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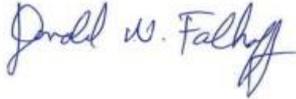
PROPOSED DEVELOPMENT AT HDB EASTERN

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN (EMMP) FOR HDB DEVELOPMENT (EASTERN)

Job No: SO00797-1 Rev 7

HOUSING DEVELOPMENT BOARD

**480 Lorong 6 Toa Payoh
Singapore 310480**

Company Details: Singapore Environmental Consultancy and Solutions Pte Ltd 1 Sunview Road, #08-66, Eco-Tech @ Sunview, Singapore 627615 Tel: +65 6471 3316 www.secs.sg																													
Client Housing Development Board (HDB)		Client's Representative Mr Siah Tiong Shie																											
Report Title Environmental Management and Monitoring Plan (EMMP) for HDB Development (Eastern)		Project Title: Proposed Development at HDB Eastern																											
Authors  Shawn Adrian Tan Environmental Engineer	 Yew Min Terk Senior Environmental Engineer	Approved by  Donald Folkoff Director (Environmental)																											
Job Number: SO00797-1																													
Distribution: HDB, NParks, Contractors																													
Revision History: <table border="1"> <thead> <tr> <th>Revision</th> <th>Date</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Rev 0</td> <td>31/03/2023</td> <td>For review and approval</td> </tr> <tr> <td>Rev 1</td> <td>01/06/2023</td> <td>For review and approval</td> </tr> <tr> <td>Rev 2</td> <td>19/07/2023</td> <td>For review and approval</td> </tr> <tr> <td>Rev 3</td> <td>08/08/2023</td> <td>For review and approval</td> </tr> <tr> <td>Rev 4</td> <td>18/10/2023</td> <td>For review and approval</td> </tr> <tr> <td>Rev 5</td> <td>31/10/2023</td> <td>For review and approval</td> </tr> <tr> <td>Rev 6</td> <td>27/12/2023</td> <td>For review and approval/ Publication</td> </tr> <tr> <td>Rev 7</td> <td>22/01/2024</td> <td>For review and approval/ Publication</td> </tr> </tbody> </table>			Revision	Date	Description	Rev 0	31/03/2023	For review and approval	Rev 1	01/06/2023	For review and approval	Rev 2	19/07/2023	For review and approval	Rev 3	08/08/2023	For review and approval	Rev 4	18/10/2023	For review and approval	Rev 5	31/10/2023	For review and approval	Rev 6	27/12/2023	For review and approval/ Publication	Rev 7	22/01/2024	For review and approval/ Publication
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1. Introduction

The Environmental Management and Monitoring Plan (EMMP) is prepared for the proposed development (hereinafter referred as “the Project”) within Pasir Ris town in the east of Singapore. The Project is divided into two main developing areas, Area A – for Infrastructure works, and Area B – for Residential Housing Development (Figure 1-1). In addition, the Project consists of three phases (Phases 1A, 1B & 2). Phase 1A comprise the development of Infrastructural works for future roads, drainages, sewers, services laying, and road related facilities. Phase 1B comprise the Site Clearance, Earthwork, and Site Investigation Works. Lastly, Phase 2 would comprise building construction of future residential buildings within the land plot. This EMMP aims to cover the differing construction methodology and address related environmental impacts of all phases.

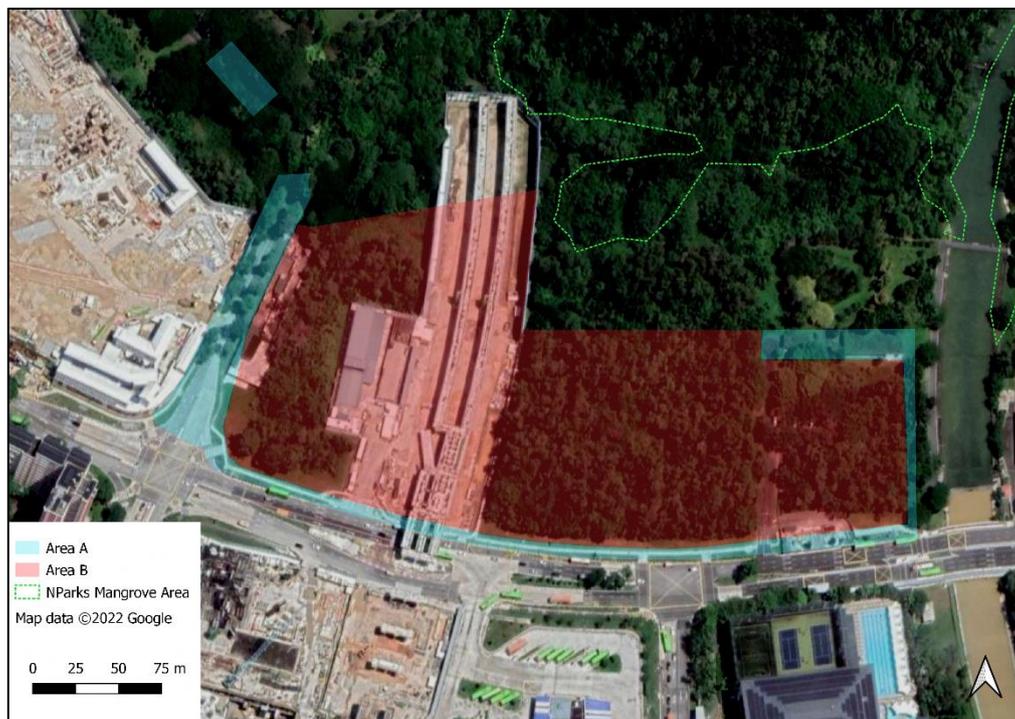


Figure 1-1. Project area for HDB Eastern development.

The key infrastructures surrounding the development are briefly listed below to highlight the proximity of any sensitive receptors, as reflected in Figure 1-2. The Project area is bounded by various infrastructures. Pasir Ris Park and Pasir Ris Mangrove are located at the north side of the Project area. In the west, the Project is adjacent to Pasir Ris Green, and the neighbouring Housing Development Board (HDB) Build-to-Order (BTO) residential project “Costa Grove”, which is under construction. In the south, the Project is bounded by Pasir Ris Drive 3, a heavily utilised 6-lanes vehicular road. Also in the south, various residential HDB blocks and communal infrastructures are located. This includes the Temporary Bus Interchange, Pasir Ris Mass Rapid Transport (MRT) Station, and the mixed-use

development, Pasir Ris Mall and Pasir Ris 8 under construction. In the east, the linear park with Park Connector Network (PCN) and various greenery allow for seamless movement into Pasir Ris Park by pedestrians and cyclist alike. The PCN lies directly adjacent to Sungei Tampines, a canal which connects directly to the sea further north.

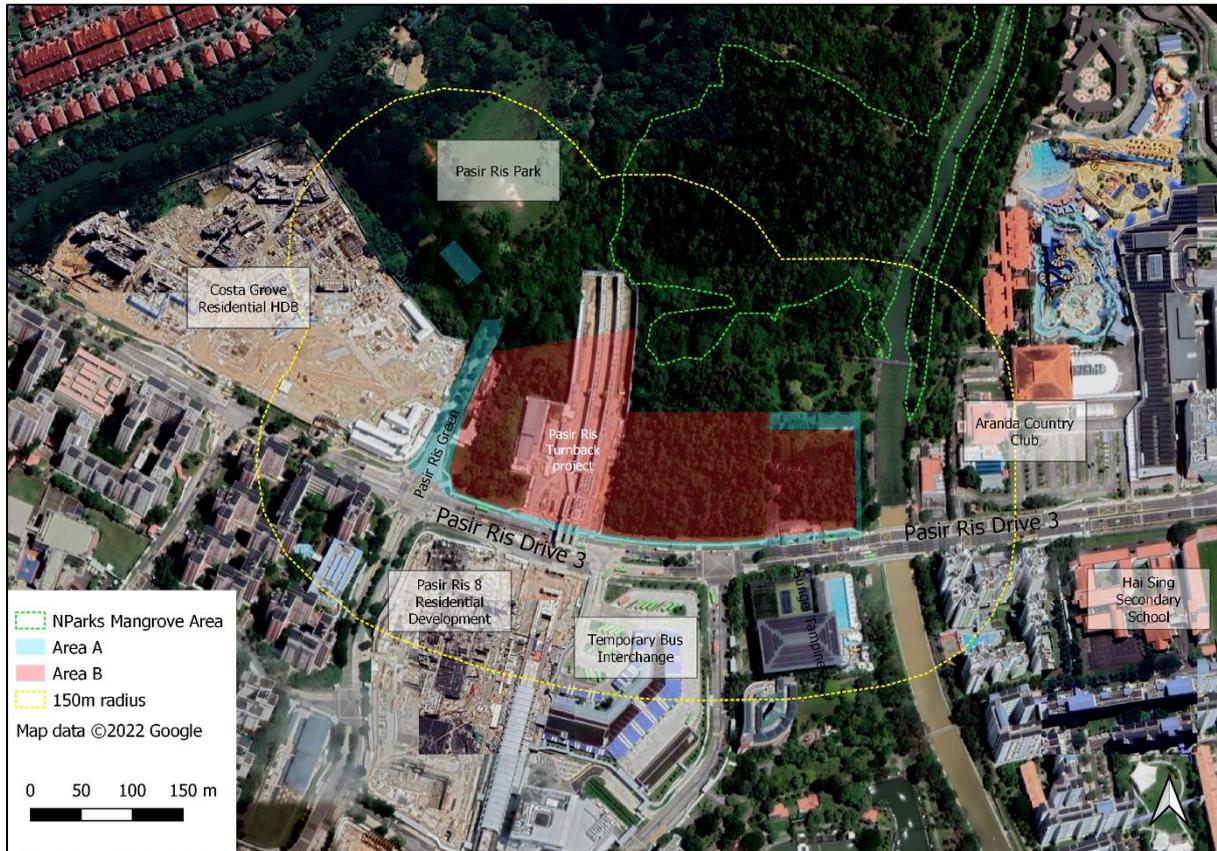


Figure 1-2. Infrastructures around HDB Eastern development.

Currently, the existing construction of Land Transport Authorities (LTA) Pasir Ris Turnback project overlaps with the HDB Eastern development Project work area. The Pasir Ris Turnback project is expected to be completed before commencement of Phase 2 of this Project.

An Environmental Impact Study (EIS) was completed in April 2019 by Ramboll Environ Singapore Pte Ltd (2019), which saw the proposed land parcel adjusted to better reduce the impact on the neighbouring mangrove, as illustrated in Figure 1-3. Singapore Environmental Consultancy and Solutions Pte Ltd (SECS) has been appointed by the Housing & Development Board (HDB) as the EMMP consultant to oversee the implementation of EMMP during construction stage.

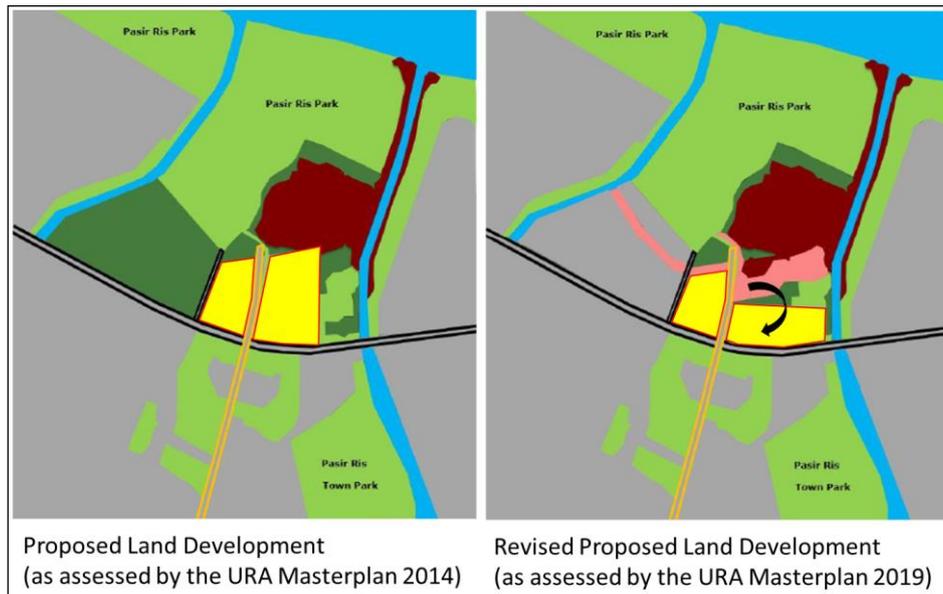


Figure 1-3. Adjusted land parcel, extracted from the recent EIS (2019)

1.1 Site History

Pasir Ris was originally a low-lying area with stretch of white beaches. It supported several villages (i.e., Kampung Pasir Ris, Kampung Bahu), and plantation estates (i.e., Singapore United Plantations, Loh Lam Estate). The plantations comprised crops such as coconuts and “tempinis” trees. The current mangrove along Sungei Tampines was larger, extending as far as Tampines Expressway (TPE). From the 1950s to 1970s, Pasir Ris beach area was a popular resort for gatherings which saw the area develop further. In 1978, land reclamation of the coastal area began, which saw the extent of the mangrove change. Similarly, realignment of the nearby Sungei Api Api and Sungei Tampines began. By the 1990s, the current-day use of the area as a public park was established. Since 2002, the mangrove forest within Pasir Ris Park has been designated as a ‘Nature Area’ under URA’s Parks and Waterbodies Plan. As such, the Project area has remained relatively untouched as the surrounding area developed.

1.2 Sensitive Receptors

Existing sensitive receptors within close proximity of the site within this EMMP have been identified. These receptors have been identified within the EIS and have also been updated to reflect the current site conditions. Possible sensitive receptors within a 300m buffer, from the Project, were thus identified. Some legislative requirements, such as the Environmental Protection and Management (Control of Noise at Construction sites) Regulations (2008) have varying regulatory limits specific to varying site conditions. In addition, understanding the various sensitive receptors surrounding the Project, specific mitigation and monitoring measures can be developed. Section 5.3 and Section 6.0 are thus developed based on the consideration of the various receptors surrounding the development.

Table 1-1. Sensitive receptors within proximity of the proposed development

Categories	Sensitive Receptors
Parks and Green Spaces	Pasir Ris Park (0m) Pasir Ris Mangrove (5m) Pasir Ris Town Park (200m)
Residential	Future Costa Grove HDB development (5m) Future Paris Ris 8 development (40m) HDB cluster Blk 570 to 580 (60m) East Vale Condominium (100m) HDB cluster Blk 500 to 521 (200m) HDB cluster Blk 405 to 421 (220m) Riverina residential area (300m)
Schools and Training Facilities	Hai Seng Secondary School (250m) Elias Park Primary School (300m)

1.3 Project Description

The Project development area is divided into Area A and Area B. Due to differing existing conditions of the site: Area A and B, the development is separated into two distinct phases: Phase 1 and Phase 2.

Phase 1

The first phase (Phase 1) includes development of supporting infrastructures within Area A (Phase 1A), and also land preparation of Area B (Phase 1B). The latter includes vegetation clearance and levelling earthworks.

Currently, the existing Pasir Ris Turnback Project partially occupies Area B of the Project. During the initial phase – Phase 1B, development within Pasir Ris Turnback project would continue and remain separated. During which, the Project site would commence vegetation clearance and levelling earthworks within the remaining Area B. The Pasir Ris Turnback project would complete before the start of Phase 2 of the Project. The land would be systematically handed over to HDB. No night work is expected for Phase 1.

Phase 2

After which, Phase 2 – development of future residential units, would commence. As a result, work boundary of Area B for both phases: Phase 1B and Phase 2, differs. The former would exclude developmental areas of the Pasir Ris Turnback project, while the latter includes the entirety of Area B. Phase 1A remains limited to Area A.

The work zones and details of construction works for each of the project phases are summarised in the table below:

Table 1-2. Summary of Construction Objectives

Sequence	Work Zone	Construction Objectives	Estimated Duration
Phase 1A	Area A	Infrastructure works: <ul style="list-style-type: none"> • Construction of drop-off point • Road widening • Construction of drainages • Services laying • Construction of sewer lines 	Q1 2024 till Q4 2024
Phase 1B	Area B* (*except for the area within Pasir Ris Turnback Project)	Land Preparation works: <ul style="list-style-type: none"> • Site Clearance • Earthworks • Site Investigation 	

Sequence	Work Zone	Construction Objectives	Estimated Duration
Phase 2	Area B	Building of residential housing development	Q4 2024 till Q4 2029

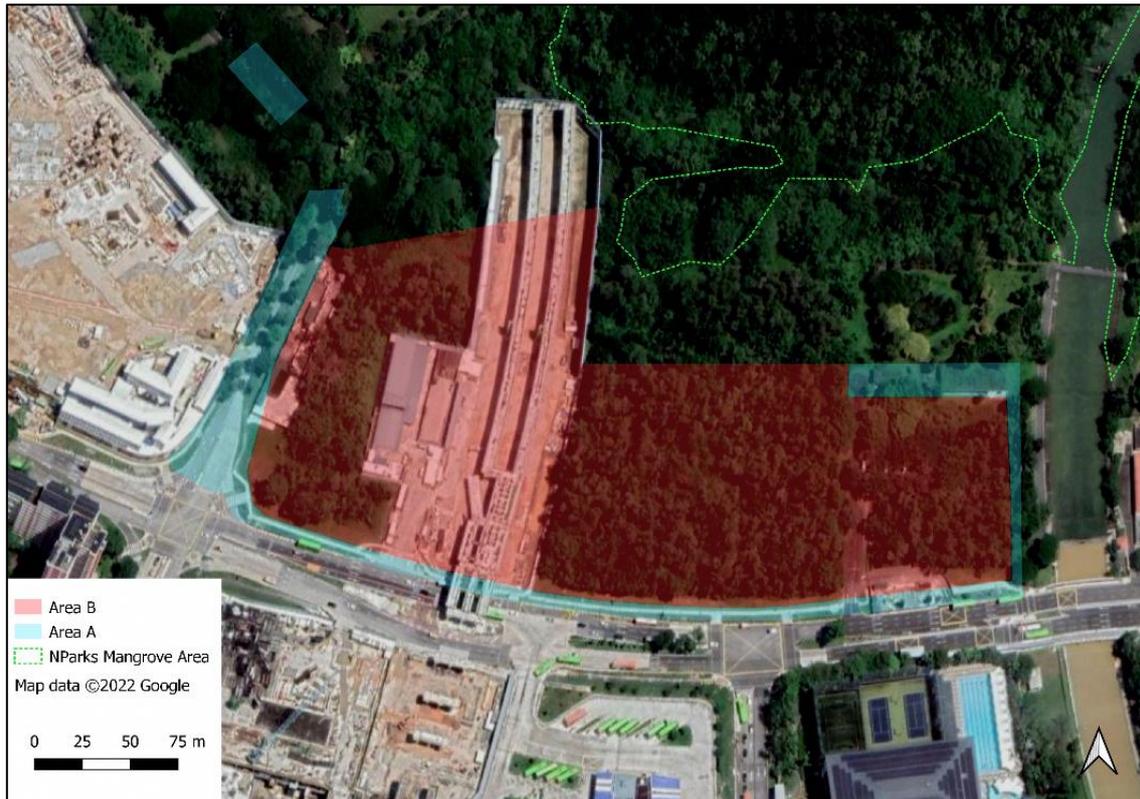


Figure 1-4. Demarcation of Area A and Area B

Area A – Infrastructure Works

Area A comprise infrastructure works such as construction of a drop-off porch, drains, sewers, road widening, and laying of services for existing facilities. Area A has an estimated total work area of 13,000 m² (1.3 hectares). This includes the work area within Pasir Ris Carpark C which is about 900 m² (0.09 hectares). The detailed information is further described below.

Construction of a drop-off porch within Pasir Ris Carpark C

This satellite work area is not connected to the larger Area A development. The work focuses on converting existing carpark lots of Pasir Ris Carpark C into a sheltered drop-off point, which may require removal of several trees. The construction of a new drop-off porch also serves as a replacement to the existing drop-off porch near Pasir Ris Carpark B which will be affected by the development works. The site is illustrated below, Figure 1-5.



Figure 1-5. Construction of drop-off porch, part of Phase 1A (photo taken on 05/02/23)

Road widening of existing Pasir Ris Green

Pasir Ris Green is an existing 2-lane road within Area A. The development work involves the widening of Pasir Ris Green by 1 additional vehicular lane to create a left-turning storage lane from Pasir Ris Green to Pasir Ris Dr 3 near the existing traffic junction. In tandem with the road widening works, a 2m wide cycling path and a 1.8m widened footpath will be constructed along Pasir Ris Green. To serve the new housing developments, a new pedestrian crossing with covered linkway will be constructed at Pasir Ris Green. The site current conditions are illustrated below, Figure 1-6.



Figure 1-6. Road widening of Pasir Ris Green, part of Phase 1A (photo taken on 05/02/23)

Construction of various drainages along Pasir Ris Green

This work consists of construction of covered drains along one side of Pasir Ris Green. Along Pasir Ris Green, the works include removal of the existing open drains along Pasir Ris Green and footpath, and construction of a covered drain and new footpath. The site current conditions are illustrated below, Figure 1-7.



Figure 1-7. Construction of covered drains, part of Phase 1A (photo taken on 05/02/23)

Laying of services and construction of service road

The work includes diversion of general services (i.e., water pipe, sanitary line, power cables) that currently serve the existing park facilities near Pasir Ris Carpark B. As the expected works within Area B would impact these services, the services would be diverted and laid around the perimeter of Area B, allowing for the park facilities to continue operations during all phase of the construction. Similarly, an existing NParks service road used for parks maintenance would also be diverted to take access off the park connector located on the eastern side of the park. The site current conditions are illustrated below, Figure 1-8.



Figure 1-8. Laying of services and construction of service road, part of Phase 1A (photo taken on 05/02/23)

Construction of Sewer Lines along Pasir Ris Drive 3

This work consists of construction of sewer lines along Pasir Ris Drive 3. The development lies within the road reserve of Pasir Ris Drive 3. Although no tree felling is expected, some streetscape flora may be impacted by the works. Eight (8) temporary construction shafts are proposed along the permanent sewer manhole located along Pasir Ris Drive 3. The installation of sewer pipes would be carried out via pipe-jacking method between temporary construction shafts, thereby reducing the affected ground area. Permanent sewer manholes are constructed within the temporary shafts with manhole access openings installed above ground level after the completion of pipe-jacking works, The site current conditions are illustrated below, Figure 1-9.



Figure 1-9. Construction of sewer and drains, part of Phase 1A (photo taken on 05/02/23)

Area B – Site Clearance, Earthworks and Future Residential HDB Development

Area B comprise the site clearance, earthworks and construction of the future residential housing development. Area B has an estimated total work area of 53 000 m² (5.3 hectares). The detailed information is further described below:

Site Clearance, Earthworks, and Detailed Site Investigation

These works are carried out during Phase 1B within the available areas of Area B not occupied by the existing Pasir Ris Turnback project. As Area B is bisected by the Pasir Ris Turnback project, two (2) separate construction access would be required for the works within both halves of Area B. For the sub-plot located in the west; the construction access is expected to be located along Pasir Ris Green. For the sub-plot in the east: the access is expected to be off Pasir Ris Drive 3. The existing vegetation within the land plot would be cleared directionally from South to North, followed by topping-up of the platform levels by approximately 0.6m from the current levels of 4.9m Singapore Height Datum (SHD) to 5.5m SHD. In addition, site investigation works would be carried out to obtain geotechnical information about the ground condition to facilitate foundation design of the buildings. The development boundary of Phase 1B is illustrated below, Figure 1-10.

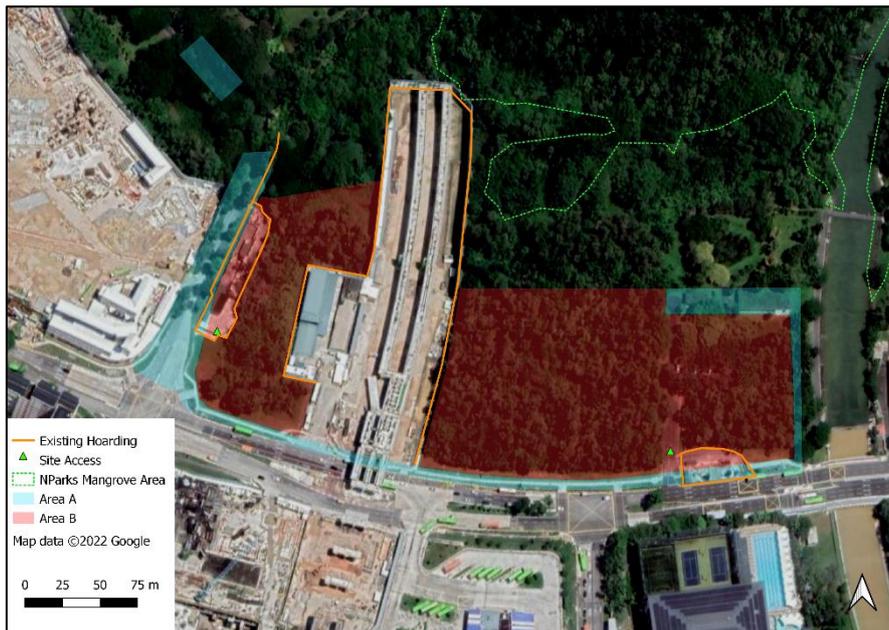


Figure 1-10. Area B separated by the neighbouring LTA project in the middle

Residential Housing Development

These works are within Area B and would commence in Phase 2, which is expected after the end of Phase 1B and the Pasir Ris Rail Turnback Project. The works include the construction of multi-storey residential housing blocks, carparks, commercial facilities, and supporting infrastructures. Agencies are exploring the provision of a proposed footpath along the Pasir Ris Rail Turnback to replace an existing footpath which provides direct connectivity for pedestrians from Pasir Ris Drive 3 into Pasir Ris Park. Night works are expected in Phase 2. The details of the housing development construction works are still being developed and a Light Management Plan will also be provided before Phase 2 works commence. The site current conditions are illustrated below, Figure 1-11 and Figure 1-12.



Figure 1-11. Current site condition, Area B (photo taken on 05/02/23)



Figure 1-12. Current site condition, Area B (photo taken on 05/02/23)

1.4 EMMP Objectives

An EMMP has been proposed as part of the Environmental Impact Study (EIS) for the project. This document serves to reiterate the EMMP proposed along with all the mitigation measures proposed for the construction stage. It serves the following objectives:

- a) Define roles and responsibilities for environmental management;
- b) Guiding document for contractors and site users on environmental management & monitoring;
- c) Ensure all construction activities are conducted in a manner consistent with Wildlife Act, Section 10;
- d) Ensures proper and effective mitigation measures are taken with proper monitoring during the construction phase.
- e) Provide a framework to track, document and monitor environmental compliance with statutory and contractual requirements and to ensure full EMMP compliance is achieved;
- f) Set out the monitoring frequency and procedures for environmental monitoring;
- g) Define reporting and submission requirements;
- h) Establish emergency response procedures for environmental incidents, including roadkill, trapped animal found at site and ensure effective corrective action is taken.

2. Environmental Roles and Responsibilities

The responsibility of the parties involved in the EMMP should:

- Ensure that the EMMP requirements are planned, implemented and maintained throughout the project in accordance with the regulations drawn by the relevant authorities;
- 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 environmental pollution issues;

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

2.1 Developer

The developer for this Project is Housing & Development Board (HDB). The developer should regularly liaise with the Project Management to review all compliances status during the implementation. The developer is available to reach at their correspondence below:

Table 2-1. Developer

	Organisation Name / Address
 HOUSING & DEVELOPMENT BOARD	Housing & Development Board (HDB) HDB Hub 480 Lorong 6 Toa Payoh, Singapore 310480

2.2 Contractor

The contractor should provide sufficient manpower and resources to implement the requirement of the EMMP. The contractor's Project Manager is the team leader responsible for the implementation of the EMMP. Appropriate personnel should be appointed by the contractor to look after all implementation and reporting (refer to Appendix II for Contractor's Organisational Chart). The contractor is also required to regularly liaise with the environmental consultant involved for monthly monitoring and site inspection.

Table 2-2. Main Contractor

	Organisation Name / Address
 大方圓土木工程私人有限公司 WFY CIVIL ENGINEERING PTE LTD	WFY Civil Engineering Pte Ltd 81 Ubi Avenue 4 #08-11 Singapore 408830

- 1) Project Manager – Mr Zhuang Xiang Lin (9083 6623)
 - 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 of significant construction matters their sub-ordinates are unable to decide;
 - To liaise with EMMP Consultant (SECS) and Developer on environmental matters; and

- 2) Environmental Control Officer (ECO) – Mr Durai (9180 9712)
 - Adhere to all legal, environmental requirements (listed in Chapter 3);
 - Perform the role of ECO stipulated in the *Code of Practise for Environmental Control Officers*;
 - Implement and monitor the EMMP 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 HDB and EMMP consultant in the event of an environmental emergency (e.g., oil/chemical spill).

