of the trees inspected will be captured using a Differential-GPS (dGPS) device for sub-meter accuracy, and mapped onto Google Earth to produce a KML file. The trees will also be tagged with labels and photographed as part of the Tree Inception Survey Report. The tree data recorded are as follows:

- Tree Bio-Data (ID, Botanical name, girth height, crown diameter etc.);
- Tagging and assessment of tree species that are identified to be of conservation significance – species listed in Lindsay et al. (2022) as Nationally Vulnerable, Endangered, Critically Endangered or Presumed Extinct – with ≥ 0.3 m girth or spread.

- Assessment of the physiological health, presence of pests or diseases and structural stability of all trees, including single-stemmed palms and strangling Ficus species of ≥ 1.0 m girth or spread.
- Conservation status and spatial coordinates of the trees
- Photographic documentation to be appended in the Arborist's report.
- Assessment of trees to be retained or felled shall be reviewed by the Arborist.
- It is to be noted that no trees shall be felled without the prior approval from NParks.

The updated Arborist's report (including the tree protection and management plan detailed the in following section) shall reference the trees to be felled and retained within the tree felling plan provided by the QP and will be appended to this EMMP as an update when available.

Tree Protection and Management Plan

The Arborist shall propose tree protection, management, maintenance or care plans for identified trees to adhere to NParks' Guidelines on Greenery Provision and Tree Conservation for Developments (i.e., tree care, pruning and TPZs). Specifically, the Arborist shall ensure that the Contractor's TPZ setup complies with the requirements on Tree Protection Zone, Tree Protection Fencing / Hoarding & Tree Protection Specification as stated in Chapter 2: Conservation of Trees/Plants of the Guidelines (NParks, 2025).

- This includes the formulation of tree maintenance or care plans that involve subsequent remediation upon identification of issues (i.e., diseased trees, disease outbreaks etc.)
- The implementation of remediation measures such as herbicides or pesticides, while permitted, should be kept to a minimum. The affected plants can also be quarantined and removed from the site if necessary.
- In particular, a TPZ should be set up by the Contractor for the *Ficus kerkhovenii* strangling fig (1m spread) that was recommended to be retained.
  - TPZ of radius 15m
  - TPZ boundary should be at least 8 m away from the peripheral pillar roots
  - Contractor to adhere to NParks guidelines on TPZs (NParks, 2025)

The Arborist shall plan and carry out tree transplanting and sapling harvesting where necessary and feasible. Where trees and vegetation are moved or translocated within the relevant work area, the Arborist shall review the method statement proposed by the tree transplanting Contractor and advise on additional recommendations necessary to ensure tree health (and its continued survival) during and after transplanting.

Post-hoarding Worksite Footprint Verification and Review

Upon completion of hoarding installation, the Arborist and/or EMMP Consultant shall conduct a site inspection to verify that the hoarding line complies with the proposed footprint, with no excessive encroachment nor intrusion into surrounding areas. To further inspect and verify if additional trees or vegetation are cleared due to deviations of the hoarding line.

Once the worksite hoarding is in place, the Flora Specialist will carry out an inspection to confirm that the footprint is as planned and that no excessive vegetation or tree removal has occurred due to any misalignments in the hoarding. The Flora Specialist will also assess the proposed locations for soil investigation (SI) works and the alignment of construction access roads in conjunction with the Client or Contractor. If feasible,

alternatives will be suggested to minimize the clearance of vegetation and trees. Before any vegetation clearing is conducted for SI, the Flora Specialist will assist in identifying suitable CS species for salvaging, as outlined in the EIA. Additionally, pre-site clearance fauna inspections will be conducted, and fauna inspections will also take place during the SI works.

Pre-site Clearance Salvaging of Identified Species of Conservation Significance

During the pre-site clearance period, the Arborist shall work with NParks in identifying species of conservation significance found within the work site, that are viable for salvaging (i.e., specimens with girth size of < 0.3 m). Salvaging procedures should be carried out prior to site clearance, where applicable and if necessary.

In the pre-construction phase, the Flora Specialist will help identify conservation-significant species (CS species) that have a girth size of less than 0.3 m and are suitable for salvaging. The Flora Specialist will collaborate with NParks to ensure the identification of viable specimens for this process.

Weed and Invasive Species Management

The EMMP Consultant shall recommend and assist in implementing the removal and management of weeds and invasive species within the worksite, where practicable and applicable. Worksite shall be inspected and cleared of any weeds or invasive species regularly (i.e., via approved herbicides and/or hand weeding). Transport of horticultural waste or matter shall be disposed of properly at a licensed waste disposal facility.

6.3.4 Water Quality and Hydrology

With reference to AECOM's EIA Report (AECOM, 2024). It is stated that only waterbodies/streams D1, D4, D7 and D14 are to be monitored and sampled during the EMMP (Figure 6-10). Where the aforementioned streams will be impacted, the sampling points shall be amended accordingly. Additionally, the Contractor shall also propose plans to redirected impacted streams to retain and maintain waterflow, thereby mitigating impacts to the stream and aquatic ecosystems. The following sections on baseline water quality and hydrology, as well as monitoring during construction phase, shall follow that of the EIA.

Water Quality Baseline Study

Water quality sampling will be conducted for two (2) dry weather and one (1) wet weather scenarios at five (5) points proposed (refer to Figure 6-9 and Figure 6-10). According to NParks' BIA (2024) guidelines, dry weather conditions are defined as a continuous 48-hour period of no-rain, and wet weather conditions are defined as a rainfall event having more than 10 mm of rainfall, with samples to be collected within 3 hours after the rain stops.

In-situ measurements will be conducted on-site using a multi-parameter probe. The probe will be placed within the waterbody (1 m sampling depth) to obtain readings. For ex-situ sampling, grab sampling will be done to collect samples into sampling bottles provided by the laboratory which are stored in ice and sent to the SAC-SINGLAS accredited laboratory for analysis. The water quality results will be compared with NEA's Allowable Limits for Trade Effluent Discharge to Sewer/Watercourse/Controlled Watercourse, and the EIA baseline levels. The following parameters in Table 6-5 below will be tested for baseline monitoring, and be referenced with during the monitoring regime.

Table 6-6 Water Quality Parameters and Guideline Limits

Parameters	Unit	NEA Trade Effluent Limits (controlled watercourse)	International Aquatic Life Criteria*
In-situ			
Temperature	°C	45	-
pH	-	6 – 9	6 – 9
Conductivity	µS/cm	-	-
Turbidity	NTU	-	2 – 200
Dissolved Oxygen (DO)	mg/L	-	> 4
Ex-situ			
Total Dissolved Solids (TDS)	mg/L	1000	1000
Total Suspended Solids (TSS)	mg/L	30	150
Biochemical Oxygen Demand (BOD)	mg/L	20	30
Chemical Oxygen Demand (COD)	mg O_2/L	60	125
Total Ammonia Nitrogen (NH_4-N and NH_3-N)	mg/L	-	1
Total Nitrogen (TN)	mg/L	-	8
Nitrate (as NO_3)	mg/L	20	7
Total Phosphorus (TP)	mg/L	-	0.1
Orthophosphate (as PO_4)	mg/L	2	0.033
Total Organic Carbon (TOC)	mg/L	-	25
Oil & Grease (Total)	mg/L	1	0.1
Lead (Pb)	mg/L	0.1	Acute:0.065 Chronic: 0.025
Zinc (Zn)	mg/L	0.5	Acute: 0.12 Chronic: 0.12
Mercury (Hg)	mg/L	0.001	Acute: 0.0014 Chronic: 0.00077
Aluminium (Al)	mg/L	-	60
Antimony (Sb)	mg/L	-	Acute: 9 Chronic: 1.6
Arsenic (As)	mg/L	0.01	Acute: 0.34 Chronic: 0.15
Barium (Ba)	mg/L	1	Acute: 1.1 Chronic: 0.62
Beryllium (Be)	mg/L	0.5	Acute: 0.13 Chronic: 0.0053
Boron (B)	mg/L	0.5	0.94
Cadmium (Cd)	mg/L	0.003	0.1
Chromium (Cr) (Trivalent and Hexavalent)	mg/L	0.05	0.016
Copper (Cu)	mg/L	0.1	Acute: 0.018 Chronic: 0.012
Cyanide (Cn)	mg/L	0.1	0.060
Iron (Fe)	mg/L	1	1
Manganese (Mn)	mg/L	0.5	0.1
Molybdenum (Mo)	mg/L	-	0.034
Nickel (Ni)	mg/L	0.1	Acute: 0.47 Chronic: 0.052
Selenium (Se)	mg/L	0.01	0.25
Silver (Ag)	mg/L	0.1	0.05
Sulphide	mg/L	0.2	0.050
Tin (Sn)	mg/L	5	0.004
Enterococcus[2]	cfu/100mL	-	-

Parameters	Unit	NEA Trade Effluent Limits (controlled watercourse)	International Aquatic Life Criteria*

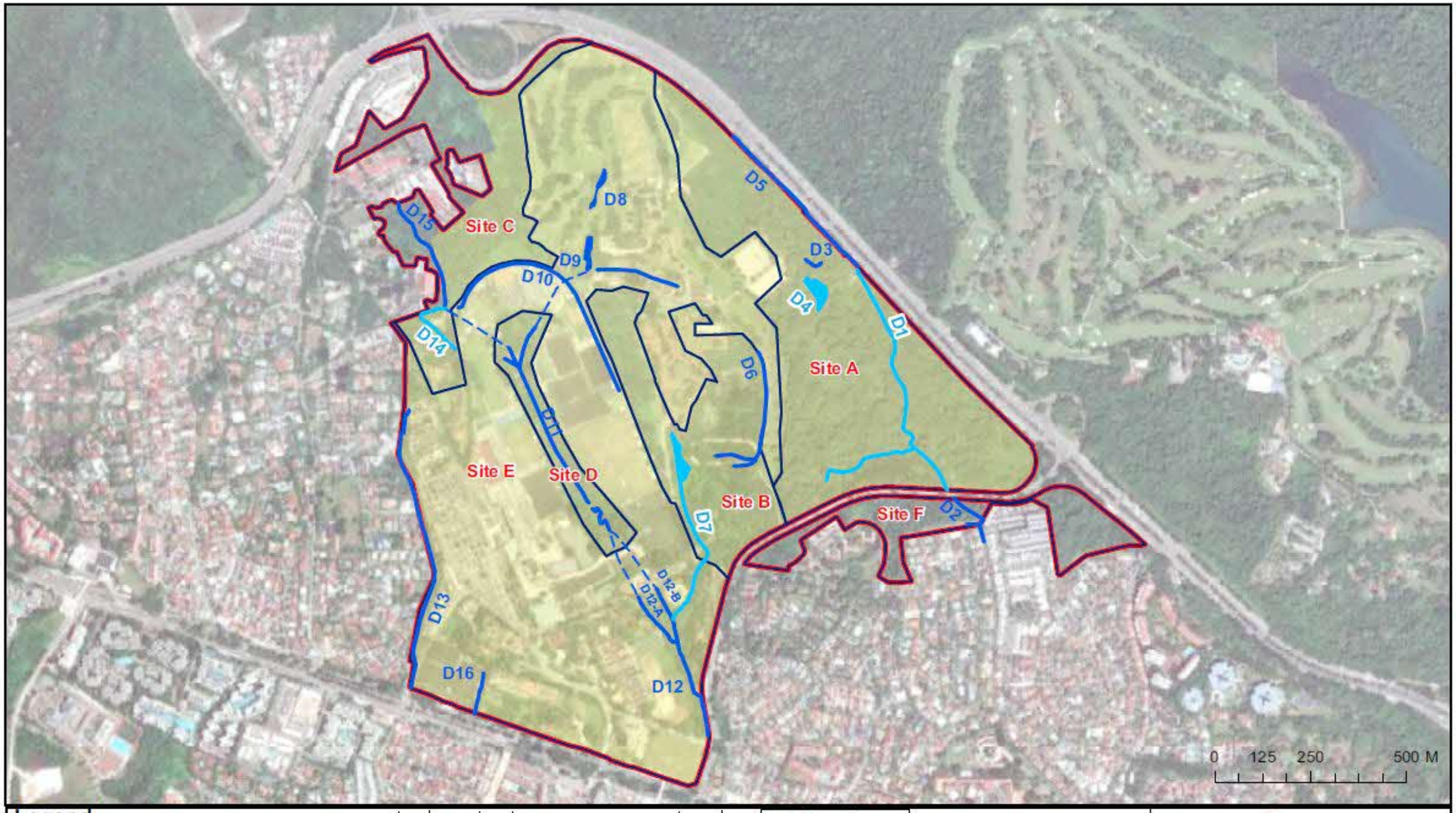
Notes:

- The sources of international water quality criteria for aquatic life includes United Nations Economic Commission for Europe, World Health Organization, United States Environmental Protection Agency, Australian & New Zealand, Canada, Philippines, and Malaysia.
- Singapore's Water Quality Guidelines for Recreational Beaches and Fresh Water Bodies requires that the Enterococcus count should be less than or equal to 200 counts per 100 millilitres of water at 99% of the time.

Hydrology Baseline Study

The hydrology of the retained and impacted streams within the Project footprint shall also be reassessed. The methodology employed shall take reference from AECOM's EIA report (AECOM, 2024) and NParks' BIA Guidelines (2024). The baseline data shall be referenced as the tolerance limits and EQOs for this parameter. Specifically, the following shall be considered and conducted for the hydrology study:

- Waterbody/Stream Mapping
- Cross-section Study
- Stream Velocity
- Flow Rate
- Groundwater Table (if applicable)



Legend

- Site Demarcation
- EIA Study Area
- Project Site

Monitoring required

- No
- Yes
- Underground connection

N

Rev.	Date	By	Description	Chk'd	App'd
-	MAY 2024	HBS	Turf Club EIA	LAL	JAG

Qualified Person Endorsement : NA

URA Endorsement : NA

Consultant : AECOM

Client : URBAN REDEVELOPMENT AUTHORITY

Project Title :
CONTRACT URA/T/22/031
ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR FORMER TURF CLUB AT BUKIT TIMAH

Figure Title :
Watercourses to monitor during construction phase

Designed	Checked	Approved
HBS	LAL	JAG
	Drawn: HBS	Date: MAY 2024

Figure No. : 12 - 8 | Rev. : - | Sheet : 1 of 1

CAD File Name : NA | A3

Note: Source of basemap - Google Earth Map

Figure 6-11 Watercourses for Baseline and to Monitor (AECOM, 2024)

Figure 6-12 Indicative Water Quality Sampling Points for Baseline and Monitoring

Key Mitigation Measures for Hydrology, Surface Water and Groundwater

- Direct clean water towards ecologically sensitive watercourses/bodies that are significantly affected by catchment loss (such as pond D4, natural stream D7, and earth drain D14).
- Ensure that no discharges occur from the construction site into the retained ecologically sensitive watercourses/bodies (including D1, D7 and D14).
- Construct a berm or an equivalent structure upstream of the tributary feeding into natural stream D1 and earth drain D14 before starting any construction activities (such as backfilling).
- Complete drainage diversion construction before it connects with natural stream D7.
- Install silt curtains or similar measures when linking natural stream D7 to the drain diversion.
- Cover all exposed and erosion-prone surfaces as quickly as possible once work is finished or if heavy rain is expected, and work shall be paused. This indicates that tarp or other protective materials shall be readily available next to any bare soil.
- Direct clean water into the retained ecologically sensitive watercourses/bodies experiencing significant catchment loss (like pond D4, natural stream D7, and earth drain D14) to enhance the flow into these areas.

6.3.5 Air Quality

Air Quality Baseline Study

One week (7 consecutive days; inclusive of weekdays and weekends) of pre-construction air quality monitoring will be conducted by the Contractor at five (5) monitoring locations to establish a baseline for the monthly EMMP monitoring. This baseline monitoring solely focuses on dust levels, specifically PM_{10} and $PM_{2.5}$, as these are the primary pollutants expected to significantly affect ambient air quality due to the Project. The monitored parameters will be compared against the Singapore Ambient Air Quality Targets (SAAQTs).

Identified air sensitive receptors (ASRs) may include hospitals, schools, childcare facilities, old age homes, residences or areas of significant ecological value nearest to the construction site or Project boundary. Refer to for the proposed air quality monitoring locations.

Key Mitigation Measures for Air Quality

- Introduce measures to control dust, such as dust screens and equipment with dust suppression features.
- Create hard-surfaced haul routes.
- Utilise cutting, grinding, and sawing tools that have dust suppression water spray systems.
- Set up hoarding around areas where dust is generated and along the site boundary.
- Establish and display a maximum speed limit of 25 km/h on paved roads and 15 km/h on unpaved roads and within work zones.
- Prohibit the burning of waste on the site.
- Cover exposed areas with turf where possible and ensure proper storage of soil stockpiles.
- Establish a Dust Control Plan (to be provided by the contractor when onboarded).

Figure 6-13 Indicative Air Quality Baseline and Monitoring Locations

6.3.6 Airborne Noise

Airborne Noise Baseline Study

One week (7 consecutive days; inclusive of weekdays and weekends) of pre-construction ambient noise monitoring will be carried out at five (5) monitoring locations to establish a baseline for the monthly EMMP monitoring. The NEA-approved Type 1 Sound Level Meter shall be deployed to capture pre-construction baseline noise levels for Leq 12 hours (long term), Leq 1 hour, and Leq 5 minutes (short term) at the specified locations in the) to provide the representative baseline noise levels prior to the commencement of site clearance.

The Contractor shall use the pre-construction baseline to calculate and establish the Project criteria by deriving a background noise correction factor to establish the maximum permitted noise level in accordance with the noise legislation stated in Environmental Protection and Management (Control of Noise at Construction Sites) Regulations (2008), which will be applied for construction works in all stages.

Key Mitigation Measures for Airborne Noise

Key mitigation measures are summarised in the pointers below. The full mitigation measures and minimum controls are detailed in the EMMP register table (Table 7-1).

- Consider implementing staggered building heights to minimise the duration of noisy activities close to sensitive receptors.
- Ensure that access routes do not directly face these NSRs.
- Employ equipment that operates at lower noise levels.
- Where necessary, applicable and based on inputs from the appointed Noise Consultant and NEA, noise barrier of the following types shall be deployed at suitable locations near NSRs (see Figure 6-14 for proposed locations):
  - Perimeter noise barriers (STC 20; NEA, 2024)
  - Noise curtain(s) containing sound absorbing material (STC 15)
  - Plant, machine noise and rotary head enclosures
  - Acoustic silencer(s) or muffler(s)
  - Vibration absorption, isolation or damping device(s)
- Use low-speed limits, speed bumps, and signage indicating speed limits at drop-off points and parking areas to reduce noise from increased road traffic.
- Explore alternative locations for roads to keep them away from areas with NSRs.
- Establish a Noise Management Plan (to be provided by the contractor when onboarded).

Figure 6-14 Indicative Airborne Noise Baseline and Monitoring Locations, and Proposed Noise Barrier Placement

6.3.7 Vector Management and Control

The Contractor shall prepare a Project-specific Vector Control Plan upon award, in accordance with NEA's Code of Practice for Vector Control Operator, Technician and Worker, as well as NEA's Mosquito and Rodent Control Measures. The Contractor shall also engage an NEA-licensed Vector Control Operator (VCO) to carry out vector control management. Below are key mitigation measures to be employed for the Project.:

- To conduct a baseline assessment to ascertain pre-existing conditions on Project site prior to works, and identify area of potential vector breeding grounds to be removed/addressed prior to commencement of works
- Conduct daily housekeeping to remove stagnant water and ensure that unwanted items are disposed of correctly.
- Install a movable roof over shafts to prevent rainwater from entering
- Use pumps to remove water in areas where drainage is not feasible, as well as on larger recessed surfaces.
- Designate specific areas for food disposal, ensuring it is done daily to deter rodents from nesting on-site and to avoid infestations of cockroaches and flies.
- Store food in rodent-proof containers or cabinets with a clearance of at least 60 cm from the ground.
- Refrain from using fogging
- Refrain from using chemical pesticides and conventional physical traps

6.3.8 Environmental Trainings for Site Personnel

Biodiversity Awareness Training

To ensure effective implementation of mitigation and monitoring measures, all relevant construction personnel (i.e., Project Manager, Construction Manager, EMMP In-charge, ECO, Site Supervisor, Foreman, Construction Worker Team Leader, etc.) will be made aware of the EMMP requirements prior to commencement of on-site work. The Contractor shall ensure that trainings are conducted before starting the construction work and at a regular interval during construction phase for the site personnel. Every training session shall be documented and reported as part of best practices. The recommended training program is provided in Table 6-6.

Table 6-7 Training Programme for Site Personnel

Training Schedule	Training Topics	Conducted by	Target Audience	Frequency
Prior to commencement of activities on site	EMMP requirements & Biodiversity Awareness Training	EMMP Consultant	Environmental Manager/ ECO/ Project Manager / Construction Manager/ Construction Engineers/ Site Supervisors/ Sub-contractors	Once
Refresher training	Biodiversity Awareness Training	Contractor's EMMP In-charge / ECO	Site Personnel including Sub-contractor	Every six months during construction phase
Toolbox	Briefing to include reminders on wildlife encounters and environmental protection	Contractor's EMMP In-charge / ECO	Construction Workers	Daily

Waste Management Training

Training sessions shall be conducted monthly, if needed, to ensure that all site personnel are adequately trained to manage construction waste effectively on-site.

- The Contractor will establish a thorough waste management system at the site to facilitate proper waste disposal.
- Illegal disposal of construction waste is strictly forbidden.
- Littering of food waste and packaging is prohibited and will be enforced by the Contractor.
- It is strictly prohibited to dispose of construction waste (both wastewater and solid waste) in streams, stormwater channels, or other bodies of water.
- The Contractor shall provide adequate wildlife-proof, covered food waste bins.
- Food waste shall be removed from the site at least once daily.
- If wildlife is observed around waste disposal areas, the Contractor is required to consult with the Ecologist / Wildlife Specialist to take steps to minimize attractants.
- The Contractor shall submit a Waste Management Plan as part of the EMMP, detailing:
  - Types of waste generated;
  - Locations and types of waste management facilities;
  - Disposal frequency; and
  - Details of waste management contractors.

Vector Control Training

Training sessions shall be conducted monthly, if needed, to ensure that all site personnel are adequately trained to manage vectors effectively on-site. The following vector control measures will be implemented:

- Eliminate stagnant water through good housekeeping practices to remove potential breeding sites.
- Conduct regular worker screenings for dengue monitoring, including temperature checks and quarantine measures where necessary.
- Implement search and destroy efforts, conduct inspections, and apply *Bacillus thuringiensis israelensis* (Bti) that is more environmentally friendly.
- Thermal fogging will not be used to avoid harming invertebrate fauna in neighbouring habitats.
- The use of chemical insecticides, pesticides, and rodenticides is not permitted.
- Sticky traps are not allowed for pest control.

6.4 EMMP during Construction Phase

A Monthly EMMP Report will be prepared and record the effectiveness of mitigation measures and pollution controls implemented during the construction period (estimated duration of 88 months, from September 2025 onwards). Where any environmental non-compliance is observed on site, recommendations will be provided to the Main Contractor for Rectification. Potential or actual incidents / non-conformances will also be highlighted to HDB and the SO Rep immediately. The contents of the report will include:

- Projects monitored and inspected for the prevailing month;
- Types of relevant mitigation and management works implemented corresponding to the specific project stage / activities;
- Performance of the mitigation and management works;
- Environmental and biodiversity monitoring results and findings (to be obtained from the Main Contractor), corresponding to the specific project stage / activities;
- Incidents on site including incident investigation, root cause, and corrective actions;
- Assessment of results against environmental standards and baseline levels; and
- Further recommendations and corrective measures and / or remedy or restoration or compensation actions, if any.

6.4.1 Fauna Monitoring

Upon completion of the wildlife shepherding, monthly monitoring of terrestrial fauna will be included in the Monthly EMMP Report until the end of construction. This aims to monitor the diversity of the wildlife that has been shepherded to immediate surroundings by comparing it to the pre-construction baseline survey results (Section 6.3). It also allows the EMMP Consultant to monitor any negative impacts from the construction on the surrounding habitat and have a better understanding of the mitigation measures in place.

The methodology and transects (as per Table 6-7) for the faunistic surveys shall closely follow that implemented for the pre-construction baseline surveys (based upon the EIA) to ensure that the data collected can be compared against the baseline data. No night works are anticipated during the construction stage. However, should night works be required, nocturnal surveys will be conducted. Comparisons will be against the following recommended indicator species (as listed in the EIA) for monitoring of the ecosystem health.

The taxa to be surveyed with the aid of binoculars and torch include birds, mammals, amphibians, reptiles, butterflies, and odonates. Monitoring field surveys during the construction phase will be carried out in the morning (diurnal surveys), typically from 0700 – 1100. The transects will be within the forest and carried out by a Wildlife Specialist, where survey routes will follow the three (3) proposed transects as shown in Figure 6-13, and take guidance from NParks' BIA (2024) guidelines (Table 6-7). Depending on the actual development and its location, the requirement or necessity of the type and taxon to be surveyed shall be decided in consultation with NParks. The methodology of the baseline fauna surveys is as follows:

- Record all animals heard and seen within 50 m (birds and mammals), 10 m (herpetofauna), 5 m (butterflies) of either side of the transect and 50 m ahead;
- Record the coordinates of all animals, sighting of bird nest(s), and animal burrow(s); and

- Species of conservation significance will be noted based on the status outlined in the Singapore Red Data Book 3rd Edition (2024) and International Union for Conservation of Nature (IUCN) Red List of Threatened Species, for national and international status respectively.

Table 6-8 Survey Type and Technique for each Taxon

Taxon	Timing	Survey Type	Survey Technique	Sampling Frequency (per transect)
Herpetofauna (Amphibians and reptiles)	0700 – 1000 1900 – 2200	Diurnal and nocturnal transect surveys	Field survey – Visual and auditory	One (1) cycle
Birds		Diurnal and nocturnal transect surveys		One (1) cycle during migratory/non-migratory seasons
Mammals (Non-volant)		Diurnal and nocturnal transect surveys		One (1) cycle
	Continuous	Camera Trapping	-	24 hours; 60 days
Mammals (Bats)	1900 – 0700	Nocturnal surveys	Bioacoustics surveys	Two (2) continuous nights;
	1800 – 0700		Harp traps – Visual	One (1) cycle
	1900 – 2200		Field survey – Visual and bioacoustics	One (1) cycle
Odonates and Butterflies	1000 – 1200	Diurnal transect surveys	Field survey – Visual	
Aquatic fauna	-	Diurnal transect surveys	Push or scoop netting; Baited traps	One (1) cycle

Monitoring of Wildlife Connectivity Measures

The Ecologist/Wildlife Specialist engaged by the Contractor shall also conduct monitoring of wildlife connectivity measures throughout the Project site and throughout the monitoring duration. This involves visual inspection of the integrity of the equipment and/or structures constructed for the measures.

At the current stage, the exact equipment and structures, as well as their locations, are unknown. This section will be updated after the Contractor has been onboarded.