2.3 EMMP Consultant

The EMMP Consultant includes the Consultants which provides technical knowledge on the mitigation and monitoring measures pertaining to EMMP. The EMMP Consultants also includes an Environmental Control Officer (ECO) who will be stationed full time on site and will report directly to the Superintending Officer (SO) during construction stage.

The responsibilities of the EMMP Consultant (Mr Yew Min Terk – 8339 6569) are as follow:

- To ensure the implementation of the EMMP by all parties;
- Provide a solution if any environmental issue arises;
- 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, Site Engineers, Site Supervisors, Subcontractors etc) on matters related to environmental management and promote awareness within site;
- Ensure the preparation and submission of EMMP to Developer and Agencies is within a specified time frame;
- To ensure the monthly environmental inspection is carried out; and
- To liaise with Agencies on environmental matters.

.2) The responsibilities of the ECO (Mr Kang Rui Yuan – 8305 3805) are as follow:

- Support the SO as an environmental advisory role;
- Conduct environmental site inspections;
- Conduct environmental performance audits;
- Review environmental monitoring and management regime;
- Review implementation of environmental protection measures; and
- Advise remediation actions for contingency scenarios.

The contact detail of the EMMP Consultant is provided below:

Table 2-3. EMMP Consultant

	Organisation Name / Address

3. Environmental Legislations

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

3.1 Biodiversity

The main legislations enforced relevant to the protection, preservation and management of biodiversity within Singapore is the *Parks and Trees Act 2020* (Table 3-1), and the *Wildlife Act 2020* (Table 3-2).

Parks and Trees Act

The *Parks and Trees Act* has been passed since 2005. Its inclusion 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 even Heritage Road Green Buffer.

Table 3-1. Summary of Parks and Trees Act

Activity	Applicable Section	Legal Requirement	Penalty
No cutting or damaging of tree having girth of more than one metre	14	<i>A person must not, except with the approval of the Commissioner under section 20 and in accordance with the terms and conditions of such approval, cut any tree with a girth exceeding one metre growing on —</i> (a) <i>any tree conservation area;</i> <i>or</i> (b) <i>any vacant land (whether within or outside a tree conservation area).</i>	<ul style="list-style-type: none"> • <i>fine not exceeding \$50,000</i>
Application for approval to cut trees and plants, etc.	20	<i>An application for an approval to carry out or cause the carrying out of any activity mentioned in section 14(1), 18(1) or 19(1) must be —</i> (a) <i>made to the Commissioner in such manner as may be prescribed; and</i> (b) <i>accompanied by such non-refundable</i>	-

Activity	Applicable Section	Legal Requirement	Penalty
		<i>application fee as may be prescribed.</i>	

Wildlife Act

The *Wildlife Act* has been enforced since June 1, 2020. The following table provides the summary of relevant section to this project based on the current version. New site personnel will be briefed on the relevant legal requirement and penalty from the *Wildlife Act* during the Biodiversity Awareness Briefing, prior to implementation of any physical work at site.

Table 3-2. Summary of Wildlife Act 2020

Activity	Applicable Section	Legal Requirement	Penalty
Feeding of wildlife	5A	<i>A person must not intentionally feed any wildlife in any place unless the person has the Director-General's written approval to do so</i>	<ul style="list-style-type: none"> • 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	<i>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.</i>	<ul style="list-style-type: none"> • 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	<i>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</i>	<ul style="list-style-type: none"> • 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. EIS / Pre-Construction Baseline Findings

This EMMP document was prepared based on the Environmental Impact Study (EIS) by Ramboll Environ Singapore Pte Ltd in 2019. The EIS highlights development works for the area, which includes both residential and transportation development. The study area relative to the Project area is reflected in Figure 4-1.



Figure 4-1. EIS Study Area conducted in 2019.

The EIS assessed the nature and extent of the environmental impacts arising from the constructions and operation of now Pasir Ris Turnback Project, and future residential housing projects (“the Project”) (refer to Annex I for a Non-Technical Summary of the EIS).

4.1 Flora Survey

As the EIS was conducted in 2019, the baseline of specific parameters was updated. The results are also presented below:

4.1.1 EIS Findings

Based on the EIS conducted by Ramboll Environ Singapore Pte Ltd (2019), a detailed flora field survey was conducted between September 2016 and January 2017. The flora survey consisted of nine (9) 20 x 20m site survey plots, as well as walking / roaming transects. The aim of the flora survey was to establish a detailed habitat map, assess regeneration trajectory of the forests, and a flora inventory of the area. The GPS coordinates of large trees of conservation significance were also recorded.

The habitat map highlighted the Project area consisted mainly of Exotic-dominated secondary forest, and Urban Vegetation. The Project site is made up of Woodlands, Exotic-dominated secondary forest, Managed Vegetation, Marshland, and Herbaceous Vegetation. This was expected as the land was previously used for cultivation and have since been left untouched. Refer to Figure 4-2 below for habitat map and Table 4-1 for habitat proportion.

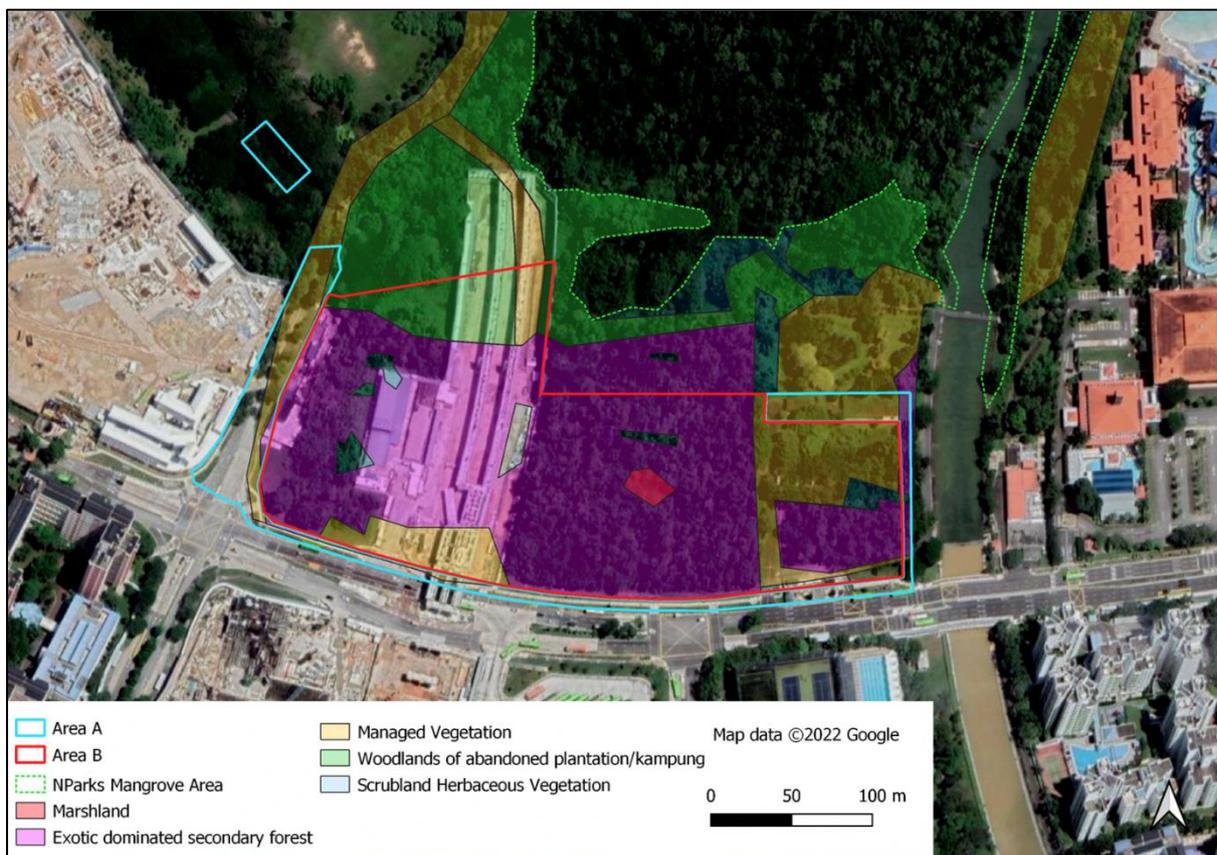


Figure 4-2. EIS Flora Habitat, extracted from recent EIS dated 11/04/2019

Table 4-1. Habitat proportion, extracted from recent EIS dated 11/04/2019

Vegetative Habitat	Estimated Area within the Project (m ²)
Managed Vegetation	13,000
Woodlands of abandoned plantation / kampung	4,000
Exotic-dominated secondary forest	39,500
Marshland	440
Scrubland Herbaceous Vegetation	1,800

This EMMP serves to identify potential species of concern identified within the EIS.

A total of 13 floral individuals of conservation significance (CS) were identified to be within the Project site. The coordinates are extracted from the EIS and compared against the Project boundary. The 13 flora individuals identified comprised four (4) species: *Glochidion lutescens*, *Licuala spinosa*, *Oxyceros longiflorus*, and *Planchonella obovata*. The conservation status of these species can be referred to the table below.

Table 4-2. EIS Flora Species of Conservation Significance within the Project site

Family	Scientific Name	Status	IUCN
Phyllanthaceae	<i>Glochidion lutescens</i>	Native	CR
Arecaceae	<i>Licuala spinosa</i>	Native	VU
Rubiaceae	<i>Oxyceros longiflorus</i>	Native	VU
Sapotaceae	<i>Planchonella obovata</i>	Native	VU

One (1) *Garcinia hombroniana* lie about 5m away from the northern boundary of the Project. This species is native, and has an IUCN status of Endangered (EN). However, this CS species lie outside the development site and would unlikely be removed. The locations of CS species are highlighted in Figure 4-3, together with other flora of conservation significance.

Similarly, two (2) large *Ficus microcarpa* (marked in purple) were identified within the EIS. Both of which lie outside the Project boundary.

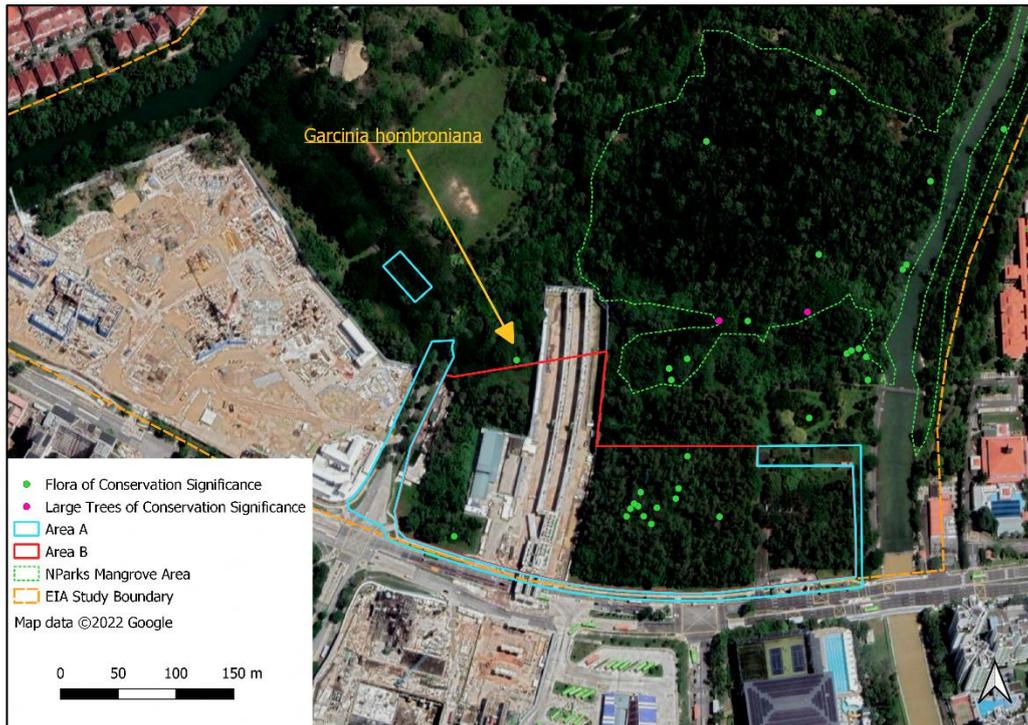


Figure 4-3. EIS Flora of conservation significance, extracted from recent EIS dated 11/04/2019

The EIS survey documented 41 unique flora species within the mangrove. Among these, 27 are true mangrove species, eight (8) are non-mangrove specific species. There are six (6) more true mangrove species but were not recorded within the EIS survey. Further elaborating, 28 species were trees, 10 were herbs, and 3 were climbers. Despite the small area, Pasir Ris mangrove has 33 of the 35 mangrove species found in Singapore.

The EIS also surveyed and documented the non-mangrove vegetation. A total of 141 species were recorded. 67 species were trees, 50 were herbs, and 24 were climbers. Exotic plants comprised 50% of the plants recorded, while 44% were native. The remaining were cryptogenic.

In addition, the EIS also suggested and explored the possibility of vegetative buffer. Vegetated buffer areas of 20m and 40m were adopted between the development boundary and Pasir Ris Park to protect and enhance the conservation value of the mangrove area. It is also aimed at retaining a corridor of woodland to allow for continued utilisation and passage of wildlife through the area. The wildlife corridors are considered necessary to maintain the existing local ecosystem connectivity between Sungei Api Api and Sungei Tampines, as well as the connectivity along the coastal woodland habitat on mainland Singapore. As such, the buffer area is situated along the northern boundary of Project area, and underneath the Rail Viaduct (also referred to as Pasir Ris Turnback Project) after construction. The specifics of the buffer can be referred to in the EIS.

4.2 Fauna Survey

4.2.1 EIS Findings

The EIS baseline encompasses the portion of the proposed development within this EMMP. However, due to the motile function of most fauna wildlife, the fauna information would not be extracted based on the development area. Instead, the fauna information used is intended to be relevant to this EMMP.

The faunistic field assessment was conducted between November 2016 and December 2016. This amounted to a total of 2 months of targeted field surveys. The study aims to determine the faunal diversity (i.e., birds, mammals, reptiles, amphibians, butterflies, odonates) of the site and the surrounding environment. The summary of the survey timings and methods are included in 3.

The fauna survey involves diurnal and nocturnal field surveys. All terrestrial fauna surveys were conducted via visual and/or auditory encounter, with aid of a binoculars and torchlight while along the terrestrial transect sampling routes. In addition, invertebrate surveys were carried out at mangrove plots in the mangrove forest, and belt transects at the intertidal mudflats at the mouth of Sungei Tampines.

Table 4-3. Summary of the Survey Timings and Methods for each Faunal Group, recent EIS dated 11/04/2019

Faunal Group	Survey Timings	Survey Methods
Odonates	0730 – 1130 hrs	Diurnal field surveys
Butterflies	0730 – 1130 hrs	Diurnal field surveys
Invertebrates (Spiders, Crustaceans, Anthozoans, Molluscs)	- -	Line Transects with selected quadrats within the mangrove area Two (2) Belt Transects along Sungei Tampines
Herpetofauna (Amphibians and Reptiles)	0730 – 1130 hrs 1930 – 2200 hrs	Diurnal and Nocturnal field survey Includes surveying of suitable microhabitat
Birds	0730 – 1130 hrs 1930 – 2200 hrs	Diurnal and Nocturnal field surveys
Mammals	0730 – 1130 hrs 1930 – 2200 hrs	Diurnal and Nocturnal field surveys

The fauna study recorded 230 faunal species within the EIS study area. This was dominated by birds (Aves) and butterflies. The results were included in Table 4-4 and Table 4-5. The species were classified using the Singapore Red Data Book Version 2 and 3 (NParks, 2022) and IUCN Red List of Threatened Species (IUCN, 2022).

Table 4-4. EIS Summary of Recorded Faunal Species

Faunal Group		Number of Recorded Species	
		All species	Species of Conservation Significance
Mammals		16	3
Birds		149	41
Herpetofauna	Reptiles	29	5
	Amphibians	8	0
Invertebrates	Spiders	8	-
	Crustaceans	12	-
	Anthozoans (Corals)	8	-
	Molluscs	25	-
	Butterflies	34	1
	Odonates	7	-
Total		230	50

Table 4-5. EIS List of Faunal Species of Conservation Significance Recorded

Legends	
LC – Least Concern	EN – Endangered
NT – Near Threatened	CR – Critically Endangered
VU – Vulnerable	EX – Extinct

No	Name	Scientific Name	Status	SRDB2	SRDB3	IUCN
Birds						
1.	Baya Weaver	<i>Ploceus philippinus</i>	Native	-	VU	LC
2.	Black Drongo	<i>Dicrurus macrocercus</i>	Native	-	VU	LC
3.	Black Kite	<i>Milvus migrans</i>	Native	-	EN	LC
4.	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Native	CR	EN	LC
5.	Blue-eared Kingfisher	<i>Alcedo meninting</i>	Native	CR	EN	LC
6.	Brown Shrike	<i>Lanius cristatus</i>	Native	-	VU	LC
7.	Brown-chested Jungle Flycatcher	<i>Cyornis brunneatus</i>	Native	-	VU	VU
8.	Buffy Fish-Owl	<i>Ketupa ketupu</i>	Native	CR	VU	LC

No	Name	Scientific Name	Status	SRDB2	SRDB3	IUCN
9.	Changeable Hawk-Eagle	<i>Nisaetus cirrhatus</i>	Native	EN	VU	LC
10.	Chinese Egret	<i>Egretta eulophotes</i>	Native	-	EN	VU
11.	Common Greenshank	<i>Tringa nebularia</i>	Native	-	VU	LC
12.	Common Kingfisher	<i>Alcedo atthis</i>	Native	-	VU	LC
13.	Common Sandpiper	<i>Actitis hypoleucos</i>	Native	-	VU	LC
14.	Copper-throated Sunbird	<i>Leptocoma calcostetha</i>	Native	NT	VU	LC
15.	Eastern cattle Egret	<i>Bubulcus coromandus</i>	Native + Introduced	-	VU	LC
16.	Eastern Yellow Wagtail	<i>Motacilla tschutschensis</i>	Native	-	VU	LC
17.	Great Egret	<i>Ardea alba</i>	Native	-	VU	LC
18.	Greater Crested Tern	<i>Thalasseus bergii</i>	Native	-	EN	LC
19.	Green Imperial Pigeon	<i>Ducula aenea</i>	Native	-	EN	LC
20.	Grey-headed Fish Eagle	<i>Haliaeetus ichthyaeus</i>	Native	CR	VU	NT
21.	House Swift	<i>Apus nipalensis</i>	Native	-	VU	LC
22.	Javan Myna	<i>Acridotheres javanicus</i>	Introduced	-	NA	VU
23.	Kentish Plover	<i>Charadrius alexandrinus</i>	Native	-	EN	LC
24.	Large-billed Crow	<i>Corvus macrorhynchos</i>	Native	-	VU	LC
25.	Lesser Crested Tern	<i>Thalasseus bengalensis</i>	Native	-	EN	LC
26.	Little Tern	<i>Sternula albifrons</i>	Native	EN	EN	LC
27.	Long-tailed Parakeet	<i>Psittacula longicauda</i>	Native	-	NT	VU
28.	Mangrove Pitta	<i>Pitta megarhyncha</i>	Native	CR	CR	NT
29.	Oriental Magpie-Robin	<i>Copsychus saularis</i>	Native	EN	VU	LC
30.	Oriental Reed Warbler	<i>Acrocephalus orientalis</i>	Native	-	VU	LC
31.	Pacific Golden Plover	<i>Pluvialis fulva</i>	Native	-	VU	LC
32.	Pacific Reef Heron	<i>Egretta sacra</i>	Native	-	EN	LC
33.	Purple Heron	<i>Ardea purpurea</i>	Native	EN	EN	LC
34.	Ruddy Kingfisher	<i>Halcyon coromanda</i>	Native	CR	CR	LC
35.	Spotted Wood-Owl	<i>Strix seloputo</i>	Native	CR	VU	-
36.	Square-tailed Drongo-Cuckoo	<i>Surniculus lugubris</i>	Native	CR	VU	LC
37.	Straw-headed Bulbul	<i>Pycnonotus zeylanicus</i>	Native	EN	EN	CR
38.	Swinhoe's White-eye	<i>Zosterops simplex</i>	Native + Introduced	-	VU	LC
39.	White-rumped Shama	<i>Copsychus malabaricus</i>	Native + Introduced	CR	EN	LC
40.	White-winged Tern	<i>Chlidonias leucopterus</i>	Native	-	EN	LC

No	Name	Scientific Name	Status	SRDB2	SRDB3	IUCN
41.	Yellow Bittern	<i>Ixobrychus sinensis</i>	Native	-	VU	LC
Reptiles						
1.	Cantor's Water Snake	<i>Cantoria violacea</i>	-	CR	EN	LC
2.	Crab-eating Water Snake	<i>Fordonia leucobalia</i>	-	EN	EN	LC
3.	Estuarine Crocodile	<i>Crocodylus porosus</i>	-	CR	CR	LC
4.	Gerard's Water Snake	<i>Gerarda prevostiana</i>	-	EN	EN	LC
5.	Shore Pit-Viper	<i>Trimeresurus purpureomaculatus</i>	-	EN	VU	LC
Mammal						
1.	Greater Bamboo Bat	<i>Tylonycteris malayana</i>	Native	-	VU	LC
2.	Long-tailed Macaque	<i>Macaca fascicularis</i>	Native	-	LC	VU
3.	Smooth Coated Otter	<i>Lutrogale perspicillata</i>	Native	CR	EN	VU
Butterflies						
1.	Striped Black Crow	<i>Euploea eyndhovii</i>	Resident	-	CR	-

4.3 Noise Monitoring

4.3.1 EIS Findings

Long-term noise measurement (7 consecutive days) was conducted between 14th November to 5th December 2016, while short-term noise measurement (1 full day) was conducted on 24th and 26th November 2016. Point measurements for one weekday and one weekend over a 5-minute period was also measured. The locations of the Noise Measurement Meters are located in Figure 4-4 and Table 4-6.

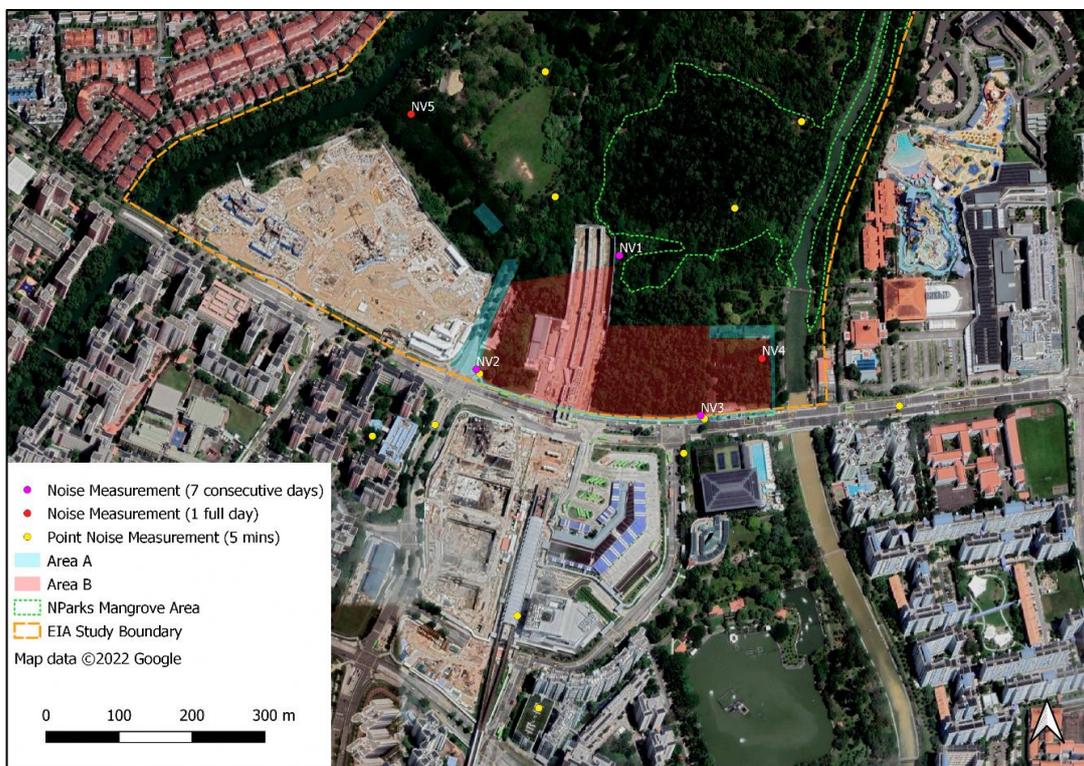


Figure 4-4. EIS Noise Meter Locations, extracted from recent EIS dated 11/04/2019

Table 4-6. EIS Noise Meter Locations and Durations

Noise Measuring Meter	Location	Duration
NV1	1.377082, 103.950503	7 days
NV2	1.375660, 103.948740	7 days
NV3	1.375083, 103.951504	7 days
NV4	1.375795, 103.952258	1 day
NV5	1.378849, 103.947936	1 day

The breakdown (Table 4-7 and Table 4-8) represents the typical baseline noise level in the surrounding area.

Table 4-7. EIS Noise Meter Results, extracted from the recent EIS dated 11/04/2019

Noise Measuring Meter	Period	Averaging Period, dB(A)		
		Laeq 5 mins	Laeq 1 hour	Laeq 12 hours
NV1	Day	56.3	54.4	56.3
	Evening	52.9	52.0	53.0
	Night	51.4	52.0	
NV2	Day	58.1	58.5	59.3
	Evening	57.3	54.1	55.5
	Night	51.8	54.1	
NV3	Day	59.2	59.3	59.5
	Evening	58.1	55.2	56.2
	Night	53.3	55.2	
NV4	Day	59.0	59.1	58.8
	Evening	58.5	56.0	57.0
	Night	54.0	56.0	
NV5	Day	50.6	52.0	52.7
	Evening	50.5	49.3	50.4
	Night	47.3	49.3	

D – Day (7am – 7pm), E – Evening (7pm – 10pm), N – Night (10pm – 7am)

The EIS baseline conditions around the northern portion of the Project are generally tranquil. This is because of the denser vegetation acting as buffer, and lack of construction activity. The baseline ambient noise levels are presented below.

Table 4-8. Average EIS Baseline Noise Level

Locations	Average ambient noise levels, dB(A)	
	Daytime (0700 – 1900hrs)	Night-time (1900 – 0700hrs)
NV1	54	52
NV2	58	54
NV3	59	55
NV4	59	56
NV5	50	48

4.3.2 Pre-Construction Baseline Findings

Long-term noise measurement (7 consecutive days) was conducted between 1st April to 7th April 2023. This was sampled using three noise level monitoring devices. The locations of the Noise Measurement Meters are located in Figure 4-5. The breakdown (Table 4-9) represents the typical baseline noise level in the surrounding area.