Figure 6-15 Indicative Fauna Survey Transects

6.4.2 Flora Monitoring

The flora monitoring regime during the construction phase should include the following:

- Monthly flora inspections shall be conducted within the Project boundary and in forested areas with a 15m buffer from the hoarding (where applicable & practicable)
- Identification of any unauthorised removal of flora within areas of conservation or outside the designated Project worksite (where applicable & practicable)
- Identification of both direct and indirect effects on vulnerable vegetation and habitats. These effects encompass soil erosion and degradation caused by construction activities, as well as the unauthorized disposal of waste materials, construction debris, or leaks of oil and chemicals.
- Identification of forest edge effects and recommendation of mitigation measures where necessary.
- Evaluation of the current situation regarding invasive plant species and weeds, along with recommendations for their removal when needed. Examination of previously cleared areas for any signs of invasive species seedlings.
- Monitoring of the health of all retained and planted flora, including identification of diseases and recommendations for treatment

6.4.3 Arboriculture Monitoring

The Arborist will inspect and monitor the retained trees on site. Trees to be retained shall have a TPZ around them. When a tree or vegetation exhibits signs of stress, the Arborist will inspect the tree or vegetation and advise on measures to further reduce impacts and rehabilitation or rectification measures. The Contractor (including the Tree Felling Subcontractor) will need to carry out the rehabilitation or rectification measures within a week (7 working days), barring special circumstances where materials or equipment need to be delivered. After the rehabilitation or rectifications measures have been carried out, the tree health shall be monitored to see if there is any improvement, and the findings will be incorporated into the Monthly EMMP Report.

Retained Trees

During the construction stage, the Arborist will continue to monitor the trees identified in the Tree Inception Survey Report via monthly site inspections. The resultant monthly report produced will be incorporated into the Monthly EMMP Report, and includes the above-mentioned tree data, checks on the Tree Protection Zone (TPZ), and recommendations on any mitigation/remedy measures necessary for trees based on the site inspection.

The Arborist is to conduct monthly inspection of the surrounding trees and TPZs at the edge of Project boundary. The Arborist is to assess and determine the health of the trees and should any action be necessary. This includes and is not limited to determining if the tree crown might pose a threat to the hoardings, or if the climbers on the hoarding are to be removed. The condition of the TPZs shall also be assessed, and recommendations be made should any remediation be needed. Table 6-8 below lists parameters which the arborist will inspect. The Arborist's monthly inspections aim to ensure Contractor's TPZ status and maintenance complies with the requirements on Tree Protection Zone, Tree Protection Fencing / Hoarding & Tree Protection Specification as stated in Chapter 2: Conservation of Trees/Plants of the Guidelines (NParks, 2025).

Photos of each tree are to be included in the Monthly EMMP Report. Past or current maintenance activities will also be reflected in the report (such as last tree pruning date) during the development period.

Table 6-9 Parameters for Monthly Tree Inspections

Tree Health and Bio-Data	TPZ Condition
Foliage colour (Normal, Chlorotic, Necrotic)	TPZ barriers installed/good condition
Foliage density (Normal, Sparse)	Potential signs of Illegal Encroachment
Leaf size (Normal, Small)	Potential signs of Damage to Tree
Epicormic shoots (Yes, No)	Potential signs of Toxic Splash
Twig dieback (Yes, No)	Potential signs of Illegal Compaction
Wound wood roll development (Good, Average, Poor, None)	Potential signs of Materials Storage
Vigour (Good, Average, Poor)	Potential signs of Machinery, Equipment, and Vehicle Storage
Pests/Diseases (Yes, No)	

Monthly Tree Monitoring

The Arborist will perform the following tasks during the monthly tree inspection or as necessary:

- **Condition Monitoring**: Monitor the condition of trees at the new forest edge to assess their physiological health and structural stability. This is crucial as edge effects can lead to canopy dieback as well as branch and structural failures.
- **Method Statement Review**: Review the method statements associated with construction activities near retained trees to evaluate whether additional tree removals are needed following site clearance.
- **Recommendation of Solutions**: Propose solutions in cases where there are conflicts with the proposed works, including design changes, reductions in working space, modifications to the TPZ, and reassessment of the impacted trees.
- **Health and Stability Assessment**: Evaluate the physiological health, vigour, and structural stability of retained trees. Recommend any additional mitigation measures if deemed necessary.
- **Condition Assessment of Retained Trees**: Check the condition of retained trees to ensure there has been no deterioration or mechanical damage and determine if additional tree removal is required.
- **Stress Inspection**: Inspect trees that display signs of stress and provide advice on strategies to mitigate further impacts and implement rehabilitation measures. If monitoring indicates drying out or edge impacts, immediate remediation measures will be carried out, such as providing supplemental watering during dry spells (e.g., seven (7) consecutive days without rainfall). Long-term solutions will also be investigated and implemented.
- **Disease Management**: If tree disease outbreaks are detected, the Arborist will recommend necessary management measures as part of the ongoing tree maintenance and care.
- **TPZ Integrity Inspection**: Conduct inspections to ensure the integrity of the TPZs is maintained and that they continue to provide effective protection for retained trees.

6.4.4 Water Quality and Hydrology Monitoring

Water Quality

During the construction phase, water quality monitoring will be conducted at the proposed five (5) sampling points once every month (Figure 6-10). Continuous Total Suspended Solids (TSS) monitoring and CCTV including a Silt Imagery Detection System (SIDS) will be implemented at the final discharge point(s) of ECM to ensure the concentration of TSS is < 50 mg/L before being discharged into public drainage.

In-situ measurements will be conducted on site using a multi-parameter probe. The probe will be placed within the waterbody (1 m from water surface) to obtain readings. For ex-situ sampling, grab sampling will be done to collect samples into sampling bottles provided by the laboratory which will then be stored in ice and sent to the SAC-SINGLAS accredited laboratory for analysis.

Water Quality EQO

The water quality results will be compared with NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse, the International Aquatic Life Criteria from other countries (i.e. United States (USEPA), Australia & New Zealand, Canada, Philippines, and Malaysia), as well as the pre-construction baseline data the sampling methodology, parameters to be tested for and EQOs shall follow that of Table 4-3 and Table 6-6 above. In the event that water quality exceedances are detected, the response plan in Section 8.4 will be followed.

Hydrology Monitoring

The waterbodies/streams identified to be sampled/monitored during the baseline study shall be visually monitored by the Contractor's EMMP Specialist team for degradation and visual impacts during the construction phase (Figure 6-9 and Figure 6-10). The baseline flow rates and water quality readings shall serve as the tolerance limits and EQOs for this parameter.

6.4.5 Air Quality Monitoring

The five (5) air quality monitoring locations during construction will follow the baseline conducted during pre-construction assessment (Figure 6-11). The monitored parameters – PM_{10} and $PM_{2.5}$ will be compared against both the pre-construction baseline data and Singapore Long Term Air Quality Targets, as outlined in EIA, to monitor any major impacts from the construction activities. The locations of the air quality monitoring meters may be shifted due to site conditions and construction work phases. The latest locations will be updated in the Monthly EMMP Reports, if necessary.

The Contractor and ECO shall carry out the following:

- Daily visual inspection to ensure bare earth areas are covered when no works are carried out in the areas;
- Weekly visual inspection to ensure hoarding and physical barriers are well-maintained and repaired where necessary;
- Weekly visual inspection to ensure all equipment or vehicles emitting black smog are turned off and removed from the site for repair; and

- Water suppression measures on dry days to reduce dust emission.

Air Quality EQO

For any exceedance of permissible limits stated in monitored parameters will be compared against the Singapore Ambient Air Quality Targets (SAAQTs), the Contractor shall investigate the causes and take immediate steps to address the sources of pollution. On-site visual inspection of particulate matter from construction machinery operations and construction activities will be conducted during the entire construction phase. The response plan detailed in Section 8.5 shall be implemented.

6.4.6 Airborne Noise Monitoring

The main causes of noise pollution are likely to come from foundation works (piling works) and vehicular movement. The use of high-impact stationary and mobile equipment (e.g., excavators, piling rig and dump trucks) might cause spikes in the noise level around the surrounding areas. The airborne noise monitoring data at the proposed five (5) locations (Figure 6-12) will be compared against the pre-construction baseline data and guideline limits stipulated by Environmental Protection and Management (Control of Noise at Construction Sites) Regulations (2008) to determine the impact of construction noise on the nearby NSRs. The locations of noise meters may be shifted due to site-specific conditions and construction work phases. The latest locations will be updated in the Monthly EMMP Reports, if necessary.

Airborne Noise EQO

The permissible limits for airborne noise levels shall adhere to the adjusted limits based on the baseline noise monitoring results, as well as the NEA-approved noise management plan submitted by the Contractor's Noise Specialist. For any exceedance of permissible limits, the Contractor shall investigate the causes of exceedance and take immediate steps to address the sources of pollution. On-site visual inspection of noise mitigation measures will be conducted during the entire construction phase. The response plan for exceedances in airborne noise limits in Section 8.6 shall be implemented.

6.4.7 Vector Monitoring

The Contractor's VCO and ECO/EMMP In-Charge shall work together to implement the vector management plan as detailed in Table 6-9 below.

Table 6-10 Summary of Vector Monitoring Plan

Location	Monitoring Parameters and Frequency	Responsible Party
All works sites within Project boundary	Daily inspection of potential mosquito breeding grounds (stagnant water), rodent burrows and droppings of other vectors (e.g. cockroaches, flies).	ECO, Contractor
	Daily inspection and housekeeping across the construction site.	
	Weekly inspection by an external NEA-licensed Pest Control Operator.	VCO

6.4.8 Monthly Visual Site Inspection

The environmental site inspection plays an important role to oversee the construction activities and assess the effectiveness of protection and mitigation measures on-site. This is to ensure compliance with EMMP requirements and verify that measures are adequate to protect the surrounding environment. The visual site inspection will be conducted monthly throughout the construction phase. The sample checklist below will be incorporated with representative photos into the Monthly EMMP Report.

Date of Inspection:	
Conducted By:	

S/N	Inspection Item	Implementation			Comment	Follow-up Action / Recommendation
		Yes	No	N.A.		
Biodiversity						
1.	Has the biodiversity awareness training been conducted for the key staff and workers prior to land clearance?					
2.	Are there wildlife emergency protocols and biodiversity awareness information displayed on site?					
3.	Has the pre-felling check been conducted before felling any trees or removing any vegetation?					
4.	Are the construction zones and retained areas clearly demarcated before commencement of works?					
5.	Are the hoardings properly installed and maintained with no gap between the panels and between the bottom of hoarding and ground?					
6.	Are biodegradable erosion control blankets (ECBs) used to cover exposed areas?					
7.	Is there any incident of roadkill or entrapped fauna?					
8.	Are there any designated eating houses/ canteens/ rest areas? Any wildlife-proof bins provided for daily food waste collection and disposal?					
9.	Has regular monitoring been carried out to assess the tree condition alongside the construction boundary?					

S/N	Inspection Item	Implementation			Comment	Follow-up Action / Recommendation
		Yes	No	N.A.		
Water Quality						
10.	Has silt fence / curtain been provided before commencement of works?					
11.	Any there any visible sediment plume(s) observed outside of silt curtains or construction boundary?					
12.	Have Perimeter Drains, Silt Fences, and ECMs (i.e., Holding Ponds, Treatment Tank) been set up? (where applicable)					
13.	Are ECMs maintained regularly i.e., replacement of silt fences and biodegradable ECBs, re-paving of concrete surfaces, etc?					
14.	Is continuous monitoring and recording system (CCTV) set up at the final discharge points of ECM to monitor water quality of discharges i.e., to comply guideline limit of 50 mg/L for total suspended solids (TSS)?					
15.	Are exposed areas/ bare slopes/ stockpiles covered, concreted, and/or turfed properly? (where possible)					
16.	Is the fuel and chemical storage area located away from the mangrove area and properly secured i.e., provision of concrete bunded base and/or secondary containment (110% of the largest volume stored)?					
17.	Is spill control kit (or sand) readily available on site?					
18.	Are engines/generators provided with secondary containment to prevent spillage?					
19.	Has regular monitoring been carried out to ensure the discharges from the site are in accordance with NEA's allowable limits for trade effluent discharge?					
Air Quality						
20.	Have the exposed soil/ stockpiles been covered under canvas sheets or biodegradable ECBs?					
21.	Is regular water bowsing conducted at temporary unpaved areas during ambient dry periods?					
22.	Is wheel washing facility provided to clean the construction vehicles before entering the public roads?					
23.	Are the truck loads carrying dry materials (i.e., cement, sand, aggregate, soil, etc.) covered properly?					
24.	Is maximum-speed-limit for all construction vehicles imposed within the site?					

S/N	Inspection Item	Implementation			Comment	Follow-up Action / Recommendation
		Yes	No	N.A.		
Noise Level (applicable to both day and night works)						
25.	Has continuous noise monitoring been carried out to monitor the noise from construction activities?					
26.	Have the noise control measure at sources (e.g., silencer/ noise blanket/ portable noise barrier) for noisy equipment or machineries been provided?					
27.	Are equipment, machinery and vehicles switched off when not in use?					
28.	Are equipment, machinery and heavy vehicles used properly maintained on a regular basis?					
Waste Management						
29.	Does the site have proper segregation and storage of waste to extract recoverable and recyclable materials?					
30.	Are waste storage areas located away from the mangrove areas?					
31.	Is food waste collected using garbage/ trash bins with tight lid (animal proof bin) and disposed off from the site on daily basis?					
32.	Are hazardous waste stored in properly covered locations with secondary containment, and disposed off routinely by a NEA licenced hazardous waste contractor?					
33.	Have suitable/unsuitable excavated materials from the site been collected and disposed off at designated dumping ground location by NEA licensed waste contractor?					
Illumination						
34.	Are all lights directed away from forest areas?					
35.	Are all light fixtures directed downwards and towards the construction activities and to be switched off at all non-essential areas?					
36.	Are all lights below the height of hoardings?					
Vectors						
37.	Are designated rest areas and wildlife-proof bins provided to prevent animals from scouring food?					
38.	Are domestic/ food waste collected and removed from the site on daily basis?					
39.	Have the empty containers been kept indoor and the building materials been stored under shelter and off the ground?					
40.	Have the housekeeping practices been conducted regularly to remove any stagnant water and keep the site in a clean and tidy condition?					

6.5 EMMP for Post-construction Phase

6.5.1 Close-off EMMP Audit

A Close-Off Environmental Audit Report will be prepared and submitted upon completion of each stage of the construction works, to report on the satisfactory completion of the different aspects of the EMMP implementation across the whole construction phases. The Close-Off Audit report serves to document the post-construction phase environmental conditions which shall include the results of water quality, sediment quality, noise, air and ecological habitat surveys, as compared to the baseline conditions. The report will include the following:

- The environmental impacts occurring during the construction phase
- Compliance with the relevant regulatory and EMMP requirements during the construction phase
- The results of the control monitoring throughout construction and audit stages
- The results of habitat monitoring throughout construction and audit stages

7 Environmental Impact and Mitigation Registry (EMMP Table) for Stage 1

7.1 Construction Phase

The management actions and monitoring actions for works during the construction phase where applicable and practicable are shown in the Environmental Impact and Mitigation Registry table below (Table 7-1).

Table 7-1 Summary Table of EMMP Measures during Construction

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
Biodiversity				
▪ Impacts on flora and vegetation	▪ Demarcation of site boundary. ▪ Establish TPZs around trees and other plants to be retained on site. ▪ Tag trees meant for protection and transplantation to prevent accidental removal.	▪ Document the locations, species, and number of transplant candidates impacted by construction activities.	▪ Prior to site clearance	▪ Aurecon
	▪ A TPZ of radius 15 m shall be set up around the large *Ficus kerkhovenii* in Parcel A4. The TPZ boundary shall be at least 8 m away from the peripheral pillar roots. ▪ Check the integrity of the TPZ hoarding. ▪ Determine physiological health and vigour of trees. ▪ Assess trees with mechanical damage that leads to instability. ▪ Review method statements of construction work nearby retained trees. ▪ Conduct mitigation measures for soil erosion when vegetation has been removed, and soil is exposed.	▪ Assess instances of excessive or unauthorized tree removal. ▪ Identify trees that need management and maintenance, including care and pruning. ▪ Check for any unauthorized removal of plants in conservation areas, if applicable, or outside the designated worksite. ▪ Identify locations experiencing soil erosion and degradation caused by construction activities. ▪ Investigate any unauthorized disposal of waste materials, construction debris, or oil/chemical spills that could contaminate the soil and water sources or harm vegetation. ▪ Identify areas showing negative responses because of development.	▪ Monthly during construction	▪ Contractor
▪ Impacts on fauna	▪ NIL	▪ Conduct directional clearing. ▪ Implement fauna inspection prior to site clearance.	▪ Prior to site clearance	▪ Aurecon
	▪ Ensure that machinery that may leak harmful chemicals and fuel-powered equipment is stored correctly. ▪ Keep the faulty equipment away from water bodies and sensitive habitats.	▪ Evaluate the condition of habitats (such as water quality and excessive vegetation removal). ▪ Look for trapped, injured, or deceased animals, potential entrapment hazards for wildlife, and any gaps in the site hoarding. ▪ Carry out toolbox meetings to raise awareness about biodiversity.	▪ Monthly during construction	▪ Contractor
	▪ Ensure adherence to the minimum noise control measures outlined in the Airborne Noise section below.	▪ Perform a biodiversity survey to assess the effects of construction on animal activity and presence.	▪ Monthly during construction	▪ Contractor
		▪ Document the frequency of human-wildlife conflict incidents.	▪ Continuous	▪ Contractor
Hydrology and Surface Water Quality				
▪ Stormwater runoff and contamination ▪ Chemical leakage ▪ Domestic waste ▪ Solid waste ▪ Wastewater from construction activities	▪ Runoff from within, upstream, and surrounding the construction site will be effectively managed to prevent flooding in the area. ▪ Any potential increase in peak flow resulting from land use changes at the site can be alleviated by installing detention tanks or ponds on the premises. These facilities will collect stormwater during intense rainfall events to help minimize peak runoff. ▪ The geotechnical considerations regarding slope stability, including ERSS, shall be incorporated into the detailed engineering design for the construction phase.	▪ Divert clean water into retained ecologically sensitive watercourses/bodies that have experienced significant catchment loss (such as pond D4, naturalised stream D7, and earth drain D14). ▪ Ensure that no discharges from the construction site enter the retained ecologically sensitive watercourses/bodies (including D1, D4, D7, D14, and D15).	▪ Monthly during construction	▪ Contractor

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
	▪ Design engineers responsible for the detailed plans should ensure that ERSS are proposed during site clearing and excavation. At the same time, the ECO shall verify that these measures are executed during construction, as slope cutting can lead to instability. ▪ ECM measures encompass a variety of strategies, including but not limited to reducing bare soil exposure, covering all bare or erodible surfaces, implementing concrete cut-off drains, installing silt fences or traps along perimeter cut-off drains, and utilizing turbidity curtains for operations near watercourses (such as drains and streams). ▪ Thorough designs must ensure adequate drainage, piping, and/or channelling of stormwater runoff for collection and treatment in ECM tanks or ponds before discharging into watercourses. ▪ Consistent and dedicated procedures shall be established for the inspection and maintenance of stormwater collection, storage, and treatment infrastructure, such as pipes and oil-water separators. ▪ Regular procedures for managing stormwater collection, settling, testing, and the eventual release of 'clean' water into watercourses shall be implemented, including measures to prevent high sediment concentrations in stormwater discharges. ▪ A SOP should be developed for the safe handling, transfer, and storage of hazardous waste, with daily housekeeping checks to ensure the site is clear of any toxic waste. ▪ Appropriate testing is required to determine the presence or absence of contamination in excavated soil and sand. ▪ A fully sheltered storage area is necessary for chemical substances, with a storage capacity of at least 110% of the largest volume of chemicals held (the area must be curb-contained on at least three sides, covered, and properly ventilated). ▪ Toxic waste storage containers shall be constructed with appropriate materials, with periodic leak detection tests conducted. ▪ Secondary containment shall be provided for all bulk-stored toxic waste, adhering to COPPC/SS593 requirements. ▪ An emergency response plan should be developed, with training for the ERT to ensure they can execute the response mechanism, including having response kits for spill incidents. ▪ A consignment notification and tracking system, alongside a transport emergency response plan for moving toxic waste, should be established. ▪ Toxic waste disposal shall comply with the Environmental Public Health (Toxic Industrial Waste) Regulations through licensed waste operators or collectors. ▪ Portable toilets and an on-site septic tank shall be provided, with regular maintenance to clean the toilets and remove sanitary waste. ▪ Toilet facilities shall be appropriately sited away from any nearby watercourses, ensuring they are at least 30 m from such areas. ▪ Regular inspections and audits shall be conducted to assess on-site hygienic conditions. ▪ Workers shall receive training on best practices for contributing to environmental protection. ▪ Waste disposal shall follow the Environmental Public Health (General Waste Collection) Regulations, utilizing licensed operators regardless of whether the waste is sent off-site or to the public sewer. ▪ Unmanaged discharge of wastewater streams is prohibited.	▪ Construct a berm or similar structure at the upstream end of the tributary of natural stream D1 and earth drain D14 before commencing construction work (e.g., backfilling) ▪ Complete the drain diversion construction before linking it to naturalised stream D7. ▪ Use silt curtains or similar measures when connecting naturalised stream D7 to the drain diversion. ▪ All exposed or erodible surfaces shall be covered as soon as possible once work is finished or at the onset of heavy rain, necessitating that tarpaulins or other impervious materials be readily available next to exposed soil.		

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
	▪ The principles of reducing, reusing, and recycling shall be applied to on-site wastewater management. ▪ Regular audits of environmental management procedures will be conducted on-site. ▪ No hazardous liquids shall be directed to the detention pond or tank. ▪ Hazardous wastewater, including oily water, thinners, solvents, or paints, shall be stored on a hardstand, sheltered, and surrounded by a curb. This wastewater shall be treated and disposed of off-site by an approved Waste Management Contractor, with all hazardous liquids handled as Hazardous Waste. ▪ Containment ponds and kerbs shall be made of impervious material and designed to handle the volumes of wastewater generated on-site, including potential fire-fighting water runoff. ▪ ECM tanks and ponds shall be sized adequately to store turbid stormwater before treatment at the ECM treatment facility. ▪ Temporary storage capacities shall be established to manage overflow situations involving untreated wastewater. This temporary storage shall be large enough to accommodate any anticipated excess volumes and to ensure that untreated wastewater is not discharged into watercourses unless it meets Singapore's NEA Guidelines for trade effluent discharge concentrations. ▪ ECO shall be responsible for overseeing the proper functioning of the containment pond and kerbs while adhering to 'Good Housekeeping' practices. This area shall be meticulously maintained to prevent spills, leaks, and odour concerns, with daily inspections of the containment pond/kerbs to verify their functionality. ▪ Daily logs shall be kept to document the volumes of wastewater, sludge, and other waste produced. ▪ The Contractor must obtain approval from the relevant authorities (i.e., PUB and NEA) in accordance with PUB Sewerage and Drainage (Trade Effluent) Regulations for discharging wastewater into the public sewer or for compliance with NEA's Trade Effluent Discharge Limits if the treated trade effluent will be disposed of into surface watercourses. If approvals are not granted, the trade effluent will need to be stored, treated, or recycled on site before being disposed of off-site. ▪ The Contractor shall seek feedback and approval from the authorities (e.g., SCDF and NEA) regarding the use of treated wastewater for firefighting purposes. ▪ Discharging pumped dewatered groundwater or other wastewater into sensitive aquatic habitats is strictly prohibited. ▪ Effluent from tunnel washing shall be directed to containment ponds/kerbs, from which it will be manually collected by a contracted private wastewater collector for transfer to a treatment plant. ▪ Containment ponds/kerbs and areas generating wastewater on-site shall be equipped with spill clean-up kits. ▪ Comprehensive drainage systems, including cut-off drains, sump pits, road kerbs, piping, and toe walls, shall be designed to separately channel construction wastewater (e.g., from concrete batching or wash water) and stormwater runoff for capture and treatment in the containment ponds/kerbs. Where necessary (e.g., near liquid storage or refuelling zones), this infrastructure shall feature oil-water separators to manage any spills or leaks of oils or greases. ▪ The CEMMP shall incorporate Standard Operating Procedures (SOPs), an ERP, an inventory of wastewater streams, staff training, and a schedule for inspections, maintenance, and audits; ▪ Comprehensive development of Wastewater Management Procedures that detail management and monitoring practices for the effective operation of containment ponds/kerbs or other wastewater discharge points/equipment.			