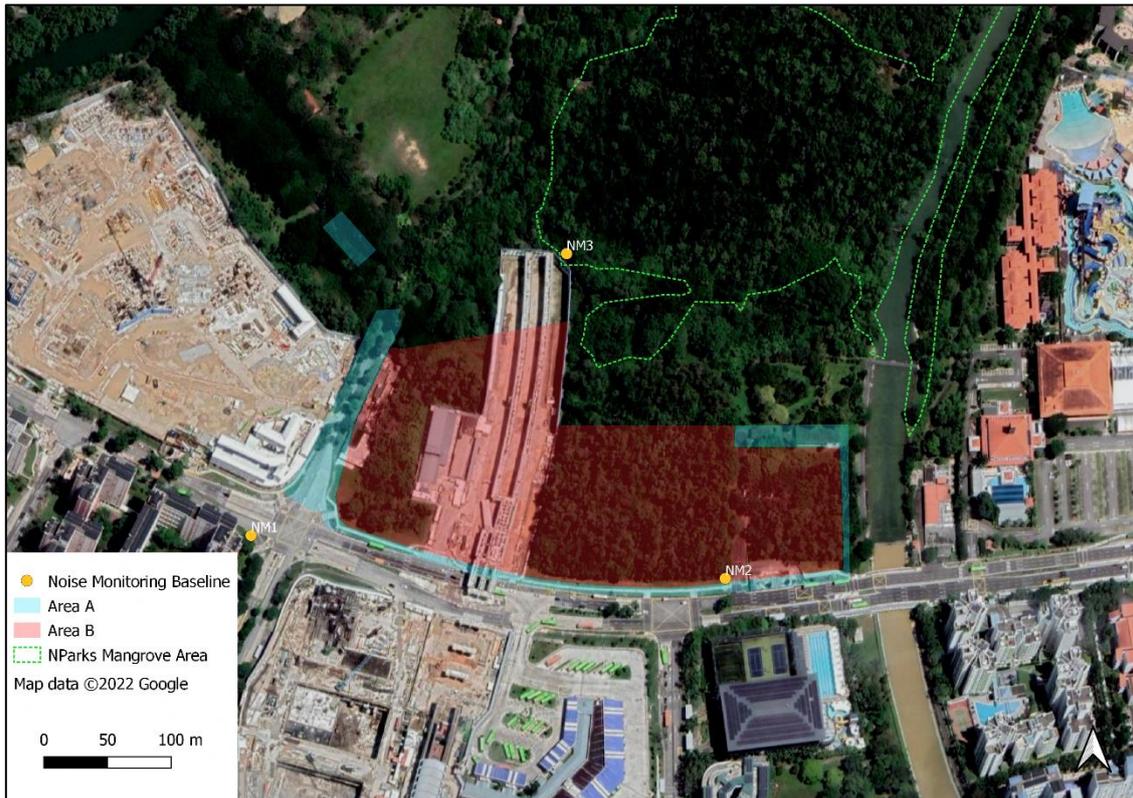


Figure 4-5. Pre-Construction Baseline Noise Meter Locations

The baseline ambient noise levels and adjusted permissible limits are presented below:

Table 4-9. Pre-Construction Baseline Noise Meter Results

NM1 (at Blk 586)	Time Period		
	7am – 7pm (Leq 12hr)	7pm – 10pm (Leq 1hr)	10pm – 7am (Leq 1hr)
Background Noise Level	71.6	69.3	65.7
Permissible Limit (Resident)	75	65	55
Adjusted Permissible Limit (Resident)	77	70.3	65.7

NM2 (Before Pasir Ris Park Carpark B)	Time Period		
	7am – 7pm (Leq 12hr)	7pm – 10pm (Leq 1hr)	10pm – 7am (Leq 1hr)
Background Noise Level	72.1	68.4	65.1
Permissible Limit (Resident)	75	65	55
Adjusted Permissible Limit (Resident)	77	70.4	65.1

NM3 (Mangrove within Pasir Ris Park)	Time Period		
	7am – 7pm (Leq 12hr)	7pm – 10pm (Leq 1hr)	10pm – 7am (Leq 1hr)
Background Noise Level	71.6	72.5	65.1
Permissible Limit (Resident)	75	65	55
Adjusted Permissible Limit (Resident)	77	73.5	65.1

Table 4-10. Pre-Construction Baseline Adjusted Permissible Noise Level, based on the recent baseline noise levels

(NM1) Period	Parameter	Baseline Noise Level (dBA)	Permissible Noise Level (dBA)	Correction Factor	Adjusted Permissible Noise Level (dBA)
01/04 /2023 – 07/04 /2023	7am – 7pm (Leq 12 hours)	71.6	75	2	77
	7pm – 10pm (Leq 1 hours)	69.3	65	1	70.3
	10pm – 7am (Leq 1 hours)	65.7	55	0	65.7

(NM2) Period	Parameter	Baseline Noise Level (dBA)	Permissible Noise Level (dBA)	Correction Factor	Adjusted Permissible Noise Level (dBA)
01/04/2023 – 07/04/2023	7am – 7pm (Leq 12 hours)	72.1	75	2	77
	7pm – 10pm (Leq 1 hours)	68.4	65	1	70.4
	10pm – 7am (Leq 1 hours)	65.1	55	0	65.1

(NM3) Period	Parameter	Baseline Noise Level (dBA)	Permissible Noise Level (dBA)	Correction Factor	Adjusted Permissible Noise Level (dBA)
01/04/2023 – 07/04/2023	7am – 7pm (Leq 12 hours)	71.6	75	2	77
	7pm – 10pm (Leq 1 hours)	72.5	65	1	73.5
	10pm – 7am (Leq 1 hours)	65.1	55	0	65.1

In view of the effects of Baseline Noise Levels being above the Permissible Noise Level, the Maximum Permissible Noise Level may be adjusted by adding the correction factor – which is based on the corresponding difference between the Permissible Noise Level and the Baseline Noise Level, to the higher of the two noise levels, to form the Adjusted Permissible Noise Level, in accordance with the *Third Schedule of Environmental Protection and Management (Control of Noise at Construction Sites) Regulations*. Aside from the establishing the Adjusted Permissible Noise Level. Noise mitigation measures at source are considered as the preferred option. Mitigation measures along transmission path, mainly barriers, can achieve additional reduction of noise levels. The sound insulation at recipients' end is the final barrier to the potentially intruding effects of noise.

4.4 Water Monitoring

4.4.1 EIS Findings

Two (2) rounds of surface water sampling were carried out. Round 1 was conducted on 22nd November 2016, between 5 pm and 7 pm, when the tide was ~2.2 m to 2.5 m and observed to be flowing towards Sungei Tampines. While Round 2 was carried out on 28th November 2016, between 10 am and 12 pm, when the tide was ~2.6 m to 2.9 m and observed to be flowing towards Sungei Tampines. The surface drain (W5) was sampled once on 23rd January 2017 after a heavy rain event which resulted in sufficient water level in the drain for sampling. The sampling was executed once during low to mid tide and once during mid to high tide for the samples within the mangrove forest, and after rain events for the samples within the surface drain. The monitoring locations are indicated in Figure 4-6 and the rationale for the selected locations is provided in Table 4-11. While Table 4-12 tabulates the analysis results.

Table 4-11. EIS Surface Water Sampling Locations

Location	Description	Rationale
W1	Eco-pond within Pasir Ris Park at the east of the Project site	Baseline pre-development water quality of the hydrogeological linked Eco-pond
W2	Waterbody in the mangrove forest towards Sungei Tampines	Baseline pre-development water quality in the mangrove
W3	Waterbody in the mangrove forest parallel to the boardwalk	Baseline pre-development water quality in the mangrove
W4	Waterbody in the mangrove forest perpendicular to the boardwalk	Baseline pre-development water quality in the mangrove
W5	Surface drain along Pasir Ris Green	Baseline pre-development water quality in the surface drain which could contain runoffs from the Project site

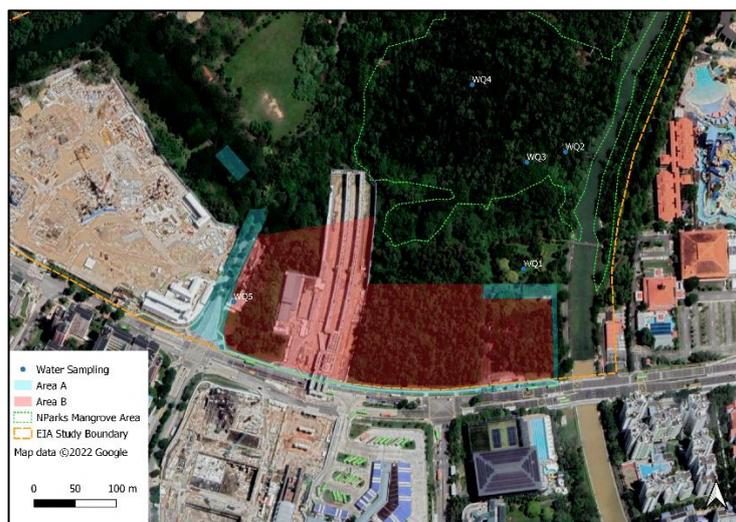


Figure 4-6. EIS Water Sampling Locations, extracted from recent EIS dated 11/04/2019

The baseline results were compared to WHO Drinking Water Guidelines and NEA’s Environmental Protection and Management (Trade Effluent) Regulations 2008 for discharge into a waterway, as illustrated in Table 4-12. The surface water quality at the selected sampling locations was generally within the NEA permissible limits, except at W4 during the first round of sampling where Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) were exceeded the limits. Nonetheless, the exceedance was expected and likely to be naturally occurring as the first round of sampling was conducted at a relatively low tide with sediments and organic matter in the trench/stream at W4 being collected together during the time of sampling.

Table 4-12. EIS Water Quality Results, extracted from the recent EIS dated 11/04/2019

Parameter	EPH (DW) Regs ¹	EPM (TE) Regs ²	WHO DW ³	Results								
				W1		W2		W3		W4		W5
				W1A	W1B	W2A	W2B	W3A	W3B	W4A	W4B	W5C
Temperature (°C)	-	45	-	29.3	28.4	27.8	28.8	27.5	28.3	28.0	27.7	25.6
pH	6.5-9.5	6-9	-	7.2	7.7	7.3	7.9	7.3	7.6	7.3	7.5	6.4
Total Suspended Solids (mg/L)	50	30	-	ND	19.3	ND	6.67	36.0	19.7	12,100	ND	16.0
Total Dissolved Solids (mg/L)	-	1,000	-	1,859	2,784	2,588	29,010	2,752	29,688	3,003	29,717	42.0
Turbidity (NTU)	5	-	< 0.1	19	12	5.5	2.8	50	15	3,600	4.5	45
Dissolved Oxygen (mg/L)	-	-	-	1.4	1.7	1.8	4.2	1.1	3.4	0.5	2.8	4.4
Chemical Oxygen Demand (mg/L)	-	60	-	51	23	42	ND	27	ND	116	ND	61
Biochemical Oxygen Demand (mg/L)	-	20	-	7.61	4.69	ND	ND	3.54	ND	55.2	ND	4.13
Oil & Grease (mg/L)	-	1	-	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Escherichia Coli (E.Coli) (CFU/100mL)	ND ⁵	-	< 1	100	ND	400	ND	200	100	300	400	500

Notes:

1. Drinking water quality standards under the Environmental Public Health (Quality of Piped Drinking Water) Regulations 2008.
2. Allowable limits for discharge to Controlled Waters under the Environmental Protection and Management (Trade Effluent) Regulations 2008.
3. Guideline values under the World Health Organisation (WHO)’s Guidelines for Drinking Water Quality, 4th Ed, 2011.
4. Round 1 of sampling (marked ‘A’ in the sample ID); Round 2 of sampling (marked ‘B’ in the sample ID); Round 3 of sampling (marked ‘C’ in the sample ID).
5. E.Coli shall not be detectable in any 100 mL sample.
6. ND = Not Detected. Data reported is lower than the detection limit of the test.

4.4.2 Pre-Construction Baseline Findings

One (1) rounds of surface water sampling were carried out on 17th April 2023, when the tide was ~2.2 m to 2.5 m and observed to be flowing towards Sungei Tampines. The sampling was executed during mid to high tide for the samples within the mangrove forest. Refer to Figure 4-7 for baseline water sampling locations.

Table 4-13 shows the water quality results of different sampling points. TSS was found to generally be high, especially at W2 and W3. The exceedance was expected and likely to be naturally occurring as sediments and organic matter may have been disturbed during sample collection at W3.

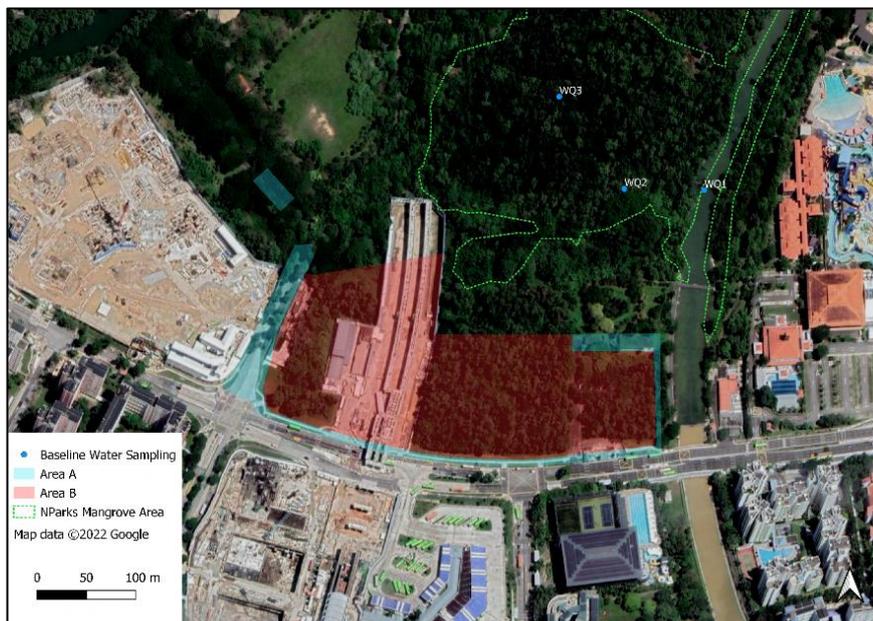


Figure 4-7. Pre-Construction Baseline Water Sampling Locations

Table 4-13. Pre-Construction Baseline Water Quality Results

Parameter	Unit	NEA Allowable Limit for Watercourse	W1 17/04/2023	W2 17/04/2023	W3 17/04/2023
Temperature	°C	45	28.59	27.83	26.68
pH	-	6 – 9	7.8	7.4	7.1
Conductivity	µS/cm	-	27061	36099	22988
Dissolved Oxygen	mg/L	-	6.32	5.70	5.71
Turbidity	NTU	-	12	26	180
Biochemical Oxygen Demand, BOD ₅	mg/L	50	4.65	4.89	5.18
Chemical Oxygen Demand, COD	mg O ₂ /L	100	24.0	30.0	48.0
Total Suspended Solids, TSS	mg/L	50	46.7	96.7	384
Free Chlorine, Cl ₂	mg/L	1	ND	ND	ND
Oil and Grease	mg/L	10	0.16	0.19	ND
Aluminium	µg/L	-	85.7	313	4129
Cadmium	µg/L	100	ND	ND	ND

Parameter	Unit	NEA Allowable Limit for Watercourse	W1 17/04/2023	W2 17/04/2023	W3 17/04/2023
Copper	µg/L	100	ND	ND	ND
Lead	µg/L	100	ND	ND	ND
Nitrate, NO ₃	mg/L	-	1.97	0.48	ND
Phosphate, PO ₄	mg/L	5	0.20	0.43	0.70

* ND – Not Detected

4.5 Sediment Quality Monitoring

4.5.1 EIS Findings

Sediment sampling was carried out on 8th December 2016, between 11 am and 12.30 pm. The sampling time was scheduled to coincide with the neap tide periods for effective sampling at the designated locations, when the tide height was ~1.6 to 1.8 m. The sampling locations are presented in Figure 4-8 and Table 4-14.

Table 4-14. EIS Sediment Monitoring Locations

Location	Description	Rationale
SS1	Mangrove area at the north of the Project site	Baseline pre-development sediment quality of the mangrove downstream of the Project site
SS2	Southwest corner of mangrove at the north of the Project site	Baseline pre-development sediment quality of the mangrove downstream of the Project site
SS3	Southeast corner of mangrove at the northeast of the Project site	Baseline pre-development sediment quality of the mangrove downstream of the Project site

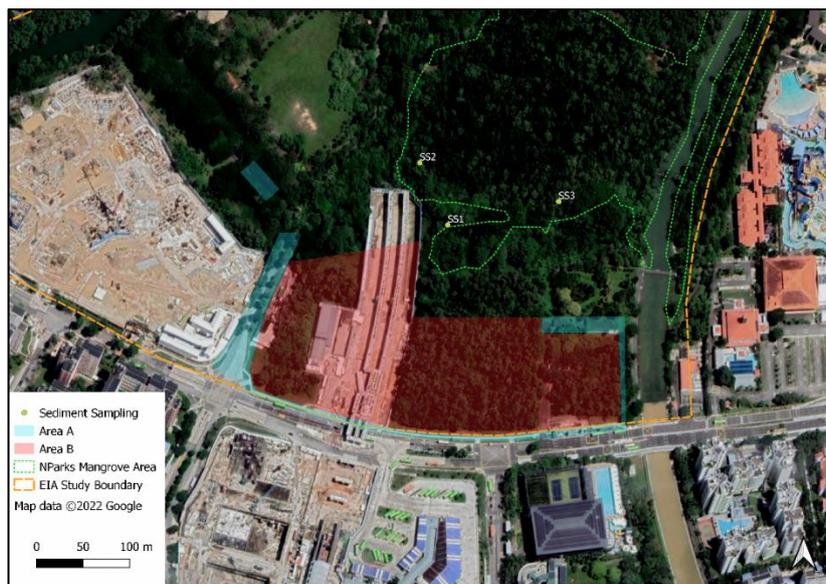


Figure 4-8. EIS Sediment Sampling Locations, extracted from recent EIS dated 11/04/2019

The sediment analysis results (Table 4-15) were compared to the Australian and New Zealand Environment Conservation Council (ANZECC) recommended Sediment Quality Guidelines (SQGs) and the Dutch Standards (2000 edition) for assessing land contamination and remediation, as there is no sediment quality regulatory standard available in Singapore. Based on the observation when collecting the sediment samples, the surficial sediment in the mangrove area generally comprised sandy and lighter-coloured sediments, and slowly became clayey and darker-coloured below the surface layer after taken the samples.

The results for metals, aromatics, polynuclear aromatic hydrocarbons (PAHs) and pesticides are generally complied with the ANZECC SQGs and the Dutch Intervention Values (DIV). However, the Total Petroleum Hydrocarbons (TPH) at SS2 had exceeded the limit set out by ANZECC SQGs and was close to the DIV value. The detected TPH fractions were mid to heavy petroleum hydrocarbons (C10-C36), where the sources could be from the bunker fuels due to vessel spills. The sediments at SS2 have likely been affected by marine oil spills in the past, where the most recent one being the oil spill in Johor which caused by the vessel collision back in January 2017. The northeastern coast of Singapore, included Pasir Ris beach, has been impacted during that time and the mangrove forest at Pasir Ris Park is a likely trap for oil spills since they are not protected by booms.

Table 4-15. Summarised EIS Sediment Monitoring Results, extracted from the recent EIS dated 11/04/2019

Parameter	ANZECC SQGs ¹	Dutch Standards DIV ²	SS1	SS2	SS3
pH	-	-	6.6	6.5	6.3
Metals					
Arsenic (mg/kg)	20	55	2.90	6.83	4.82
Antimony (mg/kg)	2.0	15	ND	ND	ND
Barium (mg/kg)	-	625	6.54	5.64	6.11
Cadmium (mg/kg)	1.5	12	0.074	0.19	0.084
Chromium (mg/kg)	80	380	3.70	8.48	6.70
Cobalt (mg/kg)	-	240	0.52	0.69	0.69
Copper (mg/kg)	65	190	5.35	12.1	8.44
Mercury (mg/kg)	0.15	10	0.10	0.26	0.093
Lead (mg/kg)	50	530	6.83	11.0	12.7
Molybdenum (mg/kg)	-	200	0.47	1.15	1.11
Nickel (mg/kg)	21	210	1.40	3.37	2.42
Zinc (mg/kg)	200	720	16.9	33.6	18.3
Aromatic Compounds: BTEX – Volatile Organic Compounds (VOCs)					
Benzene (mg/kg)	-	1	ND	ND	ND
Ethylbenzene (mg/kg)	-	50	ND	ND	ND
Toluene (mg/kg)	-	130	ND	ND	ND
Xylenes (mg/kg)	-	25	ND	ND	ND

Parameter	ANZECC SQGs ¹	Dutch Standards DIV ²	SS1	SS2	SS3
Aromatic Compounds: Semi-Volatile Organic Compounds (SVOCs)					
Phenol (mg/kg)	-	40	ND	ND	ND
Cresols (mg/kg)	-	5	ND	ND	ND
Catechol (mg/kg)	-	20	ND	ND	ND
Resorcinol (mg/kg)	-	10	ND	ND	ND
Hydroquinone (mg/kg)	-	10	ND	ND	ND
Pesticides: Semi-Volatile Organic Compounds (SVOCs)					
Sum DDT/DDD/DDE (mg/kg)	-	4	ND	ND	ND
DDT (mg/kg)	0.12-0.28	-	ND	ND	ND
DDE (mg/kg)	0.0014	-	ND	ND	ND
DDD (mg/kg)	0.0035	-	ND	ND	ND
Sum aldrin, dieldrin, Endrin (mg/kg)	-	4	ND	ND	ND
Aldrin (mg/kg)	-	-	ND	ND	ND
Dieldrin (mg/kg)	0.28	-	ND	ND	ND
Endrin (mg/kg)	0.01	-	ND	ND	ND
Sum HCH (mg/kg)	-	2	ND	ND	ND
a-HCH (mg/kg)	-	-	ND	ND	ND
b-HCH (mg/kg)	-	-	ND	ND	ND
g-HCH (mg/kg)	-	-	ND	ND	ND
d-HCH (mg/kg)	-	-	ND	ND	ND
Atrazine (mg/kg)	-	6	ND	ND	ND
Carbaryl (mg/kg)	-	5	ND	ND	ND
Carbofuran (mg/kg)	-	2	ND	ND	ND
Maneb (mg/kg)	-	35	ND	ND	ND
Other Compounds: Total Petroleum Hydrocarbons (TPH)					
C6-C9 (mg/kg)	280	5,000	ND	ND	ND
C10-C36 (mg/kg)			420	4,226	625
C6-C36 (Total) (mg/kg)			420	4,226	625
Other Compounds: Total Nitrogen and Phosphorus					
Total Nitrogen (mg/kg)	-	-	603	2,567	1,214
Total Phosphorus (mg/kg)	-	-	41.5	175	66.2
Other Compounds: Total Organic Carbon					
Total Organic Carbon (%)	-	-	1.40	6.53	3.87

Notes:

- Under the ANZECC, sum of PAHs are the sum of 18 parent PAHs. The guideline values for individual PAHs were removed because, for the majority of assessments, it is considered unlikely that an individual PAH will, by itself, either dominate the total PAHs concentration.
- Dutch Standards (2000 edition or its latest edition) Dutch Intervention Values (DIV).
- ND = Not Detected. Data reported is lower than the detection limit of the test.
- Results are expressed as per dry weight.

4.6 Air Quality Monitoring

4.6.1 EIS Findings

Ambient air quality monitoring was conducted between 21st November 2016 and 5th December 2016. Air quality parameters such as NO₂, SO₂, CO and particulate matter (PM_{2.5} and PM₁₀) were monitored during the period of time. Meteorological parameters were also monitored at one of the air quality monitoring stations (AM1), where it is nearer to the Project site (Figure 4-9 and Table 4-16). Continuous monitoring (24-hr) was carried out at all selected air quality monitoring stations, with two stations deployed simultaneously for one week each due to the limited availability of particulate matter measurement equipment.

Table 4-16. EIS Air Quality Monitoring Locations

Location	Description	Rationale
AM1	Approximately 15 m off to the right of the paved footpath, near to the edge of mangrove area	<ul style="list-style-type: none"> Baseline pre-development ambient air quality at the Project site and at the edge of mangrove forest Meteorological conditions in the vicinity of the Project site
A1	Near Piai Plaza at Pasir Ris Park, east of the Project site	Baseline particulate matter levels at Pasir Ris Park directly adjacent to the Project site
A2	Vegetated area within the site boundary, facing Pasir Ris Sports Centre	Baseline particulate matter levels at the edge of Project site, facing sensitive receiver (Pasir Ris Sports Centre)
A3	Vegetated area at the diagonally across HDB cluster Blk 570 to 580	Baseline particulate matter levels at the edge of Project site, facing sensitive receiver (HDB cluster Blk 570 to 580)

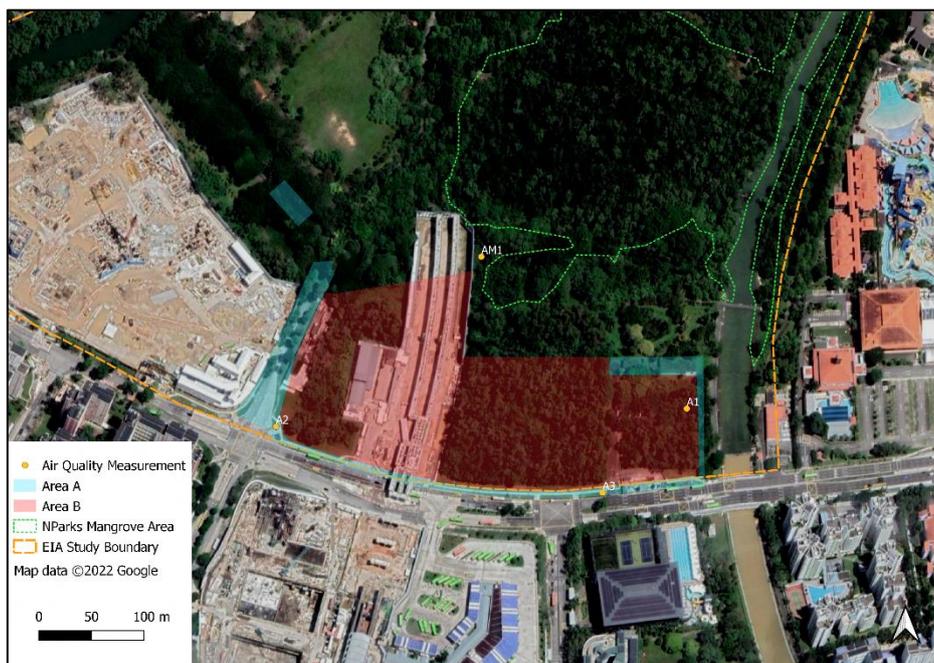


Figure 4-9. EIS Air Quality Monitoring Locations, extracted from recent EIS dated 11/04/2019

The analysis results (Table 4-17) proved that the air quality was generally good in the vicinity of the Project site, with the exception of the following:

Where the daily average was slightly higher than the Singapore Ambient Air Quality Guidelines. The exceedance was likely due to the motor vehicles in the area as the traffic exhaust, particularly exhaust from diesel engine is a common source contributing to the PM_{2.5} levels, and no strong wind or major rainfall event was observed over the monitoring period.

Table 4-17. EIS Air Quality Results, extracted from the recent EIS dated 11/04/2019

Parameter	Singapore Ambient Air Quality Guidelines	AM1	A1	A2	A3
PM _{2.5} (ug/m ³)	37.5	23.9	23.7	27.1	26.9
PM ₁₀ (ug/m ³)	50	25.4	25.4	29.4	29.3
SO ₂ (ug/m ³)	50	< 0.5	-	-	-
NO ₂ (ug/m ³)	200	25.3	-	-	-
CO (ug/m ³)	200	< 0.2	-	-	-

Notes:

1. The values for each parameter at each location are averages across the seven (7) days of the monitoring period.
2. 24-hour average results over entire monitoring period.

4.6.2 Pre-Construction Baseline Findings

Ambient air quality monitoring was conducted between 10th May 2023 and 29th May 2023. Air quality parameters such as particulate matter (PM_{2.5} & PM₁₀) was monitored during the period of time. Continuous monitoring (24-hr) for the duration of one week was carried out at all selected air quality monitoring stations, Figure 4-10 and Table 4-18.

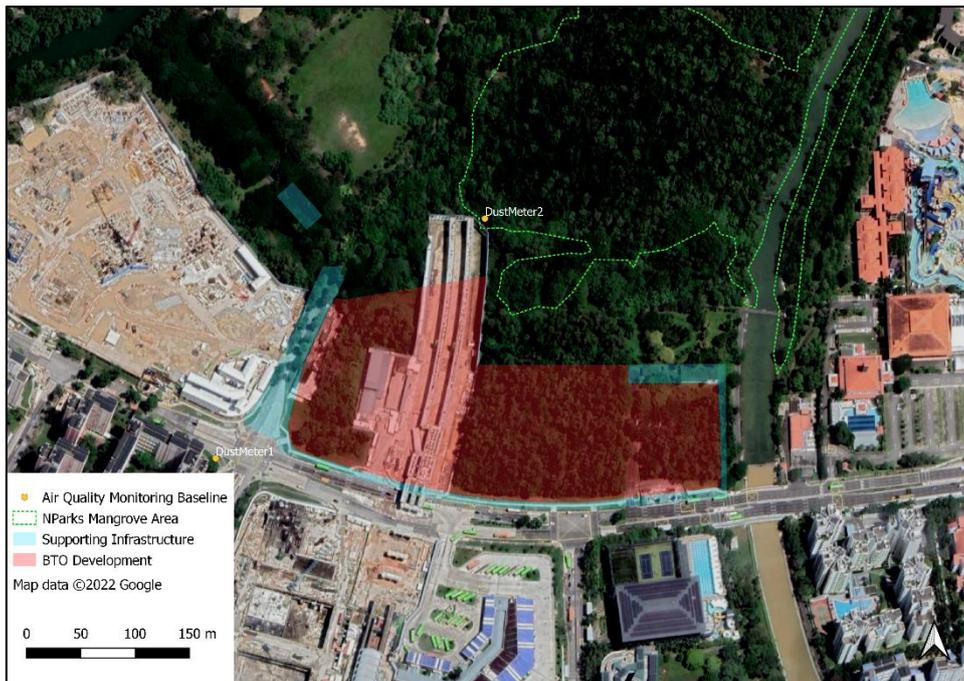


Figure 4-10. Pre-Construction Baseline Air Quality Monitoring Locations

Table 4-18. Pre-Construction Baseline Air Quality Locations

Name	Location of Noise Meter
Dust Meter 1	Along Pasir Ris Drive 3, in front of Blk 586
Dust Meter 2	Within Mangrove

Table 4-19. Pre-Construction Baseline Air Quality Results

Parameter	Singapore Ambient Air Quality Guidelines	Dust Meter 1	Dust Meter 2
PM _{2.5} (ug/m ³)	37.5	23	29
PM ₁₀ (ug/m ³)	50	29	37

When comparing the EIS and the above information (Table 4-19) the air quality of PM₁₀ did not vary or change significantly. This is despite the construction ongoing adjacent to the Project area (i.e., Pasir Ris Turnback Project, Pasir Ris 8 residential development).