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
	▪ Regular inspection and maintenance procedures shall be established for wastewater collection, storage, and treatment infrastructure, including pipes, oil-water separators, and silt screens. ▪ A training program shall be developed for all on-site personnel, including Subcontractors, focusing on their responsibilities for maintaining proper water quality management. ▪ SOPs for the safe handling, transfer, storage, and disposal of solid waste shall be created. ▪ Effective ECM and monitoring shall be implemented, as recommended in the Code of Practice on Surface Water Drainage, to ensure that discharges into the stormwater drainage system do not exceed the prescribed TSS limits outlined in the Sewerage and Drainage (Surface Water Drainage) Regulations. ▪ ECM measures encompass a range of strategies, including minimizing the exposure of bare soil, covering all bare or erodible surfaces, ensuring slope stability, installing concrete cut-off drains, setting up silt fences or traps along perimeter cut-off drains, and using turbidity curtains for activities near watercourses. ▪ The use of CCTV, including SIDS, will be implemented at public drains to monitor surface runoff discharges from construction sites, in accordance with the PUB's guidelines on Preventing Muddy Waters from Construction Sites (October 2015). ▪ Enclosed bins and waste disposal facilities will be provided and emptied as needed to prevent waste accumulation, with daily housekeeping checks to ensure all litter is removed from the site. ▪ Hazardous materials and toxic waste shall be stored on a hard surface, under shelter, and surrounded by a curb to contain any spills. ▪ All waste shall be disposed of at designated waste disposal facilities, where trained personnel will sort and label different types of waste (including reusable, recyclable, toxic, and non-toxic). ▪ Surface Water Drainage plans must be approved by a QECP and submitted to PUB. ▪ The ECM plan should be put into action before commencing any construction activities. ▪ Manholes shall always be properly covered and temporarily sealed. ▪ Stockpiles shall be protected with erosion blankets, and demolition and earthworks shall be scheduled appropriately to minimize the amount of stockpiled materials on-site. ▪ Temporary or open storage of excavated materials shall also be covered. ▪ All vehicles shall pass through a wheel washing process before leaving the site to prevent dirt, mud, and debris from being deposited on roadways; any wastewater generated during this process shall be collected and disposed of off-site by an approved Waste Management Contractor.			
Soil and Groundwater				
▪ Imported and excavated soil/stockpile ▪ Extracted groundwater ▪ Generation of runoff and potential contamination ▪ Chemical substances ▪ Household waste ▪ Wastewater from construction activities	▪ Identify all forms of solid waste and establish a thorough waste management system at the site to ensure proper disposal and mitigate environmental pollution. The Contractor shall carry out a construction risk assessment and develop a detailed health, safety, and environment plan for construction. If there are anticipated health risks to workers from handling such waste, appropriate precautionary measures, in accordance with the safety data sheet (SDS), including the provision of personal protective equipment, must be implemented on site. ▪ Following the receipt of results indicating that tested parameters (chemicals, heavy metals) exceed regulatory limits, the Contractor shall further evaluate the potential	▪ Utilise approved materials for backfilling that are of equal or better quality than the surrounding area. All backfill material shall be free of debris and consist of suitable soil. ▪ Handle excavated soils and identify potential contamination areas. If a site is identified as a Potential Area of Contamination (PAC), the soils shall be tested for exceedances in defined intervention values (DIVs). If these tests reveal exceedances, the soils can be either disposed of by toxic waste collectors or undergo treatment. Soils that have been treated to meet acceptable standards, such as	▪ Continuous monitoring	▪ Contractor

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
▪ Solid waste ▪ Leaks or spills from construction machinery and vehicles	inhalation and dermal contact risks associated with these exceeded parameters for site workers exposed to areas with identified soil and/or groundwater contamination. This risk assessment shall be conducted prior to the commencement of construction, with the findings incorporated into the Contractor's construction risk assessment, and health, safety and environment plan. Should health risks to workers be anticipated, precautionary measures as outlined in the respective chemical SDS, shall be enforced on site. ▪ A site management plan ought to encompass protocols for the safe handling, transfer, and storage of excavated soils. ▪ Bentonite slurry utilised in the Tunnel Boring Machine (TBM) will be directed to the slurry treatment plant for recycling, cleaning, and removal of native cut materials. The treatment processes at the slurry treatment plant will include de-sanding (e.g., using cyclones) and filtration. ▪ All categories of toxic chemical waste shall be identified, and a comprehensive waste management system shall be established on-site to ensure proper disposal and prevent environmental contamination. ▪ Dispose of all construction debris (falling under the category of construction and demolition waste) at designated Government dumping grounds or at other locations as directed by the NEA. ▪ Be aware that ECM are intended for the containment and treatment of silty discharges resulting from rainwater and are not designed for the treatment of wastewater from construction activities (such as pipe-jacking and bore-piling), which must be treated in accordance with current legislative requirements. ▪ Wastewater resulting from construction activities shall be stored and removed for off-site treatment and disposal by an approved Waste Management Contractor. ▪ Remove any hazardous substances or chemicals if safer alternatives are available. ▪ Ensure all hazardous substance and chemical containers are clearly labelled, returning them to designated storage areas when not in use. ▪ Review the SDS for all hazardous substances and chemicals prior to their entry on-site to assess their suitability concerning safety, health, and environmental hazards, while also considering safer alternatives. ▪ Ensure that no trade effluent, apart from that of a type or nature approved by the NEA Director-General, is discharged into any watercourse or onto land. ▪ Ensure that all activities related to repair, servicing, engine overhauls, and similar operations are conducted in an adequately contained area (for instance, a concreted space with proper containment and sumps), and all waste should be directed for suitable treatment or disposal in accordance with regulations.	the DIV, can be disposed of at the staging ground or through a general waste collector, depending on contaminant levels determined during staging ground testing. ▪ The discharge of extracted groundwater must be directed to a location approved for disposal by the NEA. It is advisable for the Contractor to remain attentive to site conditions and conduct regular tests on extracted groundwater, particularly if it exhibits oily sheens or noticeable odours. ▪ Prior to site entry, inspect all equipment for issues such as fuel/hydraulic line leaks, leaking tanks, and other potentially faulty components that may result in contamination of soil or groundwater. ▪ Store all toxic chemical waste under shelter within concrete bund walls or in well-ventilated storage containers. Spill trays should be supplied for all waste containers and maintained regularly to prevent rain from leaching out pollutants.		
Air Quality				
▪ Dust disturbances from construction activities and gaseous emissions produced by construction machinery and vehicles.	▪ The construction area must be enclosed with hoardings on all sides. ▪ A concrete batching plant is not permitted on-site. ▪ It is advisable to finish and pave the access road or expansion before starting any other development activities.	The following are general mitigation measures to be implemented by the Contractor during construction: **Communication** ▪ Display the name and contact information of the individual(s) responsible for handling air quality and dust concerns at the site boundary. This may be the environmental manager/engineer or site manager. ▪ Develop and implement an Air Pollution Control Plan (APCP). **Site Management**	▪ One-week monitoring prior to site clearance ▪ Monthly during construction ▪ Continuous monitoring	▪ Contractor ▪ Contractor ▪ Contractor

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
		■ Document all complaints related to dust and air quality, identify the causes, take timely action to minimize emissions, and record the measures implemented. ■ Provide access to the complaints log to local authorities upon request. ■ Log any unusual incidents that cause dust and/or air emissions, whether on-site or off-site, along with the actions taken to address the situation. ■ Hold coordination meetings with other high-risk construction sites within 500 m of the site boundary, if applicable, to ensure aligned plans and minimised dust and particulate emissions. **Monitoring** ■ Conduct regular inspections (daily is recommended) both on-site and off-site, and record the findings. Inspections shall include regular checks for dust soiling on surfaces such as street furniture, vehicles, and windowsills within 100 m of the site boundary, with cleaning provided as necessary. ■ Perform routine site inspections to monitor adherence to the APCP. ■ Increase the frequency of inspections during extended dry or windy conditions. ■ Monitor PM_{10} and $PM_{2.5}$ levels at the proposed locations. **Site Preparation and Maintenance** ■ Organise the site layout to position machinery and dust-generating activities away from sensitive receptors whenever possible. ■ Install hoarding around activities that generate dust and at the site boundary wherever feasible. Boundary screens shall be at least as tall as any stockpiles or sources of dust emissions on-site. ■ Completely enclose specific activities with a high potential for dust generation, especially if these areas will be active for an extended duration. ■ Keep site hoarding, barriers, and scaffolding clean by regularly using wet cleaning methods (dry cleaning may lead to the release of fugitive dust). ■ Remove any materials that could generate dust from the site as quickly as possible, unless they are to be reused on-site. If materials are being reused, they should be covered, seeded, fenced, or enclosed to prevent the creation of fugitive dust. **Operating Vehicles/Machinery and Sustainable Travel** ■ Establish and display a maximum speed limit of 25 km/h on paved haul roads and 15 km/h on unpaved roads and work areas. ■ Develop a Construction Logistics Plan to oversee the sustainable delivery of goods and materials. ■ Ensure that all vehicles and engine-powered equipment adhere to Singapore's legislative requirements.		

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
		▪ Require all vehicles and equipment to turn off their engines while stationary to prevent idling. Clear signs shall be placed at the entrance to inform visitors. ▪ When feasible, refrain from using diesel or petrol generators and instead utilise mains electricity or battery-operated equipment. **Construction** ▪ Utilise cutting, grinding, or sawing tools equipped with appropriate dust suppression methods, such as water sprays or local extraction systems. ▪ Ensure there is a sufficient water supply on-site for effective dust and particulate matter control, using non-potable water when suitable. ▪ Employ enclosed chutes and conveyors, as well as covered skips, whenever possible. ▪ Limit drop heights from conveyors, loading shovels, hoppers, and other handling equipment, and apply fine water sprays on these tools as needed. ▪ Implement a strict “Clean as you go” policy to prevent loose dry materials from being left exposed when not in use. Cleaning equipment shall be readily available on-site to address spills, and cleanup shall occur as soon as feasible using wet cleaning methods. **Waste Management** ▪ Avoid the burning of waste or other materials.		
		Mitigation Measures for Earthworks ▪ Implement closed turfing in exposed areas whenever feasible and ensure proper storage of soil stockpiles to stabilize surfaces promptly. ▪ Use Hessian, mulches, or soil tackifiers in situations where revegetation or topsoil application is not possible, as soon as practical. Soil erosion blankets can also be utilised as an alternative. ▪ Remove the cover only in designated working areas, rather than removing it all at once.	▪ Monthly during construction	▪ Contractor
		Mitigation Measures for Construction ▪ Refrain from scabbling (roughening of concrete surfaces) whenever possible. ▪ Ensure that sand and other aggregates are kept in bunded areas and do not dry out, unless necessary for a specific process. ▪ Ensure that bulk cement and other fine powdered materials are delivered in enclosed tankers and stored in silos equipped with suitable emission control systems to prevent material spillage and overfilling during delivery. ▪ For smaller quantities of fine powder materials, make sure that bags are sealed after use and stored properly to avoid dust release.	▪ Monthly during construction	▪ Contractor

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
		Mitigation Measures for Trackout ▪ Utilize water-assisted dust sweepers on access roads and nearby local roads to remove any materials tracked out from the site as needed. This may necessitate the continuous operation of the sweeper. ▪ Refrain from dry sweeping over large areas. ▪ Ensure that vehicles entering and exiting the site are adequately covered to prevent material loss during transport. ▪ Regularly inspect on-site haul routes for any damage and promptly initiate necessary repairs to the surface. ▪ Document all haul route inspections and any resulting actions in a site logbook. ▪ Set up hard-surfaced haul routes that are routinely dampened with either fixed or mobile sprinkler systems or mobile water bowsers, and maintain them through regular cleaning. ▪ Establish a wheel washing system that includes rumble grids designed to dislodge accumulated dust and mud before vehicles leave the site. ▪ Ensure there is a sufficient stretch of hard-surfaced road between the wheel washing facility and the site exit, based on site size and layout constraints. ▪ Position site access gates at least 10 m away from sensitive receptors whenever possible.	▪ Monthly during construction	▪ Contractor
Airborne Noise				
▪ Noise generated by construction machinery and equipment, particularly from rotational and vibratory devices such as dozers, cranes, excavators, trailers, generators, and others.	▪ Activities shall be scheduled to avoid breeding seasons and to minimize noisy operations between 7 am and 9 am whenever possible, as this can help reduce disturbances to the wildlife's behaviour and communication. ▪ Intermittently used machines, such as trucks, shall be shut off during breaks or operated at a minimum throttle. ▪ Only well-maintained construction equipment shall be used on-site, with regular servicing throughout the construction period. ▪ The number of plant machinery equipment (PMEs) shall be limited as much as feasible when working near noise-sensitive locations. ▪ Silencers or mufflers shall be installed on construction machinery and maintained properly during the project. ▪ Workers shall maintain quiet conduct by refraining from shouting, using loud radios, dropping materials from heights, or throwing metal objects. ▪ For construction respite, high-noise drilling activities shall be limited to three-hour continuous sessions, followed by a minimum one-hour break, if possible. ▪ An independent third party shall conduct periodic noise monitoring to ensure compliance with regulations and to provide advice on noisy equipment and potential additional mitigation strategies. ▪ Night work, excluding approved activities or site clearance, shall be prohibited after 6 pm to minimize disturbances to nocturnal wildlife. ▪ The site layout shall install noise barriers. ▪ Construction machinery that emits directional noise shall be oriented, whenever feasible, to direct sound away from nearby NSRs.	▪ Control noise sources directly at the construction site by analysing the construction inventory list and identifying equipment that generates high noise levels. Prioritize the use of equipment that produces lower noise levels. ▪ When it is not possible to control noise at the source, implement acoustic enclosures or sheds to reduce noise emission. An effective acoustic enclosure will cover the machinery as completely as possible (with or without ventilation, as appropriate) to provide sound insulation. ▪ Consider using buildings of varying heights, with shorter structures placed near noise-sensitive areas to lessen the duration of noise impacts. ▪ Avoid situating access routes close to or directly facing NSRs to minimise sound leakage along the worksite boundaries and to prevent increased noise from road traffic due to a potential rise in heavy-duty vehicle (HDV) traffic. ▪ Noise barriers shall be installed at the construction perimeter facing NSRs or residential areas, guided by noise modelling and the management plan provided for contract-specific objectives.	▪ One-week monitoring prior to site clearance ▪ Monthly during construction ▪ Continuous monitoring	▪ Contrator ▪ Contractor ▪ Contractor

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
	▪ All handheld percussive tools and air compressors used on-site shall comply with local laws and regulations. ▪ Personnel operating the plant or equipment shall use appropriate hearing protection that reduces sound exposure to levels below 85 dB (A). Signs will be displayed in noisy work areas to remind staff to wear hearing protection. Options for hearing protection include earplugs for sound levels below 100 dB (A), earmuffs for levels between 100 dB (A) and 120 dB (A), and a combination of earplugs and earmuffs for levels above 120 dB (A). ▪ Regular noise awareness training shall be held to emphasize noise mitigation strategies, including machinery placement, the use of portable noise barriers, and guidelines for nighttime machinery use. ▪ If noise issues persist despite implementing recommended measures such as noise barriers, the Contractor shall explore the use of proprietary high-performance noise barriers to further mitigate noise to acceptable levels.			
Vector Control				
▪ Build-up of stagnant water ▪ Inadequate housekeeping practices ▪ Incorrect management or disposal of solid waste (particularly food waste)	▪ Comply with the Control of Vector and Pesticide Act (CVPA) and maintain proper housekeeping on-site. ▪ Develop and implement an effective vector control plan and measures in accordance with NEA's Code of Practice for Environmental Control Officers. ▪ Ensure that water-holding containers, gaps in the ground and equipment (such as openings in concrete barriers), as well as stockpiled areas are covered or sheltered, particularly during the northeast monsoon season from November to January. ▪ The site entrance shall be paved to prevent ground depression. ▪ Recycled waste can be utilized to level the ground prior to placing steel plates. ▪ After clearing trees, ensure that tree stumps are either thoroughly removed or effectively patched. ▪ Install a pitched roof on top of site container offices or seal the bottom to prevent water ingress. ▪ A pipette can be used for checking larvae in unreachable parts of trees. ▪ Thermal fogging is not recommended on-site due to its proximity to areas of high ecological value. Instead, focus on preventive methods such as regular inspections and maintaining good housekeeping practices to ensure that mosquito breeding does not occur on-site.	▪ Conduct daily housekeeping to remove stagnant water and ensure that unwanted items are disposed of correctly. ▪ Install a movable roof over shafts to prevent rainwater from entering ▪ Use pumps to remove water in areas where drainage is not feasible, as well as on larger recessed surfaces. ▪ Designate specific areas for food disposal, ensuring it is done daily to deter rodents from nesting on-site and to avoid infestations of cockroaches and flies. ▪ Store food in rodent-proof containers or cabinets with a clearance of at least 60 cm from the ground.	▪ Continuous monitoring	▪ Contractor

7.2 Post-construction Phase

The management actions and monitoring actions for works during the construction phase where applicable and practicable are shown in the Environmental Impact and Mitigation Registry table below (Table 7-2).

Table 7-2 Summary Table of EMMP Measures Post-construction

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
Biodiversity				
▪ Impacts on flora and vegetation	▪ NIL	▪ Determine areas that are negatively impacted by operational activities. ▪ Ensure that post-construction planting is thriving in relation to the surrounding developments.	▪ Monthly for 12 consecutive months of operational period	▪ Contractor
	▪ NIL	▪ Maintain the integrity of the neighbouring forest (if applicable). ▪ Look for indications of edge effects on the new forest boundary of the adjacent forest (if applicable).		
▪ Impacts on fauna	Ensure that the minimum water quality management actions outlined in the next section – Hydrology and Surface Water Quality are followed.	▪ Evaluation of habitat quality (e.g., water quality, excessive vegetation clearing). ▪ Check for trapped, injured, or dead wildlife, as well as potential entrapments and any gaps in site hoarding. ▪ Document the frequency of human-wildlife conflicts. ▪ Perform a biodiversity survey to assess the effects of construction on wildlife activity and presence.		
Hydrology and Surface Water Quality				
▪ Stormwater runoff and contamination ▪ Unmanaged liquid and solid waste	▪ Establish procedures for the inspection and maintenance of stormwater collection, storage, and treatment systems, including pipes, oil-water separators, silt screens, and so forth. ▪ Implement regular protocols for managing stormwater collection, settling, testing, and the eventual discharge of 'clean' water into surface waters. This shall also involve measures to prevent the drainage of stormwater with high sediment concentrations into surface waters. ▪ The potential increase in peak flow resulting from changes in land use at new developments can be mitigated by incorporating detention ponds within the Project Site. These ponds can accumulate stormwater during heavy rainfall events to help reduce peak runoff. The retained water can then be released back into the system after the storm. As per PUB requirements, the storage system shall ensure that peak flow during operation is equal to or less than the current condition. ▪ Consider increasing the amount of soft landscape in the development design to lower the runoff coefficient, which will help decrease peak flow and minimise flood risk in downstream areas. ▪ Introduce more permeable surfaces to enhance the infiltration of surface water into the soil. ▪ The geotechnical aspects concerning the stability of the site's slopes (such as ERSS) shall be incorporated into the detailed design engineering for the operational phase. ▪ Ensure adequate disposal bins are provided around the Project site to prevent improper waste disposal.	▪ Divert clean water into preserved ecologically sensitive watercourses or bodies experiencing considerable catchment loss (such as pond D4, naturalized stream D7, and earth drain D14) to enhance the flow in these areas.	▪ Monthly during the first three (3) months of operational period	▪ Contractor

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
	▪ Conduct regular inspections of the waste storage system associated with the Project. ▪ Regular CCTV monitoring of the proposed water features and its surroundings shall be implemented to ensure that no contamination occurs. ▪ Create an ERP and provide sufficient training for maintenance workers to manage accidental water contamination. ▪ Enhance awareness among various stakeholders through initiatives (such as signage and warning signs).			
Soil and Groundwater				
▪ An increase in impervious surfaces within the new development results in reduced infiltration of surface water and stormwater into the soil.	▪ Include a greater number of permeable surfaces in the development design.	▪ No additional mitigation measures required.	▪ Not Applicable.	▪ Not Applicable.
▪ Intense rainfall and stormwater runoff can carry pollutants that have accumulated in the new development area, which can then be released into the adjacent soil and groundwater. ▪ Runoff or leaks of waste and chemicals into the soil.	▪ Ensure that no trade effluent, except for that of a type approved by the NEA Director-General, is discharged into any watercourse or onto land. ▪ Store all toxic chemical waste and hazardous substances (if any) in a designated sheltered area with access control and concrete bund walls, or in well-ventilated containers. Spill trays shall be provided for all chemical drums and potentially harmful substances, and these trays shall be regularly maintained to prevent rain from washing away pollutants. ▪ Arrange for the disposal of all toxic chemical waste (if any) through licensed Toxic Industrial Waste (TIW) collectors for proper treatment. ▪ Ensure all hazardous chemicals/substances are properly labelled and return them to designated storage areas when not in use. ▪ Conduct all activities, including repairs, servicing, and engine overhauls that involve hazardous chemicals/substances, in an appropriately contained area (e.g., a concreted space with proper containment and sumps). ▪ Provide emergency spill kits on-site in case of any chemical spills, and ensure that the ERT is trained in the use of these kits.	▪ No additional mitigation measures required.	▪ Continuous monitoring	▪ Contractor
Air Quality				
▪ Impact on air quality resulting from dust nuisance and emissions from vehicle exhaust due to heightened traffic volume.	▪ It is assumed that there will be no minimum level of control in place.	▪ No additional mitigation measures required.	▪ Not Applicable.	▪ Not Applicable.
Airborne Noise				
▪ Noise generated by air conditioning and mechanical ventilation (ACMV), as well as noise from traffic.	**Minimum Controls for ACMV Noise** ▪ A Noise Consultant shall assess the noise levels in line with the NEA's Technical Guidelines on Boundary Noise Limits for ACMV Systems in Non-Industrial Buildings. ▪ Utilize low-noise ACMV equipment. ▪ Ensure that any exhaust outlets or intakes from the mechanical ventilation system are positioned as far back from the development's boundary line as possible. ▪ Design and implement any needed acoustic treatments. ▪ Ensure that the AC system is designed with Air Handling Unit (AHU) units located as far back from the boundary line as feasible. ▪ Install acoustic enclosures for outdoor equipment.	**Mitigation Measures for ACMV Noise** ▪ Noise attenuators and other Best Available Technology (BAT) and Best Environmental Practice (BEP) measures for noise control should be implemented. ▪ Sufficient setbacks for developments with ACMV systems shall be established in front of NSRs, incorporating features like park areas to ensure that operational noise sources are located at a safe distance from these receptors. **Mitigation Measures for Traffic Noise** ▪ Traffic noise at drop-off zones and parking lots will be reduced by implementing low speed limits, speed bumps, and speed limit signage. These speed control measures are expected to decrease noise levels, as vehicles will be traveling at lower speeds.	▪ Not Applicable.	▪ Not Applicable.

Environmental Issues	Management Actions	Monitoring Actions	Frequency	Responsibility
	Minimum Controls for Traffic Noise ▪ Explore alternative locations for new road networks to minimise proximity to NSRs during the pre-design phase. ▪ Consider using low-noise pavement materials for segments of new road networks situated near NSRs. ▪ Because there is insufficient data at this reporting stage, the appointed Noise Consultant will provide assessments, minimum controls, and mitigation strategies during the preliminary design phase, following the Technical Guidelines for Land Traffic Noise Impact Assessment.	▪ Locate roads in areas that are further away from NSRs.		
Vector Control				
▪ The buildup of stagnant water, inadequate cleanliness, and improper management or disposal of solid waste (particularly food waste).	▪ Comply with the Control of Vector and Pesticide Act (CVPA) and maintain cleanliness on-site within the development boundary. ▪ Conduct weekly inspections for potential breeding sites in areas such as unused containers in open spaces, under bushes, in open and closed drains, gully traps, tree holes, branches' bifurcations, leaf axils of banana trees, Travellers Palms, and other palms, as well as outdoor litter bins. ▪ Apply sand granular insecticides every two weeks to gully traps, depressions around manhole covers, lightning conductor pits, stop-cock pits, valve chambers, and sumps. ▪ Insecticides shall be applied immediately to eliminate any breeding habitats identified during inspections and to remove potential breeding sites (e.g., stagnant water or waste). Accurate records of these incidents shall t be kept after the breeding areas have been addressed. ▪ Avoid thermal fogging due to its closeness to ecologically sensitive areas. Instead, implement preventive measures like regular inspections and maintaining cleanliness to prevent mosquito breeding on-site. Monthly pest control checks shall be carried out at all locations.	▪ No mitigation measures need to be suggested, as the minimum vector control practices recommended by the NEA shall be implemented.	▪ Not Applicable.	▪ Each household or its housing / school / building / public committee and other relevant parties.

8 Environmental Response Plan

This ERP is developed to provide guidance and strategies for the protection of wildlife during wildlife encounter(s) and incident(s). The ERP includes:

- Wildlife Encounter Protocol for specific animals (refer to Section 8.2)
- Wildlife Response Plan (refer to Section 8.3)
- Response Plan for Drainage, Surface Water and Groundwater Incidents (Section 8.4)
- Response Plan for Relevant Air Quality Incidents (Section 8.5)
- Response Plan for Relevant Airborne Noise Incidents (Section 8.6)

8.1 Summary of Emergency Contact for Environmental Incident

Figure 8-1 provides a summary of the emergency contacts for the environmental incident(s):

Table 8-1 Emergency Contacts for Environmental Incident

Incident	Responsible Party	Person-in-charge	Contact
All environment incidents	ECO	TBC	HP: TBC
Encounter of dead animals	CEMMP Consultant	Mr. Shane Chiok	HP: 9362 4611
Encounter of injured animals	CEMMP Consultant	Mr. Shane Chiok	HP: 9362 4611
	Animal Response Centre	TBC	HP: TBC Animal Response Centre Hotline: 1800 476 1600
Fire events	Contractor	TBC	HP: TBC
Chemical/oil spills	Contractor	TBC	HP: TBC
	CEMMP Consultant	Mr. Shane Chiok	HP: 9362 4611

8.2 Wildlife Encounter Protocol for Specific Animals

Figure 8-2 are recommendations to be implemented for encounter of specific animals (live):

Table 8-2 Wildlife Encounter for Specific Animals

Animal Encounter	Procedure
▪ Bird nest ▪ Beehive	▪ Do not start work if there is a bird nest with eggs or chicks and beehive in the immediate vicinity of site clearance. ▪ Keep a safe distance and refrain from disturbing the bird nest/beehive. ▪ Site supervisor to inform CEMMP Consultant for further action.
▪ Wild boars	▪ Be calm and move slowly away from the animal. Do not approach or attempt to feed the animal. ▪ Keep a safe distance, do not provoke the animal (e.g., using flashlight) ▪ If encounter adults with young piglets, leave them alone. They are potentially more dangerous because they may attempt to defend their young. ▪ If the wild boar is running towards you, move out of the way immediately. ▪ Refer Section 8.3 if wild boar is sighted within the Project site.
▪ Macaques	▪ Stop work (only at the immediate vicinity) if monkeys approach during work. ▪ Do not make sudden movements and do not maintain direct eye contact with the monkeys. ▪ If site personnel are holding an object which is attracting the monkeys, conceal or discard it. ▪ Resume work after the monkeys have left.
▪ Snakes	▪ Stop work (only at the immediate vicinity) if a snake is sighted. ▪ Do not attack with any object. ▪ Do not confront the snake and keep a safe distance away from the snake. ▪ The snake may try to look for dark and secure areas and site personnel shall observe where it hides, inform the site supervisor only if the snake is hiding within the immediate vicinity of construction works. ▪ Site supervisor to inform CEMMP Consultant for further action. ▪ If the snake is still in the immediate vicinity of the construction site and disruptive to the work, Contractor shall arrange a licensed wildlife management company to relocate the snake. ▪ If site personnel are bitten by a snake, do not chase after the snake. Take a photo of the snake, if possible, inform site supervisor and seek medical care immediately. ▪ Resume work after the immediate site is cleared of snakes.

Animal Encounter	Procedure
▪ Bats	▪ Where there is bamboo of culm more than 3cm in width to be felled, inspection shall be done to observe for bamboo bats. These bats may roost within the internodes which they enter through a slit visible externally on the bamboo culm. ▪ Manual removal of bamboo culms with a chainsaw or hand saw is preferred and all cuts shall be made as close to the ground as possible. Care shall be taken during vegetation clearance, and no excavator shall be used. The individual bamboo culms shall be lowered in a controlled manner and checked for slits. ▪ Bamboo culms with identified slits will be set aside, under shade, for the duration of bamboo felling. If stalks are too long to be managed, cross sectional cuts can be made as close to the node as possible. ▪ At the end of felling operations, all bamboo culms with slits will be transported to the next nearest bamboo cluster unaffected by ongoing works, identified beforehand and propped against the unaffected bamboo cluster. All slits observed on the bamboo culms shall be placed furthest away from ground level and facing outwards. ▪ If any trapped/injured/dead bats are observed during the bamboo felling operation, an approved wildlife management company (a registry is available at www.nparks.gov.sg/avs/animals/animal-related-businesses/animal-management-companies/public-registry-of-certified-animal-management-specialists) must be engaged to safely relocate or remove the bats from site.
▪ Stray dogs ▪ Stray cats	▪ Do not guide the dog / cat out from the site. ▪ Do not allow the dog / cat to flee from the site. ▪ Supervisor / ECO to call Animal Management Contractor to capture the dogs / cats and surrender to NParks Animal Management Centre (AMC), 57 Sungei Tengah Road , S699013 immediately during operating hours (**https://www.nparks.gov.sg/avs/who-we-are/our-centres/animal-management-centre**). ▪ If the company cannot deliver during AMC's operating hours, they must have a suitable safe and sheltered location to hold the animal. Food and clean drinking water must be provided to the animal. ▪ Supervisor / ECO to inform CEMMP Consultant. ▪ CEMMP Consultant to notify NParks Animal Response at 1800-476-1600 and via online feedback form at **https://www.nparks.gov.sg/avs/feedback**.
▪ Otters and/or crocodiles	▪ Where otters and/or crocodiles are sighted where works are to be carried out (whether at the Site or in the vicinity of the Site), the Contractor must ensure that the works are halted until the animals have passed or are no longer in the vicinity of the Site. Also, the Contractor must ensure that all visitors to the Site, and all consultants, employees and staff (including all construction workers who are working on the Project) are aware of this requirement. ▪ Wildlife must not be disturbed at any time and not interacted with unless in an emergency.
▪ Other animals	▪ Do not be alarmed. ▪ Most animals are shy and will not attack human. ▪ Do not touch, chase or corner them. ▪ Refer Section 8.3 if animal cannot be guided out safely/flee away from the site.