5. Construction Plan / Methodology

5.1 Expected Work Activities

SECS highlighted the possible construction activities specific to this project, through the extraction of construction activities from the EIS, and supporting documents from WFY Civil Engineering Pte Ltd.

Specific construction activities for all phases that are associated with environmental aspects includes:

- Site clearance;
- Site preparation / Earthwork;
- General Construction Activities (i.e., Excavation, Backfilling);
- General Infrastructure Works (Construction of road, drains, sewer);
- Concrete works (concrete batching);
- Casting of construction components;
- General Construction of multistorey building;
- Piling;
- Back Filling;
- Vehicle movement;
- Use of chemicals and fuels;

Site specific Construction Method Statement for Hoarding and Tree Felling Works is included in Appendix III. Site Utilisation Plan is provided in Appendix IV.

5.2 Key Impacts identified from the document

Table 5-1 shows the activities and its respective impacts identified from the construction method statements provided by the EIS.

Table 5-1. List of construction activities and its associated environmental impacts

Process / Activity	Impacts / Pollution
Site Clearance	<ul style="list-style-type: none"> - Dust emission - Noise Pollution - Air Pollution - Soil erosion - Loss of habitat - 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; increase runoff volume, rate and duration - Loss of tree cover
Site preparation / Earthwork	<ul style="list-style-type: none"> - Dust emission - Noise Pollution - Human-wildlife interaction – animals may stray into nearby populated areas to seek new foraging grounds - Silty Discharge; increase runoff volume, rate and duration
General Construction Activities (Excavation, backfilling)	<ul style="list-style-type: none"> - Dust emission - Noise Pollution - Human-wildlife interaction – animals may stray into nearby populated areas to seek new foraging grounds - Silty Discharge; increase runoff volume, rate and duration
General Infrastructure Works (Construction of road, drains, sewer)	<ul style="list-style-type: none"> - Dust emission - Noise pollution
Concrete works (concrete batching)	<ul style="list-style-type: none"> - Dust emission - Noise pollution - Construction waste
Casting of construction components	<ul style="list-style-type: none"> - Dust emission - Noise pollution - Construction waste - Changes in illumination

Process / Activity	Impacts / Pollution
General Construction of multistorey building	<ul style="list-style-type: none"> - Dust emission - Noise pollution - Sun-shading of adjacent mangrove - Changes in wind flow - Changes in illumination - Land contamination by spillage of concrete
Piling	<ul style="list-style-type: none"> - Dust emission - Noise pollution - Groundwater pollution due to bentonite improper disposal
Back Filling	<ul style="list-style-type: none"> - Dust emission - Noise pollution - Silty runoff, discharge of effluent
Vehicle movement	<ul style="list-style-type: none"> - Dust emission - Noise emission
Use of chemicals and fuels	<ul style="list-style-type: none"> - Spills and leakage into surface water bodies

5.3 Proposed Mitigation and Monitoring

The proposed mitigation and monitoring portion of this EMMP has been developed to provide a holistic framework for management of environmental impacts. This includes measures to reduce potential impacts from excessive noise, dust, or pollution arising from the development of the area. In addition, a detailed monitoring plan would be conducted to ensure the wildlife and surrounding sensitive receptors (i.e., residents, park users) are protected.

Information on the various proposed mitigation and monitoring measures can be found in Table 5-2: Wildlife Shepherding Plan (Section 5.3.1), Biodiversity Awareness Training (Section 5.3.2), Noise barriers (Section 5.3.3), Flora Management Plan (Section 5.3.4), Artificial Light Management Plan (Section 5.3.10), and various Monitoring Parameters (from Section 5.3.5 to 5.3.9, and Section 6.0)

Table 5-2. Summary of monitoring parameters

Parameter	Monitoring Instrument	Section (reference to this EMMP)
Biodiversity	Monthly Visual Fauna Survey	Section 5.3.5
Water Quality	Monthly <i>In situ</i> and <i>ex situ</i> water sampling	Section 5.3.6
Airborne Noise Levels	Monthly airborne noise monitoring using Noise Meters	Section 5.3.7
Airborne Dust Levels	Monthly airborne dust monitoring using Air Quality Probe	Section 5.3.8
Sediment Quality	Quarterly <i>Ex situ</i> sediment sampling	Section 5.3.9
Visual Site Inspection	Monthly on-the-ground site inspection	Section 6.0

5.3.1 Wildlife Shepherding Plan

The main objective of the Wildlife Shepherding Plan (WSP) is to prevent and mitigate fauna mortality during the clearing of the forest habitat. This plan was developed as part of SECS' EMMP.

The key considerations for clearing of the forest land:

- Passive shepherding should be directed away from roads and northwards towards the available vegetation.
- Passive shepherding should lead fauna to similar surrounding habitat. Preferably towards the northern mangrove.
- Must be done in multiple stages to provide wildlife sufficient time to move.
- All site personnel should be trained to handle encounters with wildlife during site clearing/construction phase (wildlife reporting protocol).
- Maintaining connectivity between forested patches would allow seamless movement of wildlife, without forcing them to cross roads – which may undesirably result in road kills.

The proposed Wildlife Shepherding Plan (WSP) would thus involve the proposed staged directional clearing of the site (in the recommended direction). The WSP also takes into consideration future development of the surrounding areas, and existing hoardings, and obstacles that might impede wildlife movement. In addition, the WSP would highlight the various stages of hoarding deployments, and various pre-clearance trainings (i.e., Biodiversity Awareness Training, Wildlife Shepherding Training) which would be carried 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 would be conducted.

The WSP is thus intended to minimise impact to the existing wildlife within the site, while providing them sufficient time to move. Should that not be possible, shepherding would be done towards the available forested patches. If these options remain unavailable, relocation of trapped wildlife would instead be carried out.

The Wildlife Shepherding Plan is divided into Hoarding and ECMS Designs (Section 5.3.1.1), Phased Clearing (Section 5.3.1.2), and Monitoring (Section 5.3.1.3) to best categorised the various tasks.

In summary, site clearance follows these steps:

- Biodiversity Awareness Training and Wildlife Shepherding Training should be conducted to all participating construction personnel. Refer to Section 5.3.2
- Put up of perimeter hoardings, perimeter drains, ECMs, and silt fences around the site. This should be set up from the direct of any roads to prevent wildlife from entering the roads and residential areas. A work area of 5m width is granted for establishing of the perimeter hoarding. Refer to Section 5.3.1.1.
- Setting up of full One-way Hoarding along the north boundary prior to any shepherding.
- Site inspection / Pre-clearance checks are conducted to identify any nest, burrows, and wildlife. If these are detected, relocation or provision of a vegetative buffer would be implemented. Refer to Section 5.3.1.2.
- Phased directional clearing of the undergrowth vegetation.
- Three (3) days of rest between clearance of undergrowth, and the eventual clearance of trees.
- Pre-felling checks prior to tree felling. The validity of Pre-felling check is seven (7) days.
- On the fifth day, trees can be felled after Pre-felling check.
- Close up of Sections without any biological materials with temporary barriers.
- Clearing of the next Section can only commence when the Tree Felling for the previous Section has concluded.
- Upon completion of all site clearance, the permanent hoarding should be set up covering the full perimeter of the Project.
- From the commencement of the Phased Clearing, weekly biodiversity survey would be conducted. Refer to Section 5.3.1.3.

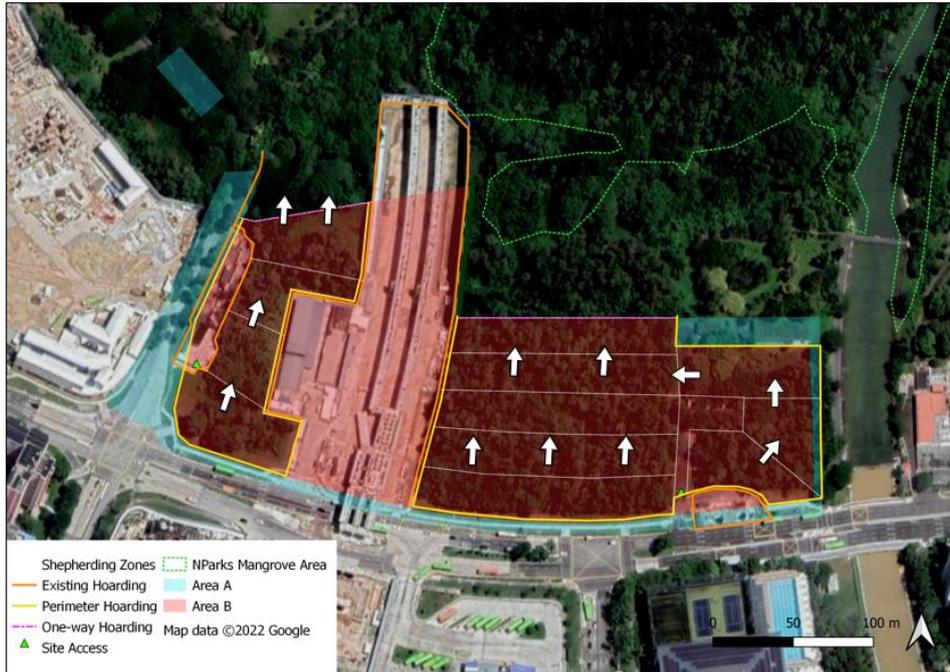


Figure 5-1. General Shepherding Direction

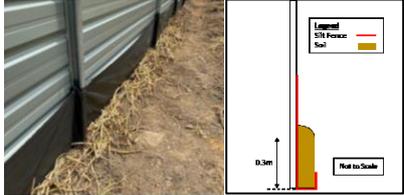
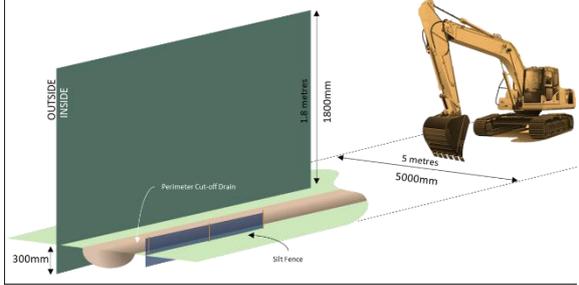
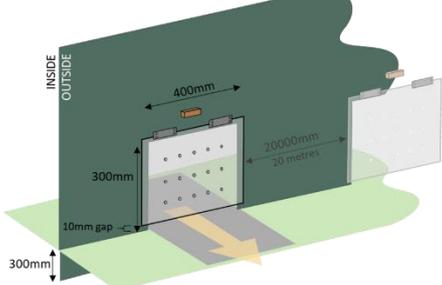
From the recent EIS prepared; the general shepherding direction would be towards the northern mangrove area. The recommended shepherding direction proposed in the recent EIS is reflected in Figure 5-1. The current proposed shepherding direction agrees with the EIS.

Most of Area A are along areas within little or no vegetation. Such as within road buffers, grass patches, pavements, and managed vegetation. In which case, passive shepherding would not be conducted, as there are little to no wildlife to shepherd. This is especially so within areas with just grass, or ornamental shrubs. However, where necessary, passive direction shepherding would be conducted. This would be determined by the surveyor or consultant.

The shepherding for most of the development would be conducted towards the northward direction. The only exception is on the east of the development which has existing nearby public facilities (i.e., public toilets) to avoid. This portion would first be shepherd westward into existing forest, before eventually shepherd northwards. The wildlife would be first shepherded into the adjacent forest patches in the north. By doing so, the risk of human-wildlife conflict would be minimised.

5.3.1.1 Hoarding and ECMs Design

The hoardings should take into consideration the existing hoardings around the development so as to prevent wildlife from being trapped. The perimeter hoardings should also be first established on the south side (along Pasir Ris Drive 3), west side (along Pasir Ris Green), and eastern side (along the PCN). Thereafter, the One-way Hoardings should be installed along the north (along Pasir Ris Park direction). The installation of the hoardings should be in tandem with the Perimeter Drains and Silt Fences. Once the Project area is fully hoarded up – on all sides, the ECMs should be set up. Only which can Phased Clearing commence. The hoarding specification is listed below. In general, hoardings should be made of opaque, non-reflective materials.

Permanent Hoarding	Temporary Barriers
Utilised to prevent wildlife from exiting the boundary. Some existing requirements: <ul style="list-style-type: none"> - At least 2.4m in height - Sufficient counterweight to withstand impact - Extends at least 300mm into the ground - Smooth top edge 	Utilised for short-term boundary function. These may be temporary fixtures which can be moved to allow access or before permanent hoardings are set up.
Examples: 	Examples: 
Perimeter Hoarding	One-way Hoarding
	

Due to the potential presence of wild boars within the Project area, One-way Hoardings would be set up along the northern boundary of the Project. The One-way Hoarding serves as wildlife exits. This ensures all wildlife, except for wild boars, can leave the site during shepherding. In addition, the One-way Hoardings are designed to ensure single directional movement of wildlife (out of the site), while also preventing wildlife beyond a pre-determined size from exiting the site. Refer to the Wildlife Shepherding Plan (Appendix I) for more details.

Perimeter Hoarding would 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 would occur after putting up the Perimeter Hoarding. This would minimise the impact to the necessary work area. The expected working space to set up the Perimeter Hoarding and Drains is 5m width along the boundary of the Project, or where hoardings are required. The ECMs should also be fully set up and operational, with Holding Ponds and Treatment Tanks prior to Phased Clearing. As vegetative clearance for the setting up of these preliminary mitigation measures are necessary, Pre-Felling Check for nest and entrapped fauna should be conducted before any clearance. Clearance should also be limited to the necessary work area for the implementation of these mitigation measures.

Should access gates be installed, silt fence should be attached to the bottom of the gates. The gate should also remain closed during shepherding, and whenever it is not in use. No opening greater than 50mm, where possible, to ensure wildlife do not leave through these openings.



Figure 5-2. Example of access gate with silt fence

The initial hoarding layout of the site should be as illustrated below. This would ensure all wildlife are passively shepherded towards the designated forested areas outside of the Project site's boundary, and do not enter the nearby roads and residential areas. Currently, there is an existing pedestrian path on the right of the Pasir Ris Turnback Project development, which bisects Area B of the Project. The existing path which allows pedestrian a quick access from Pasir Ris Drive 3 into Pasir Ris Park would be closed (Refer to Figure 5-3). However, boundary hoardings would extend beyond the Project boundary to reduce the chance of wildlife entering the footpath.

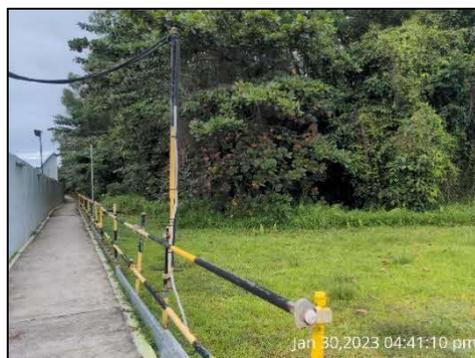


Figure 5-3. Footpath from Pasir Ris Drive 3 towards Pasir Ris Park

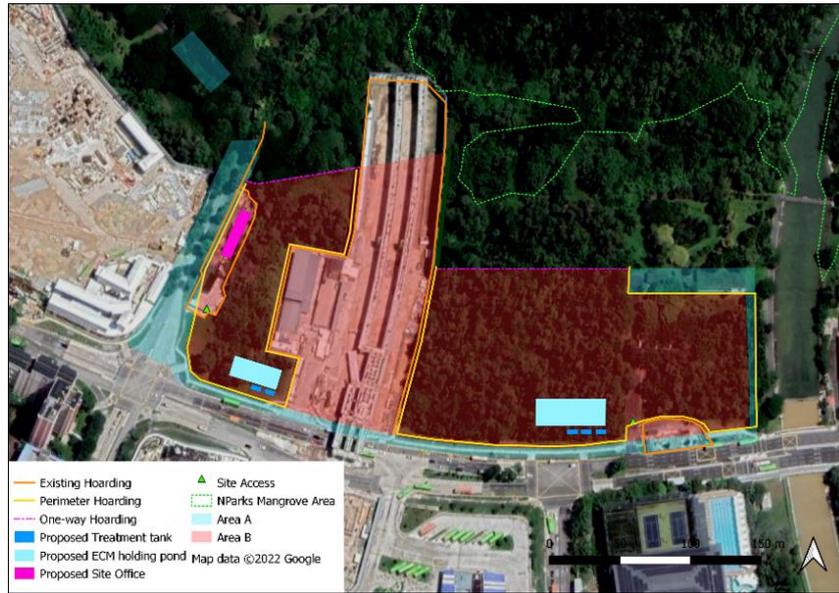


Figure 5-4. Layout of Boundary hoarding before the start of wildlife shepherding



Figure 5-5. Zoom in Layout of Boundary hoarding to show existing pedestrian path

5.3.1.2 Phased Clearing

The wildlife shepherding with site clearing follows the typical site clearing methods. Extra consideration for the wildlife in the habitat, and time are provided for the wildlife to move away from the areas to be cleared. Clearance would also be scheduled during daylight hours (8am to 6pm) as to reduce impact on wildlife activities at dawn and dusk. Housekeeping can still be carried out (limited till 10pm), however, should also be limited wherever possible. Directional Phased Clearing is thus conducted in systematic steps.

- **Step 1:** The areas to be cleared are divided into sections, each section is typically 100 x 30m.

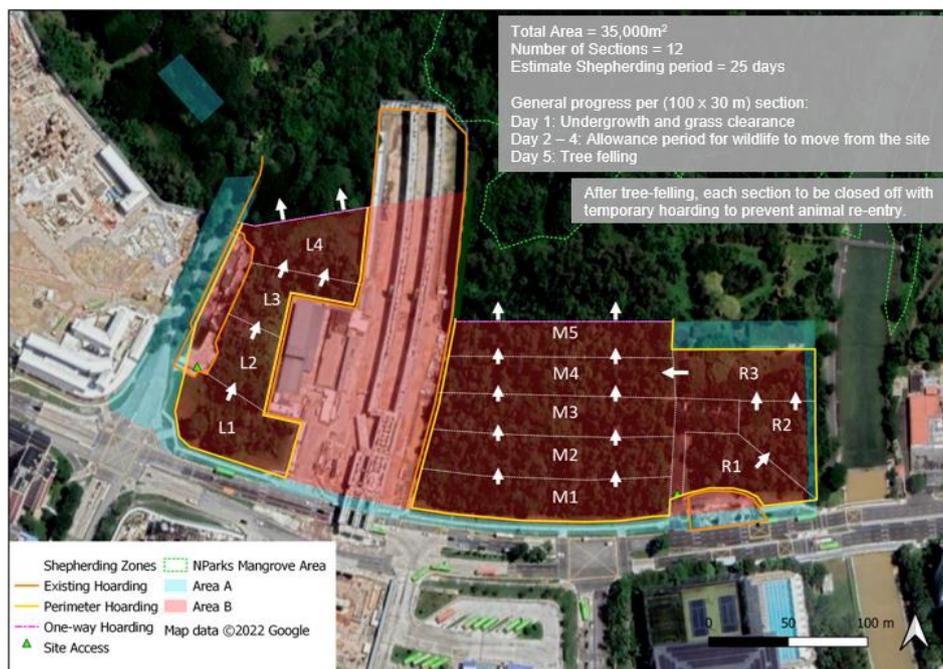


Figure 5-6. Wildlife Shepherding Phased Clearing

- **Step 2:** Pre-clearance check of the area to be conducted. This checks for nests, burrows or any other sensitive species. The wildlife specialist surveying the site should inspect the ground for presence of fauna for potential nest or burrows.
- **Step 3:** If no nest or burrows were detected on the ground, clearing of undergrowth and low-lying vegetation may commence. This is typically conducted manually or with a small excavator. Workers and operators should 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. The site clearance should be conducted from the direction of any road or site access, and towards the designated forested area. In addition, 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. The clearing should be done while avoiding the trees. No trees are to be felled during this process.

The rate of clearance in each area will be predetermined based on the zones identified. Markings (i.e., on the perimeter hoarding) can be adopted to demarcate the zones/sections. A maximum of two (2) excavators should be used. Section L1, M1, and R1 can commence simultaneously.

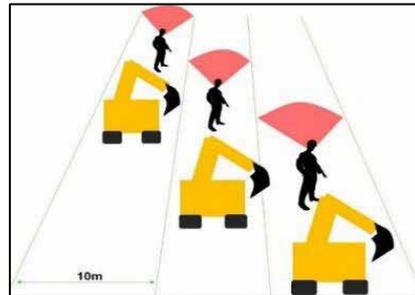


Figure 5-7. Illustration of Clearing using Excavator

Both S1 and S2 can be cleared simultaneously. However, shepherding of Section M4 may only proceed after the entirety of S1 (Section M1, M2, M3) and S2 (Section R1, R2, R3) have completed tree felling. This is best illustrated below. This ensures the wildlife from S2 are shepherded out and would not be trapped as the shepherding phase progresses.



Figure 5-8. Sequence of Clearing for M4

- **Step 4:** Once the undergrowth is cleared, a buffer of three (3) full days is given for arboreal wildlife to migrate from the site.
- **Step 5:** Pre-felling check can be conducted during the 3-day resting period or prior to tree felling. The surveyor should survey 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 sufficient buffer (if necessary) to ensure the nesting sites are protected until the young are able to leave.

- Pre-felling check should be conducted prior to tree felling. Clearing of trees should be conducted within seven (7) days from the Pre-felling check. If more than seven (7) days have passed from Pre-felling check and tree felling has not commenced, the inspection should be carried out again.
- Step 6: After three (3) days — on the 5th day since Step 3, trees can be felled. Temporary hoardings should be put up after all trees of each section has been cleared. This would prevent wildlife from re-entering the areas that have been cleared.
- Only after tree felling completed within the previous Section, Step 2 (undergrowth clearing) for subsequent section may commence.
- After the vegetation have been cleared (both undergrowth and trees), the One-way Hoarding along the northern boundary should be replaced with permanent hoardings to prevent wildlife from re-entering. The planned 12m Noise Barrier (Refer to Section 5.3.3) along the northern boundary can be utilised as a permanent hoarding. Similar specifications for the perimeter hoarding apply to the permanent hoardings used. This will allow the contractor to begin earthworks within the completely cleared site. Temporary hoardings may be used during the period permanent hoardings are set up. The site should eventually be hoarded up entirely, as based on the project boundary.

A shepherding schedule is provided in the detailed wildlife shepherding plan as the clearance and wildlife shepherding occurs in stages (refer to Appendix I).

5.3.1.3 Monitoring

Prior to any vegetation clearing, Pre-felling checks of the affected vegetative areas would be conducted. Vegetative clearing (i.e., Undergrowth clearing, Tree-felling) should be conducted within seven (7) days of the Pre-felling check. If not, another Pre-felling check should be conducted. Once Phased Clearing has commenced, the fauna specialist will conduct weekly biodiversity surveys. Similarly, a Weekly site inspection would also be conducted to ensure that the Phased Clearing is done at an acceptable speed and in the correct manner.

In addition, due to the proximity of the Project from active roads (i.e., Pasir Ris Drive 3 and Pasir Ris Green), a surveillance system would be established both during and after the wildlife shepherding. This would be conducted by the contractor daily. The daily monitoring of construction access roads or nearby active roads is aimed at detecting for any road kills present. Any roadkill must be directly reported to the appointed ECO, and subsequently the EMMP consultant immediately. NParks would also be informed if it's a rare animal carcass prior to disposal. The Wildlife Response (in Section 8.3) procedure should be followed if there is any sighting of entrapped wild boars. Similarly, the appointed ECO, and the EMMP consultant should be notified immediately. Subsequently, NParks would also be informed.

Survey / Inspections	Frequency	Function	Done by
Monitoring of nearby roads	Daily	Regularly monitoring of nearby roads and access roads to detect for any road kill (This should be conducted at the start of the day)	Contractor's ECO
Site Monitoring	Daily	Regular monitoring of the site drains, ECMs, and ECBs to detect for any entrapped fauna (This should be conducted at the start of the day)	Contractor's ECO
Pre-Felling Check	Weekly	Inspect for nest, burrows, and entrapped wildlife within the undergrowth and tree canopy before clearing	SECS
Weekly Inspection	Weekly	Inspect hoarding designs and contractor compliance	SECS
Biodiversity Survey	Weekly	Biodiversity Survey during Phased Clearing	SECS

Notes:

- All works are to be restricted within the approved hoarding boundary. No workers or machinery should venture into forested areas outside the contract boundary. Working space used to erect the hoarding prior to wildlife shepherding should only be 5m. If there are any large trees encountered along the hoarding line, contractors are to avoid and continue hoarding beyond that.
- Work around the vicinity should stop if animal is witnessed on site, dead or alive, until full investigation or relocation is completed.

5.3.2 Biodiversity Awareness Training

The main objective of the Biodiversity Awareness Training is to educate the workers and construction personnel on the types of wildlife they may encounter, and how to react. Key and relevant site personnel on site are to attend the onsite Biodiversity Awareness Training. After the initial training, refresher training during toolbox meetings is to be conducted.

Biodiversity Awareness Training, together with Wildlife Shepherding Training should at least be conducted to all relevant workers prior to Directional Clearing (or wildlife shepherding). Personnel involved in wildlife shepherding works will be trained on the shepherding methodology, plan and execution, including how to handle encounters with wildlife.

Summary of the Biodiversity Awareness Training

- This training is conducted once prior to key staff working at the site (contractor, sub-contractor etc). This should be incorporated into the safety induction course, and toolbox meetings and communicated to the workers.
- Information on potential wildlife sightings and what to do when wildlife is encountered should be put up and available at site office notice boards accessible by all workers.
- The training would 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 should not be provoked, caught or handled by anyone. The NParks Animal Response Centre (+65 1800 476 1600) or appointed licensed wildlife contractors is 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 fauna specialist on how to look out for animals in the undergrowth, borrows or trees.
- Refer to Appendix VIII for Biodiversity Awareness Training document.
- Refer to Section 8.3 for Wildlife Reporting Protocol.

5.3.3 Noise Barrier

Permanent hoardings shall be installed along the boundary of the Project. The noise barriers may also serve as a hoarding, should they meet the requirement of being installed at least 300 mm into the ground. The noise barrier along the northern boundary (facing Pasir Ris Mangrove) should be at least 12 m in height. The new 12 m noise barrier will be put up after the shepherding has been completed. This was proposed by the recent EIS with anticipation of the specific construction works within the Project. This would thus ensure the noise generated from construction activity are mitigated. A standardised 2.4 m hoarding should also be installed for the remaining boundaries (west, south and east sides) of the Project. All noise barriers to utilise material with a theoretical capability of at least 10 dB(A) noise reduction so as to reduce source noise levels, as proposed by the EIS. In addition, the noise barrier would also act as a barrier to reduce light pollution / spilling beyond the Project site and into the adjacent mangrove and woodlands area.

The proposed layout for the 12m noise barrier is as illustrated in Figure 5-9.

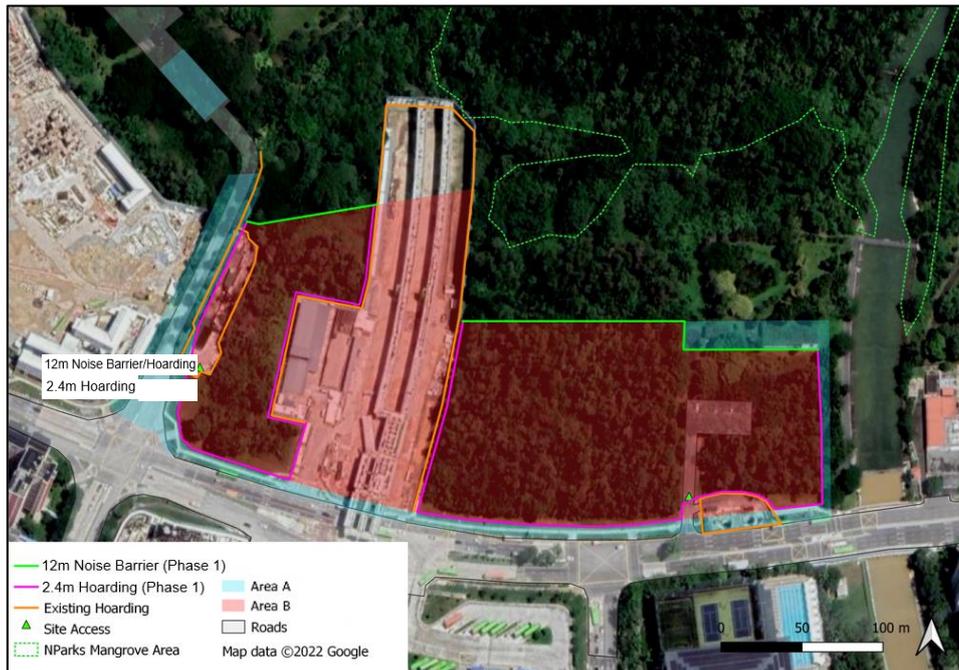


Figure 5-9. 12m Noise Barrier and Hoarding

5.3.4 Flora Management Plan

The Flora Management Plan highlights the details on best practices to carry out plant salvaging, tree protection works, and also a monthly arborist tree assessment / monitoring. The site would retain some trees within the Project area, as such, protection of the retained trees should be done through establishment of an appropriate Tree Protection Zones (TPZ). The Flora Management Plan can thus be further elaborated below:

Salvaging of Flora specimens

Before the commencement of any clearance or shepherding works. NParks would be invited to lead any plant salvaging activities within the Project site. The salvaged plants are typically assessed and determined based on their origin status (i.e., native or exotic), conservation significance, and suitable health for transplanting. Some highlighted flora individuals within the Project are listed below:

Table 5-3. Flora identified as potential for salvaging

Plant ID	Botanical Name	Girth (m)	Height (m)	Latitude	Longitude
CS1	<i>Oxyceros longiflorus</i>	0.05	1.5	1.375724	103.951298
CS2	<i>Oxyceros longiflorus</i>	0.03	1	1.375850	103.951328
CS3	<i>Oxyceros longiflorus</i>	0.03	1	1.375803	103.951292
CS4	<i>Oxyceros longiflorus</i>	0.03	1.5	1.375642	103.951133
CS5	<i>Glochidion lutescens</i>	0.03	0.5	1.375840	103.951031
CS6	<i>Glochidion lutescens</i>	0.02	0.4	1.375741	103.950681
CS7	<i>Planchonella obovata</i>	1	15	1.375594	103.950794
CS8	<i>Glochidion lutescens</i>	0.6	2.5	1.375509	103.949239

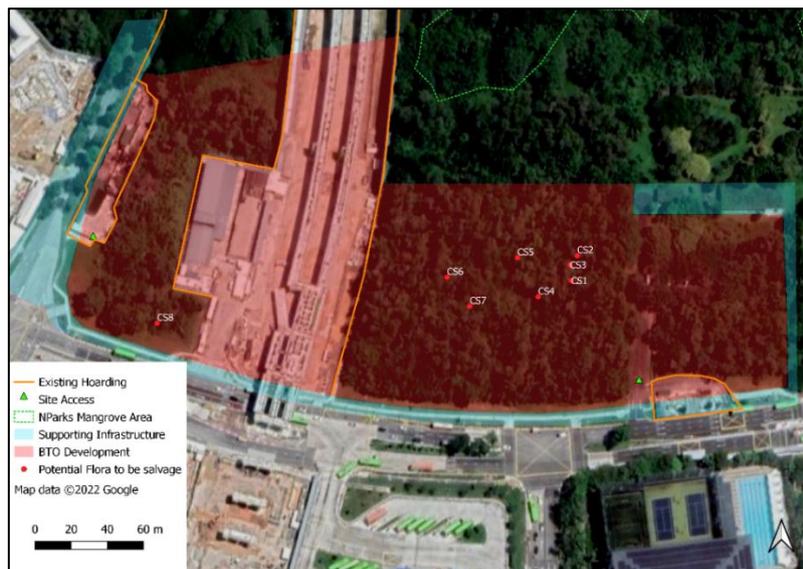


Figure 5-10. Flora identified as potential for salvaging

It is unlikely that CS7 parent plant would be salvage. This is due to the size; CS7 is large, with girth of 1m and height of 15m. However, there would potentially be saplings around the parent plant which could be salvage. Hence, CS7 was highlighted for having salvaging potential.

Retention of Trees within the Project area

Several trees and flora specimens within the Project site have been identified for potential retention for landscaping. These trees have been selected after consultation between the Architect and the Arborist to determine the design and suitability of the tree’s health within the area.

Before the commence of any clearance or shepherding, the trees within the Project site highlighted to be retained would be visibly marked out, as illustrated in Figure 5-10. The Tree Protection Zone (TPZ) would then be established to ensure the retained trees are provided with sufficient space such that the tree crown and roots are not affected by construction activities (i.e., soil compaction, mechanical damage, setting up of hoarding). The objective of the TPZ is to minimise the impact of construction activities on trees, including but not limited to mechanical injury to roots, trunks and branches due to contact with equipment, materials, debris or other activities. It also aims to minimise compaction of soil, which results in poor functioning of roots, and changes in soil levels that can cut off or suffocate roots. The TPZ size varies depending on the tree size. In general, all development works should consider the space of the TPZ into the planning of the Project as no permanent or temporary use of the space (i.e., for storage, scaffolding) within the TPZ should occur so as to ensure the trees within the TPZ remain healthy. The TPZ recommended measures are highlighted in the recommended TPZ size is listed below:

Table 5-4. Recommended Tree Protection Zone radius

Girth	Recommended TPZ radius (Measured as distance from centre of a tree)
<0.5m	1 m
0.5m – 1m	2 m
1m – 1.5m	3 m
1.5m – 2m	4 m
>2m	5m

In order to successfully prevent tree damage, construction activities have to be diverted away from the trees. A good practice to prevent tree damage and ensure tree survival is to place a fence around the TPZ. Bright orange polyethylene fencing or other effective tree protection fencing should be provided along the limits of the protection zone around the tree identified to be retained. This is to demark the TPZ within which activities are restricted before construction begins and kept intact until completion. There must be no excavation, raising or lowering of soil level, compaction or any form of construction activities including temporary works within the hoarded area. Dumping of debris, excavated materials and/or storage of construction materials and equipment is not allowed within the TPZ. Protection

hoarding is required, unless otherwise stated, and should be installed prior to site works. The extent of each individual TPZ is illustrated in Figure 5-11.



Figure 5-11. Tree Protection Zone (NParks, 2018)

The trees that are to be retained within the Project site (refer to Figure 5-12) are listed below:

Table 5-5. Recommended Retained Trees

No	Tree ID	Botanical Name	Latitude	Longitude	Buffer Size	Physiological Health	Tree Structure
1	209	<i>Terminalia mantaly</i>	1.375834	103.951739	3	Good	Good
2	210	<i>Terminalia mantaly</i>	1.375901	103.951729	3	Good	Good
3	211	<i>Terminalia mantaly</i>	1.375879	103.951790	2	Good	Good
4	213	<i>Terminalia mantaly</i>	1.375903	103.951897	2	Good	Good
5	219	<i>Terminalia mantaly</i>	1.376003	103.951814	4	Good	Good
6	N21	<i>Terminalia catappa</i>	1.376205	103.950444	2	Average	Fair



Figure 5-12. Tree Protection Zone of respective trees identified to be retained

There would be maintenance of existing ground level around the north boundary of the Project as shown in Figure 5-12. The proposed maintenance of existing ground level would minimise impact to the trees. The proposed construction works and hoarding line would avoid the areas where existing ground levels are retained.

Arborist Monthly Inspection of Trees surrounding the Project Area

The arborist is to conduct monthly inspection of the surrounding trees outside the Project site. The arborist is to assess and determine the health of the trees and should any action be necessary. This includes determining if the tree crown might pose a threat to the hoardings, or if the climbers on the hoarding are to be removed.

5.3.5 Biodiversity Monitoring

Biodiversity Monitoring would occur at various stages of the development, as shown in Table 5-6. This includes the Pre-felling check prior to Directional Clearing (or Wildlife Shepherding), weekly monitoring during the shepherding phase, and monthly monitoring once the site has been cleared and earthwork have commenced. This is summarised below.

Table 5-6. Biodiversity Monitoring Frequency

Stages of development	Frequency
Before Wildlife Shepherding	Once (or whenever lapsed)
During Wildlife Shepherding	Weekly
During Construction	Monthly

Biodiversity Monitoring would involve an experienced Wildlife Specialist. The survey would be conducted from 7 am – 11 am. This would allow for a representative survey of the birds, mammals, herpetofauna, butterflies, and odonates. This also allows for the surveyor to identify various roosting sites, nest, and burrows.

Before Wildlife Shepherding

Pre-clearance check will be done around the site by the wildlife specialist as part of the Wildlife Shepherding Plan. The objective is to determine if there are any active roosting/nesting sites by birds. Refer to the Wildlife Shepherding Plan in Section 5.3.1.

During Wildlife Shepherding

As described in Section 5.3.1.3, pre-felling check will be done at the affected areas by the wildlife specialist / consultant, and weekly biodiversity surveys and inspection will be conducted while wildlife shepherding is ongoing. The objectives are to monitor the wildlife shepherding process, animal safety, and identify any wildlife concerns in shepherding sites such as active nests or burrows that dictates stopping of work in that area.

During Construction

Upon completion of the wildlife shepherding, monthly biodiversity monitoring will be included in the monthly environmental monitoring report by the EMMP consultant until the construction is completed. This is to monitor the diversity of wildlife that have been shepherded to immediate surroundings and compare it to the baseline. It also allows the EMMP consultant to monitor any negative impacts of the construction on the surrounding habitat by monitoring monthly results. The monthly monitoring results would be compared against the EIS and Baseline Fauna Survey to better understand the impacts posed

by the construction on the surrounding environment. This would allow a better understanding of the impacts, and the effectiveness of the mitigation measures in place.

The Biodiversity Monitoring Survey would include a field survey of the surrounding vegetation. The field survey includes a roaming transect along accessible paths. The focus of the monthly surveys would be on the vegetation north of the Project site. The Project area, accessible roads, and proposed roaming transects are illustrated below:

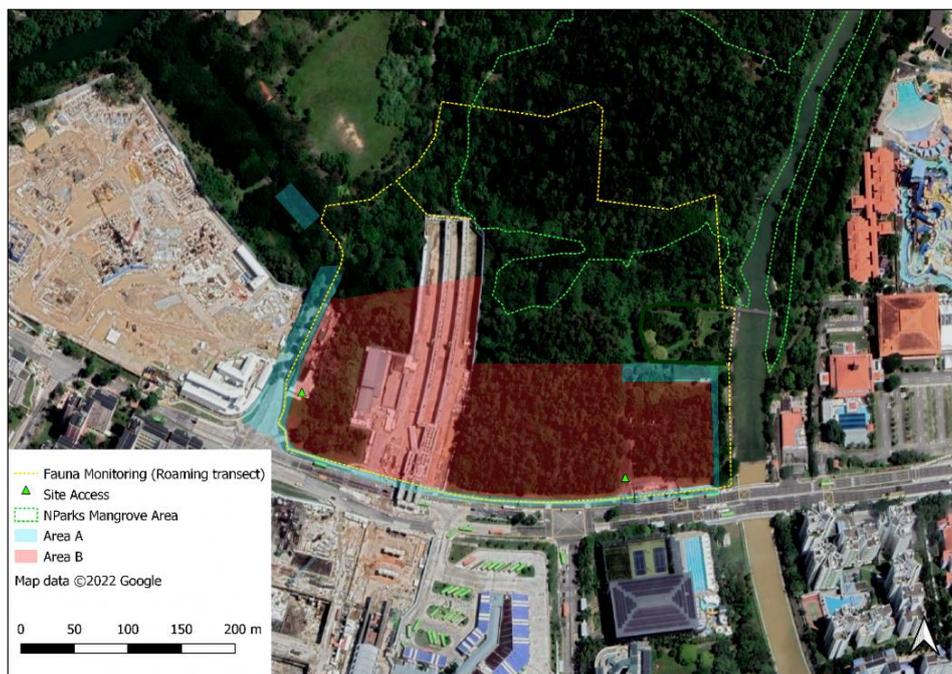


Figure 5-13. Monthly Fauna Monitoring Proposed Survey Transect

For wild boars found at or around the site at any time during the project, NParks is to be informed as soon as possible at nparks_wildlife_management@nparks.gov.sg for advice and subsequent action. An approved wild boar removal contractor must also be engaged to trap and remove the said animals, the process of which may take about 4– 8 weeks.

5.3.6 Monthly Water Quality Monitoring Plan

Water sampling shall be done monthly at four (4) sampling points at water bodies outside the Project, and two (2) sampling within the Project (at ECMs). The sampling location of the external water bodies are as seen in Figure 5-14 and Table 5-7. All sampling points are similar to the ones conducted during the EIS Water Sampling points. Furthermore, they do not differ much from the Pre-Construction Baseline Water Sampling points. Should any sampling points be not available during the construction and operation phase, a similar sampling location would be chosen, or a sampling point downstream from the same sampling point. Comparisons may be made with the baseline results and NEA and PUB trade effluent guidelines to monitor any major impacts from the construction on the existing water bodies. Sampling of water from the ECMs are to determine if the water is properly treated before discharge into the public drainage.

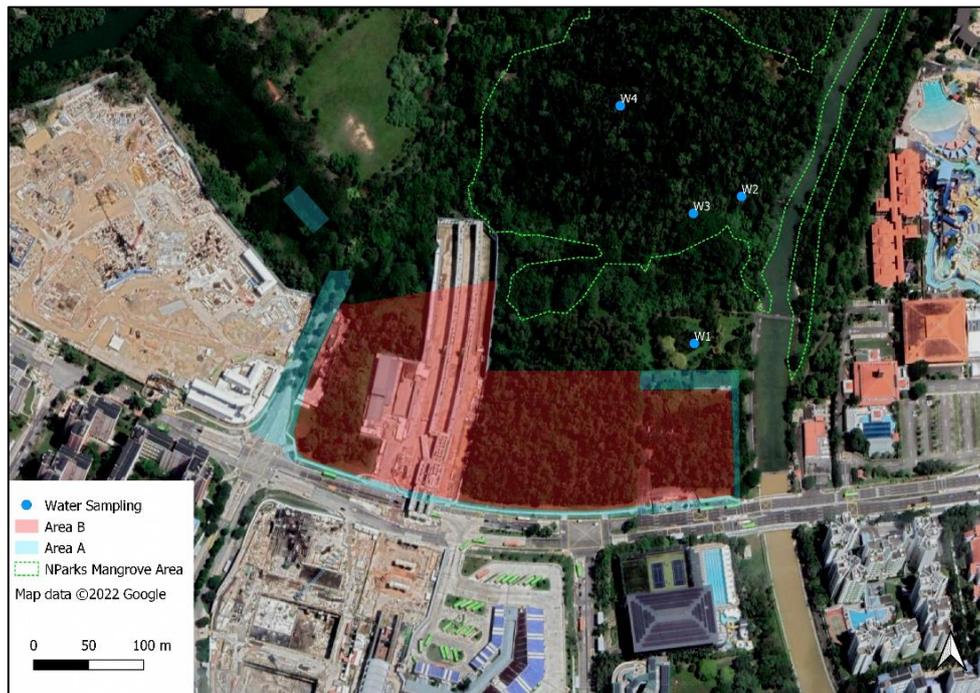


Figure 5-14. Monthly Water Quality Sampling Points

Table 5-7. GPS Coordinates of water sampling points during construction phase

Sampling Point	Latitude	Longitude	Description
W1	1.376432	103.952051	Eco-pond within Pasir Ris Park
W2	1.377650	103.952437	Waterbody in the mangrove forest lead towards Sungei Tampines
W3	1.377509	103.952044	Waterbody in the mangrove forest parallel to the boardwalk
W4	1.378401	103.951448	Waterbody in the mangrove forest perpendicular to the boardwalk
ECM1	-	-	Discharge water from ECM1
ECM2	-	-	Discharge water from ECM2

The discharge of wastewater into open drains, canals, and rivers is regulated by the Environmental Protection and Management Act (Trade effluent) Regulations. As the discharge is into the open drains leading into Sungei Tampines, which eventually leads into the sea, the tested parameters are compared with the allowable limits for trade effluent discharge to watercourse, within Table 5-8. This guideline, along with the baseline water quality results, will serve as a form of comparison to understand the state of ECM discharge into the reservoir / drain.

The table below shows the water quality parameters, guidelines used and its method of collection or testing. Discharge should be following the Environmental Protection and Management Act Trade Effluent Regulations.

Table 5-8. Water Quality Parameters and guidelines

Parameter	Unit	EIS Baseline	Pre-Construction Baseline	Guideline used	Guideline value	Sampling Method	
Temperature	°C	✓	✓	Allowable Limits for Trade Effluent Discharge to Watercourse (Watercourse)	45	In-situ – using multiparameter probe	
pH	-	✓	✓		6 to 9		
Dissolved Oxygen	mg/L		✓		-		
Turbidity	NTU		✓			-	Ex-situ using grab sampling techniques and send to accredited lab for analysis
Total Suspended Solids (TSS)	mg/L	✓	✓		30		
Total Dissolved Solids (TDS)	mg/L	✓	✓		1000		
Biological Oxygen Demand (BOD)	mg/L	✓	✓		20		
Chemical Oxygen Demand (COD)	mg O ₂ /L	✓	✓		500		
Nitrate (NO ₃)	mg/L		✓		20.0		
Phosphate (PO ₄)	mg/L		✓		2.0		
Oil & Grease	mg/L	✓	✓		10		
Total Escherichia Coli (E. Coli)	CFU/100ml	✓			-		
Aluminum	mg/L		✓		-		

In-situ measurement will be conducted on site using a multi-parameter probe. The probe will be placed within the water body to obtain readings. For ex-situ sampling, grab sampling techniques will be used to collect samples into laboratory provided sampling bottles which will then be stored in ice and sent to an accredited laboratory for analysis.

5.3.7 Monthly Noise Monitoring Plan

The main causes of noise pollution should be from advanced works (preparation of site office, road access, boundary fence installation), excavation works (cutting into slope or other land area), 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 the spike in noise level around the surrounding areas.

Three (3) continuous noise monitoring location were selected to understand the construction noise levels. The same baseline locations for NV1 and NV6 will be used for this continuous noise monitoring. In addition, the baseline for NV2 will be updated prior to implementation. Measurements are taken in compliance with the standards contained in the Environmental Protection and management (Control of Noise at Construction Sites) Regulations. Comparisons will be made against the Adjusted Maximum Permissible Noise Limit (may refer below) which was calculated using the Pre-Construction Baseline noise collected in April 2023. The Adjusted Maximum Permissible Noise Limit allows for a higher noise threshold based on the site current conditions. For any exceedance of limits, the contractor shall investigate the cause of exceedance and take immediate steps to address the source of pollution.

The Noise Monitoring Meter will be temporary stationed at the selected locations as indicated in Figure 5-16 and Table 5-9. But this may also shift due to the site conditions, and construction work phasing. The location will be constantly updated within the Monthly Monitoring Report.



Figure 5-15. Example of Noise Monitoring Meter

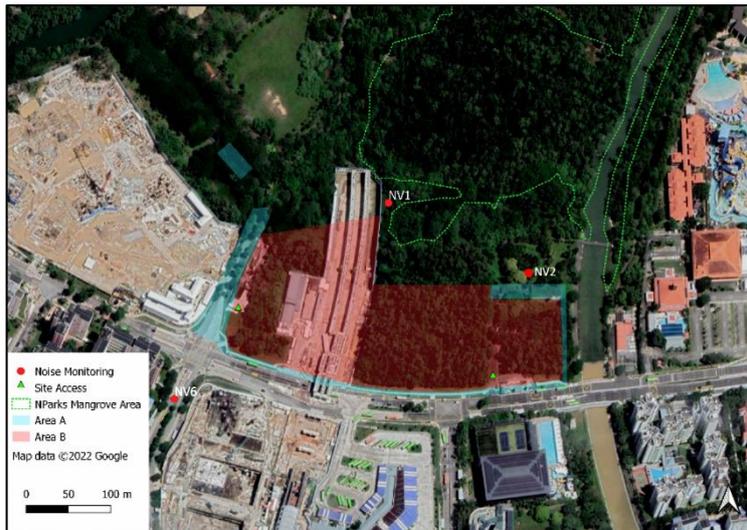


Figure 5-16. Noise Meter Location

Table 5-9. GPS Coordinates of Noise Monitoring Location during construction phase

Sampling Point	Latitude	Longitude	Description
NV1	1.377089	103.950520	Adjacent to Pasir Ris mangrove
NV2	1.376246	103.952008	Adjacent to Kingfisher Pond
NV6	1.374972	103.948246	Adjacent to residential blocks

The position of the Noise Monitoring Meter might be moved depending on site conditions and construction phasing but their primary role of monitoring noise at their respective sensitive receptor (i.e., residential building, schools) would remain unchanged. Any additional Noise Monitoring Meters should be located on the east side, similar to the EIS monitoring points to best determine the impact of noise on the sensitive receptors in the east.

Measurements are taken in compliance with the standards contained in the Environmental Protection and Management (Control of Noise at Construction sites) Regulations (2008). The Environmental Protection Act (Chapter 94A, Section 77) Control of Noise at Construction Sites stipulates the permissible noise limits, shown in the Table 5-10 and Table 5-11 below, which the construction project has to abide by. For any exceedance of limits, the contractor shall investigate the cause of exceedance and take immediate steps to arrest the source of pollution.

Table 5-10. NEA permissible noise limits for Monday - Saturday

Types of Affected buildings	7am – 7pm	7pm – 10pm	10pm – 7am
Hospitals, schools, institutions of higher learning, homes for aged, etc.	60 dB LAeq, 12hr	50dB LAeq, 12hr	
	75 dB LAeq, 5min	55 dB LAeq, 5min	
Residential buildings located less than 150m from construction site	75 dB LAeq, 12hr	65 dB LAeq, 1hr	55 dB LAeq, 1hr
	90 dB LAeq, 5min	70 dB LAeq, 5min	55 dB LAeq, 5min
Buildings other than a) and b)	75 dB LAeq, 12hr	65 dB LAeq, 12hr	
	90 dB LAeq, 5min	70 dB LAeq, 5min	

Table 5-11. NEA permissible noise limits for Sundays and Public Holidays

Types of Affected buildings	7am – 7pm	7pm – 10pm	10pm – 7am
Hospitals, schools, institutions of higher learning, homes for aged, etc.	60 dB LAeq, 12hr	50dB LAeq, 12hr	
	75 dB LAeq, 5min	55 dB LAeq, 5min	
Residential buildings located less than 150m from construction site	75 dB LAeq, 12hr	-	
	90 dB LAeq, 5min	55 dB LAeq, 5min	
Buildings other than a) and b)	75 dB LAeq, 12hr	65 dB LAeq, 12hr	
	90 dB LAeq, 5min	70 dB LAeq, 5min	

However, due to the site conditions experiencing slightly elevated levels of baseline noise, an Adjusted Permissible Noise Limit would be used (Table 5-12).

Table 5-12. Maximum Adjusted Permissible Noise Level for this Project

(NM1) Period	Parameter	Baseline Noise Level (dBA)	Permissible Noise Level (dBA)	Correction Factor	Adjusted Permissible Noise Level (dBA)
01/04 /2023 – 07/04 /2023	7am – 7pm (Leq 12 hours)	71.6	75	1	77
	7pm – 10pm (Leq 1 hours)	69.3	65	3	70.3
	10pm – 7am (Leq 1 hours)	65.7	55	1	65.7

(NM2) Period	Parameter	Baseline Noise Level (dBA)	Permissible Noise Level (dBA)	Correction Factor	Adjusted Permissible Noise Level (dBA)
01/04 /2023 – 07/04 /2023	7am – 7pm (Leq 12 hours)	72.1	75	1	77
	7pm – 10pm (Leq 1 hours)	68.4	65	3	69.4
	10pm – 7am (Leq 1 hours)	65.1	55	1	65.1

(NM3) Period	Parameter	Baseline Noise Level (dBA)	Permissible Noise Level (dBA)	Correction Factor	Adjusted Permissible Noise Level (dBA)
01/04 /2023 – 07/04 /2023	7am – 7pm (Leq 12 hours)	71.6	75	0	77
	7pm – 10pm (Leq 1 hours)	72.5	65	0	73.5
	10pm – 7am (Leq 1 hours)	65.1	55	2	65.1

5.3.8 Monthly Dust Monitoring

Two (2) continuous dust monitoring location were selected. PM_{2.5} and PM₁₀ would be monitored during this period. All monitoring points are similar to the ones conducted during the baseline assessment. Comparisons may be made with baseline results and the Singapore Ambient Air Quality Targets to monitor any major impacts from the construction activities. For any exceedance, the contractor shall investigate the cause and take immediate steps to address the source of pollution.

The location of the Air Quality Monitoring Meter will be temporary stationed within Figure 5-17 and Table 5-13. But this may also shift due to the site conditions, and construction work phasing. The location will be constantly updated within the Monthly Monitoring Report. The aim of the Air Quality Probe would be to determine any excessive introduction of pollutants into the ambient environment.

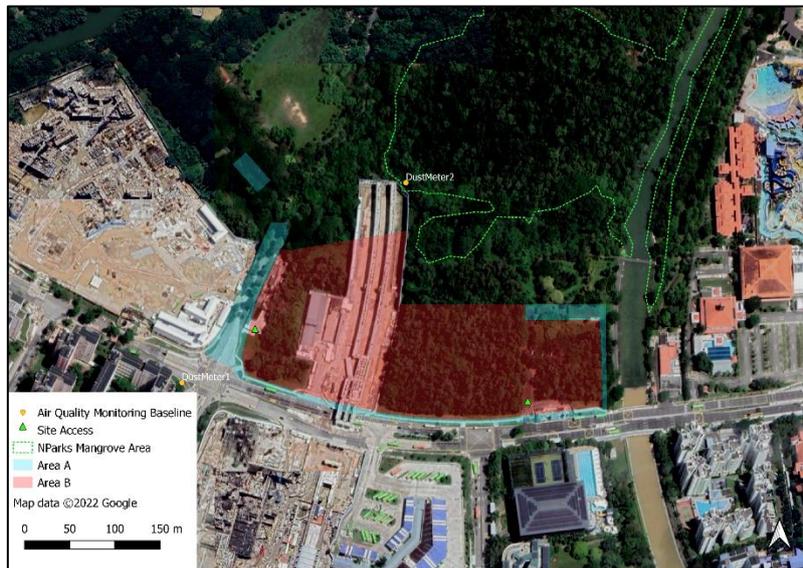


Figure 5-17. Dust Meter Location

Table 5-13. GPS Coordinates of Air Quality Monitoring Location during construction phase

Sampling Point	Latitude	Longitude	Description
Dust Meter 1	1.375419	103.948191	Along Pasir Ris Drive 3, in front of Blk 586
Dust Meter 2	1.377437	103.950420	Within Mangrove

Included below is an extract of the Singapore Ambient Air Quality Targets.

Table 5-14. Singapore Ambient Air Quality Targets

Pollutant	Singapore Targets by 2020	Long Term Targets
Particulate Matter (PM _{2.5})	Annual mean: 12 µg/m ³ (Sustainable Blueprint target) 24-hour mean: 37.5 µg/m ³ (WHO Interim Target)	Annual Mean: 10 µg/m ³ 24-hour mean: 25 µg/m ³ (WHO Final)
Particulate Matter (PM ₁₀)	Annual mean: 20 µg/m ³ 24-hour mean: 50 µg/m ³ (WHO Final)	

5.3.9 Quarterly Sediment Sampling

Two (2) quarterly sediment sampling were selected. A sample of 500g per sampling point will be collected quarterly (every 3 months). The sediment samples will collect the top 10cm of mangrove sediment at each of the sampling location. This carried out through the use of dedicated sampling equipment (i.e., Van Veen Grab Sampler). The sample would be sent to an accredited Comparisons may be made with baseline results to monitor any major impacts from the construction activities. For any exceedance, the contractor shall investigate the cause and take immediate steps to address the source of pollution. All sediment samplings are similar to the ones conducted during the EIS.

The location of the Sediment Sampling points was temporary selected within Figure 5-18 and Table 5-15. But this may also shift due to the site conditions, construction work phasing, or natural changes (i.e., tide conditions). The location will be constantly updated within the Monthly Monitoring Report. The aim of the Sediment Sampling would be to determine any excessive introduction of pollutants into the ambient environment. The sediment samples would be collected from the boardwalk within Pasir Ris Mangrove.