8.3 Wildlife Response Plan

The Wildlife Response Plan will be activated whenever a trapped, injured, dead, or dangerous animal is found in or around the worksite. The main aim of this plan is to reduce animal injury and mortality by responding appropriately to various scenarios as illustrated in Figure 8-1. This will be highlighted during toolbox briefings. All wildlife incidents shall be reported and recorded using a Wildlife Incident Form [Appendix D].

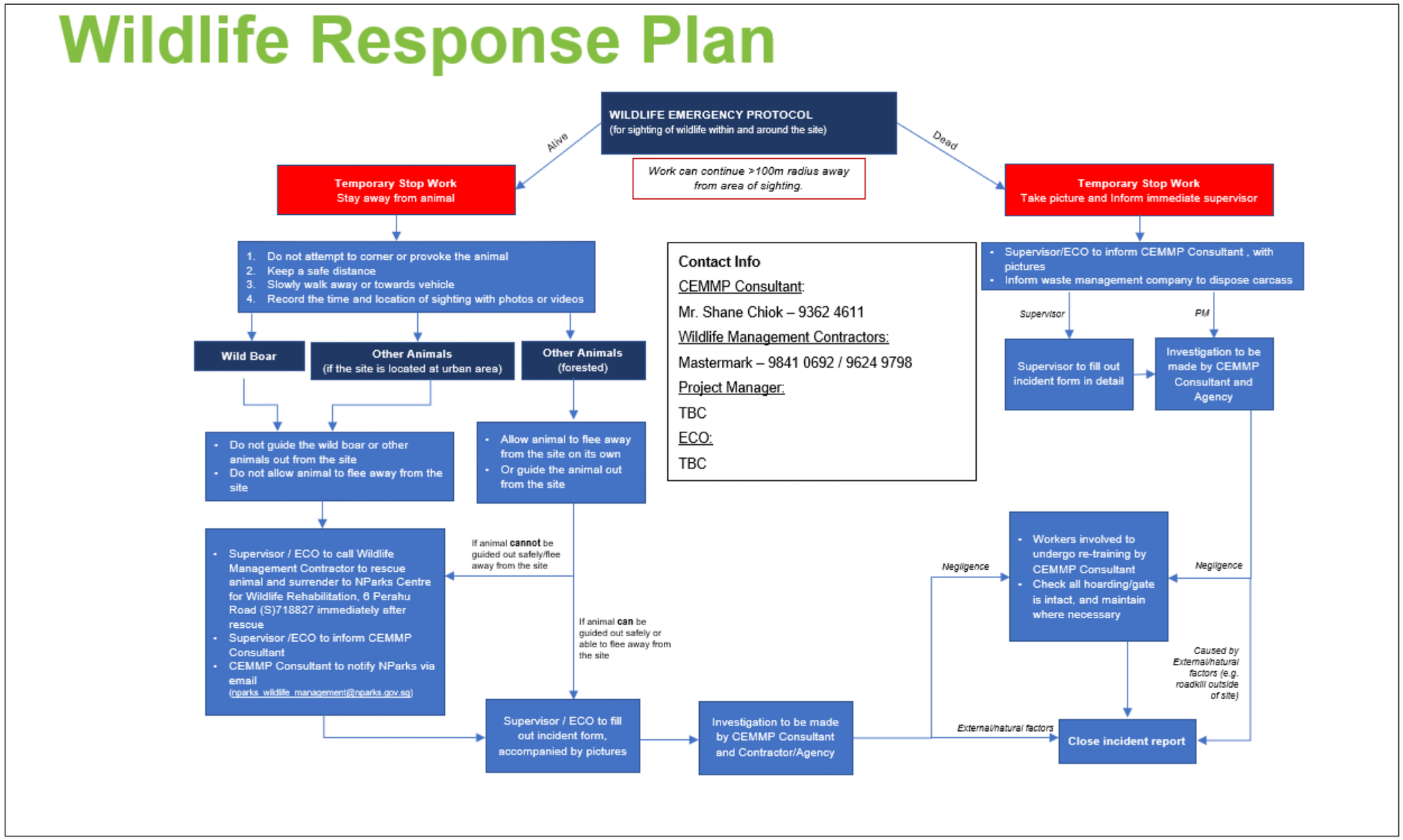


Figure 8-1 Wildlife Response Plan and Flowchart

8.4 Response Plan for Drainage, Surface Water and Groundwater Incidents

The response plan (refer to Figure 8-2) will be initiated when there is any relevant drainage, surface water or groundwater incidents occurred around or within the worksite. All incidents shall be reported and documented in an Environmental Incident Form [Appendix E].

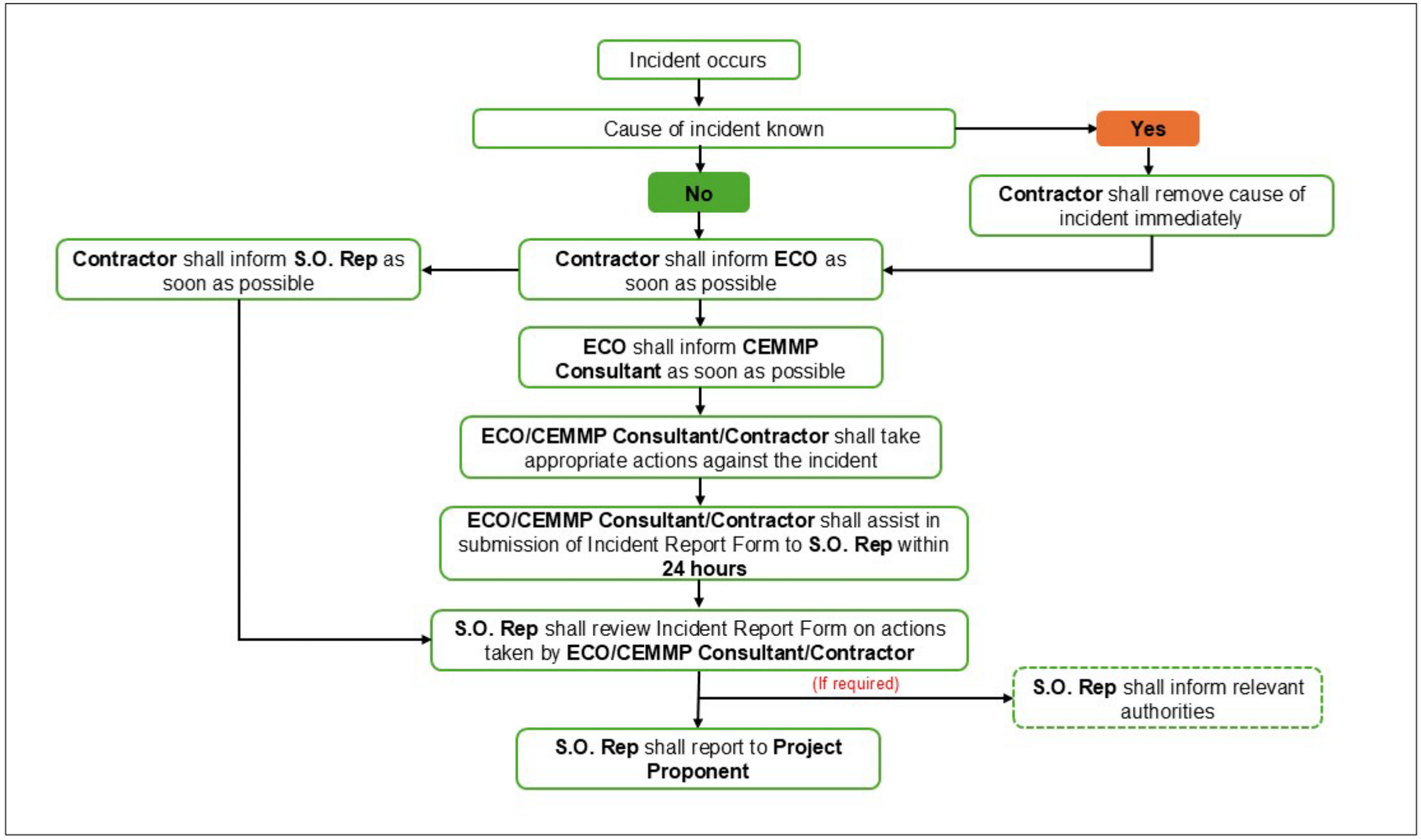


Figure 8-2 Response Plan for Drainage, Surface Water and Groundwater Incidents

8.5 Response Plan for Relevant Air Quality Incidents

If excessive smoke, dust or odour is emitted from the Project site, the Contractor shall follow the procedures as shown in Figure 8-3. All incidents shall be reported and documented in an Environmental Incident Form [Appendix E]. The report shall be submitted to the S.O. Rep by the CEMMP Consultant.

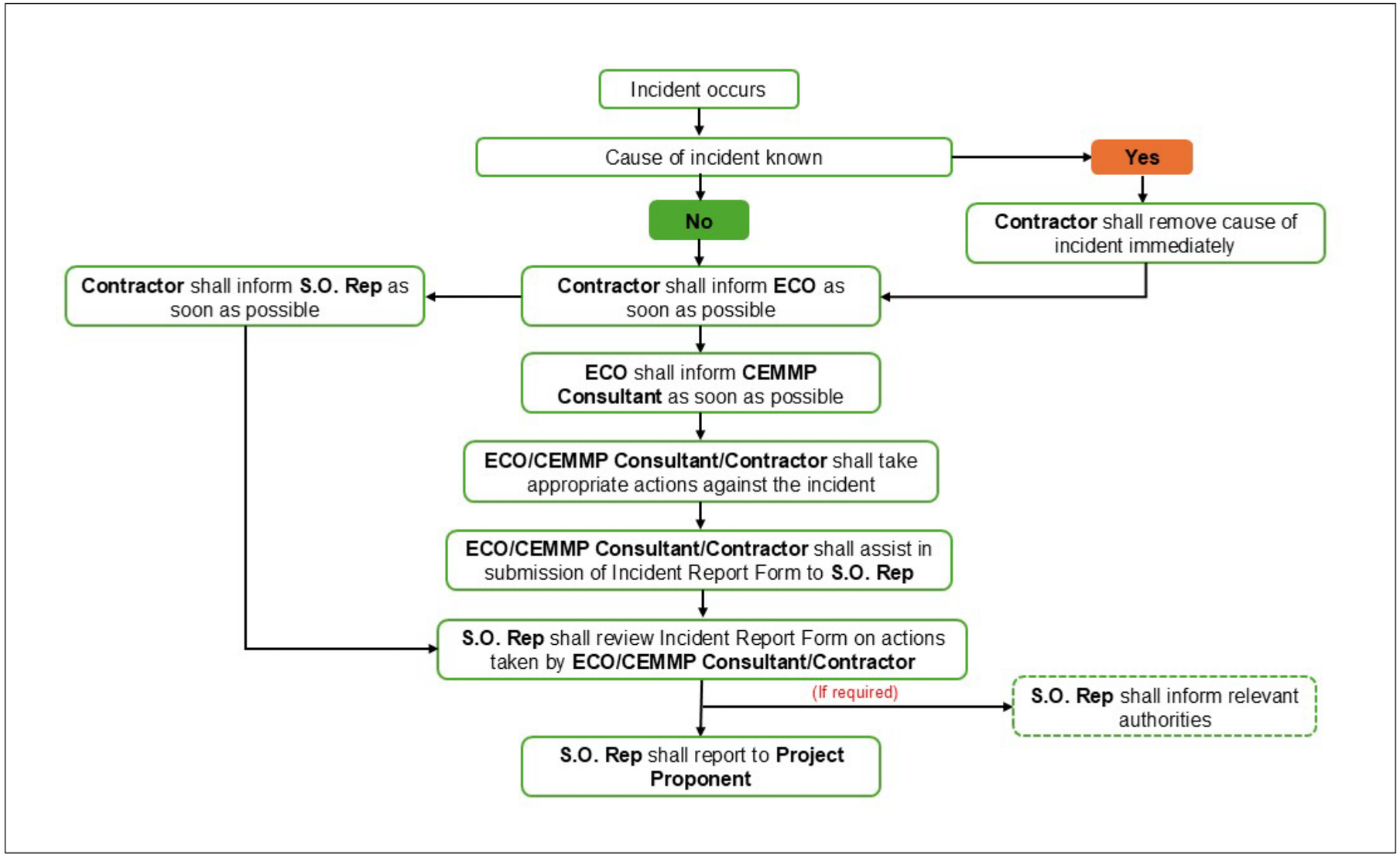


Figure 8-3 Response Plan for Air Quality Incidents

8.6 Response Plan for Relevant Airborne Noise Incidents

If excessive noise levels are detected at the Project site, the Contractor shall follow the procedures as shown in Figure 8-4. All incidents shall be reported and documented in an Environmental Incident Form [Appendix E]. The report shall be submitted to the S.O. Rep by the ECO or CEMMP Consultant.

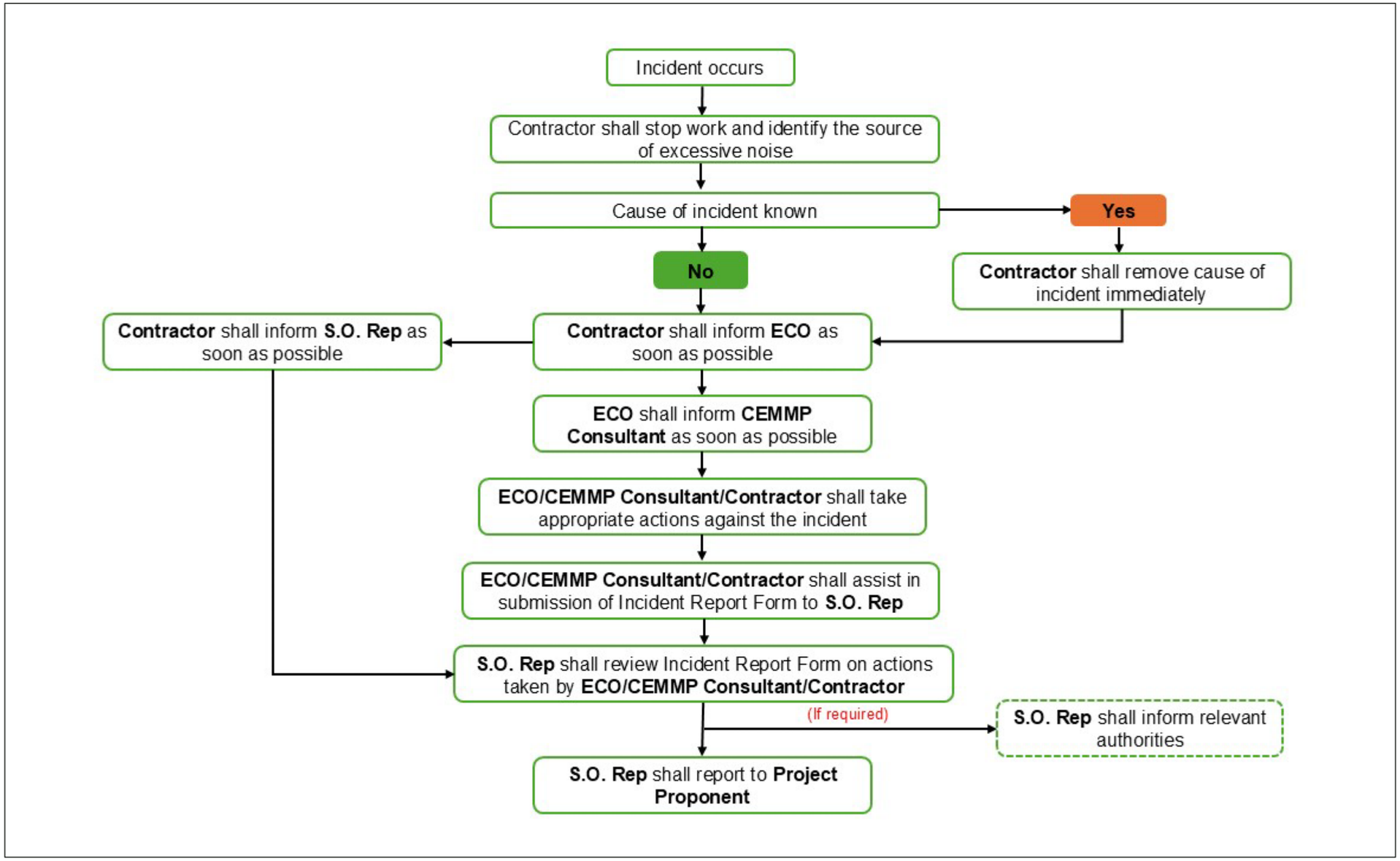


Figure 8-4 Response Plan for Airborne Noise Incidents

9 Reporting and Communication Plans

9.1 Reporting Schedule

As part of the EMMP, routine reports in Table 9-1 will be provided to the Contractor for onward submissions to relevant agencies e.g. HDB and NParks.

Table 9-1 Routine Reporting

S/N	Document / Report	Frequency
1.	Biodiversity Awareness Training	Once prior to start of works Every 6 months upon commencement of works
2.	CEMMP Document	Once at the beginning of the Project (Live document) Addendums/revised version(s) will be provided if required
3.	Pre-felling Inspection Report	Per inspection
4.	CEMMP Implementation Audit and Monitoring Report Monthly inspection of: ■ Wildlife / Fauna mitigation measures ■ Health of retained trees and TPZs ■ On-site visual inspection ■ Compilation of other relevant reports from Contractor (e.g., ECO SECR report, air and noise monitoring data etc.) ■ Documentation of any non-compliance, follow-up actions, and progress of past follow-up actions if unrectified	Monthly (during construction/demolition stage)
5.	Incident Reports	As required
6.	Minutes of Meetings	As required
7.	Environmental Close-off Audit Report	Once at the end of construction

9.2 Communication Plans

- Post the name and contact information of the individuals responsible for managing air quality and noise issues on-site, which may include the environmental manager/engineer or the site manager.
- The Contractor shall engage a Public Relations Officer (PRO) to foster positive relationships with the community and to manage and respond to community complaints.

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Appendices

Appendix A – Wildlife Shepherding Plan

Wildlife Shepherding Plan (Rev 2)

EMMP Specialist Consultancy Services for Central Area

SECS
Member of the Aurecon Group

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Wildlife Shepherding Guidelines (NParks, 2024)

Below are the guidelines* of wildlife shepherding:

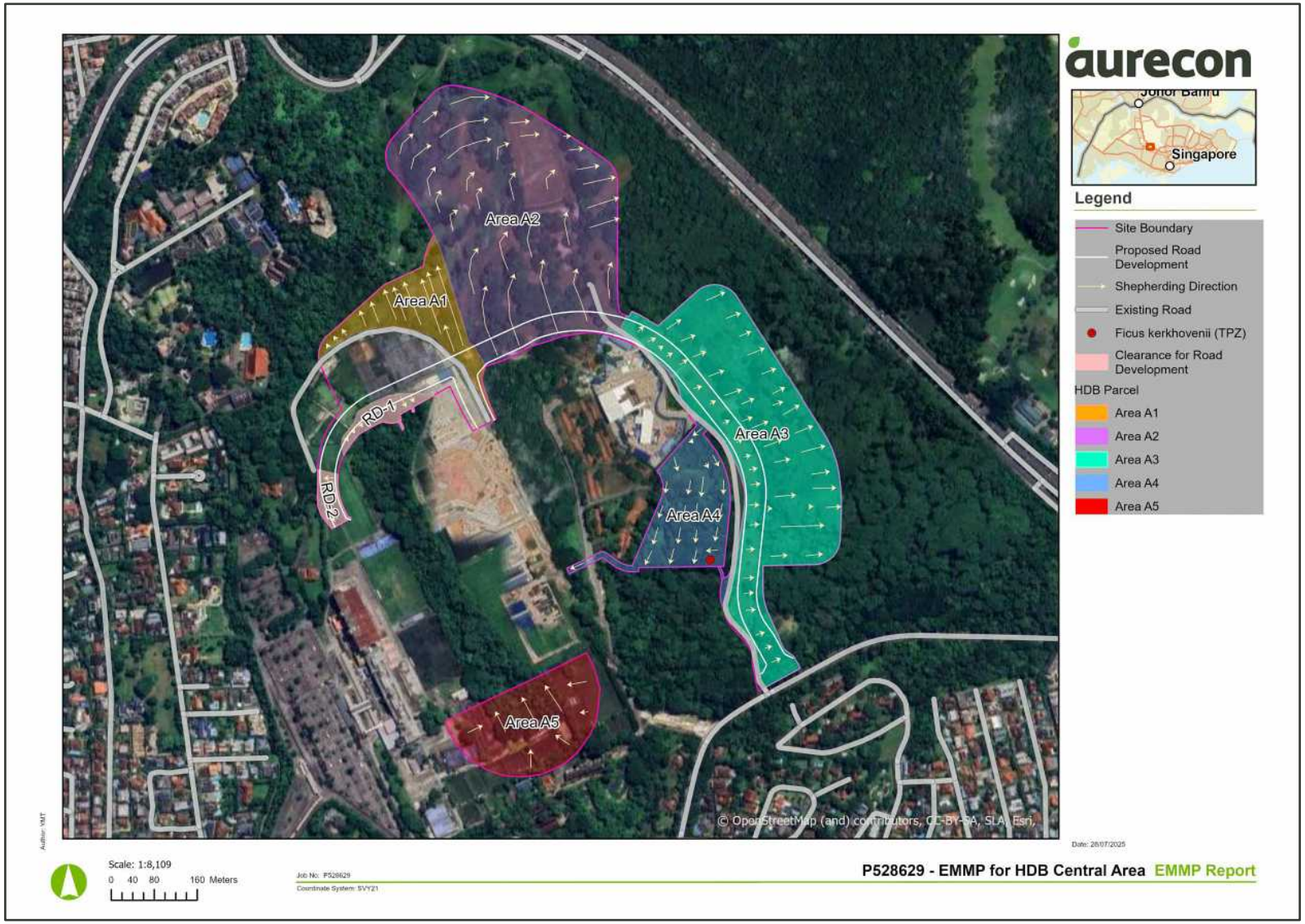
1. Clearance should be phased from the most disturbed area (usually the side nearest to roads or existing developments) towards the **least disturbed area**.
2. An **unobstructed escape route** should be designed to channel wildlife out of the development site.
3. Clearance of the development site can be broken up into **zones**, where each zone is isolated from the next either by natural barriers that prevents animal movement or permanent hoarding structures.
4. Opaque **temporary hoarding** without gaps should be installed for each subzone that is being worked on, leaving the side furthest from the disturbed area open for fauna to exit the site

*Credit: *Technical note on Wildlife shepherding and pre-felling fauna inspection (*NParks, 2024)

Overall Wildlife Shepherding Areas

- Approximate area to be cleared (exclude building area or developed area):
  - Area ‘A1’ – 26,207 m^2
  - Area ‘A2’ - 150,928 m^2
  - Area ‘A3’ – 112,556 m^2
  - Area ‘A4’ - 33,827 m^2
  - Area ‘A5’ – 40,336 m^2
  - Road Development – 10,213 m2

- Area ‘A1’ towards north direction
- Area ‘A2’ towards east direction
- Area ‘A3’ towards east direction
- Area ‘A4’ towards south direction
- Area ‘A5’ towards north direction
- Road development towards south and west directions.
- Each area is divided into subsections of 3,000 m^2 - 4,000 m^2, depending on the terrain and tree density per section.
- Sections with lesser trees or partially developed have bigger clearance area.



Overall Wildlife Shepherding Process

Shepherding is divided into 3 main phases:
- Installation of Hoardings and ECM
- Phased Clearing
- Monitoring

Typical Shepherding timeline is illustrated here.

1. Trainings for the site personnel
2. Installation of hoardings, perimeter drains and clearing for access roads
3. Installation of ECM
4. Undergrowth clearance
5. Tree Felling
6. Closing up of Cleared Area
7. Commencement of Earthworks

*Localised wildlife shepherding is similar to Step 5 and 6

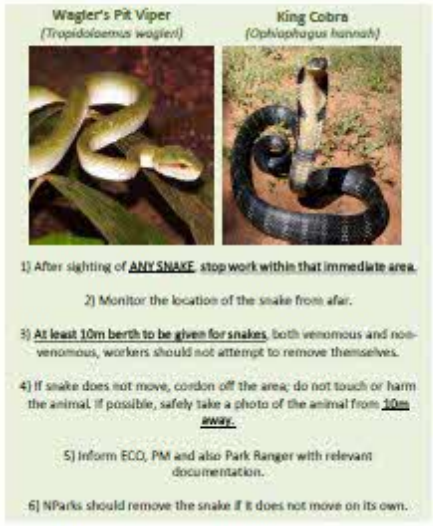
Trainings

Shepherding Steps

Step 1: Trainings

Before the start of shepherding:

- Site personnel should be trained on how to respond when encountering wildlife *(Biodiversity Awareness Training)*
- Site personnel should also be trained on how to conduct wildlife shepherding *(Wildlife Shepherding Training)*
- Training documents should be incorporated into the safety induction course and regular toolbox meeting.



Installation of Hoarding

Shepherding Steps

Step 2: Installation of Hoardings

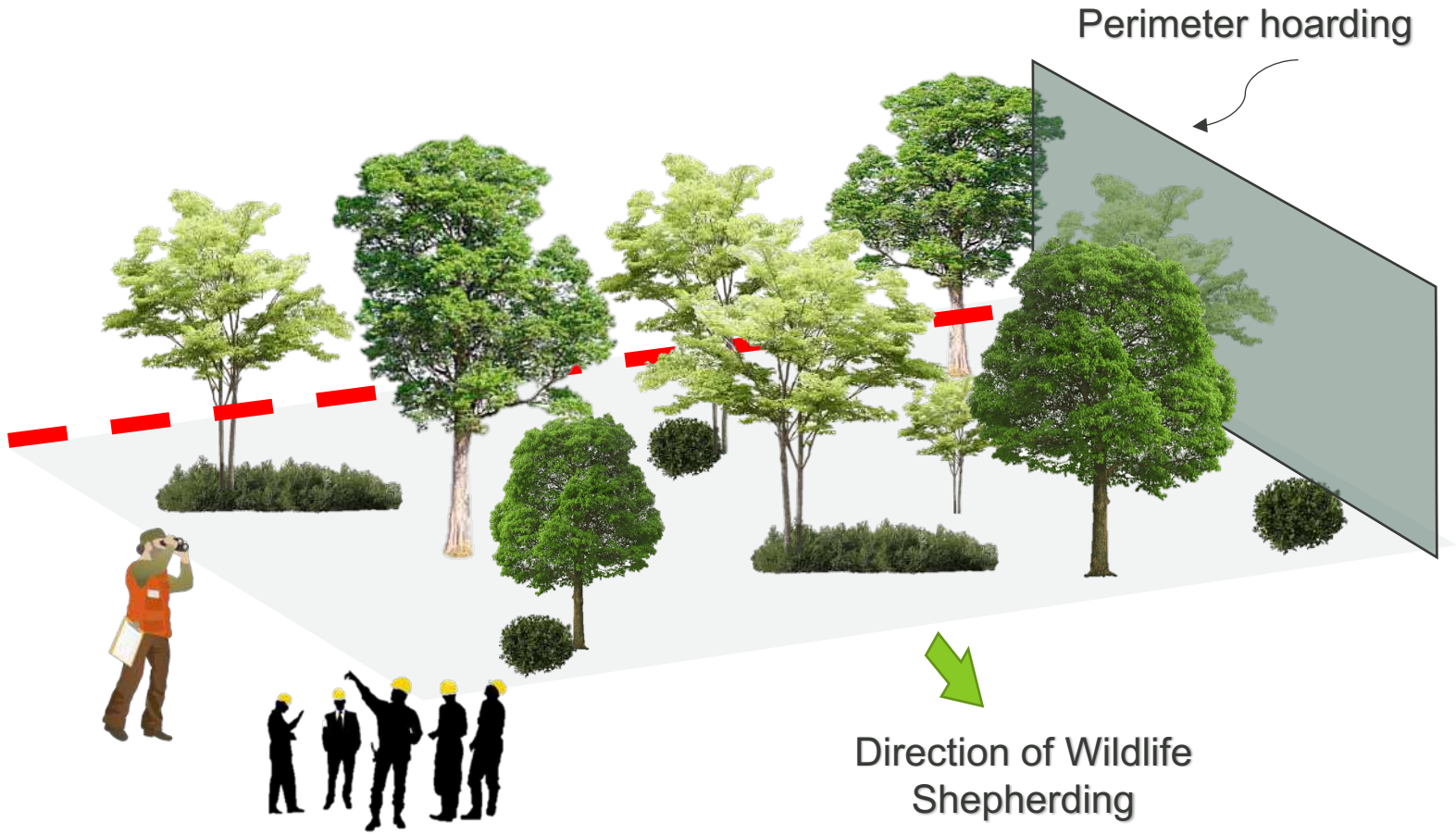
Before the start of shepherding:

- Installation of perimeter hoardings to prevent animals moving towards roads.
- 2 - 4 m working space for the installation of hoardings

Step 3: Installation of ECM

Before the start of shepherding:

- Setting up of Perimeter drain, Silt Fences, and ECM



Installation of Preliminary Hoardings and Speed Calming Measures

The Project boundary at each Area should be hoarded up with preliminary hoarding as per indicated in the map. Hoarding set up should start make use of existing access road.

During shepherding, Contractor should allow an opening on the specific direction (refer slide on shepherding direction) for animal to escape towards the forested area. The perimeter hoardings are positioned at the site boundary.

Perimeter Hoardings:

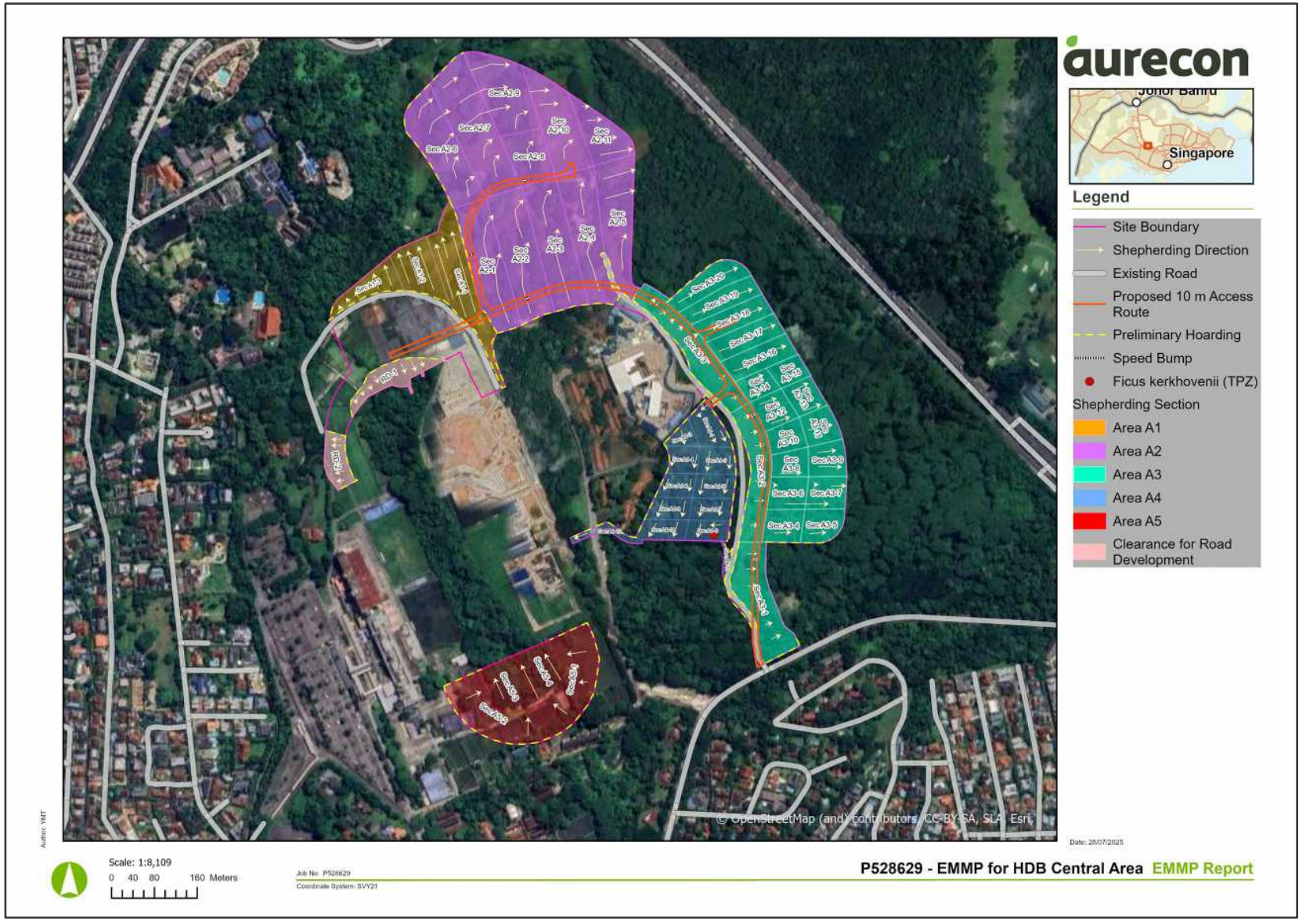
- 2 - 4 m working space, where appropriate
- 1.8 m minimum height
- Smooth edge
- Perimeter drain
- Silt fence
- Embedded 300 mm into the ground

The clearing of 10 m access road should be cleared first, and subsequently installation of preliminary hoardings and ECM should occur before Phased Clearing. In addition, installation of hoardings should also occur before installation of ECM.

A Pre-Felling Check should be carried out for these advance clearings (i.e., 10 m access road, setting up of hoarding and ECM) if there are trees along the proposed hoarding route.

Speed Calming Measures:

- Animal crossing and speed limit signages would be installed to warn drivers to be wary of animal crossing the roads.
- Speed limit of 15km/h along construction access road
- Provide speed bumps along construction access road as per indicated in the map.

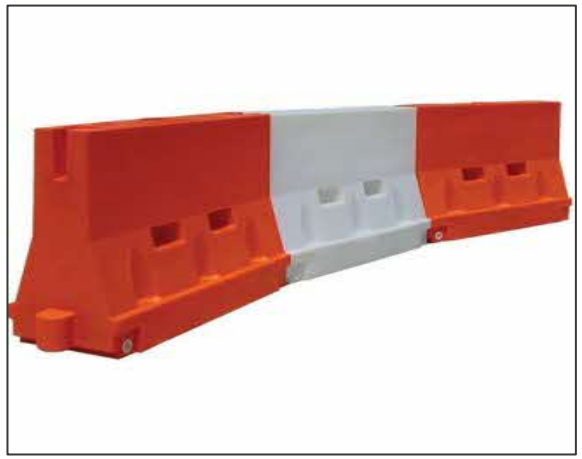


Types of Hoardings

Fixed / Permanent hoarding

- Smooth top edge and silt fence weighted down towards the ground.
- Minimum height of 1.8 m, and opaque.
- The hoarding should also be embedded 300 mm into the ground.
- Perimeter hoarding prior to Phased Clearing should follow the above hoarding specifications.
- Noise barriers after Phased Clearing should also follow the hoarding specifications as above.

Gate with silt fence below
(Openings should not be larger than 50 mm)



Interlocking **Water barrier** (without openings), as form of temporary barrier can be used in between sections

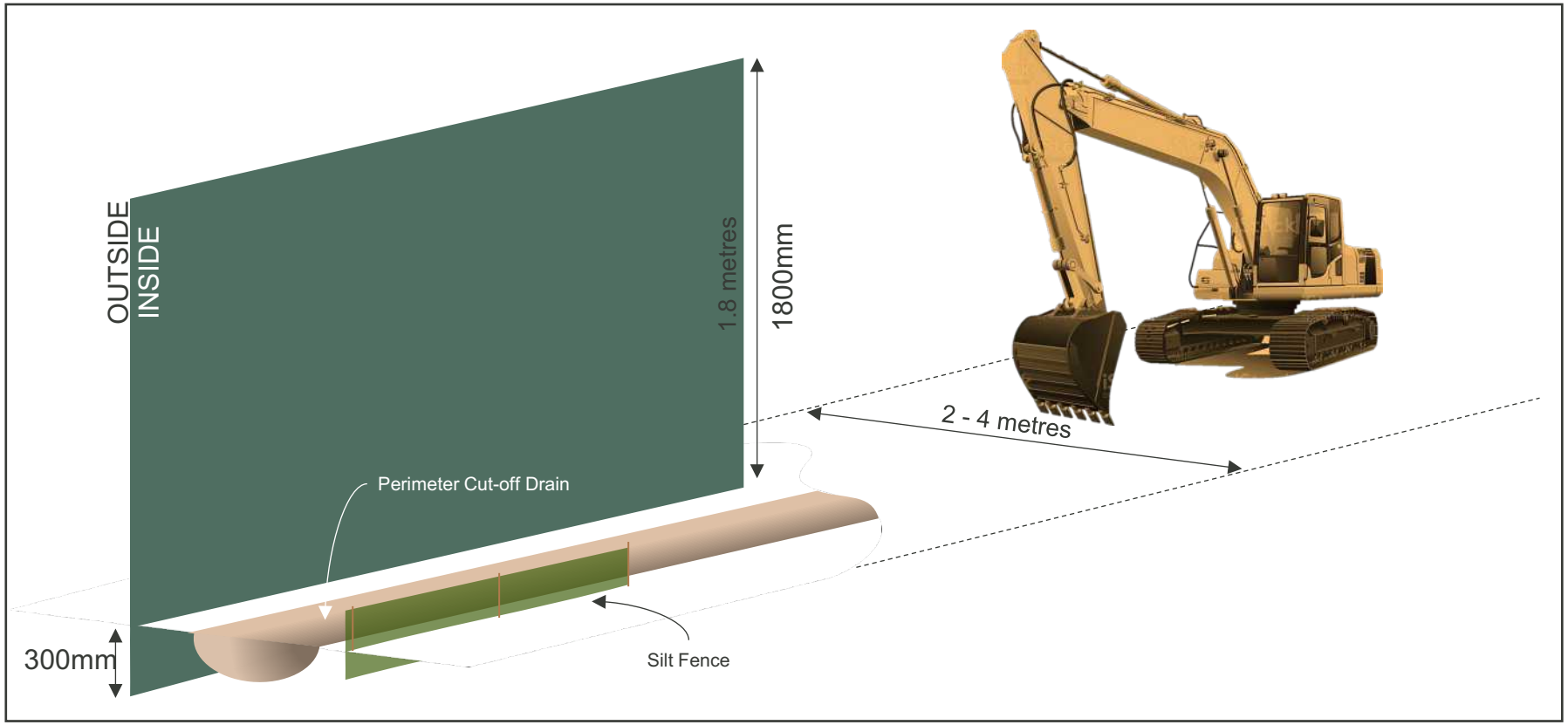
Fence netting for sections where terrain is challenging and not feasible for water barrier.

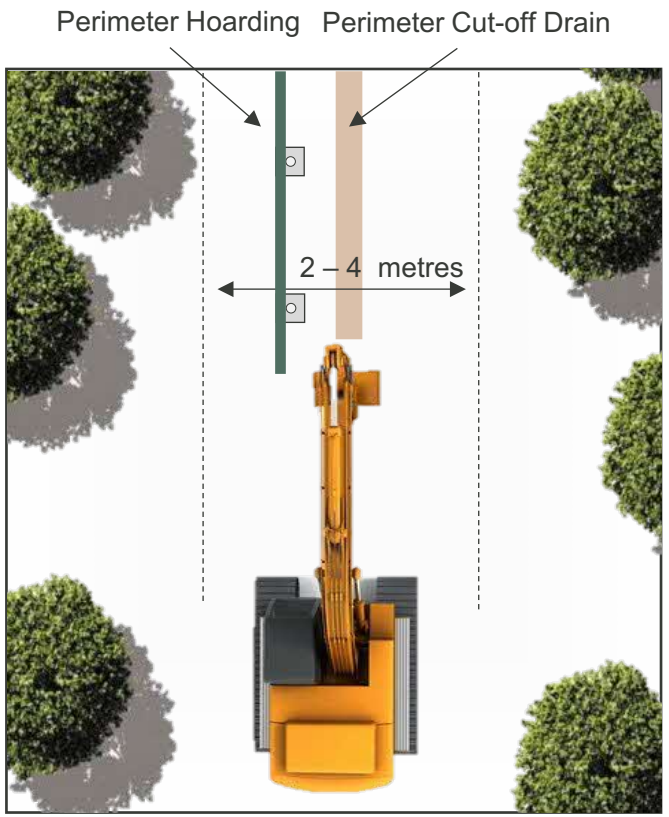
Marking

Spray paint is used on the initial hoarding to mark out wildlife shepherding sections. This ensures vegetation clearing is kept to the stipulated ~2,500 – 3,500 m^2 per day.

Clear demarking of shepherding sections prior to any clearing. This can be done using red/white tape, or pegs in the ground. This ensures no excessive clearing beyond the intended boundary is carried out.

2 - 4 m width working space for Preliminary hoarding/Permanent Hoarding

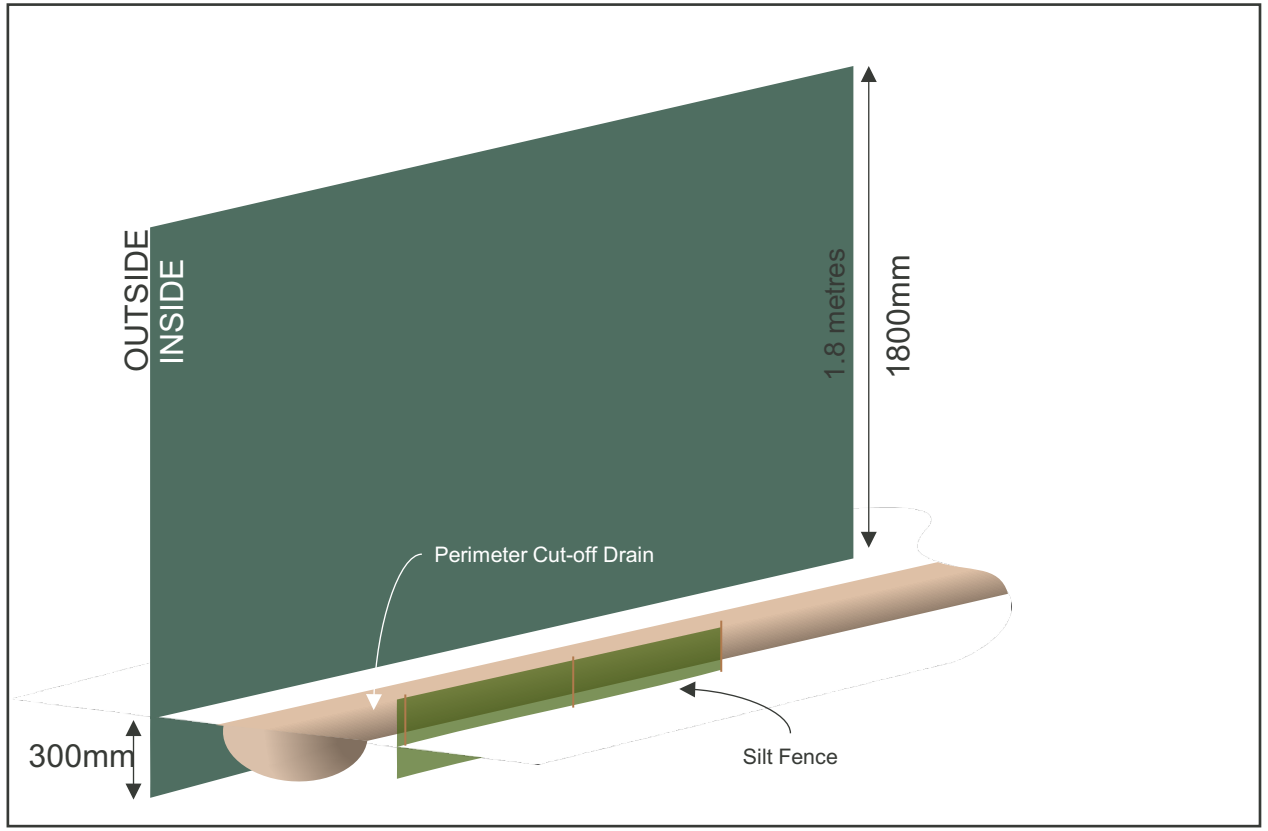




<u>Perimeter hoarding</u> is to be set up around the site. This should be done before wildlife shepherding (Hoarding to be set up along the intended sides of the development)

Should setting up of the **<u>perimeter hoarding</u>** require any vegetation to be cleared, a pre-felling check should be conducted prior to the clearing. The clearing width should also not exceed 4 m. Use of a small excavator is ideal.

Preliminary Hoarding/ Permanent Hoarding



Perimeter drains, 300mm embedded hoardings, silt fence, and ECM are to be in place before Phased Clearing commences. This ensures silty water does not exit the site during shepherding phase

Examples of **<u>Permanent hoardings</u>** placed along the perimeter. The installation of concrete bund or embedded silt fence may be tailored to better suit the site conditions.

Earth Control Measures (ECM)

Earth Control Measures (ECM) should be implemented prior to site clearance. This is to prevent silty discharge into the surrounding drain and canal. A detail ECM Plan will be prepared and endorsed by the Qualified Erosion Control Professional (QECP). The ECM Plan should be approved by PUB prior to the site clearance.

Perimeter Earth Drain and Silt Fences are advised to be set up in tandem with the hoardings to minimize working space. The ECM should only be set up after the hoardings have been set up. Holding Pond / Detention Tank should have Water Barriers and subsequently a permanent fence to prevent wildlife from entering the pond/tank. The site clearance for ECM facilities (treatment tank and sediment pond) will be cleared from the road side.

Water Barriers around Holding Pond

Perimeter Drain

Treatment Tank

Silt Fences

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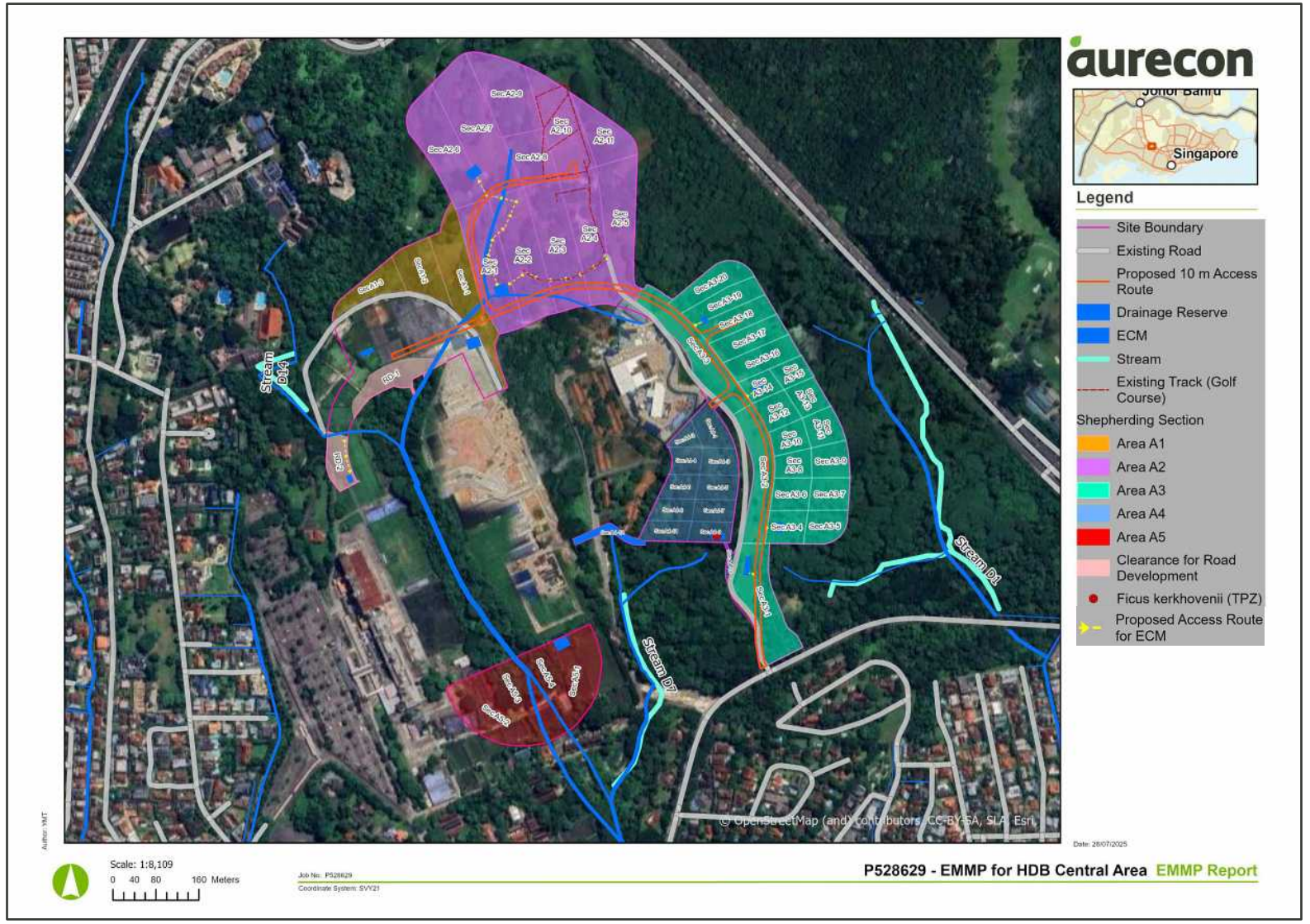
Earth Control Measures (ECM)



Wildlife Shepherding Plan

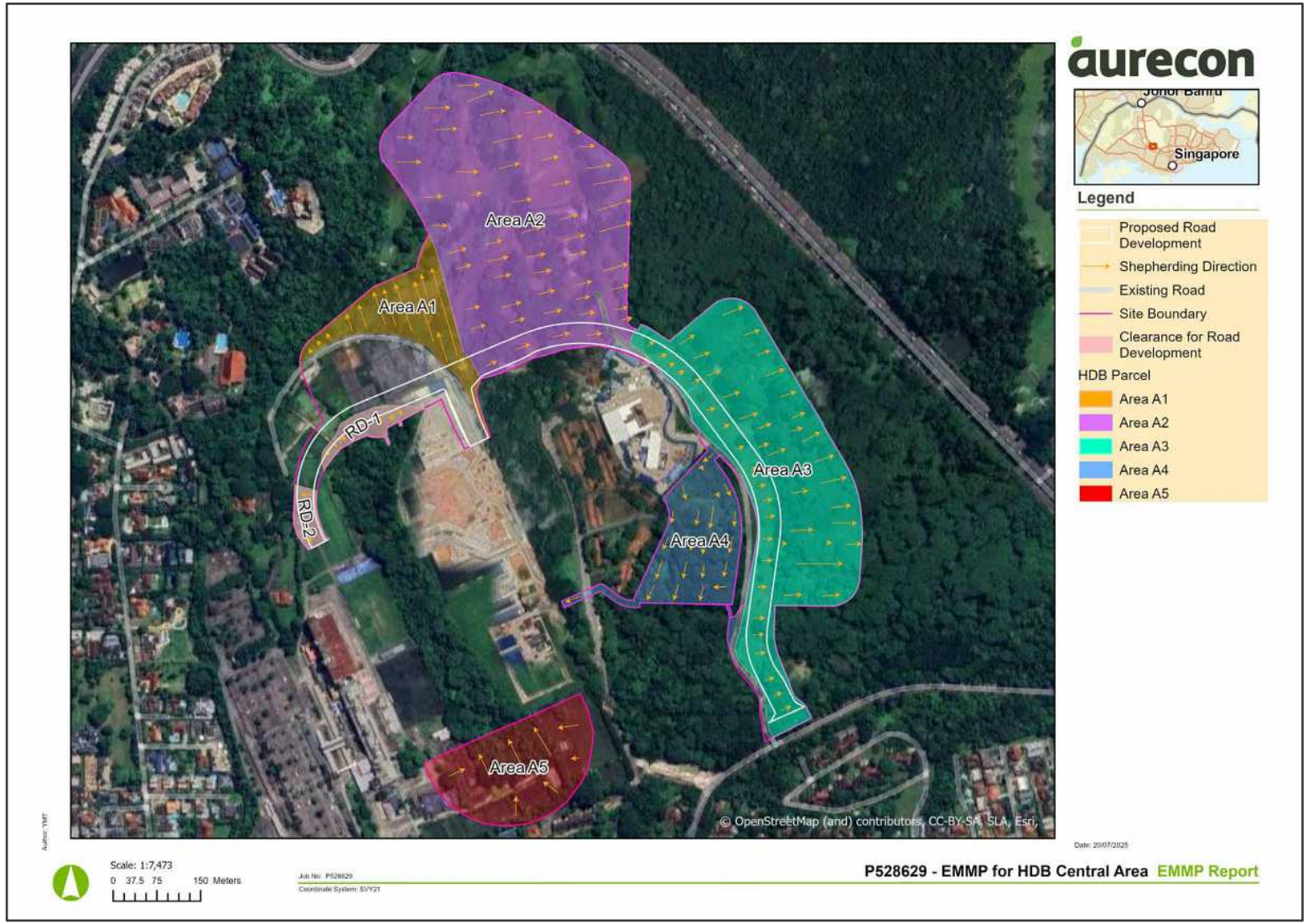
Wildlife Shepherding is conducted through staged directional clearing of the site.