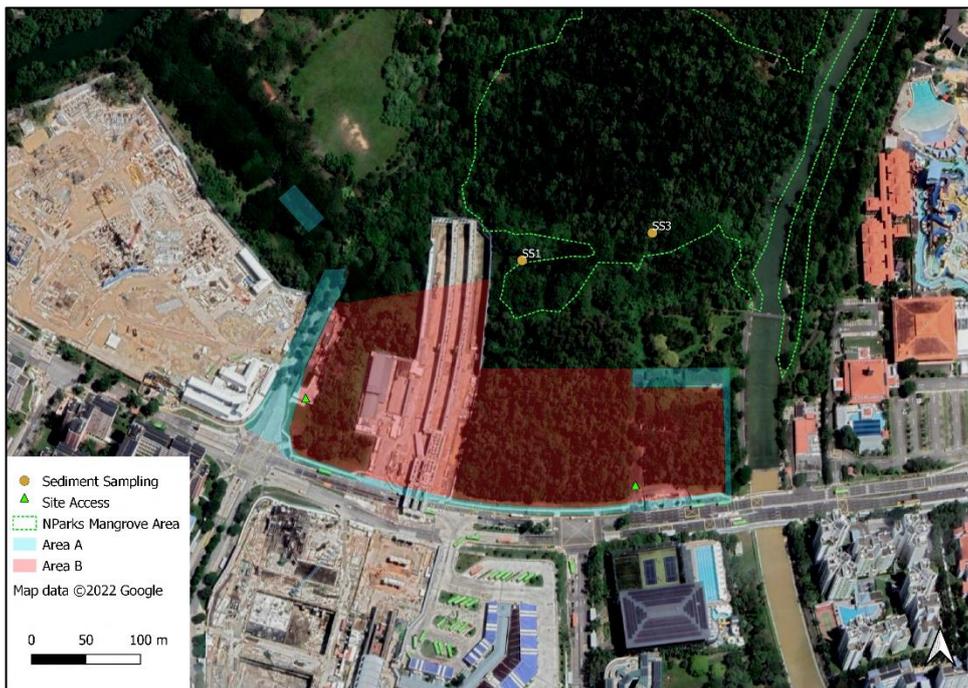


Figure 5-18. Sediment Sampling Location

Table 5-15. GPS Coordinates of Sediment Sampling during construction phase

Sampling Point	Latitude	Longitude	Description
SS1	1.377110	103.950702	Along mangrove boardwalk
SS3	1.377340	103.951774	Along mangrove boardwalk

The table below shows the sediment quality parameters that would be monitored. These parameters are similar to those measured during the EIS. The parameters would be assessed to the EIS baseline obtained. These standards were utilised due to there being no sediment quality regulatory standards available in Singapore.

Table 5-16. Sediment Guideline Values

Parameter	Unit	EIS Survey
pH	-	-
Arsenic	mg/kg	20
Antimony	mg/kg	2.0
Barium	mg/kg	-
Cadmium	mg/kg	1.5
Chromium	mg/kg	80
Cobalt	mg/kg	-
Copper	mg/kg	65
Mercury	mg/kg	0.15
Lead	mg/kg	50
Molybdenum	mg/kg	-
Nickel	mg/kg	21
Zinc	mg/kg	200

The sediments are taken as concerns on sediment quality was highlighted to be important in assessing the health of the mangrove ecosystem.

5.3.10 Artificial Light Management Plan

The Artificial Light Management Plan (ALMP) is prepared in accordance to the *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:

- Start with natural darkness and only add light for specific purposes;
- Use adaptive light controls to manage light timing, intensity, and colour;
- Light only the object or area intended – keep lights close to the ground, directed, and shielded to avoid light spill;
- Use the lowest intensity lighting appropriate for the task;
- Use non reflective, dark coloured surfaces; and
- Use lights with reduced or filtered blue, violet and ultra-violet wavelengths.

The objectives of this ALMP:

- Artificial light 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 impact of artificial lighting on the surrounding environment as far as reasonably practicable.

The proposed artificial lighting layout for specific purpose would be provided in a Light Management Plan when the details of the Phase 2 construction works are available.

5.3.10.1 *Ambient Lighting along Access Road and Casting Yard*

Ambient lighting will be constant and typically be provided to aid the safe access for areas such as access roads, footpaths, car parks contractors' compounds. For lighting along the access road and casting yard, the following measures are required:

- All light fittings should be directed or shielded to avoid lighting anything but the target object or area (Figure 5-19) except lighting for safety and security purpose. Existing lights can be modified by installing a shield.
- Ambient lighting should not exceed the height of noise barriers or hoarding. Use the possible lowest lighting where practicable except for safety and security purposes.
- Erection of temporary shielding using tall flexible (non-flammable) barriers for some of the lower-level casting works with lighting confined within the barriers, which can be easily set up and de-mob and moved from location to location, if applicable.
- Higher site hoarding should be installed in the vicinity of potential bat roosting site (if applicable).
- Use wildlife-friendly light throughout the site where possible with the following features:
 - Warm light with colour temperature 3000K and below;

- o Use non-reflective, dark-coloured surfaces to reduce contribution to sky glow.
- o Use low-glare lighting and lights with reduced or filtered blue, violet and ultra-violet wavelengths.



Figure 5-19. Lights should be shielded to avoid lighting anything but the target area or object. Figure adapted from (Witherington & Martin, 2003)

5.3.10.2 Task Lighting for Construction

Task lighting will typically be provided for construction activities 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. However, task lighting is typically required only when work is required in a specific area. The following measures shall be adopted for construction work during night time:

- Limit the hours of lighting – only be used during specific times at specific locations and will typically be provided by portable units which will have manual switching. If the units are to be in place for a prolonged period it would be beneficial for the unit to have a photo electric control cell which will automatically turn the lighting on at dusk and off again at dawn when natural lighting levels have increased or reached predetermined levels;
- Localised control of lighting – lights should not be centralised and should be able to switched off when not required;
- Direct luminaires into the area to be lit (light from the boundary inwards); and
- Mobile crane/tower crane – Any illumination that is required for the crane during operational times for safety to be switched off when crane is not in use except for obstacle-avoidance lighting/safety purposes.

5.3.10.3 Artificial Lighting Audit

Audits will be undertaken where night work is required to assess the effectiveness of mitigation measures and for contractor to held accountable of the implementation of the EMMP. A monthly artificial lighting 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 will be incorporated in the monthly EMMP compliance report:

Table 5-17. Checklist for Night Work EMMP Audit

No.	Environmental Inspection Items	Verification	Observation	Follow-up action
1.	Is ambient lighting in the observed area directed or shielded to avoid lighting spill?			
2.	Is lighting exceeding the height of noise barriers or hoarding?			
3.	Are wildlife-friendly ambient lights being used throughout the project site especially along the northern boundary – near to Pasir Ris Mangrove?			
4.	Any observation of task lighting for the construction works? Is the illumination necessary for the specific task?			
5.	Any observation of bat roosting site? Especially near Pasir Ris Park and Mangrove.			
6.	Is there any light spillage from the construction sites onto the bat roosts.			
6.	Is task lighting able to be switched off when not required?			
7.	Any illuminated crane/machinery that is not in use?			
8.	Any observation of erection of temporary shielding using tall flexible (non-flammable) barriers for some of the lower-level casting works with lighting confined within the barriers?			
9.	Any observation of zones not slated for works during the proposed period, but the lights are turned on unless ambient lighting is required for access through the zone to the work area?			
10.	Any other observations?			

5.3.10.4 *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, corrective actions should be taken within 7 days and consultant to be updated. The specific works that does 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.

5.3.10.5 *Communication*

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

6. EMMP Table Summary

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
<u>Air Quality</u>				
<ul style="list-style-type: none"> Increase in fugitive dust emission from transportation activities Increase in particulate emission as dust from construction activities (demolition, site clearance and land preparation, earthworks, excavation, and operation of construction machinery and plant) 	<p><u>Exposed Surfaces</u></p> <ul style="list-style-type: none"> Cover the exposed soil under canvas sheets or biodegradable erosion control blankets (ECB) as soon as reasonably practicable. Periodic water bowing at the temporary unpaved areas during ambient dry periods. <p><u>Demolition</u></p> <ul style="list-style-type: none"> Enclose the work area with dust screens/netting. Regular water spraying for dust suppression. Cover the stockpiles of demolished items/debris using canvas sheets or erosion control blankets. Storage period should be as short as is reasonably practicable. Schedule work in the absence of strong winds and gales. <p><u>Construction Vehicles</u></p> <ul style="list-style-type: none"> Provide wash trough with waterjet to clean the construction vehicles before entering the public roads. 	<ul style="list-style-type: none"> Daily on-site and off-site visual inspections to be undertaken and recorded. Inspection frequency should increase during the period of high activity or prolonged dry, windy weather. Monthly air quality monitoring (2 points) should be carried out to ensure that the air quality from the site is complied with the Singapore Ambient Air Quality Guidelines. 	<p>Daily</p> <p>Monthly</p>	<p>Contractor</p> <p>SECS</p>

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
	<ul style="list-style-type: none"> Cover the truck loads carrying dry materials (cement, sand, aggregate, soil, etc.) with tarpaulin. <p><u>Monitoring and Management</u></p> <ul style="list-style-type: none"> Conduct monthly air quality monitoring. Regular visual inspections for visible dust. Provide training to key staff on the importance of adhering to the requirements of the EMMP. This should be incorporated into the safety induction course, and toolbox meetings and communicated to the workers. Ensure the workers are provided with appropriate PPE. Adopt safe work practices in a dusty environment. 			
<u>Water Quality</u>				
<ul style="list-style-type: none"> Soil erosion and sedimentation due to the land clearance and construction activities Contaminated runoffs / discharges from the Project site 	<p><u>Surface Runoff Management</u></p> <ul style="list-style-type: none"> Formalized the surface runoff via installation of above-ground and / or below-ground drains. Divert the surface runoff to the south of the Project site and discharge into the existing urban drainage at Pasir Ris Drive 3 to avoid disturbance to the sensitive mangrove area. 	<ul style="list-style-type: none"> All ECM should be inspected and maintained regularly throughout the construction phase by the QECP which will be reviewed in tandem with the progress of works i.e., replacement of silt fences and erosion control blankets, re-paving of concrete surfaces, etc. Continuous monitoring and recording system should be set up at the discharge points (after ECM) before 	<p>As required</p> <p>Continuous</p>	<p>Contractor / QECP</p> <p>Contractor</p>

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
<ul style="list-style-type: none"> Risk of slope failure between the northern boundary of Project site and the mangrove area Loss of infiltration to groundwater recharge due to the impervious surfaces Turbid groundwater resulting from dewatering of excavated pit 	<p><u>Earth Control Measures (ECM)</u></p> <ul style="list-style-type: none"> Establish temporary perimeter drainage within the Project boundary. Regular maintenance of temporary drainage system, check dams and sediment basins / silt traps. Discharges from sediment basins / silt traps to comply with the limit of 50 mg/L for total suspended solids (TSS) as per requirements prior to entering the public drainage system. Regular water bowing at the temporary unpaved areas during ambient dry periods. Cover or turf the exposed areas / bare slopes where no work is being carried out. Cover the stockpiles with waterproof sheets. <p><u>Slope Stability at Mangrove Area</u></p> <ul style="list-style-type: none"> Provision of 50 m setback between the northern boundary of the Project site and the mangrove area. Formation of slope embankment along the northern boundary of the Project site. <p><u>Dewatering Practices</u></p> <ul style="list-style-type: none"> Accumulated runoff resulting from excavation, foundation or other similar work should be treated (TSS ≤ 	<p>public drain to monitor TSS concentration and turbidity in discharges from the site. The monitoring system should be able to provide continuous and live monitoring, recording which can be monitored 'live' off-site and has a SMS alert feature to warn of TSS concentrations which exceed the limit. Refer to Appendix V for the response flowchart for water quality exceedances.</p> <ul style="list-style-type: none"> Monthly external water quality (4 points), Monthly ECM water quality (2 points) and quarterly sediment quality (2 points) sampling should be taken to ensure that the runoff from the site is in accordance to NEA's allowable limits for trade effluent discharge. Audit / inspection of ECM system, hazardous material management and water quality management within the Project site. 	<p>Monthly / Quarterly</p> <p>Daily / Monthly</p>	<p>SECS</p> <p>Contractor / SECS</p>

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
	<p>50 mg/L) prior entering into the public drainage system.</p> <p><u>Handling and Storage of Potential Contaminants</u></p> <ul style="list-style-type: none"> Secure the chemicals and diesel storage tanks within a concrete bunded area to avoid material spillage. Locate the storage area at the south of the Project site and away from the mangrove area. Transfer of chemicals should be done over contaminant trays and mats to prevent spillage from entering groundwater. Put emergency and contingency plans in place in the event of a fuel, liquid waste or chemical spill. Should any accidental releases occur, the contractor should notify the Pollution Control Department of NEA immediately following the accidental release, spill or leak of oil or chemicals. <p><u>Monitoring and Management</u></p> <ul style="list-style-type: none"> Conduct monthly water quality and quarterly sediment quality monitoring on a regular basis. Provide training to key staff on the importance of adhering to the requirements of the EMMP. This 			

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
	should be incorporated into the safety induction course, and toolbox meetings and communicated to the workers. <u>Emergencies</u> <ul style="list-style-type: none"> Use fresh water for mitigating fire hazards instead of chemical suppressants. 			
<u>Noise Quality</u>				
<ul style="list-style-type: none"> Noise pollution from construction activities (e.g., piling work, excavation work, etc.) 	<u>Site Activities</u> <ul style="list-style-type: none"> Restrict noisy construction activities (i.e., piling) and necessary noise mitigation strategies to be implemented along the northern boundary. Adopt non-percussive method for piling work (e.g., rotary piling method) for less noise at highly sensitive areas along the northern boundary. Provide silencer / noise blanket / localized noise barrier for noisy equipment or machinery e.g., generators, drilling tools, etc. Use of quiet / silenced equipment to be considered during planning of a particular construction task. Turn off the equipment and / or machinery when not in use. 	<ul style="list-style-type: none"> Ensure that site office area follows the Noise pollution control measures written under the Code of Practice for Environmental Control Officers. Continuous noise monitoring to be conducted to ensure the noise levels do not exceed the stipulated noise limit. Noise parameters measured should be compared against Pre-Construction baseline and NEA limits (Environmental Protection and Management Act, 2008). Monthly Noise Level monitoring (2 points) should be carried out to ensure that the noise level from the site is complied with the Singapore Maximum Permissible Noise Level. Visual inspection of noise management within site. 	Daily Continuous Daily Monthly Daily Monthly	Contractor Contractor Contractor SECS Contractor SECS

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
	<ul style="list-style-type: none"> • Avoid parallel use of noisy equipment and machinery. • Noisy equipment / machinery and activities should be located away from the NSRs as is reasonably practicable. • Schedule the vehicle movement to avoid accumulated traffic noise. <p><u>Noise Barriers</u></p> <ul style="list-style-type: none"> • Erection of proper hoardings made of opaque, non-reflective materials and painted with colour which will blend in with the environment. • All noise barriers shall be in accordance with Singapore Standard SS 602:2014. They should be designed to achieve a theoretical minimum reduction of 10 Dba. • Noise barriers along the northern boundary (Pasir Ris Park) should be at least 12m high. While the rest of the site should be at least 2.4m high. <p><u>Inspection and Maintenance</u></p> <ul style="list-style-type: none"> • Conduct regular check / inspection of the work site boundaries. • Proper maintenance of equipment, machinery and heavy vehicles used on a regular basis. 			

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
	<ul style="list-style-type: none"> Equipment should comply with the Environmental Protection and Management (Vehicular Emission) Regulations or Environmental Protection and Management (Off-Road Diesel Engine Emissions) Regulation 2012. <p><u>Monitoring and Management</u></p> <ul style="list-style-type: none"> Carry out continuous noise level monitoring. A community liaison officer should be appointed to address any complaints. Provide training to key staff on the importance of adhering to the requirements of the EMMP. This should be incorporated into the safety induction course, and toolbox meetings and communicated to the workers. 			
<u>Waste</u>				
<ul style="list-style-type: none"> Pressure on existing waste management system Health and safety risks associated with hazardous wastes with no management 	<ul style="list-style-type: none"> A solid waste management plan to manage the collection, recycling and ultimate disposal of all generated wastes in an environmentally responsible manner. A waste management hierarchy (including avoidance, minimization, reuse, recycling, treatment and disposal of materials) shall be included in the 	<ul style="list-style-type: none"> The waste management plan should include monthly quantity records of waste generation and disposal for general non-hazardous, hazardous and construction waste. Sufficient testing of each batch of excavated material in order to determine the disposal route for the waste. 	<p>Monthly records of waste generated and disposed</p> <p>Testing determined by</p>	<p>Contractor</p> <p>Contractor</p>

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
	<p>plan and used to establish guidelines and procedures.</p> <ul style="list-style-type: none"> All excavated materials on site will be collected and disposed at approved dumping grounds. Locate worker facilities and sanitary facilities along Pasir Ris Drive 3, and away from Pasir Ris Park. 	<p>Reference should be made to the MPA's general guidelines for dredged and land-based excavated materials.</p> <ul style="list-style-type: none"> Ensure no food / waste are left out to attract wildlife. 	<p>contractor and approved by MPA.</p> <p>Daily</p>	Contractor
<u>Illumination</u>				
<ul style="list-style-type: none"> Disturbance to biodiversity due to necessary illumination of construction night work Disturbance to biodiversity utilizing the temporary wildlife crossings 	<ul style="list-style-type: none"> If potential night works to be carried out, Contractor has to notify and make request 30 days in advance for approval. Lighting of the site outside the main construction time-period (e.g., 8am – 6pm) should be limited as far as possible. These light sources shall be kept minimum only for the on-site safety and security. A Light Management Plan will be provided for any works outside of 8am-6pm and a specific Light Management Plan for Phase 2 will be provided before Phase 2 works commence. All light should be directed away from forest edge. Light fixtures are to be directed downwards in towards the construction activities and to be switched off at all non-essential 	-	<p>If night work is carried out, it has to be recorded within the Monthly report</p>	EMMP Consultant

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
	<p>areas. If ambient lights are needed at night, the colour temperature should be 3000 kelvin and below (warmer light) at the edge between construction site and forested area.</p>			
<u>Biodiversity</u>				
<ul style="list-style-type: none"> Reduction of Trees and Vegetation Direct habitat loss Habitat Alteration Physical Disturbances 	<p><u>Site Clearance</u></p> <ul style="list-style-type: none"> Minimize the impact of tree removal by retaining or transplanting of certain trees identified by NParks/HDB. A suitably qualified arborist should be appointed to oversees the tree removal/transplanting. Land clearance should be carried out following the wildlife shepherding plan. EMMP consultant to conduct pre-survey for biodiversity prior to the start of wildlife shepherding. Prohibit and prevent open fires. Temporary fire-fighting equipment in each construction work area. Ensure construction zone and retained areas are clearly demarcated before commencement of works to ensure clearing is kept to a minimum. <p><u>Site Activities</u></p> <ul style="list-style-type: none"> Reinstatement of temporary construction works (e.g., through on-site tree/shrub/grass planting). The species in the reinstatement work 	<p><u>Preservation of flora receptors</u></p> <ul style="list-style-type: none"> Ensure that Tree Protection Zones are intact and no materials are stored within the zone. Plant waste to be stored in designated area and removed regularly from site Ensure that work do not negatively impact trees marked for preservation and identify additional measures to protect trees. Monthly monitoring of the trees around the work site during the duration of the Project to assess for any impacts of edge effects from the works on trees outside the site boundary and for trees that may fail and pose hazards to the work site <p><u>Preservation of fauna receptors</u></p> <ul style="list-style-type: none"> Daily site check for animal entrapment (including inspection of biodegradable 	<p>Daily</p> <p>Daily</p> <p>Beginning of every wildlife shepherding zone</p> <p>Monthly</p> <p>Daily</p>	<p>Contractor</p> <p>Contractor</p> <p>SECS</p> <p>Arborist</p> <p>Contractor</p>

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
	<p>should be confirmed with NParks and reference should be made from those in the surrounding area.</p> <ul style="list-style-type: none"> EMMP Consultant to conduct trainings on environmental sensitivities for workers and what to do in case of human-wildlife encounters. Refer to Section 8.3 for Wildlife Reporting Protocol. <p><u>Hoarding and Signages</u></p> <ul style="list-style-type: none"> Ensure suitable and effective hoarding, especially along roads to prevent incidents of road-kills. Signages would be installed to warn workers to be wary of animals. A speed limit of 15km/h would also be imposed within the site. Ensure construction zone and retained areas are clearly demarcated before commencement of works to ensure clearing is kept to a minimum. <p><u>Discourage Wildlife from entering the site</u></p> <ul style="list-style-type: none"> Consumption of food within the construction area should be within enclosed eating houses. These eating houses should be situated away from Pasir Ris Park as practically possible. 	<p>ECB and pits) and roadkill. All incidents of entrapment, roadkill or fauna entering site should be reported. There should be no gaps between the bottom of the hoarding and ground.</p> <ul style="list-style-type: none"> EMMP consultants / wildlife specialist to conduct biodiversity pre-felling check prior to each wildlife shepherding zone. Survey should also be done along roads to report incidents of roadkill. EMMP consultant / wildlife specialist will oversee wildlife shepherding process and identify any important species on site. EMMP consultant to conduct monthly visual site audit / inspection on environmental related issues after wildlife shepherding, during construction phase. Recording of non-compliances for follow-up. Wildlife specialist to conduct monthly biodiversity survey after wildlife shepherding, during construction phase. EMMP consultant / wildlife specialist to conduct regular biodiversity awareness and wildlife shepherding training. This can be conducted through the workers' regular toolbox meetings. 	<p>Weekly during wildlife shepherding</p> <p>Weekly during wildlife shepherding</p> <p>Monthly</p> <p>Monthly</p> <p>As required</p>	<p>SECS</p> <p>SECS</p> <p>SECS</p> <p>SECS</p> <p>SECS</p>

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
	<ul style="list-style-type: none"> Use of monkey-proof bins to prevent animals like long-tailed macaque from scouring food. Installation of window mesh / grilles on windows and doors of general site facilities to prevent wildlife from gaining access. Workers should also ensure that any waste from cleared vegetation should be removed at the end of the day to prevent animals from seeking refuge. Any exposed trenches should also be covered at the end of the day with a wooden plank or similar – this should be practiced throughout the construction period. 			
<u>Vectors</u>				
<ul style="list-style-type: none"> Attraction of pests, disease vectors and scavenging animals (insects, rodents) to site. Increase in likelihood of vector-borne diseases affecting humans 	<ul style="list-style-type: none"> Use of monkey-proof bins to prevent animals like long-tailed macaque from scouring food. Domestic/sanitary waste to be removed from site promptly. Assign designated rest area within site office area. Food should only be consumed within these designated areas and waste should all be thrown into monkey-proof bins. All food should be stored away from the ground. Empty containers should be kept indoor. Building materials should be 	<ul style="list-style-type: none"> Inspect the site office area to ensure that no food or waste are left out to attract wildlife. 	Daily/ Monthly	Contractor/ SECS

Environmental Impacts	Management actions	Monitoring actions	Frequency	Responsibility
	<p>stored under shelter and off the ground.</p> <ul style="list-style-type: none"> • Stagnant water shall be pumped from the work areas and ground depressions covered with earth. Anti-mosquito oil and insecticide should be applied to stagnant water at least once a week and repeated after rain. • Installation of window mesh / grilles on windows and doors of general site facilities to prevent wildlife from gaining access. • No use of glue traps for pest management within the site. • Fogging / fumigation within the site should only be done when there is a mosquito nuisance problem. 			

7. Monitoring and Reporting Schedule

7.1 Monitoring Schedule

Routine monitoring will be conducted throughout the duration of works. During wildlife shepherding, SECS will closely monitor the progress of works done and conduct biodiversity surveys on a weekly basis. Once shepherding works are completed, monitoring frequency will be reduced to monthly and visual site inspections will be conducted. Refer to Table 7-1 for monitoring schedule.

Table 7-1. Monitoring Schedule

Monitoring	Frequency	Done by
Wildlife Shepherding (including Pre-felling check for bird nest)	Weekly (during wildlife shepherding)	SECS
Water Quality	Monthly	SECS
Air Quality	Monthly	SECS
Noise Monitoring	Monthly	Contractor
Sediment Sampling	Quarterly	SECS
Biodiversity The following taxa will be surveyed: Birds (Aves) – Diurnal survey; Mammals (Mammalia) – Diurnal survey; Reptiles (Reptilia) – Diurnal survey; Amphibians (Amphibia) – Diurnal survey; Butterflies (Rhopalocera) – Diurnal survey; Dragonflies and damselflies (Odonata) – Diurnal survey.	Pre-clearance check (before wildlife shepherding) Pre-felling check (during wildlife shepherding) Monthly (after wildlife shepherding and until construction is completed). The biodiversity survey would be conducted along the transects highlighted in Section 5.3.5, Figure 5-13.	SECS
Visual Site Inspection	Visual Site Inspection would be conducted within the Development Area, or where possible. This ensures the contractors are complying with the mitigation measures set in the EMMP including inspection of the hoardings, the ECBs, the rest areas and other measures specified in Section 6. Weekly (during wildlife shepherding) Monthly (after wildlife shepherding and until construction is completed).	SECS
Trees / Arborist	Monthly (during construction)	Arborist

7.2 Reporting Schedule

As part of the EMMP, routine reports will be provided to HDB and relevant contractors for onward submissions to relevant technical agencies like NParks (Table 7-2).

Table 7-2. Reporting Schedule

No.	Document / Report	Frequency
1.	Biodiversity Training Attendance Records	As required
2.	EMMP Document	Once at the beginning of the project (Live document)
3.	Wildlife Shepherding Report (Progress of wildlife shepherding and biodiversity monitoring data)	Weekly (During directional site clearance only)
4.	EMMP Implementation Audit and Monitoring Report (On visual inspections and monitoring data)	Monthly (During construction stage)
5.	Incident Report	As required
6.	Minutes of Meetings	As required

8. Environmental Response Plan

This Environmental Response Plan (ERP) was developed to provide guidance and strategies for the protection of wildlife during wildlife encounters and incident. The ERP includes:

1. Procedures to be implemented for an encounter of specific animal (Section 8.2);
2. Wildlife Encounter Protocol (Refer to Section 8.3);
3. Water Quality Exceedance Protocol (Refer to Appendix V);
4. Chemical Spill Protocol (Refer to Appendix VI);
5. Public Feedback Protocol (Refer to Appendix VII).