Aim:
- Shepherd wildlife to similar habitat
- Shepherd wildlife towards one direction
- Reduce mortality
- Reduce stress on wildlife from constantly moving

Temporary hoardings (e.g. water barriers) should be installed around each section (within an opening towards the shepherding direction) similar to a perimeter hoarding prior to any clearing.

Shepherding is limited to 8am – 6pm.

General progress per section:
Day 1: Undergrowth and shrub and grass clearance
Day 2 – 4: Buffer period for wildlife to move from the site
Day 5: Tree felling



Wildlife Shepherding Plan – Area A1

Wildlife Shepherding is conducted through 3 sections for Area A1.

Measures:

- Preliminary hoarding along the existing road at the south (indicated in the map as yellow dotted lines).
- ECM facilities are located outside of Area A1. ECM facilities should be operational before site clearance and wildlife shepherding.
- Shepherd wildlife to the north.
- Temporary barriers (water barriers) in between sections.
- After tree-felling, each section is to be closed off with temporary hoarding at the north to prevent animal re-entry (indicated in the map as white dotted lines) and subsequently closed off with permanent hoarding.
- Estimate shepherding period is seven (7) working days (refer table below).

Section	Remark	Day						
		1	2	3	4	5	6	7
Sec A1-1	ECM facilities from neigboring Sec A2-1 should be operational prior to shepherding							
Sec A1-2								
Sec A1-3								

Legend

- Undergrowth clearing
- 3 days buffer
- Tree Felling

Wildlife Shepherding Plan – Area A2

Area A2 is divided into 11 sections for wildlife shepherding.

Measures:

- Preliminary hoarding along the existing road at the south (indicated in the map as yellow dotted lines).
- ECM facilities are located at Sec A2-1 and Sec A2-6/7.
- Access for setting up ECM facilities before wildlife shepherding should follow the existing track and/or managed grass area, as indicated on the map with yellow arrow lines. ECM facilities should be operational before site clearance and wildlife shepherding.
- Shepherd wildlife to the east.
- Temporary barriers (water barriers) in between sections.
- After tree-felling, each Section is to be closed off with temporary hoarding at the east to prevent animal re-entry (indicated in the map as white dotted lines).
- Temporary hoarding in between sections can be removed if wildlife shepherding for the subsequent Section is completed.
- Section located along the site boundary can be closed off with temporary barrier and subsequently with permanent hoarding (for sections along the site boundary).
- Estimate shepherding period is 26 working days (refer to next page).

Wildlife Shepherding Plan – Area A2

Section	Remark	Day																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Sec A2-1	Localised clearing for ECM Facilities																										
Sec A2-6																											
Sec A2-1	ECM at Sec A2-1 should be ready prior to shepherding																										
Sec A2-2																											
Sec A2-3																											
Sec A2-4																											
Sec A2-5																											
Sec A2-6	ECM at Sec A2-6 should be ready prior to shepherding																										
Sec A2-7																											
Sec A2-8																											
Sec A2-9																											
Sec A2-11																											

Legend

- Undergrowth clearing
- 3 days buffer
- Tree Felling

Wildlife Shepherding Plan – Area A3

Area A3 is divided into 20 sections for wildlife shepherding. Sections A3-1, A3-2, and A3-3 primarily consist of managed grass areas with patches of trees. As a result, these three sections have larger shepherding areas. In contrast, Sections A3-4 to A3-15 are situated in hilly areas with slopes, therefore have smaller shepherding sections.

Measures:

- Preliminary hoarding along the existing road at the west (indicated in the map as yellow dotted lines), at the south for Sec A3-1, Sec A3-4 and Sec A3-5, and at the north for Sec A3-20
- Four (4) ECM facilities are located within Area A3 (indicated in the map). Access should be from the proposed 10 m access route, indicated in the map as yellow arrow.
- ECM facilities should be operational before site clearance and wildlife shepherding.
- Shepherd wildlife to the east.
- Temporary barriers (water barriers) in between sections.
- After tree-felling, each Section is to be closed off with temporary hoarding at the east to prevent animal re-entry (indicated in the map as white dotted lines).
- Temporary hoarding in between sections can be removed if wildlife shepherding for the subsequent Section is completed.
- Section located along the site boundary can be closed off with temporary barrier and subsequently with permanent hoarding.
- Estimate shepherding period is 17 working days (refer to next page).

Wildlife Shepherding Plan – Area A3

Section	Remark	Day																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sec A3-1	Localised clearing for ECM Facilities, access via existing road and managed grass areas																	
Sec A3-4																		
Sec A3-14																		
Sec A3-18/19																		
Sec A3-1																		
Sec A3-2																		
Sec A3-3																		
Sec A3-4																		
Sec A3-5																		
Sec A3-6																		
Sec A3-7																		
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Sec A3-14																		
Sec A3-15																		
Sec A3-16																		
Sec A3-17																		
Sec A3-18																		
Sec A3-19																		
Sec A3-20																		

Legend

- Undergrowth clearing
- 3 days buffer
- Tree Felling

Wildlife Shepherding Plan – Area A4

Area A4 is divided into 12 sections for wildlife shepherding.

Measures:

- Preliminary hoarding along the existing road at the east, at the north (next to the existing construction site) and at the west (next to old houses) indicated in the map as yellow dotted lines).
- Sections A4-10 and part of Section A4-9 will be cleared first for the setup of the ECM facility. Access should be from the existing road on Fairway Drive.
- ECM facilities should be operational before site clearance and wildlife shepherding.
- Shepherd wildlife to the forested area at the south.
- Temporary barriers (water barriers) in between sections.
- After tree-felling, each Section is to be closed off with temporary hoarding at the south to prevent animal re-entry (indicated in the map as white dotted lines).
- Temporary hoarding in between sections can be removed if wildlife shepherding for the subsequent Section is completed.
- Sections located along the site boundary can be closed off with temporary barrier and subsequently with permanent hoarding (for sections along the site boundary).
- Estimate shepherding period is 27 working days (refer to next page).

Wildlife Shepherding Plan – Area A4

Section	Remark	Day																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Sec A4-10	Localised clearing for ECM, access via existing road																											
Sec A4-9																												
Sec A4-1																												
Sec A4-2																												
Sec A4-3																												
Sec A4-4																												
Sec A4-5																												
Sec A4-6																												
Sec A4-7																												
Sec A4-8																												
Sec A4-9																												
Sec A4-10	Cleared earlier for ECM access route																											
Sec A4-11																												
Sec A4-12																												

Legend

- Undergrowth clearing
- 3 days buffer
- Tree Felling

Wildlife Shepherding Plan – Area A5

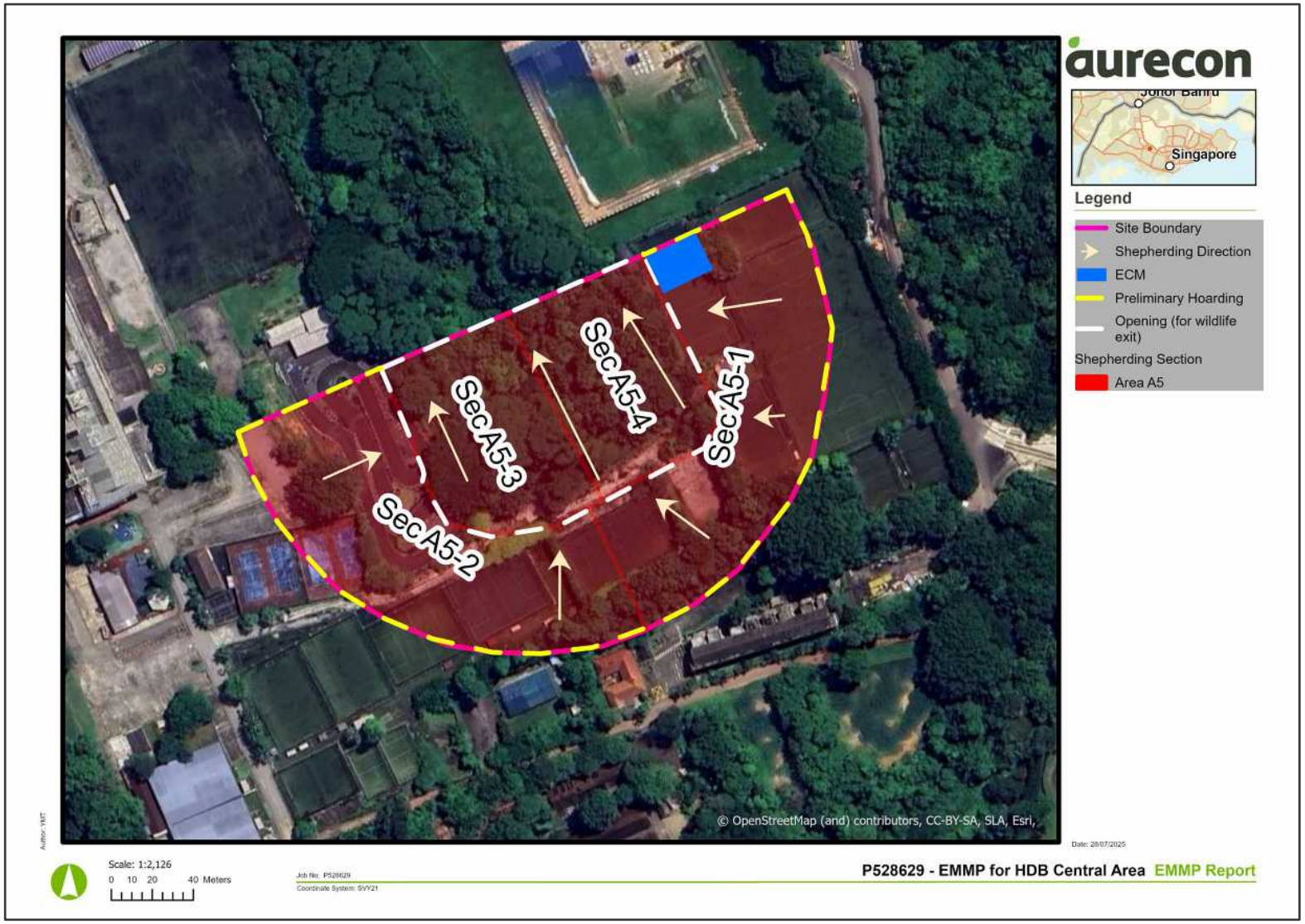
Area A5 is divided into 4 sections for wildlife shepherding.

Measures:

- Preliminary hoarding along the site boundary at the east, south and west, indicated in the map as yellow dotted lines).
- ECM facilities should be operational before site clearance and wildlife shepherding.
- Shepherd wildlife to the forested area at the northeast.
- Temporary barriers (water barriers) in between sections.
- After tree-felling, each Section is to be closed off with temporary hoarding to prevent animal re-entry (indicated in the map as white dotted lines).
- Temporary hoarding in between sections can be removed if wildlife shepherding for the subsequent Section is completed.
- Sections located along the site boundary can be closed off with temporary barrier and subsequently with permanent hoarding (for sections along the site boundary).
- Estimate shepherding period is seven (7) working days (refer to table below).

Section	Day						
	1	2	3	4	5	6	7
Sec A5-1							
Sec A5-2							
Sec A5-3							
Sec A5-4							

Legend
- Undergrowth clearing
- 3 days buffer
- Tree Felling



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Wildlife Shepherding Plan – Road Development

Only two sections will be cleared for road development on the northwest side of the site. Both sections are located adjacent to a managed grass area or a developed area and can be cleared independently.

Measures:

RD-1

- Preliminary hoarding along the site boundary at the north, indicated in the map as yellow dotted lines).
- ECM facilities are located at developed areas. ECM facilities should be operational before site clearance and wildlife shepherding.
- Shepherd wildlife to the forested area at the south.

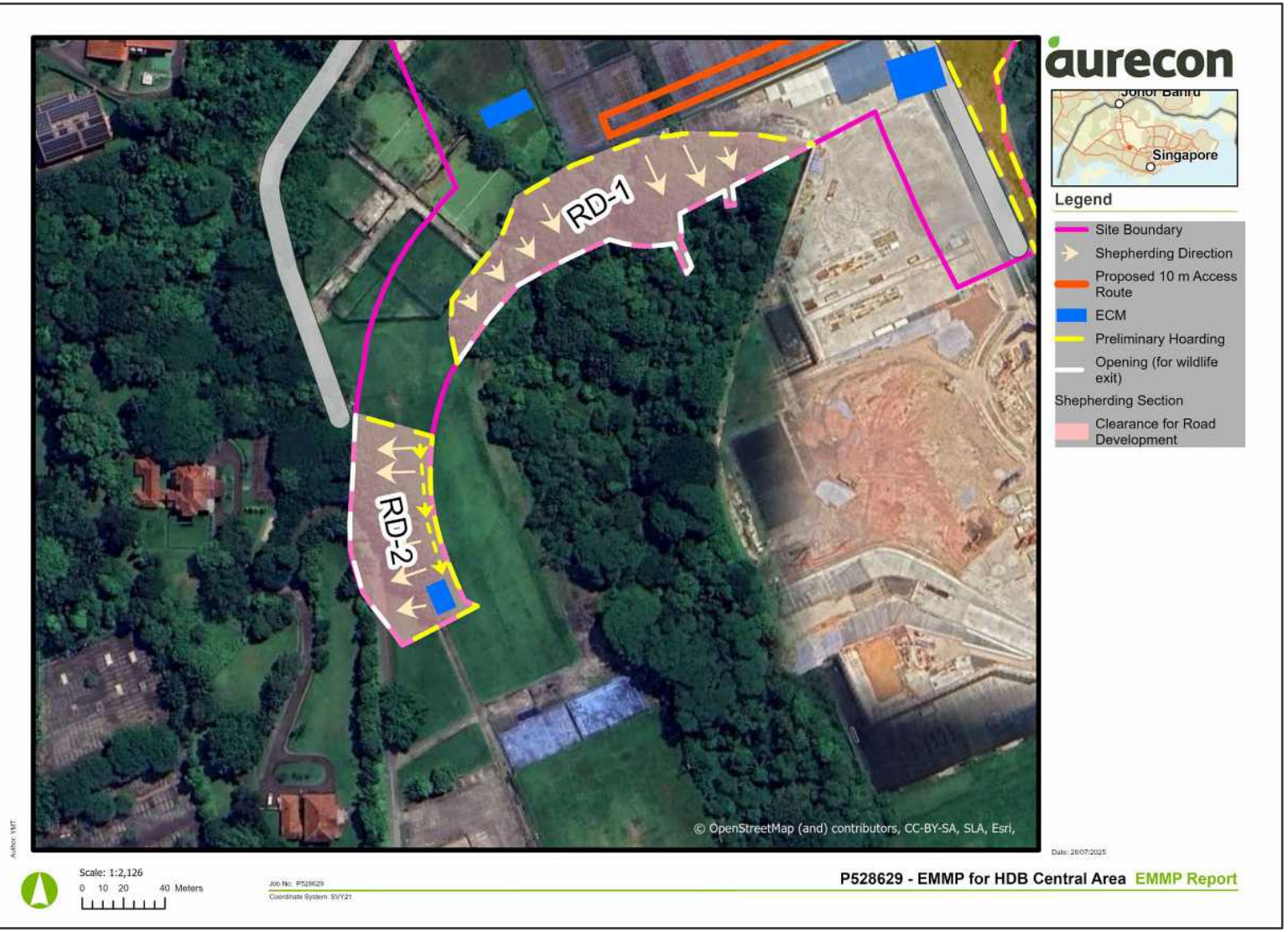
RD-2

- Preliminary hoarding along the site boundary at the west, indicated in the map as yellow dotted lines).
- ECM facility is located at managed grass area. ECM facilities should be operational before site clearance and wildlife shepherding.
- Shepherd wildlife to the forested area at the west.

- Sections can be closed off with temporary barrier and subsequently with permanent hoarding.
- Estimate shepherding period for each section is five (5) working days (refer to table below).

Section	Remark	Day				
		1	2	3	4	5
RD-1	Both sections can be cleared at the same time or separately					
RD-2						

Legend
- Undergrowth clearing
- 3 days buffer
- Tree Felling



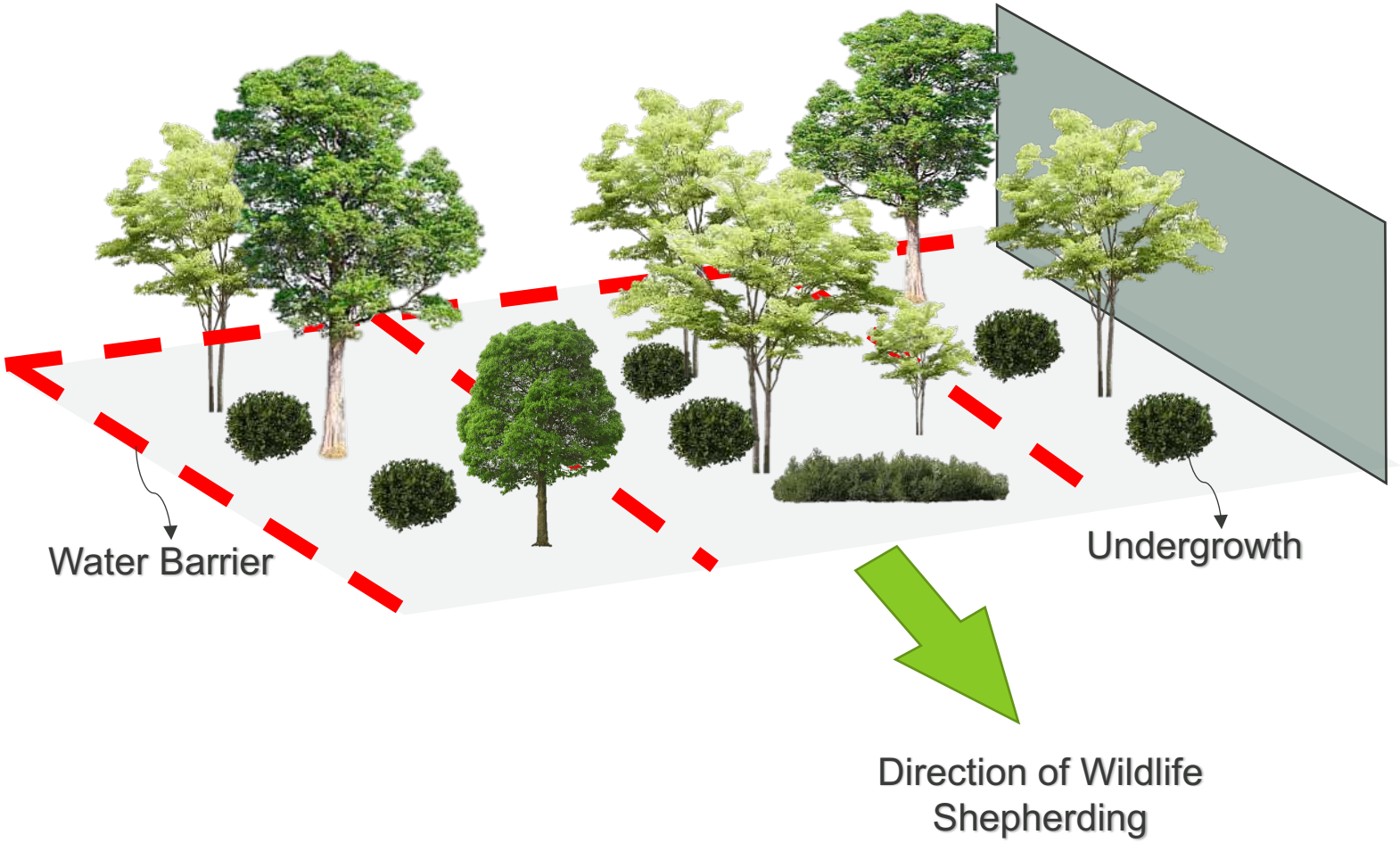
Wildlife Shepherding

Shepherding Steps

Step 4: Undergrowth Clearance

During shepherding:

- Contractors to clear the undergrowth (i.e., shrubs, grass)
- Undergrowth define as flora height ≤ 3m
- Directional Clearing encourages arboreal wildlife to migrate to similar habitat
- Reduce stress on wildlife from constant moving
- SECS will be onsite weekly to observe the shepherding



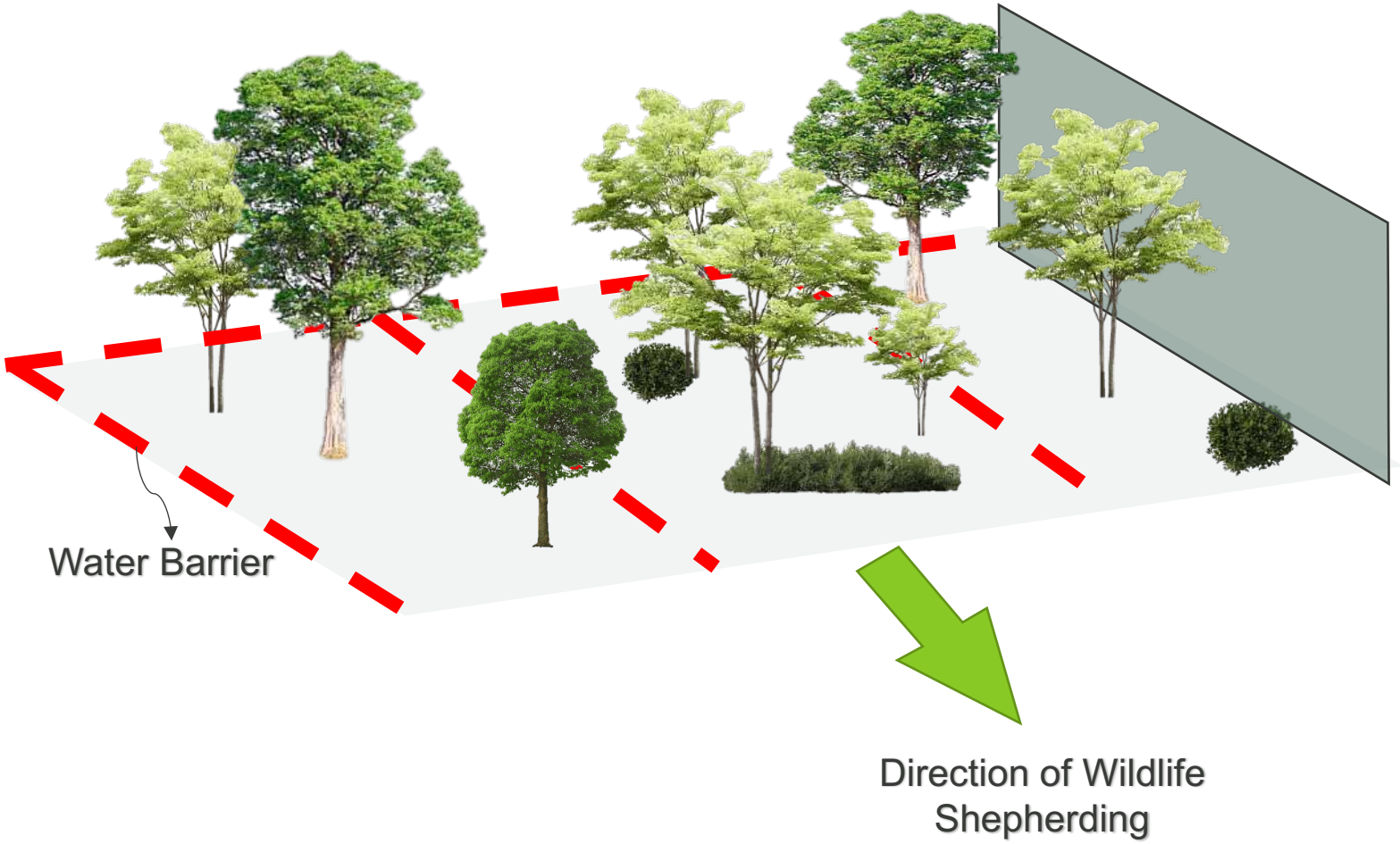
Wildlife Shepherding

Shepherding Steps

Step 4: Undergrowth Clearance

During shepherding:

- Worker can use whistle (to create noise) and stick (to disturb the vegetation) to shepherd wildlife away from the site.
- Excavator can knock the ground (to create vibration) to shepherding wildlife away from the site.
- Care should be taken during this stage, especially near trees.
- Workers are to look out for nest / burrows. If discovered, supervisor and SECS should be informed.