8.1 Summary of Emergency Contact for Environmental Incident

The table below provides a summary of an emergency contact for the environmental incident:

Table 8-1. Emergency Contact for Environmental Incident

Incident	Responsible Party	Person-in-charge	Contact No.
All environment incident	<ul style="list-style-type: none"> • Environmental Control Officer 	Mr Durai	HP: 9180 9712
Encounter of dead animals	<ul style="list-style-type: none"> • EMMP consultant 	Mr Yew Min Terk	HP: 8339 6569
Encounter of injured animals	<ul style="list-style-type: none"> • EMMP consultant • Environmental Control Officer 	Mr Yew Min Terk Mr Durai	HP: 8339 6569 HP: 9180 9712
	<ul style="list-style-type: none"> • Approved Wildlife Management Company 	Refer to the Public Registry	Refer to the Public Registry
Fire event/snake bites	<ul style="list-style-type: none"> • Singapore Civil Defence Force (SCDF) 	N/A	995
Chemical/Oil Spill	<ul style="list-style-type: none"> • EMMP consultant 	Mr Yew Min Terk	HP: 8339 6569

8.2 Wildlife Encounter for Specific Animals

The following procedures, in Table 8-2, are recommended to be implemented for encounter of specific animals (live):

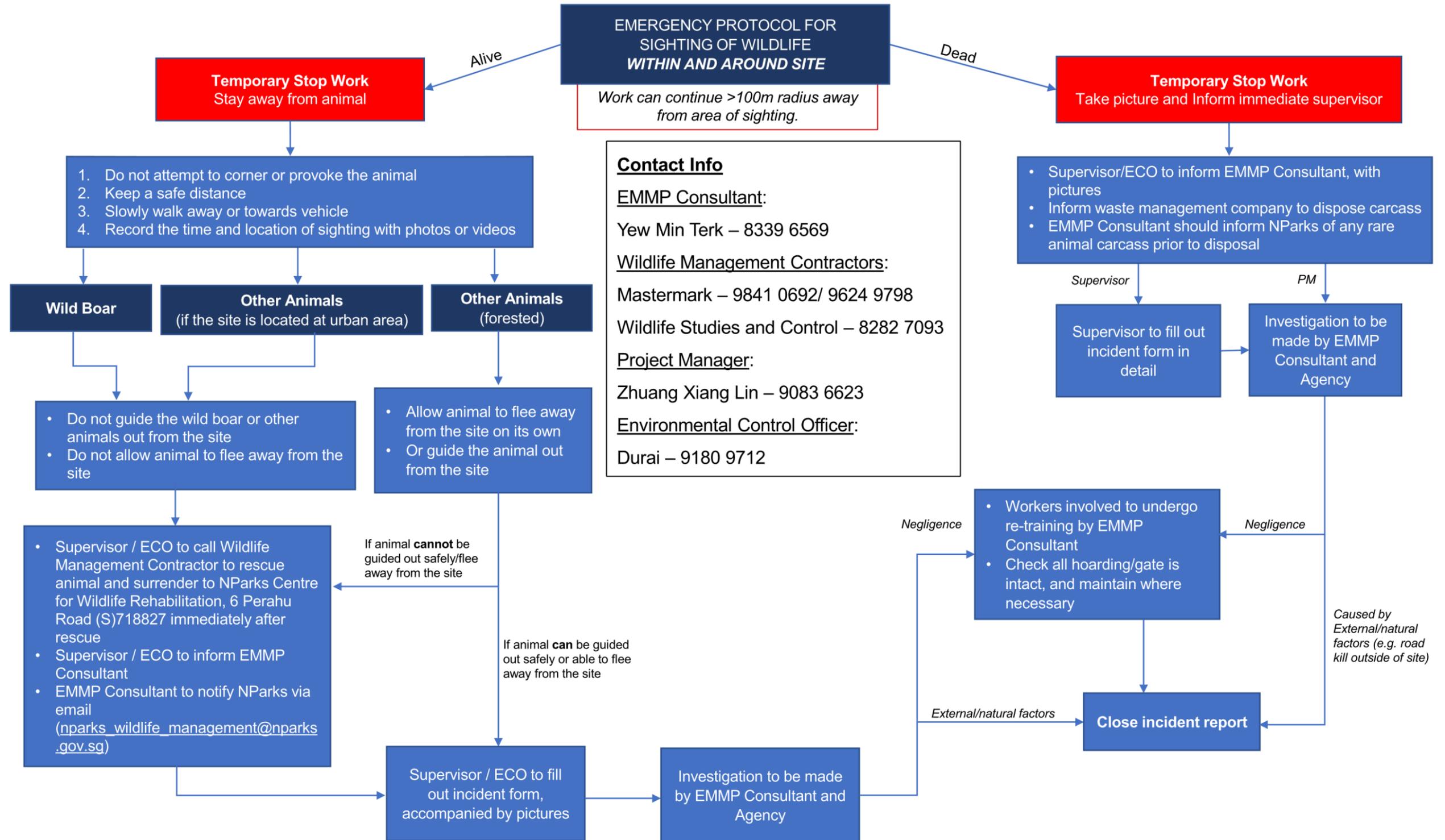
Table 8-2. Wildlife Encounter for Specific Animals

Animal Encounter	Procedure
<ul style="list-style-type: none"> • Bird nest • Beehive 	<ul style="list-style-type: none"> • 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 EMMP consultant and Environmental Control Officer for further action.
<ul style="list-style-type: none"> • Wild boars 	<ul style="list-style-type: none"> • 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 flash light) • If encounter adults with young piglets, leave them alone. They are potentially more dangerous because they may attempt to defend their young. • If any wild boar is spotted at or around the Project site at any time during the construction phase, NParks must be notified as soon as possible at nparks_wildlife_management@nparks.gov.sg for advice and subsequent action. • An approved wild boar removal contractor must also be engaged to trap and remove the said wild boar. • Do note that the trapping and removal process may take about 4 – 8 weeks.
<ul style="list-style-type: none"> • Macaques 	<ul style="list-style-type: none"> • Stop work (only at the immediate vicinity) if monkey 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 monkeys have left.

Animal Encounter	Procedure
<ul style="list-style-type: none"> • Snakes 	<ul style="list-style-type: none"> • Stop work (only at the immediate vicinity) if snake is sighted. • Do not provoke or confront the snake (i.e., using a 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. • Site supervisor to inform EMMP consultant and Environmental Control Officer for further action. • If the snake is still in the immediate vicinity of construction site and disruptive to the work, EMMP consultant will arrange a licensed wildlife expert to relocate the snake. • Resume work after the immediate site is cleared from snake.
<ul style="list-style-type: none"> • Other animals 	<ul style="list-style-type: none"> • Do not be alarmed. • Most animals are shy and will not attack human. • Do not touch, chase, corner or provoke them. • Stop work immediately and keep a safe distance from the animal. • Site supervisor to inform EMMP consultant and Environmental Control Officer for further action. • Resume work after the animal has left the site.

8.3 Sighting of Fauna within and around the site

The following flow chart provides direction in the event of wildlife encounter during work activity.



9. References

- Australian Government. (2020, January). National Light Pollution Guidelines for Wildlife. *Light Pollution Guidelines*. (D. o. Energy, Ed.) Department of Biodiversity, Conservation and Attractions.
- Environmental Protection and Management Act. (2008). *Environmental Protection and Management (Control of Noise at Construction Sites) Regulations*. Singapore: Singapore Statutes Online.
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- NParks. (2018). *Guidelines on Greenery Provision and Tree Conservation for Development*. Retrieved Mar 31, 2023, from National Parks Board: <https://www.nparks.gov.sg/-/media/nparks-real-content/partner-us/developers-architects-and-engineers/gdp-handbook-2018-apr-3.pdf>
- NParks. (2022, September 21). *Species List (Red Data Book List)*. (National Parks Board) Retrieved January 1, 2023, from NParks: <https://www.nparks.gov.sg/biodiversity/wildlife-in-singapore/species-list>
- Ramboll Environ Singapore Pte Ltd. (2019). *Environmental Impact Study - Contract C1397: Scenario 2 Proposed MRT Track Modification and Residential Developments at Pasir Ris*. Singapore: LTA. Retrieved March 31, 2023
- Witherington, B. E., & Martin, E. (2003). Understanding, Assessing, and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches. *Florida Marine Research Institute Technical Report*. Retrieved March 31, 2023

APPENDIX

Appendix List

Appendix I	:	Wildlife Shepherding Plan
Appendix II	:	Contractor's Organisational Chart
Appendix III	:	Method Statement for Hoarding and Tree Felling Works
Appendix IV	:	Site Utilisation Plan
Appendix V	:	Water Quality Exceedance Flowchart
Appendix VI	:	Chemical Spillage Flowchart
Appendix VII	:	Public Feedback Response Flowchart
Appendix VIII	:	Biodiversity Awareness Training Documents
Appendix IX	:	Pre-Construction Baseline Fauna Photos
Appendix X	:	Pre-Construction Baseline Water Analysis
Annex I	:	Non-Technical Summary of Environmental Impact Study



SINGAPORE ENVIRONMENTAL CONSULTANCY AND SOLUTIONS PTE LTD

APPENDIX I

WILDLIFE SHEPHERDING PLAN

Wildlife Shepherding Plan

HDB Development (Eastern)
Proposed Public Housing in Pasir Ris



Shepherding Information

- Wildlife shepherding direction
- Hoarding designs and equipment

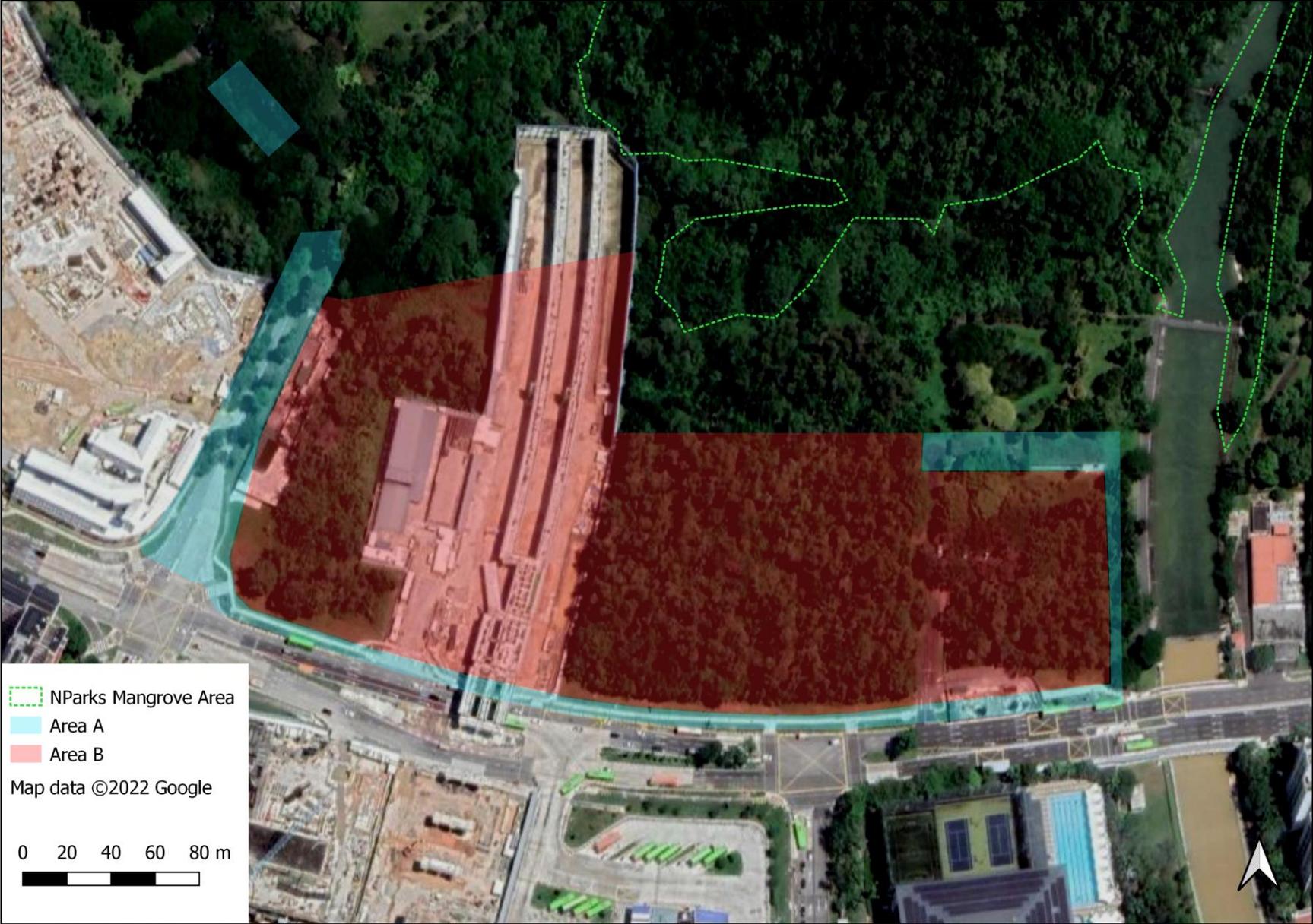
Shepherding Methodology

- Shepherding steps
- Hoarding locations
- Timeline / Schedule

Reporting

- Documentation and Checks

Proposed Development Area



Work Zone	Construction Objectives
Area A	<p>Supporting Infrastructure Works:</p> <ul style="list-style-type: none">• <i>Construction of a drop-off porch within Pasir Ris Carpark C</i>• <i>Road widening of existing Pasir Ris Green</i>• <i>Construction of various drainages along Pasir Ris Green</i>• <i>Laying of services and construction of service road</i>• <i>Construction of Sewer Lines along Pasir Ris Drive 3</i>
Area B	<p>Site Clearance, Earthworks and Future Residential HDB Development:</p> <ul style="list-style-type: none">• <i>Site Clearance, Earthworks, and Detailed Site Investigation</i>• <i>Residential Housing Development</i>

Overall Wildlife Shepherding Direction



Shepherding is towards the northern direction (towards Pasir Ris Park).

The area to be cleared is divided into 12 zones / sections. Shepherding is conducted in zones / sections.

Each zones / sections is divided into ~3000 m², or adjusted based on the environmental conditions.

Shepherding is divided into 2 main phases:

- Installation of Hoardings and ECMs
- Phased Clearing



Proposed Development Area



Shepherding is divided into 3 main phases:

- Installation of Hoardings and ECMs
- Phased Clearing
- Monitoring

Typical Shepherding timeline is illustrated here.

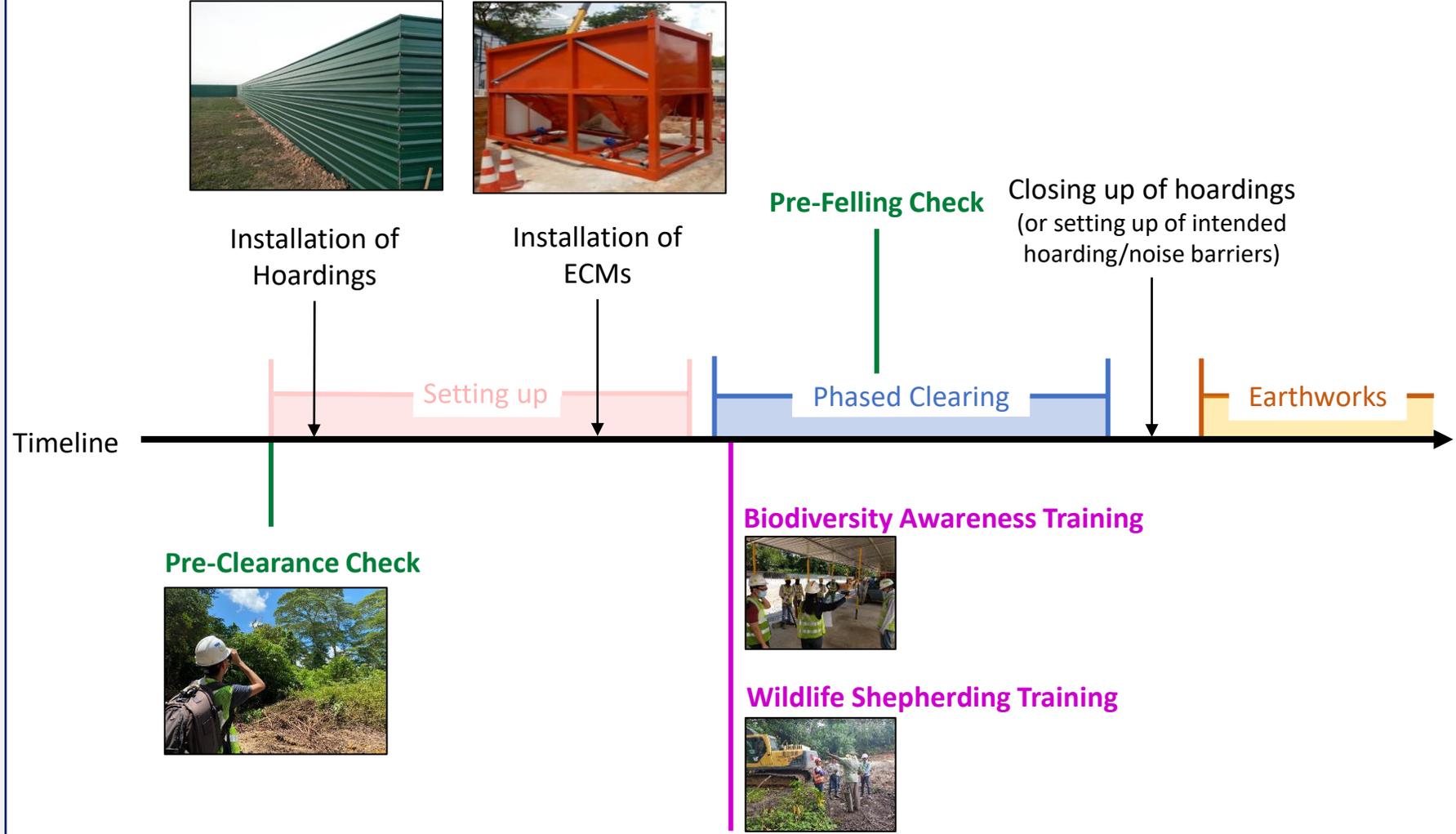
1. Pre-clearance check would be conducted prior to the setting up of hoardings, ECMs, drains.
2. Installation of Hoardings and Perimeter drains
3. Installation of ECMs and Holding ponds
4. Pre-felling check and Trainings for the site personnel
5. Phased Clearing
6. Closing up of any hoardings
7. Commencement of Earthworks



Installation of Hoardings



Installation of ECMs



Passive Wildlife Shepherding

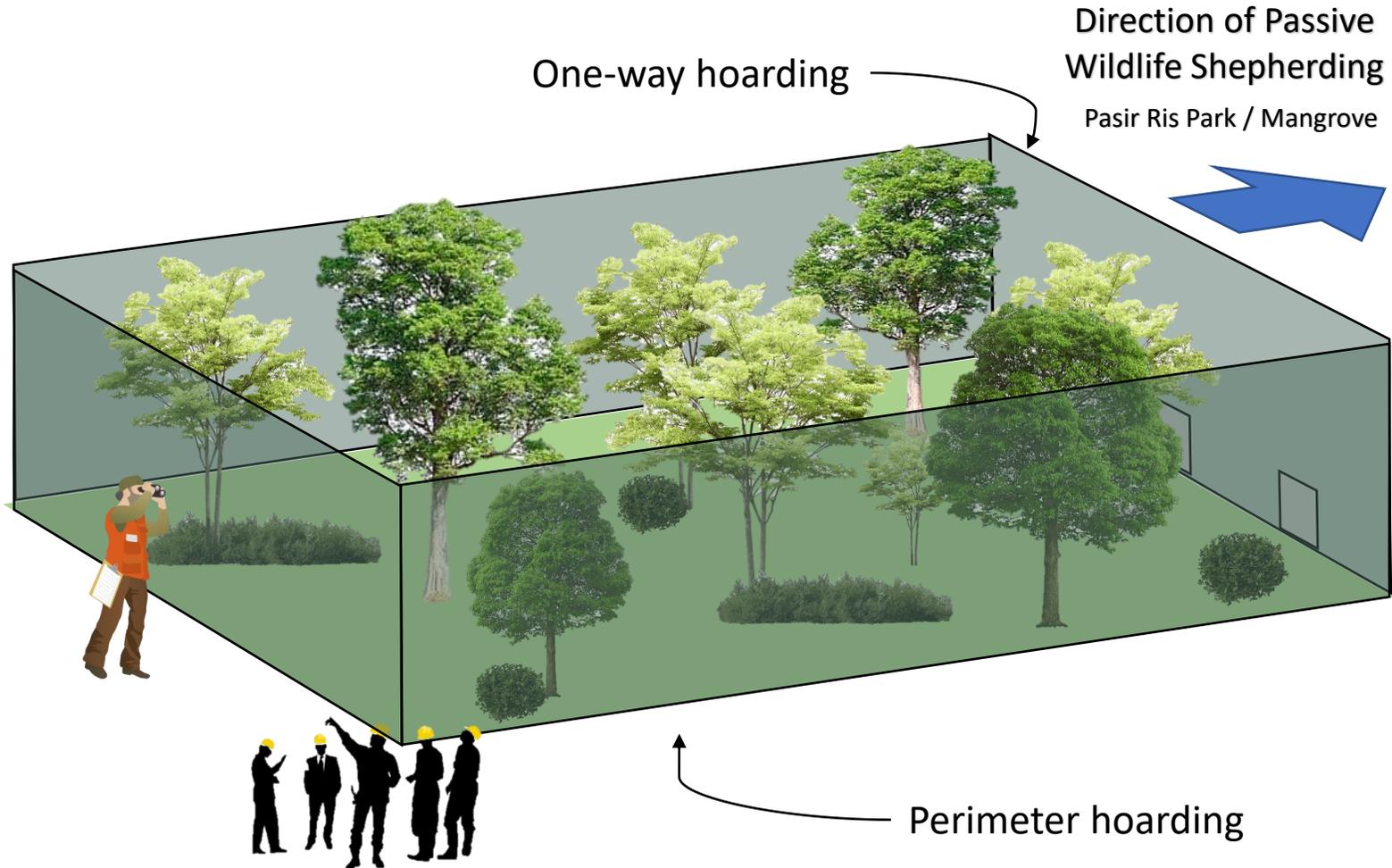


Shepherding Steps

Step 1: Training and Hoarding

Before the start of shepherding:

- Installation of perimeter hoardings to prevent animals moving towards roads.
- Due to the presence of wild boars within the site, a one-way hoarding would be installed along the northern boundary.
- Setting up of Perimeter drain, Silt Fences, and ECMs
- 5 m working space for the installation of hoardings



Installation of Hoardings and ECMs



The Project boundary should be hoarded up entirely. Use of Perimeter Hoardings and One-way Hoardings.

Perimeter Hoardings:

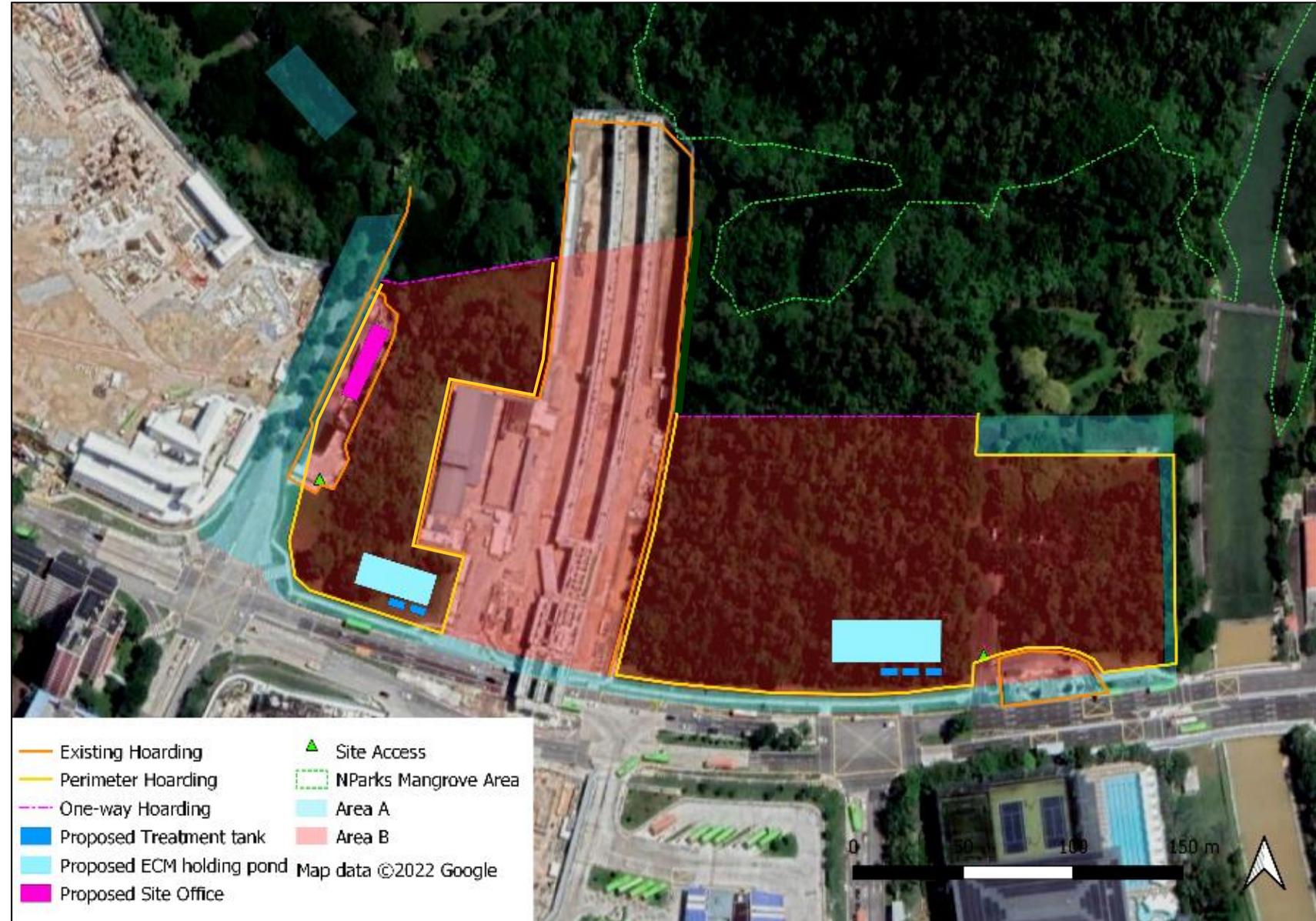
- 5 m working space to construct
- 2.4 m minimum height
- Smooth edge
- Perimeter drain
- Silt fence

One-way Hoardings:

- Similar to Perimeter Hoardings
- Installed every 20 m (estimated 11 flaps to be installed)

The installation of Hoardings and ECMs should occur before Phased Clearing. In addition, installation of hoardings should also occur before installation of ECMs.

A Pre-Felling Check should be carried out for these advance clearings (i.e., setting up of hoarding and ECMs)



Types of Hoardings



Fixed / Permanent hoarding

- Smooth top edge and silt fence weighted down with earth.
- Minimum height of 2.4 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.
- 12 m height of noise barriers facing the mangrove areas after Phased Clearing should also follow the above hoarding specifications.



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



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

Types of Hoardings

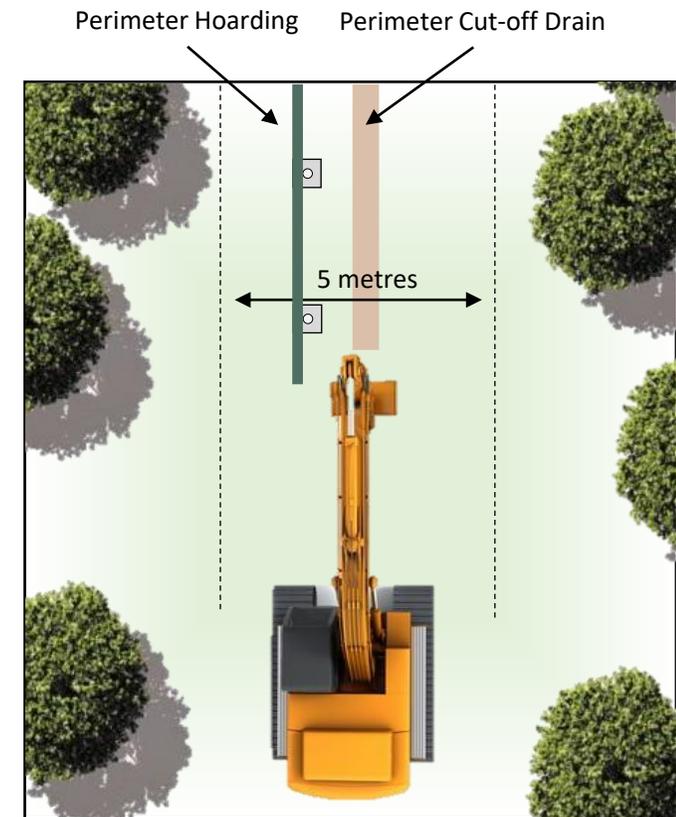
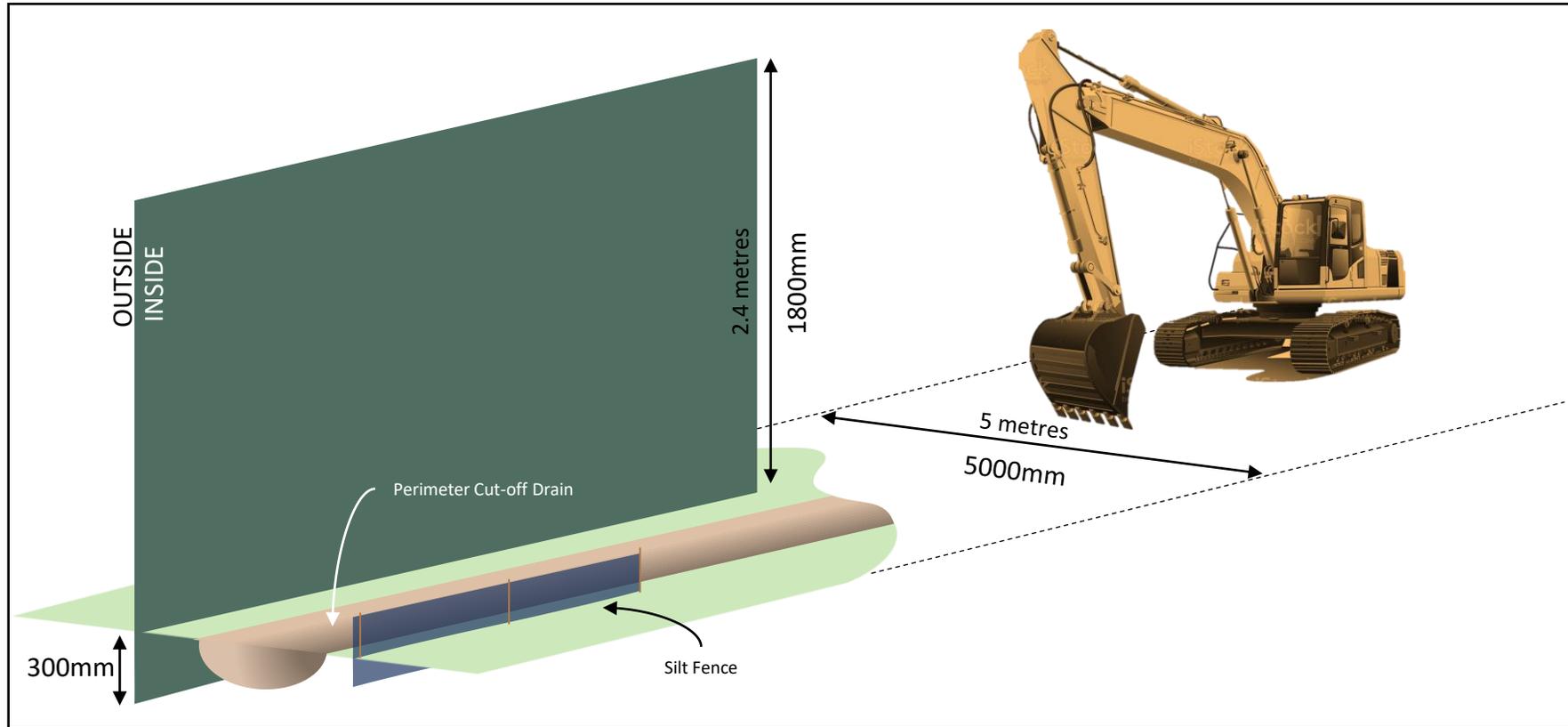


Spray paint is used on the initial hoarding to mark out wildlife shepherding sections. This ensures vegetation clearing is kept to the stipulated $\sim 3000 \text{ m}^2$ (or $100 \times 30 \text{ m}$) per day.