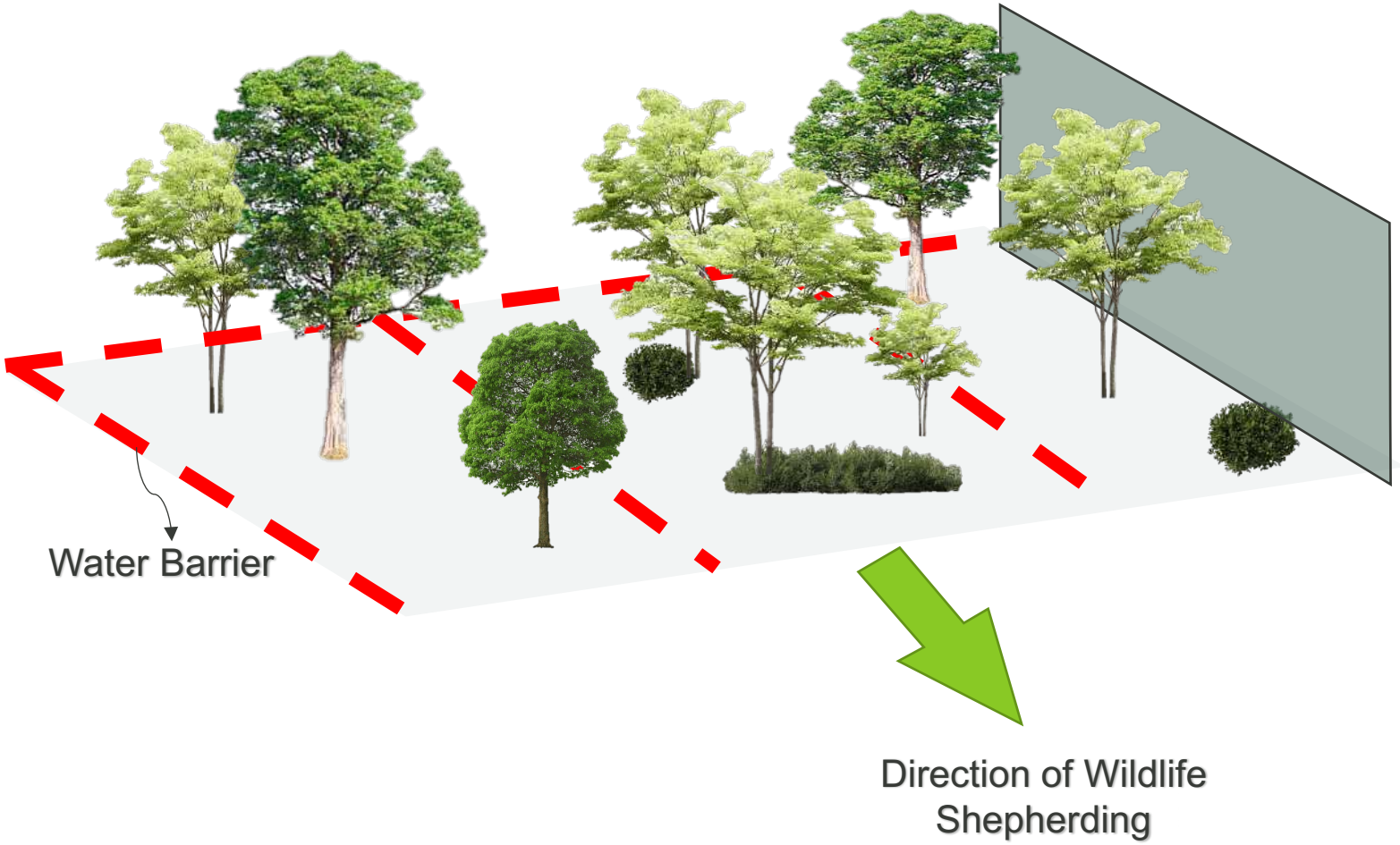
Wildlife Shepherding

Shepherding Steps

Buffer of 3 days

During shepherding:

- 3 days buffer after clearing would allow arboreal wildlife (tree dwelling wildlife) to move out of the site.
- During this period, no other clearing should be carried out.
- Movement of construction equipment through the buffer section is allowed.



Wildlife Shepherding

Shepherding Steps

Pre-Fell Check

- SECS would conduct survey of the area to be cleared. This is to check for nests, animals that may be burrowed, arboreal animals, or any sensitive species.
- Pre-Felling Check is only valid for ≤7 days.
- If a nest is detected, further assessment and eventually cordoning of the area around the nest.
- Assessed trees with active nests should be flagged and labelled to indicate tree is to be retained temporarily. Tree number, location and photographs of tree and nest are to be reported in the weekly pre-felling report.

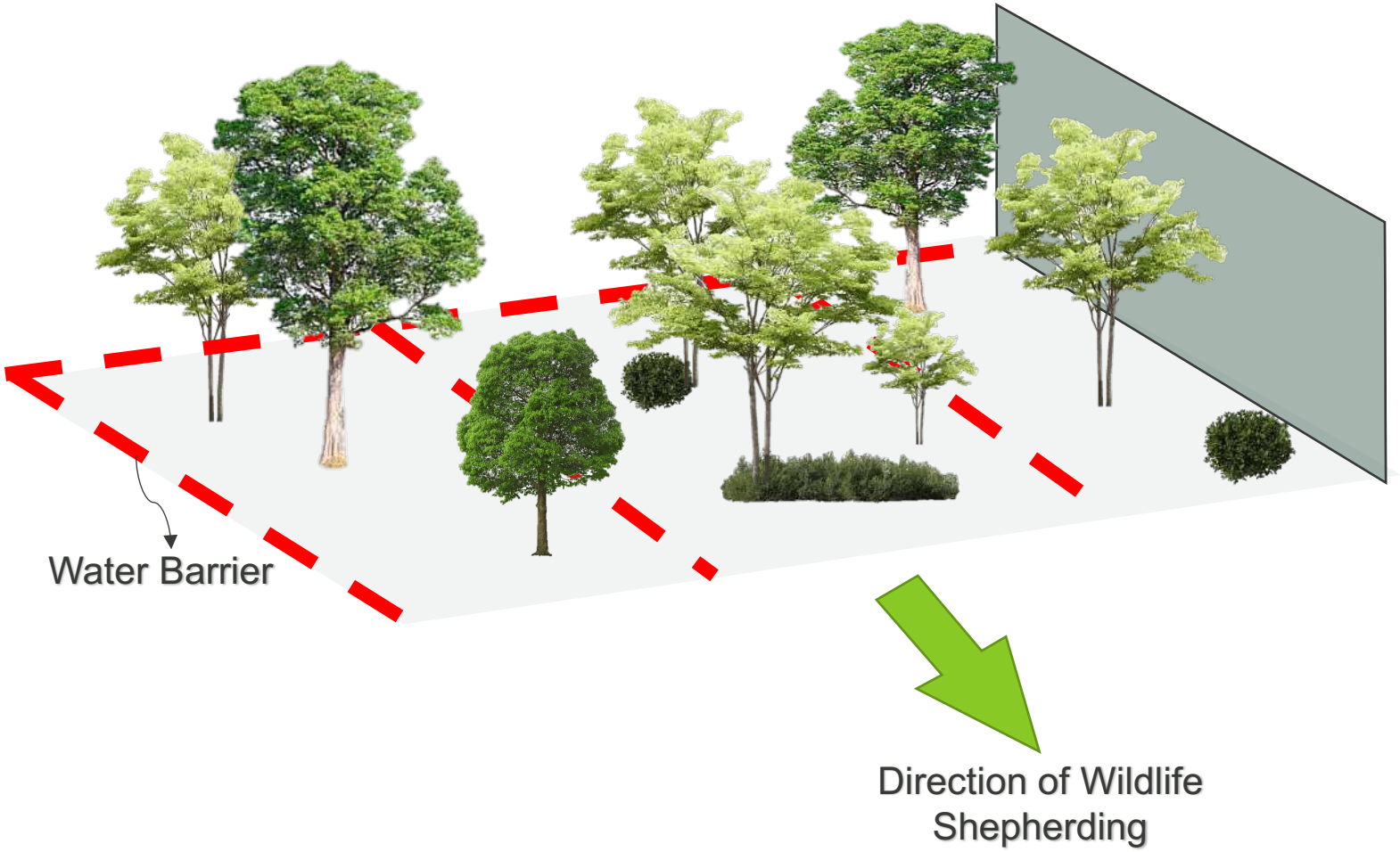
Critically Endangered Bamboo bats living within the bamboo internodes

Wildlife Shepherding

Shepherding Steps

Step 5: Tree Felling

- After buffer period has concluded and pre-fell checks have been completed, trees can be felled.
- Felled trees should be removed
- Should a nest be discovered during this stage, works are to halt immediately.
- Areas which are fully cleared should be entirely hoarded up by the end of the day. This is to prevent wildlife from reentering the site.



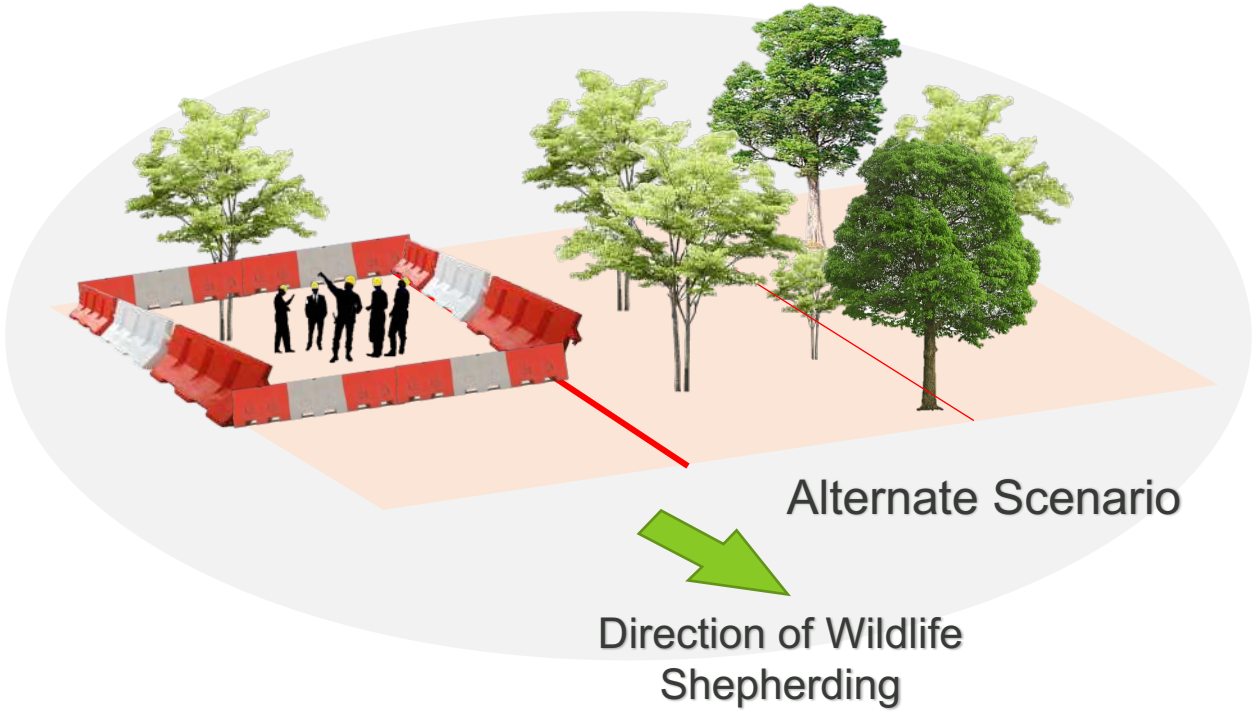
Wildlife Shepherding

Shepherding Steps

Step 5: Tree Felling

During shepherding:

- Should more time be required to remove either trees, or felled trees, any area that does not contain any trees should be fully hoarded up at the end of the day.

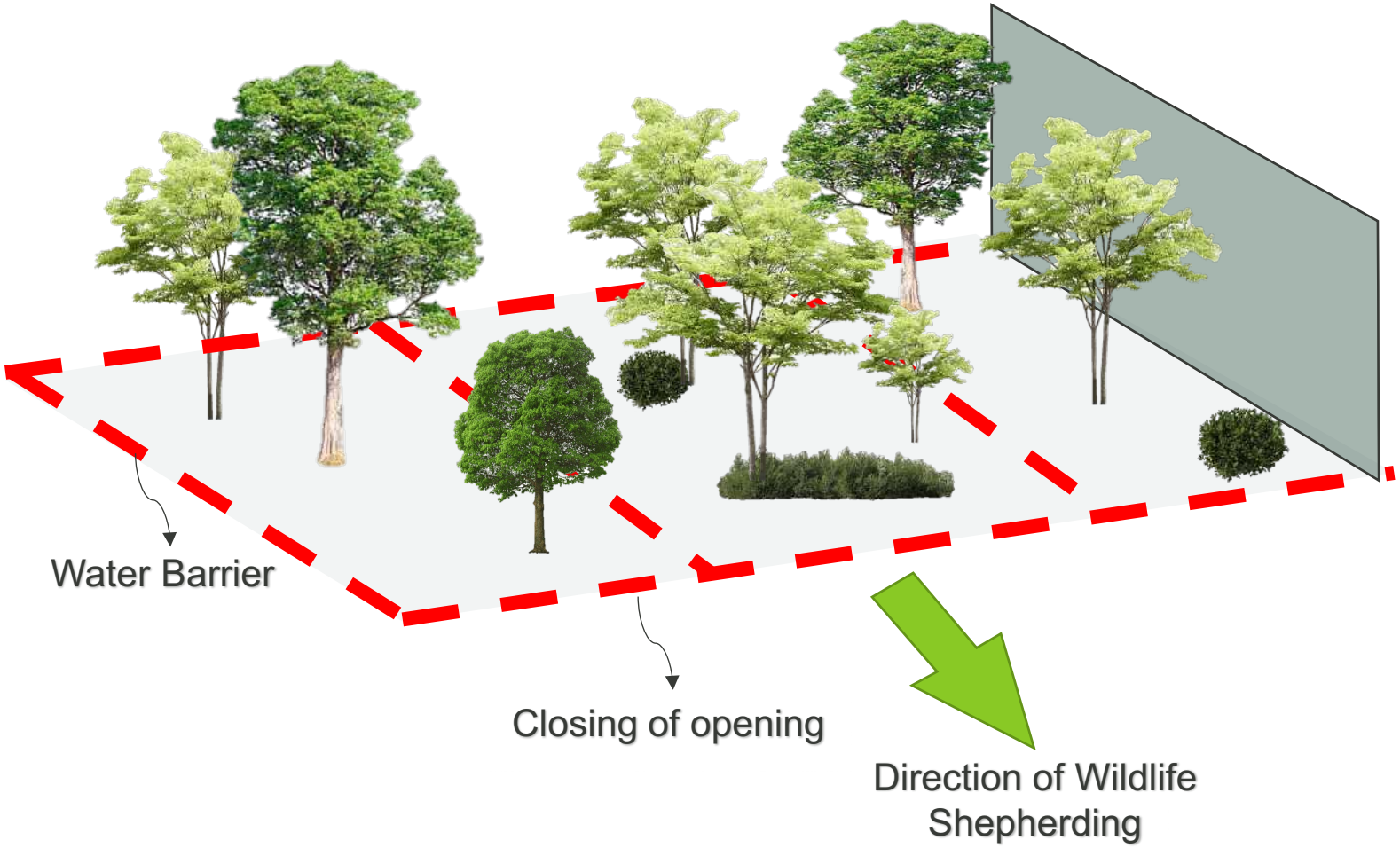


Wildlife Shepherding

Shepherding Steps

Step 6: Closing of Opening

- Water barriers may be used as a temporary barrier to prevent wildlife entry into cleared sites.
- Subsequently, water barrier should be replaced by proper hoarding/noise barrier.



Monitoring and Reporting

- Daily Checks by Contractor for wildlife entrapped within the development site (conducted at the start of the day).
- These checks should be along drains and at areas where ECBs are utilized.
- If trapped animal is found, proper procedure should be followed.
- Daily Checks by Contractor along access and adjacent roads. This is aimed at to identifying any roadkills or unnatural wildlife death (conducted at the start of the day).
- If carcass is found, proper disposal and reassessment of the mitigation measures.

Monitoring and Reporting

- Proper documentation of all shepherding sections and pre-felling checks by SECS.
- Weekly Wildlife Shepherding Report would be submitted by SECS.
- Weekly inspection by SECS would also be conducted

Sample Weekly Wildlife Shepherding and Inspection Report

Checks-List					**Conducted by:**		**Date**
Hoarding and ECM Pre-Felling Check					xxx		20/12/2023
Hoarding and ECM Installation					xxx		21/12/2023 – 31/01/2023
Shepherding Training and Biodiversity Awareness Training					Xxx		01/01/2023
Total Number of Sections : 5							
Sections	Pre-Fell Check Date:	Undergrowth Clearing			Tree Felling		
		Planned	Actual date	Comment	Planned	Actual date	Comment
1	1/1	2/1	2/1	On Schedule	6/1	6/1	On Schedule
2	1/1	3/1	3/1	On Schedule	7/2	7/1	On Schedule
3	1/1	4/1	4/1	On Schedule	8/2	10/1	Delayed

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Appendix B – Biodiversity Awareness Training Deck

Wildlife Response Plan and Awareness Training

SECS
Member of the Aurecon Group

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Objectives

- Ensure all construction activities are conducted in a manner consistent with the **laws and regulations**, including applicable regulatory approval conditions from relevant authorities and agencies;
- Ensures proper and effective **mitigation measures** are taken with proper monitoring during the construction phase.
- Establish **emergency response** procedures for environmental incidents, including roadkill, trapped animal found at site and ensure effective corrective action is taken

General Biodiversity Awareness

Do not pluck flowers

Do not litter

Do not trap or kills animals

Do not feed the animals

Do not fish

Do not smoke

No naked flames

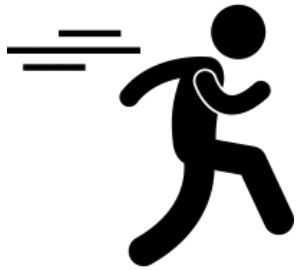
General Fauna Awareness and Responses

At the sight of any wildlife:

- Stay away
- Leave the particular area
- Document (with photo/video)
- Inform person in charge

1

2



3

Dangers of snakes

- Stop work (only at the immediate vicinity) if snake is sighted.
- Do not provoke or confront the snake (i.e., using broom/stick) and keep a safe distance away from the snake.
- The snake may try to look for dark and secure area and site personnel should observe where it hides, inform site supervisor only if the snake is hiding within the immediate vicinity of construction works.
- If the snake is still in the immediate vicinity of construction site and disruptive to the work, a licensed wildlife management contractor should be arranged to relocate the snake.
- Resume work after the immediate site is cleared from snake.
- Site supervisor to inform CEMMP consultant for documentation and reporting.

Dangers of Macaques / Monkeys

1. Stop work
2. Stay calm and quite
3. DO NOT look at the monkey's eyes
4. Hide or discard any object with you
5. Back off slowly
6. DO NOT run
7. DO NOT hit the monkeys
8. Stay away from the are until monkey has left

Dangers of Wild Boar

1. Stop work
2. DO NOT go near the wild boars
3. Back off slowly
4. DO NOT feed the wild boars
5. If you see adult with young piglets, leave them alone
6. Call approved Wildlife Contractor to remove wild boar if the animal is not able to be guided out safely from the site

Monitor Lizard

If you see any monitor lizard,

1. DO NOT touch / chase / corner it
2. Slowly move away and keep a safe distance
3. Seek medical attention immediately if you are bitten
4. Risk of bacterial infection

Bee/Wasp

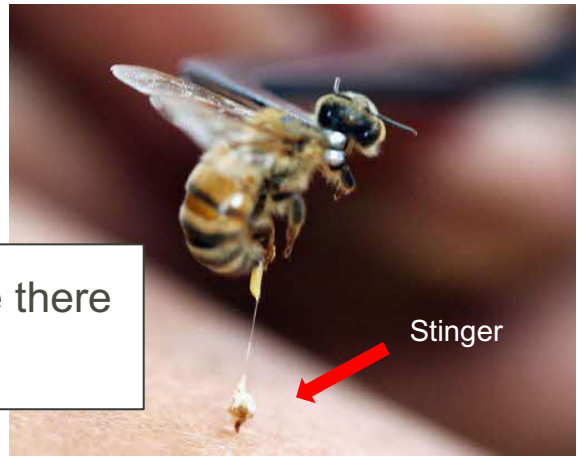
If a bee / wasp lands on you?

1. DO NOT smack the insect!
2. Calmly move the part of your body that the insect is resting on
3. If not, gently brush it off

If you have been stung by a bee / wasp?

1. DO NOT pull the stinger with your fingers!
2. Scrape the stinger out using the edge of the card
3. Wash wound with soap and water
4. Apply ice pack and monitor for allergic reactions
5. Seek immediate medical attention

- By a honey bee, a stinger will be there
- By a wasp, no stinger to remove



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Bee/Wasp

If you are swarmed by bees / wasps?

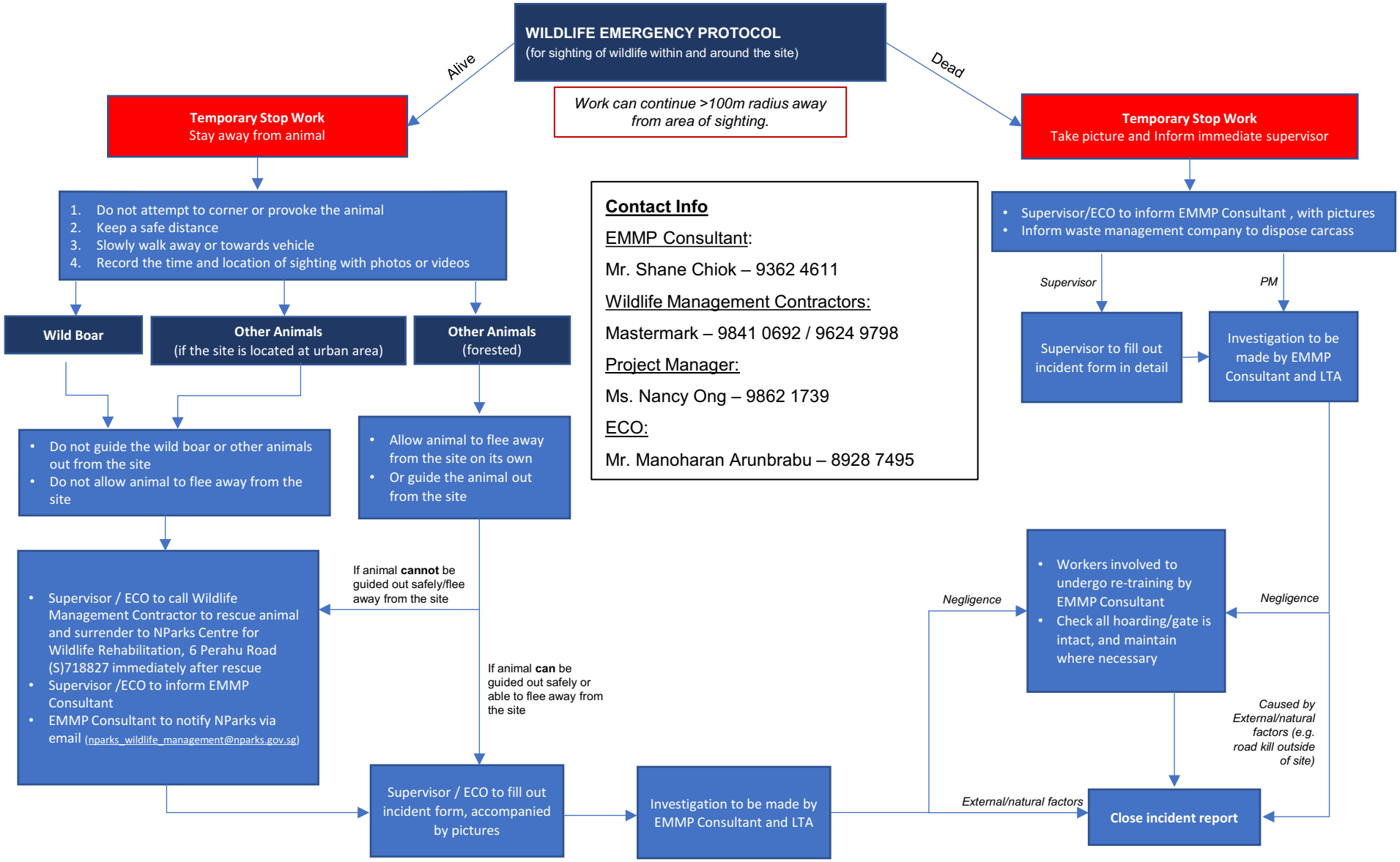
1. Cover head and move away from hive
2. Move towards shelter to disorient the attacking bees
3. DO NOT swat at the insect
4. DO NOT jump into water

Bird Nests

If you see any bird nests,

1. Stop work
2. Inform CEMMP consultant
3. CEMMP consultant will arrange fauna specialists to check the nest
4. If an active bird nest is detected in a particular tree or vegetation patch at the Site at any time of the project, stop work in the immediate vicinity until there is no discernible activity at the said nest.

Wildlife Response Plan



Other Rules

No Exiting the Project Work Boundary

- No walking outside the Project Work Boundary
- Unless emergency

No Eating inside the Forest

- No consumption of food inside the forest

Equip Trash Bins with Buggy cords

- Install Buggy cords on trash bins near nature areas to prevent wildlife from rummaging through it

Erosion Control Blankets (ECB)

Only 100% Biodegradable **Erosion Control Blankets (ECBs)** is allowed to be used.

Some examples includes ECBs made of coconut husks

Non-biodegradable **ECBs** such as with nylon nets, could trap and cause injuries to small animals (i.e., snakes, pangolins, porcupines, and frogs)

In addition, Non-biodegradable ECBs takes a longer time to break down if left unattended in the forest

Public Registry of Certified Animal Management Specialists

A list of certified Animal Management Specialists is available for download:

https://www.nparks.gov.sg/-/media/avs/am-public-registry-listing-19102022.ashx?la=en&hash=BED4DD1AE943902378346C0AAD30A9CFA3B4193D

Animal Management Professional Certification Programme - Basic & Intermediate Electives (B - Basic; R - Reptiles; M - Mammals)

S/N	Full Name of CAMS	Cert No	B	R	M	Company Name	UEN	Company Address	Company Email	Contact #	OG-approved species to trap & take
1	Agnes Teong Suan Li	CAMS20001	B			1800NOPESTS Pte Ltd	201222694E	9010 Tampines Street 93 #02-93, Tampines Industrial Park A, Singapore 528844	enquiry@1800nopests.com.sg	62446926	Reptiles (Lizards, Snakes, Green iguana)
2	Fazli Bin Buang	CAMS20002	B	R	M						
3	Kam Chia Huat (Gan Jiafa)	CAMS20003	B	R	M						
4	Tee Chea Chi	CAMS20004	B								
5	Soh Chiang Song	CAMS22037	B			800 Super Waste Management	198601155H	17A Senoko Way, Singapore 758056	enquiries@800super.com.sg	NIL	NIL
6	Lim Hoon Kok	CAMS22020	B								
7	Cheryl Chong Min	CAMS21089	B	R	M	Aardwolf Pestkare (S) Pte Ltd	199700791R	26 Third Lok Yang Road, Singapore 628015	enquiries@aardwolfpestkare.com	62681771	Reptiles (Lizards, Snakes, Green iguana), Mammals (Common palm civet, Bats)
8	Hu Jian, Jerry	CAMS20005	B	R	M						
9	Mohamad Nazree Bin Suhaimi	CAMS21090	B	R	M						
10	Mohammad Fauzee Bin Othman	CAMS21091	B	R	M						
11	Muhammad Nazmi Bin Osman	CAMS20006	B	R	M						
12	Chia Kok Tiong	CAMS21152	B	R	M						
13	Tan Gee Kee	CAMS21153	B	R							
14	Muhammad Dzulhairyan bin Dzulkifli	CAMS21154	B	R							
15	Ramlan Bin Mustapa	CAMS21155	B	R	M						
16	Mohammed Muzee bin Abdul Karim	CAMS21156	B	R	M						
17	Iswadi Bin Abdul Kadir	CAMS21157	B	R	M						
18	Muhammad Hafiz bin Saberan	CAMS21158	B	R	M						
19	Roger Tan Gak Chun	CAMS22033	B								
20	Lim Boon San	CAMS22029	B								
21	Nashrudin Bin R Azman	CAMS22034	B								
22	Ahmad Bin Wahib	CAMS22026	B								
23	Abdullah Ulhaq Bin Abdul Karim	CAMS22031	B								
24	Tay Lian Chai Martin	CAMS22007	B			ArborCulture Pte Ltd	200209302W	53 Stirling Rd, Singapore 141053	info@arborsingapore.com	67920261	NIL
25	Ng Jun Wei Dominic Pierre	CAMS22009	B								
26	Rushan bin Abdul Rahman	CAMS22011	B								
27	Kalai Vanan	CAMS20007	B	R	M	ACRES	T01SS0121K	91 Jalan Lekar, Singapore 698917	info@acres.org.sg	68929821	Birds (All), Amphibians (Frogs), Reptiles (Lizards, Snakes, Green iguana, Red-eared slider, Malayan box turtle), Mammals (Bats, Common palm civet, Squirrel, Treeshrew, Monkey, Colugo)
28	Neo Kar Chuan Terry	CAMS22028	B			All Out Pest Management Pte Ltd	202130083C	160 Robinson Road, #14-04 Singapore 068914	NIL	83660993	NIL
29	Mohamed Azahar Bin Mohamed Abdullah	CAMS22019	B			Atl Maintenance Pte Ltd	199707550Z	413 Tagore Industrial Avenue, Sindo Industrial Estate, Singapore 787803	NIL	68413128	NIL
30	Subash Gopal Pillai	CAMS22032	B			ARAS Development Pte Ltd	200904375D	2 Kaki Bukit Avenue 1, #07-01, Singapore 417938	enquiries@arasgrp.com	67822140	NIL
31	Ahmed Anik	CAMS22015	B			ARAS Development Pte Ltd					
32	Bahtiar Affindi Bin Abdullah	CAMS20008	B	R		Anticimex Pest Management Pte Ltd	198400909C	3A International Business Park #11-01/05, ICON@IBP, Singapore 609935	pestfree@anticimex.com.sg	68623828	Reptiles (Lizards, Snakes, Green iguana)
33	Mohamad Hisham Bin Noh	CAMS20009	B	R							
34	Ku Ahmad Fitri Bin Ku Azmi	CAMS20046	B			Asia White Ant Control Co Pte Ltd	11003500C	334 Kreta Ayer Road #02-02, Singapore 080334	enquiries@asiawhiteant.com.sg	68412023	Reptiles (Lizards, Snakes, Green iguana)
35	Muhammad Haikal Bin Razali	CAMS20047	B								
36	Chong Ming Yan	CAMS20038	B	R	M	System Pest Control Pte Ltd	199004930W	10 Ubi Crescent #06-81 Ubi Tech Park, Singapore 408564	singapore@systempest.com	67488966	Birds (All but Protected Wildlife Species), Reptiles (Lizards, Snakes, Green iguana), Mammals (Bats, Common palm civet)
37	Koh Teck Fong Terence	CAMS20039	B	R	M						
38	Azlam Shah Bin Alias	CAMS20010	B	R	M	AZantz Services Pte Ltd	201903500W	37 Defu Lane 10 #03-79 Singapore 539214	enquiries@azantz.com	62846956	Birds (All but Protected Wildlife Species), Reptiles (Lizards, Snakes, Green iguana) Mammals (Common palm civet)
39	Muhammed Arafat	CAMS20021	B		M	Ban Chuan Trading and Engineering Pte Ltd	199000185N	637 Veerasamy Rd, #02-123, Singapore 200637	admin@banchuan.com.sg	62965118	NIL
40	Sakthivelan S/O Nararajah	CAMS22036	B		M						
41	Soh Jun Hua, Humphrey	CAMS20011	B		M	Bird Management Pte Ltd	201301277E	2 Gambas Crescent #03-08, Nordcom Two, Singapore 757044	birdmanagementsingapore@gmail.com	98981191	NIL
42	Goh Joon Huat	CAMS21164	B	R		BION Environmental Pte Ltd	202017635C	21 Toh Guan Road East #08-02 Toh Guan Centre Singapore 608609	raymond.goh@bion.com.sg	90091438	Reptiles (Lizards, Snakes, Green iguana)

Emergency Contacts

Incident	Responsible Party	Person-in-charge	Contact
All environment incidents	Environmental Control Officer	(TBC)	HP: TBC
Encounter of dead animals	CEMMP Consultant	Mr. Shane Chiok	HP: 9362 4611
Encounter of injured animals	CEMMP Consultant	Mr. Shane Chiok	HP: 9362 4611
	Animal Response Centre	(TBC)	HP: TBC Animal Response Centre Hotline: 1800 476 1600
Fire events	Contractor	(TBC)	HP: TBC
Chemical/oil spills	Contractor	(TBC)	HP: TBC
	CEMMP Consultant	Mr. Shane Chiok	HP: 9362 4611

Thank You

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Appendix C – Light Management Plan

EMMP Specialist Consultancy Services for Central Area

Light Management Plan

Housing and Development Board (HDB) Singapore

Reference: P528629

Revision: 0

2025-04-21

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Bringing ideas to life

Document control record

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Approval			
Author signature		Approver signature	
Name	Benjamin Tan	Name	Shane Chiok
Title	Environmental Consultant	Title	Environmental Consultant

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Tables

Table 4-1 Sample Checklist for Night Work Audit

1 Introduction

The HDB-appointed Contractor (hereinafter referred to as “Contractor”) has been engaged by the Housing Development Board (“HDB”) to carryout development at the former Turf Club (hereafter referred to as the “Project”). The former Turf Club Area has been largely slated for residential development, to cater for housing needs. The Project development area is approximately 42.1 hectares (ha) located in between the Pan Island Expressway (PIE) and Dunearn Road (Figure 1-1). Singapore Environmental Consultancy and Solutions Pte Ltd (hereinafter referred to as “SECS”), a member of Aurecon Group, has been appointed as the Environmental Management and Monitoring Plan (EMMP) consultant during the construction phase by the Contractor.

As stipulated in the S10 Directions to Implement Environmental and/or Wildlife-Related Measures for Development or Works (NParks Ref No. to be updated), development works shall only be conducted during daylight hours (i.e. from 8 am to 6pm, known as “Daylight Hours”). Construction works are likely to extend beyond the stipulated daylight hours. During night time, construction works will need ample light to illuminate the site at night. Therefore, this Light Management Plan (LMP) serves as a follow-up to the S10 Directions on the detail implementation of the proposed mitigation measures for night works between 6 pm – 8 am. It provides guidance on the selection, placement, installation, and operation of all new and retrofitted lights at the site for the Contractor to conduct night works and ensure that the proposed artificial lightings comply with NParks requirement for light installation and minimise impacts to wildlife. The main EMMP has provided a brief Light Management Plan for ad hoc night work and lights for ECM facilities, with reference to NParks’ Technical Note on Light Management in Night Works (NParks, 2024).

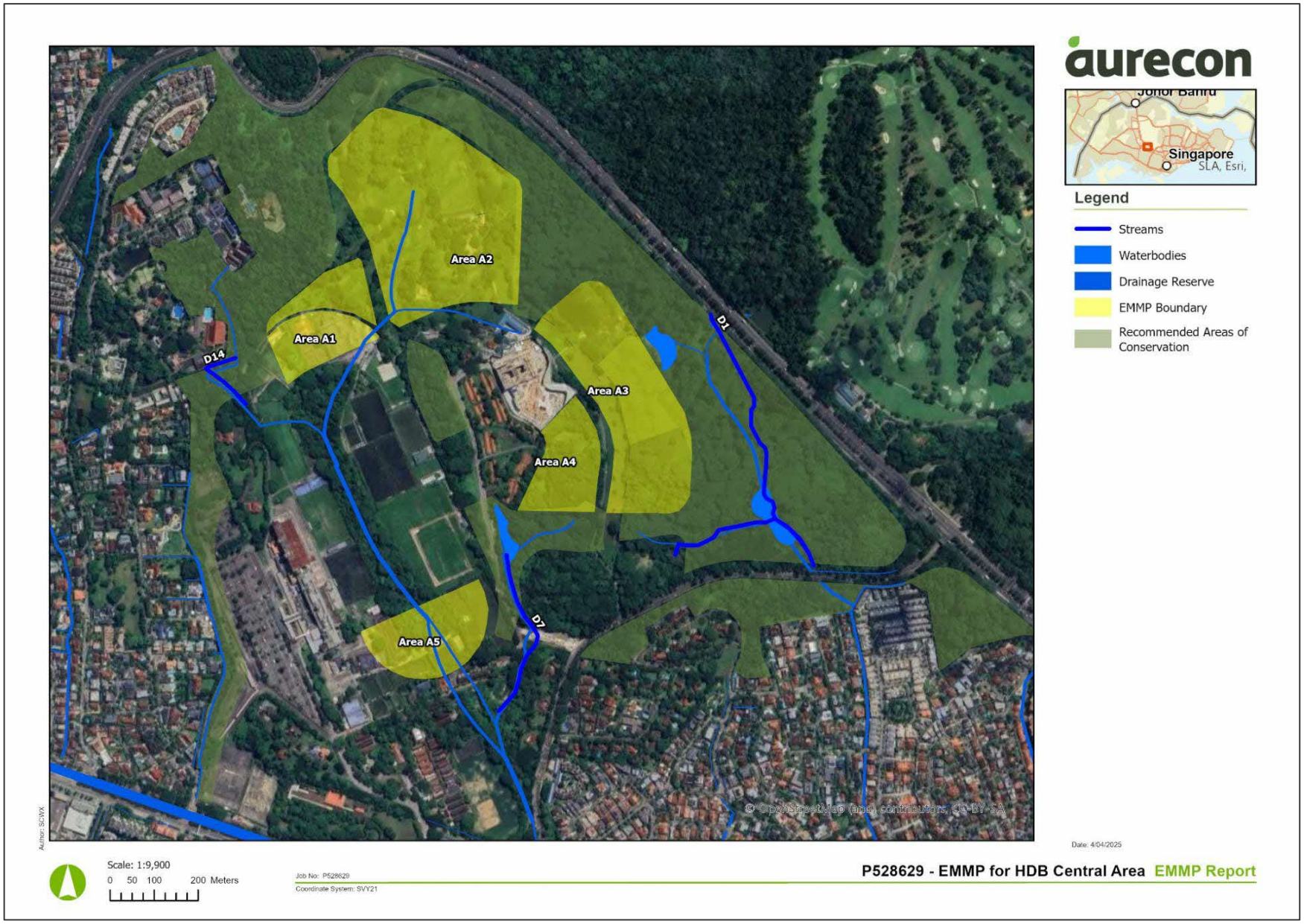

Figure 1-1 Location Plan of the Project

1.1 LMP Objectives

This document serves to define the mitigation measures proposed for the construction works and ambient light for access roads. It serves the following objectives:

- Light will be managed so that fauna is able to undertake critical behaviours such as foraging, reproduction and dispersal outside of the project boundary;
- Mitigate the impact of artificial lighting on the surrounding environment as far as reasonably practicable;
- Define roles and responsibilities for LMP;
- Guiding document for contractors and site users on light management & monitoring;
- Ensure the construction works are conducted in a manner consistent with NParks requirement;
- Provide a framework to track, document and monitor environmental compliance to ensure full LMP compliance is achieved;
- Set out the monitoring frequency and procedures for environmental monitoring; and
- Define reporting and submission requirements.

1.2 Location of Night Works

Night works are planned to take place within Areas A1 to A5 (Figure 1-1).

2 LMP Roles and Responsibilities

The responsibility of the parties involved in the LMP should:

- Ensure that the LMP requirements are planned, implemented and maintained throughout the Project in accordance with the requirement by NParks;
- Implement the procedures on monitoring and measures the effectiveness of mitigation measures undertaken;
- Implement corrective or preventive action measures to eliminate non-compliance and incidences; and
- Ensure action is taken on light pollution issues.

The following sub-sections (below) provide the parties involved and their roles in the LMP.

2.1 Developer

The developer for this Project is the Housing and Development Board (HDB) and Surbana Jurong (SJ) is the consultant for HSB. The HDB Project Coordinator and Director, as well as the Consultant Project Coordinator shall be the point of contacts for this Project. More details can be found in the main EMMP document.

2.2 Contractor

The HDB-appointed contractor shall provide sufficient manpower and resources to implement the requirement of the LMP. The Contractor's Project Manager is the team leader responsible for the implementation of the LMP. Appropriate personnel should be appointed by the Contractor to look after all implementation and reporting. The ECO is to be stationed full time on site during the construction stage, and to assist the Project Manager in implementing the LMP.

The Contractor and ECO are also required to regularly liaise with the environmental consultant involved for monthly monitoring and site inspection. More details can be found in the main EMMP document.

1) Project Manager – TBC

- To ensure implementation of all LMP mitigation measures and monitoring procedures;
- To comply with environmental legislation and contractual requirements applicable to this Project;
- To carry out planning on all project activities throughout project planning, budgeting, execution and completion of LMP;
- To provide solutions of significant construction matters if his sub-ordinates are unable to decide;
- To liaise with Environment Consultant and Developer on environmental matters; and
- Keeping track of project costs and expenditures to implement the LMP.

2) Environmental Control Officer (ECO) – TBC

- Perform the role of ECO stipulated in the Code of Practise for Environmental Control Officers;
- Implement and monitor the LMP implementation on-site and recommend any monitoring and mitigation amendments to the plan where necessary to the environmental consultant;
- Assist the Project Manager in undertaking the Project in an environmentally sustainable manner;
- Train and educate all site personnel to work in a manner to respect the surrounding environment;

- Continually identify, report, record potential, and present environmental issues on-site to the Environmental Consultant;
- Limit/Stop any activities if potential/presenting environmental issues are identified until rectified;
- To report any environmental incidence to Environmental Consultant and provide support to address the incidence; and
- Inform LTA and environmental consultant in the event of an environmental emergency (e.g. trapped animals).

2.3 Environmental Consultant

The responsibilities of the Environmental Consultant are as follows:

- To ensure the implementation of the LMP by all parties;
- Provide a solution if any environmental issue arises;
- Ensure that the project team, subcontractors and site personnel understand and implement the LMP requirements;
- Provide input for environmental mitigation measures and monitoring requirements prior to any physical works;
- To advise all parties (e.g. Project Manager, Environmental Control Officer, Night Work Supervisor, Site Engineers, Site Supervisors, Subcontractors etc) on matters related to light management and promote awareness within site;
- Ensure the preparation and submission of LMP and monthly LMP reports to Contractor, Agency and TA is within a specified time frame;
- To ensure the monthly environmental inspection is carried out; and
- To liaise with Agency/TA on environmental matters.

3 Light Management Plan

The Light Management Plan (LMP) is prepared in accordance to NParks requirement and with reference from *National Light Pollution Guidelines for Wildlife by Australian Government – Department of the Environment and Energy* (Australian Government, 2020). The Contractor shall adhere to the following light management principles:

- **Minimise Disturbance to Wildlife:**
  - At the edge between construction site and forest, the Contractor should provide at least **10 m buffer (no task work light)** from the hoarding. This is not applicable for the 5 m access roads and ambient lights.
  - There should be no night work **at least 20 m radius** of active bat roosting site.
- **Direction:**
  - Light only the object or area intended - keep lights close to the ground, directed, and shielded to avoid light spill.
- **Duration*:**
  - Limit the hours of lighting – only use during specific times and at specific locations and will typically be provided by portable light units with manual switching.
  - Any illumination that is required for the equipment and machinery during operational times for safety to be switched off when it is not in use except for obstacle-avoidance lighting/safety purposes.
- **Localised Control*:**
  - Lights should not be centralised and should be able to be switched off when not required.

*Do note that duration and localised control only apply for the use of lights with colour temperature 5000K and above for all night construction activities. Ambient lights for the access road and footpath (colour temperature of 3000K and below) will be switch on every night when there are night works, beyond 12 midnight for the construction period.

3.1 Light Requirement

In general, lighting is required to provide a safe working environment. Lights will be illuminated at the construction site or area intended during night work (Task Lighting) and along the hoarding (Ambient Lighting). All lights will be close to the ground, directed and shielded to avoid light spill unless is inevitable due to safety reasons. There is no specific height for the task lights but will be subject to working requirements with a minimum hoarding height approved by NParks. Lighting for night works shall be situated in the work area such that a safe working environment is provided for the workers.

3.2 Ambient Light

Ambient lighting will be constant and typically provided to aid the safe access and will be placed along the hoarding. Ambient lighting will be switched on only at areas where works are conducted that evening. The following measures will be implemented for all ambient lighting:

- Warm white light with 3000 Kelvin (K) (refer Figure 3-1 below):

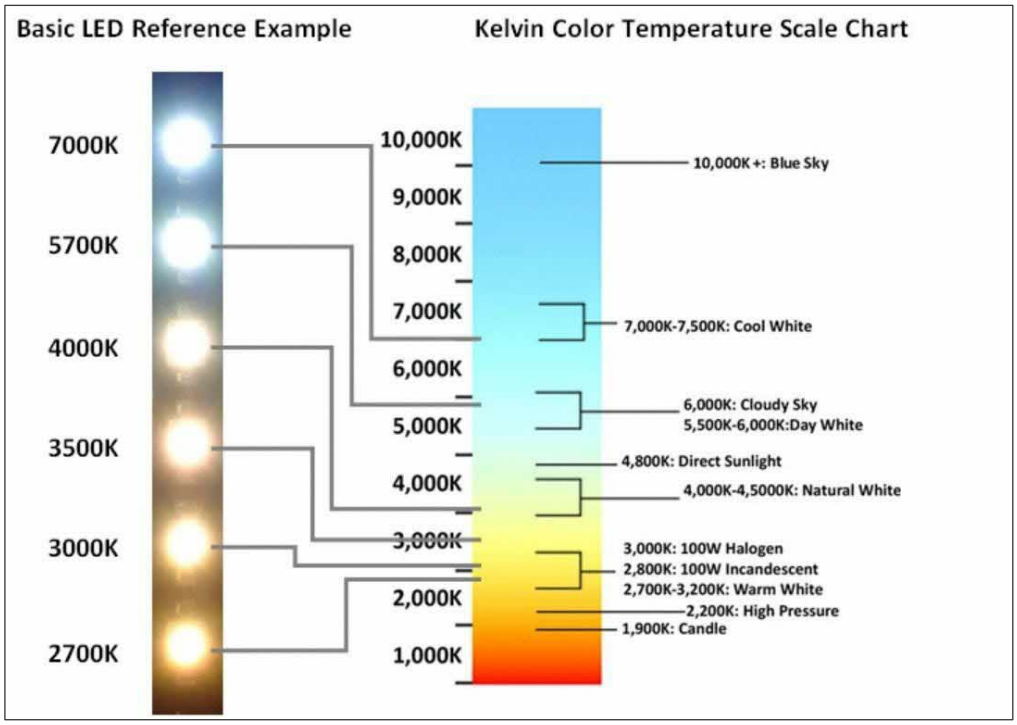

Figure 3-1 Colour Temperature of LED Light

- All light fittings should be directed or shielded (Figure 3-2) to avoid lighting anything but the target object or area except lighting for safety and security purpose.

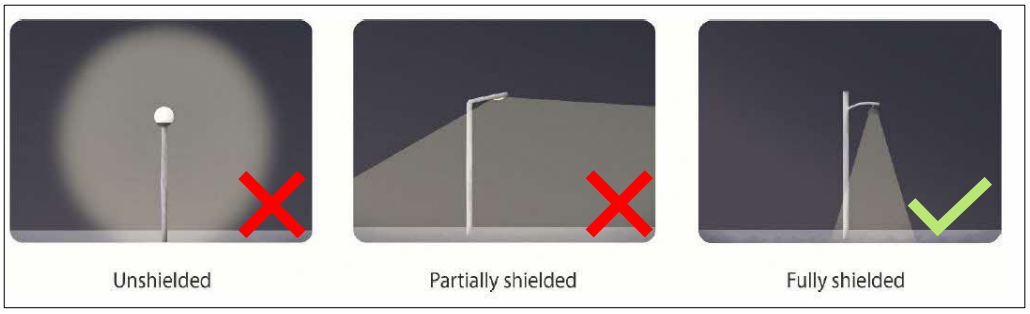

Figure 3-2 Recommended Light Fitting adapted from Witherington and Martin (2003)

- Ambient lighting should not exceed the height of hoarding (2.4 m). Use the possible lowest lighting where practicable except for safety and security purposes.
- Higher site hoarding should be installed in the vicinity of potential bat roosting site (if applicable).

The Contractor shall propose the ambient lighting to be used on site and provide the specifications. It has been confirmed with the supplier that the colour temperature will be 3000K. The Contractor shall indicate the specific lighting fixtures that are planned to be deployed within the Project site.

3.3 Task Light

Task lighting will be provided for night works and the required levels will vary depending upon the type of activity being undertaken. Higher lux level of average 100 lux is typically needed for a safe working environment. The task lights will have a colour temperature of 3000K. Task lighting is typically required only when work is required in a specific area, and the following measures shall be adopted for night works:

- Limit the hours of lighting – only use when required and utilise portable light units which will have manual switches;
- Localised control of lighting – lights should not be centralised and should be able to be switched off when not required; and
- Direct luminaires into the area to be lit (light from the boundary inwards).
- All task lights will point downwards, with **no more than 45 degrees** (Figure 3-3) to prevent light spill from the site.
- The maximum height of the task lights will not go higher than the hoarding.

Light pointing downwards at 0 degree.

Light pointing downwards at 45 degrees.

Figure 3-3 Example of Task lights pointing downwards at 0 degree and 45 degrees respectively

The Contractor shall also propose the appropriate task lights to be used on site and provide the relevant specifications. The Contractor shall only use 3000K light bulbs for the task light, unless otherwise approved with NParks. When the lights are in use, the lights will be pointing downwards and not shine over the hoarding to prevent light spill from the site. The Contractor shall also furnish the lighting layout plans that illustrate the different types of night work lighting to be deployed on site.

3.4 Night Work Activities

The following construction night works will be carried out concurrently within the time periods proposed by the Contractor and are expected to continue beyond the normal stipulated hours of 8 am – 6 pm. Below are some examples of night works to be conducted:

- Excavation Until 8:00 pm
- Piling Until 10:00 pm
- Pipe laying Until 10:00 pm
- Rebar installation Until 8:00 pm

With reference to the layout plan above (Figure 3-4), not all ambient and task lights will be switched on at the same time. For example, only smaller subsections in Area A1 will have their lights switched on, dependent on the type and location of night works planned for that night.

4 Implementation of Light Management Plan

4.1 Training of Site Personnel

All site personnel shall be briefed on the Lightning Management Plan to ensure that they are aware of the site requirements.

4.2 Close Supervision

All site supervisors shall ensure that the Light Management Plan is followed. They should plan their daily work activities and minimize night work. If night works are to be conducted, supervisors are to ensure that all lights do not point at the forested areas and should be turned off immediately after work is completed.

4.3 Night Work Audit

Monthly audits will be undertaken to assess the effectiveness of mitigation measures and for contractor to held accountable of the implementation of the LMP. A monthly night work audit will be conducted at night by the EMMP consultant. The monthly findings on the light management will be incorporated in the existing monthly EMMP compliance report. The following checklist in Table 4-1 will used during the night work audit.

Table 4-1 Sample Checklist for Night Work Audit

Location/Zone:		**Date:**		
No.	**Environmental Inspection Items**	**Verification**	**Observation(s)** (State specific locations of observed non-compliance)	**Follow-up action(s)**
1	Are works being done correspond to the night works schedule?			
2.	Is ambient lighting in the observed area directed or shielded to avoid lighting spill?	-	-	-
3.	Is lighting exceeding the height of noise barriers or hoarding?	-	-	-
4.	Any observation of task lighting for the construction of viaduct/other construction works? Is the illumination necessary for the specific task?	-	-	-
5.	Any observation of bat roosting site?	-	-	-
6.	Is task lighting able to be switched off when not required?	-	-	-
7.	Any illuminated crane/machinery that is not in use?	-	-	-
8.	Any other observations?	-	-	-

4.4 Corrective Action

Corrective actions must be undertaken where mitigation measures or validated complaints indicate the environmental outcomes or Imposed Conditions are not achieved in relation to particular works, because the mitigation measures have not been implemented. Where corrective actions become necessary, the specific works that do not achieve the environmental outcomes or meet the Imposed Conditions must cease (at the immediate area only) until the corrective actions have been developed and implemented.

4.5 Communication

The environmental consultation will prepare a presentation to highlight the mitigation measures required from the LMP in an easily understandable manner with graphics and important information for site personnel including site supervisor and workers. This will be presented prior to the commencement of night works.

5 References

Australian Government. (2020). National Light Pollution Guidelines for Wildlife (p. 111). https://www.dcceew.gov.au/sites/default/files/documents/national-light-pollution-guidelines-wildlife.pdf

NParks (2024). Light management in night works. National Parks Board Biodiversity Impact Assessment (BIA) guidelines | Technical notes. Retrieved from: https://www.nparks.gov.sg/-/media/urban-biodiversity/technical-note_light-management-(may-2024).pdf

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Appendix D – Wildlife Incident Form

Wildlife Incident Form

Incident Information

Date of Incident: _____

Time of Incident: _____

Location of Incident: _____

Project Name: _____

Reported By (Name): _____

Contact Number: _____

Type of Incident (check all that apply)

- ☐ Trapped Animal
- ☐ Injured Animal
- ☐ Dead Animal
- ☐ Dangerous Animal
- ☐ Other (please specify): _____

Description of the Incident

- ☐ **Species Identified:** _____
- ☐ **Number of Animals Involved:** _____

Condition of Animal(s) (check one):

- ☐ Healthy
- ☐ Injured
- ☐ Deceased
- ☐ Unknown

Detailed Description of the Incident:

_____

_____

_____

Response Actions Taken

Actions Taken:

Was Wildlife Response Plan Activated?

- ☐ Yes
- ☐ No
- ☐ If yes, please specify the actions taken: _____

Additional Notes

Photographic Evidence (if applicable):

- ☐ Yes (attach photos)
- ☐ No

Further Actions Required:

Reporting

Name of Person Completing Form: _____

Position: _____

Date of Form Completion: _____

Signature: _____

Appendix E – Environmental Incident Form

Environmental Incident Form

Incident Details

Incident Report Number: _____

Date of Incident: _____

Time of Incident: _____

Location of Incident: _____

Reported By: _____

Contact Information: _____

Type of Incident (Please tick applicable category):

- ☐ Spillage
- ☐ Leakage
- ☐ Release of Hazardous Substances
- ☐ Waste Management Incident
- ☐ Environmental Damage
- ☐ Other (please specify): _____

Description of Incident

Please provide a detailed description of the incident, including what happened, how it happened, and the substances involved:

_____

_____

_____

_____

Immediate Actions Taken

Please outline any immediate actions taken to mitigate the incident (e.g., containment, notifications, clean-up):

_____

_____

_____

Environmental Impact

Please describe any known or potential environmental impacts as a result of the incident:

_____

Witnesses

Please provide names or contact information for any witnesses to the incident:

Photographic Evidence

Please attach photographs documenting the incident. Include descriptions of each photograph below:

1. Photo 1 Description: _____
   [Insert Photo Here]
2. Photo 2 Description: _____
   [Insert Photo Here]
3. Photo 3 Description: _____
   [Insert Photo Here]

Follow-Up Actions Required

Please outline any follow-up actions necessary (e.g., further investigations, reporting to authorities, monitoring):

Additional Notes

Any other relevant information about the incident can be noted here:

Sign-Off

Completed By: _____

Signature: _____

Position: _____

Date: _____

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