Clear demarking of boundary onsite 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.

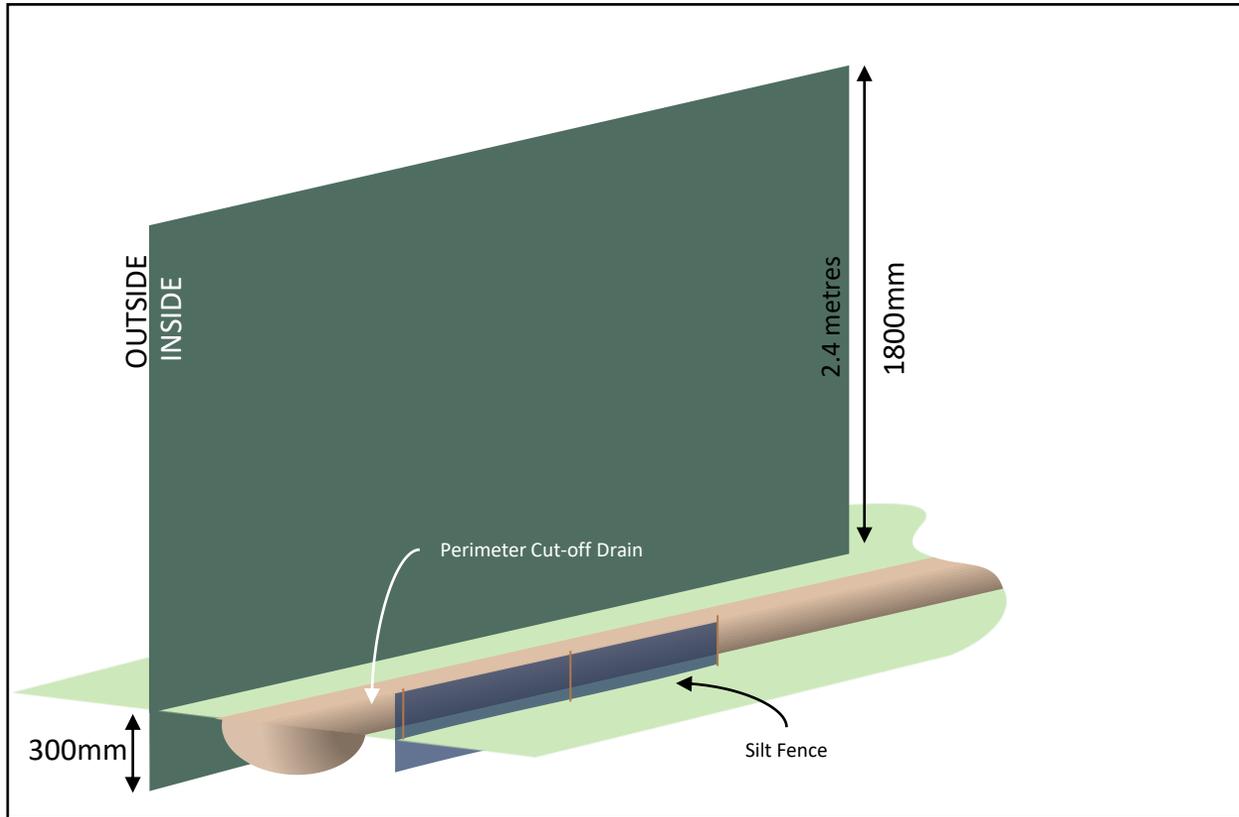
Types of Hoardings (Perimeter hoarding)



Perimeter hoarding 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 **perimeter hoarding** require any vegetation to be cleared, a pre-felling check should be conducted prior to the clearing. The clearing width should also not exceed 5 m. Use of a small excavator is ideal.

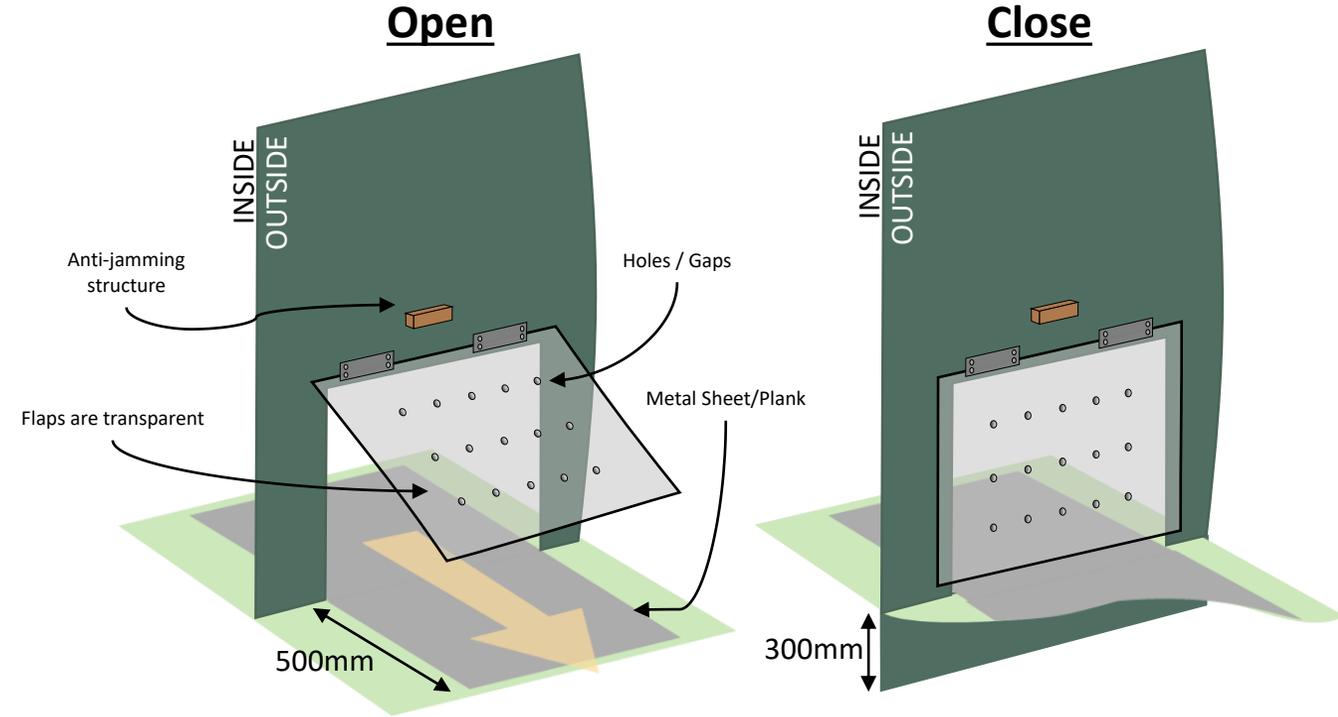
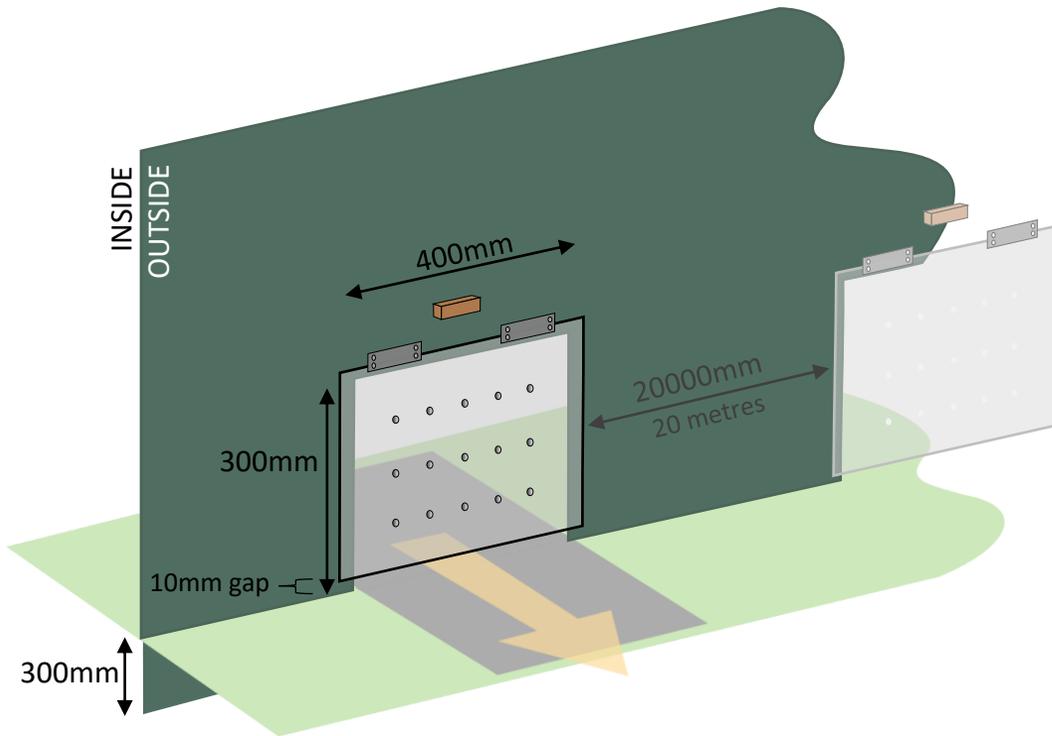
Types of Hoardings (Perimeter hoarding)



First 300mm embedded hoardings, followed by perimeter drains, silt fences, and ECMs are to be installed accordingly before Phased Clearing commences. This ensures silty water does not exit the site during shepherding phase.

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

Types of Hoardings (One-way hoarding)



One-way hoardings are utilized when the objective is to prevent larger wildlife (i.e., wild boar) from leaving the site. Placed along the direction the wildlife is shepherd towards. Flaps are spaced 20m apart (along the One-way Hoarding). These hoardings are permanent hoardings with an added one-way transparent flap, with a 1 cm gap and holes.

The **One-way hoardings** should also prevent wildlife from burrowing underneath. Use of metal sheet, or hoarding embankment is required.

The brown square above the flap acts as an anti-jamming structure, preventing the flap from being stuck while ensuring the flap remains closed.

Earth Control Measures (ECM)



Perimeter Drain and Silt Fences is advised to be set up in tandem with the hoardings to minimize working space required.

A Pre-Clearance Check should be carried out for these advance clearings

In Summary:

(During installing of hoarding)

- Pre-Clearance Check conducted
- Setting up of Perimeter Drain and Silt Fences

(After installing of hoarding)

- Pre-Fell Check conducted
- Setting up of fully operational ECM (i.e., Holding Pond, Treatment Tank)

(During Phased Clearing)

- Holding Pond / Detention Tank should have Water Barriers to prevent wildlife from entering



Water Barriers around Holding Pond



Perimeter Drain



Treatment Tank



Silt Fences

Wildlife Shepherding Plan



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

Aim:

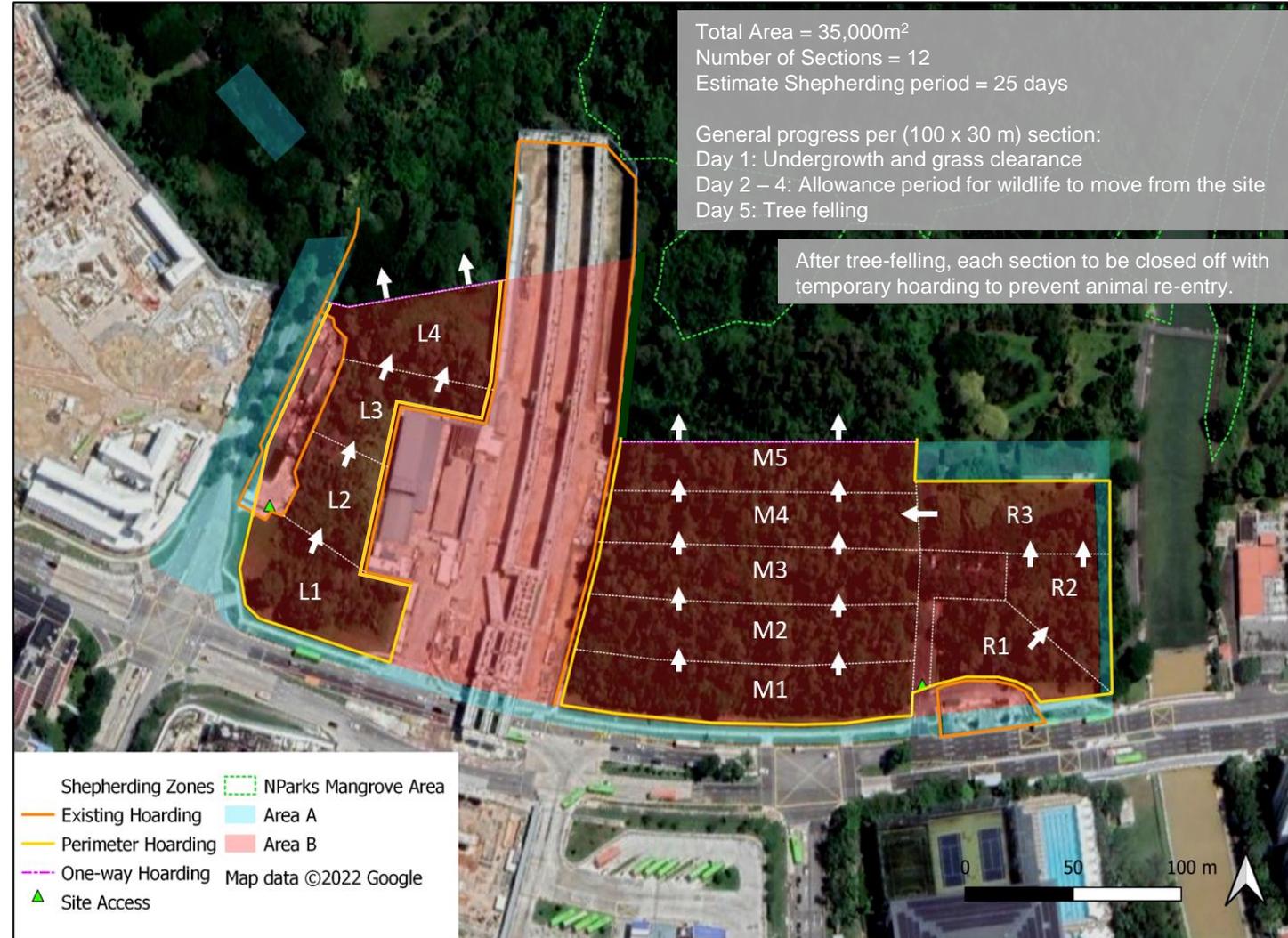
- Shepherd Wildlife to similar habitat
- Shepherd Wildlife towards one direction, or away from danger (i.e., residential areas, roads)
- Reduce mortality
- Reduce stress on wildlife from constantly moving

Should Perimeter Hoarding not be present, due to thick vegetation preventing hoardings from being installed. Temporary hoardings should be installed around each section (within an opening towards the shepherding direction) similar to a perimeter hoarding prior to any clearing.

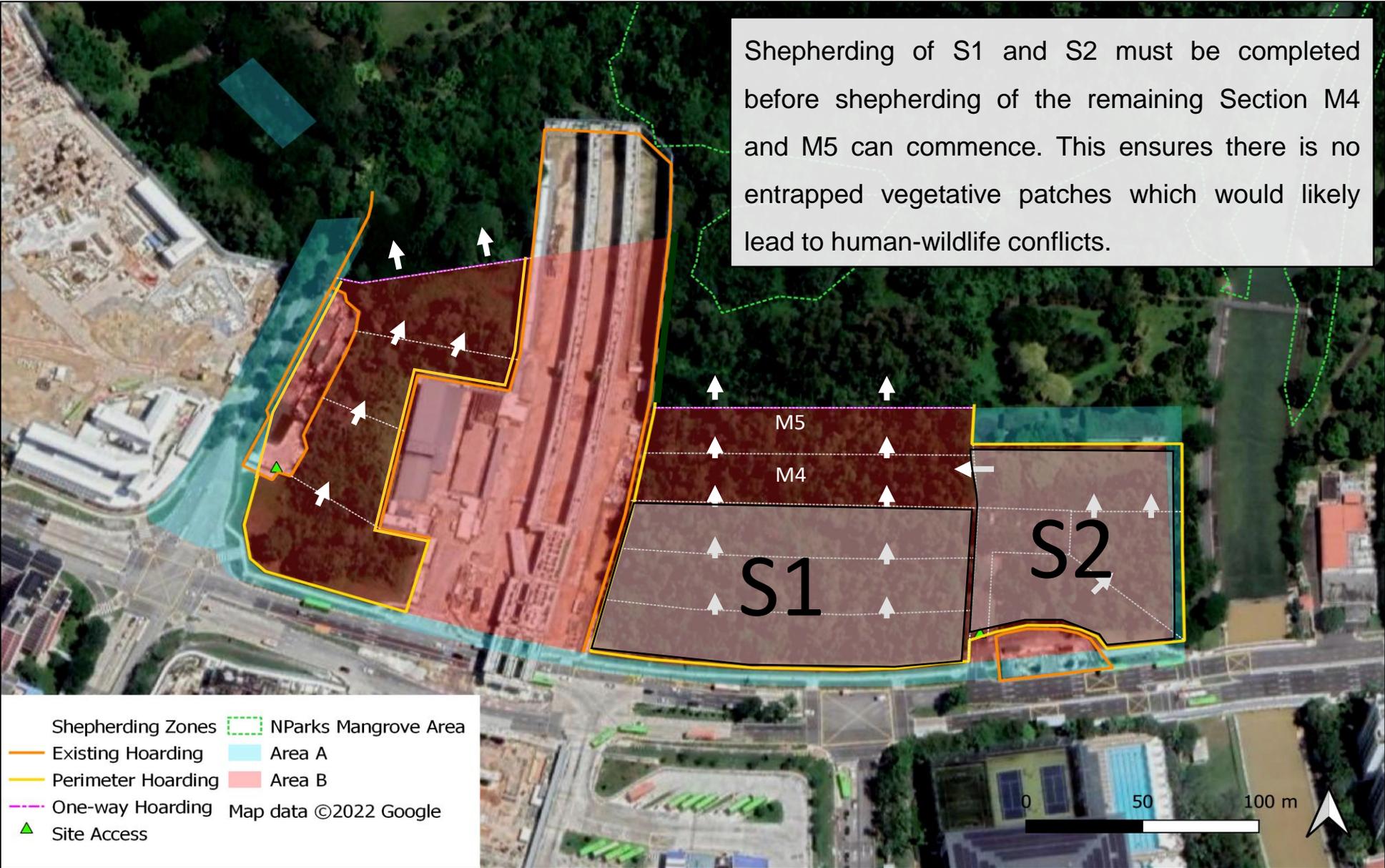
Shepherding is limited to 8am – 6pm.

L1 – L4 refers to the vegetative area on the Left
M1 – M5 refers to the vegetative area in the Middle
R1 – R3 refers to the vegetative area on the Right.

L1, M1, and R1 may commence shepherding simultaneously



Wildlife Shepherding Plan (Exceptions)



Passive Wildlife Shepherding



Shepherding Steps

Step 1: Training and Hoarding

Before the start of shepherding:

- Site personnels should be trained on how to respond when encountering wildlife (*Biodiversity Awareness Training*)
- Site personnels 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.

FAUNA AWARENESS AND RESPONSES

<p>Lesser Mousedeer (<i>Tragulus kanchi</i>)</p> 	<p>Clouded Monitor (<i>Varanus nebulosus</i>)</p> 	<p>Wild Boar (<i>Sus scrofa</i>)</p> 
<p>Asian Palm Civet (<i>Paradoxurus hermaphroditus</i>)</p> 	<p>1) <u>Do not approach animal.</u></p> <p>2) <u>Leave the area, leaving the hoarding or pathway open</u> to allow the animal to leave naturally.</p> <p>3) <u>Workers to inform their immediate supervisor.</u></p> <p>4) <u>Supervisor is to request assistance from NParks</u> at the Ranger Station.</p> <p>5) <u>NParks to inspect situation</u> and advise on follow up action.</p>	<p>Sunda Pangolin (<i>Manis javanica</i>)</p> 

<p>Wagler's Pit Viper (<i>Trapidolaemus wagleri</i>)</p> 	<p>King Cobra (<i>Ophiophagus hannah</i>)</p> 
<p>1) After sighting of ANY SNAKE, stop work within that immediate area.</p> <p>2) Monitor the location of the snake from afar.</p> <p>3) <u>At least 10m berth to be given for snakes</u>, both venomous and non-venomous, workers should not attempt to remove themselves.</p> <p>4) If snake does not move, cordon off the area; do not touch or harm the animal. If possible, safely take a photo of the animal from <u>10m away</u>.</p> <p>5) Inform ECO, PM and also Park Ranger with relevant documentation.</p> <p>6) NParks should remove the snake if it does not move on its own.</p>	

<p>Long-tailed Macaque (<i>Macaca fascicularis</i>)</p> 
<p>1) Stop whatever you are doing immediately.</p> <p>2) <u>Remain calm and quiet.</u> Do not make sudden movements and <u>do not maintain direct eye contact</u> with the monkeys.</p> <p>3) <u>Look away and back off slowly.</u> Do not turn away from the monkeys and run.</p> <p>4) If you are holding an object which is attracting the monkeys, conceal or discard it.</p> <p>5) <u>Do not try to hit the monkeys.</u></p> <p>6) Keep away from the area until the monkeys have left.</p>

RESTRICTIONS WITHIN NATURE RESERVE

<p>NO TRAPPING OR CAPTURE OF ANIMALS</p>  <p>Fine Up to \$5000</p>	<p>NO LITTERING</p>  <p>Fine Up to \$5000</p>
<p>NO FEEDING OF ANIMALS</p>  <p>Fine Up to \$5000</p>	<p>NO SMOKING OR FIRES</p>  <p>Fine Up to \$1000</p>
<p>NO REMOVAL OR DAMAGE TO PLANTS</p> 	<p>STAY ON THE DESIGNATED PATHS</p> 



Passive Wildlife Shepherding

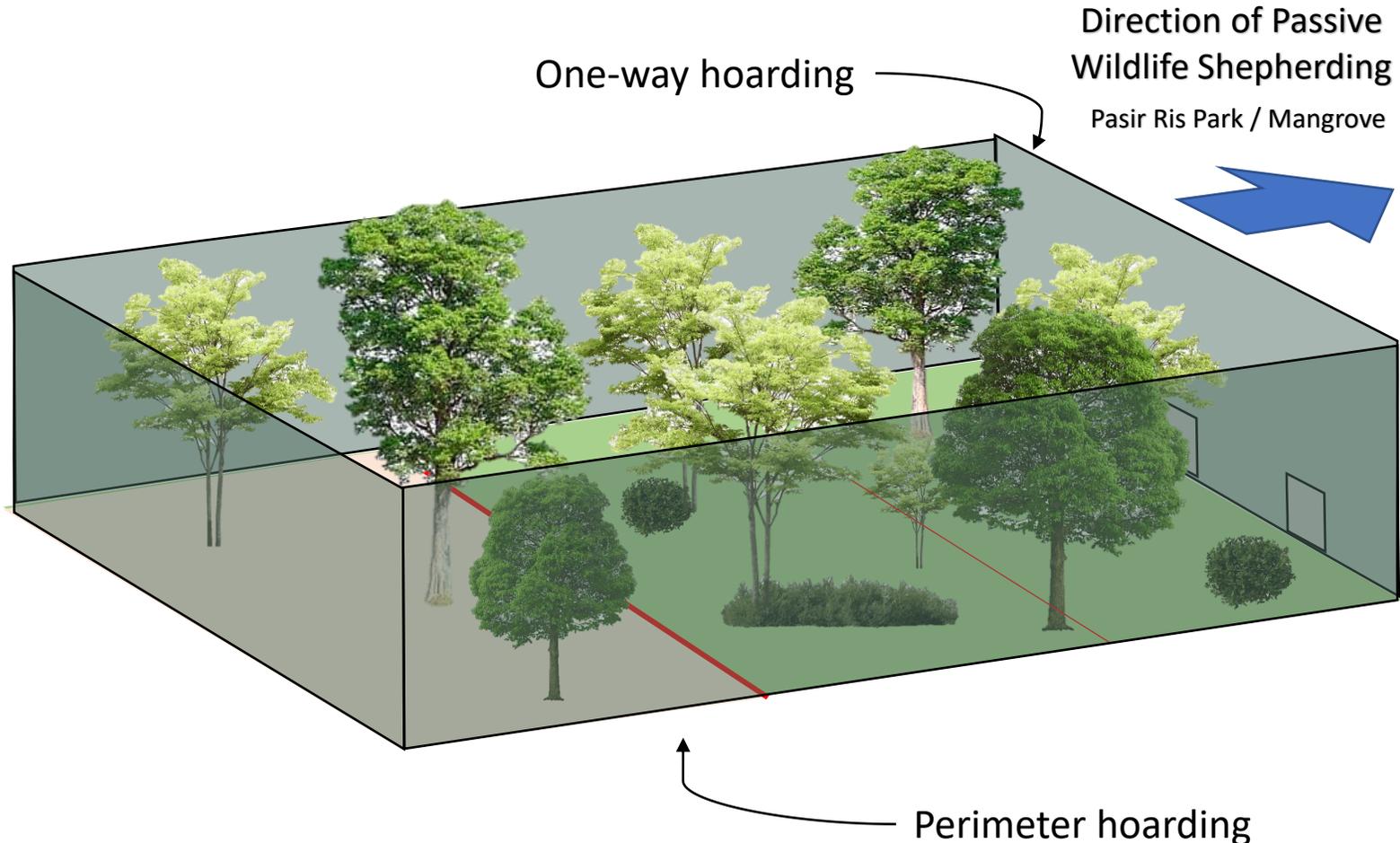


Shepherding Steps

Step 2: Clearing of Undergrowth

During shepherding:

- Contractors to clear the undergrowth (i.e., shrubs, grass)
- Undergrowth define as flora height \leq 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



Passive Wildlife Shepherding

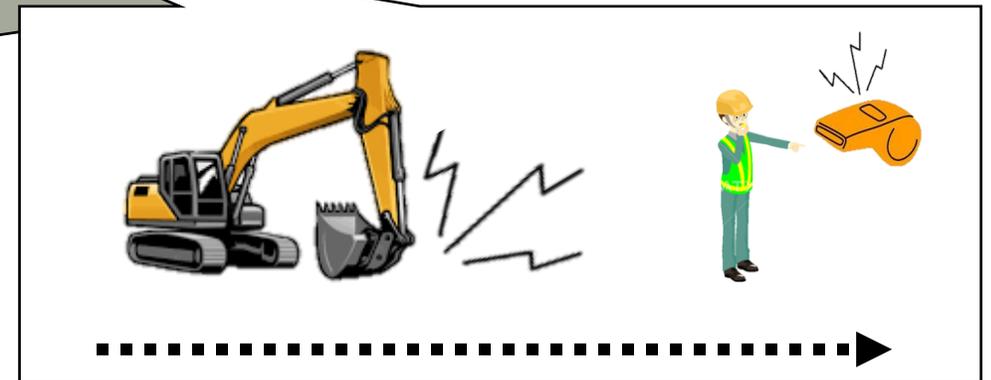
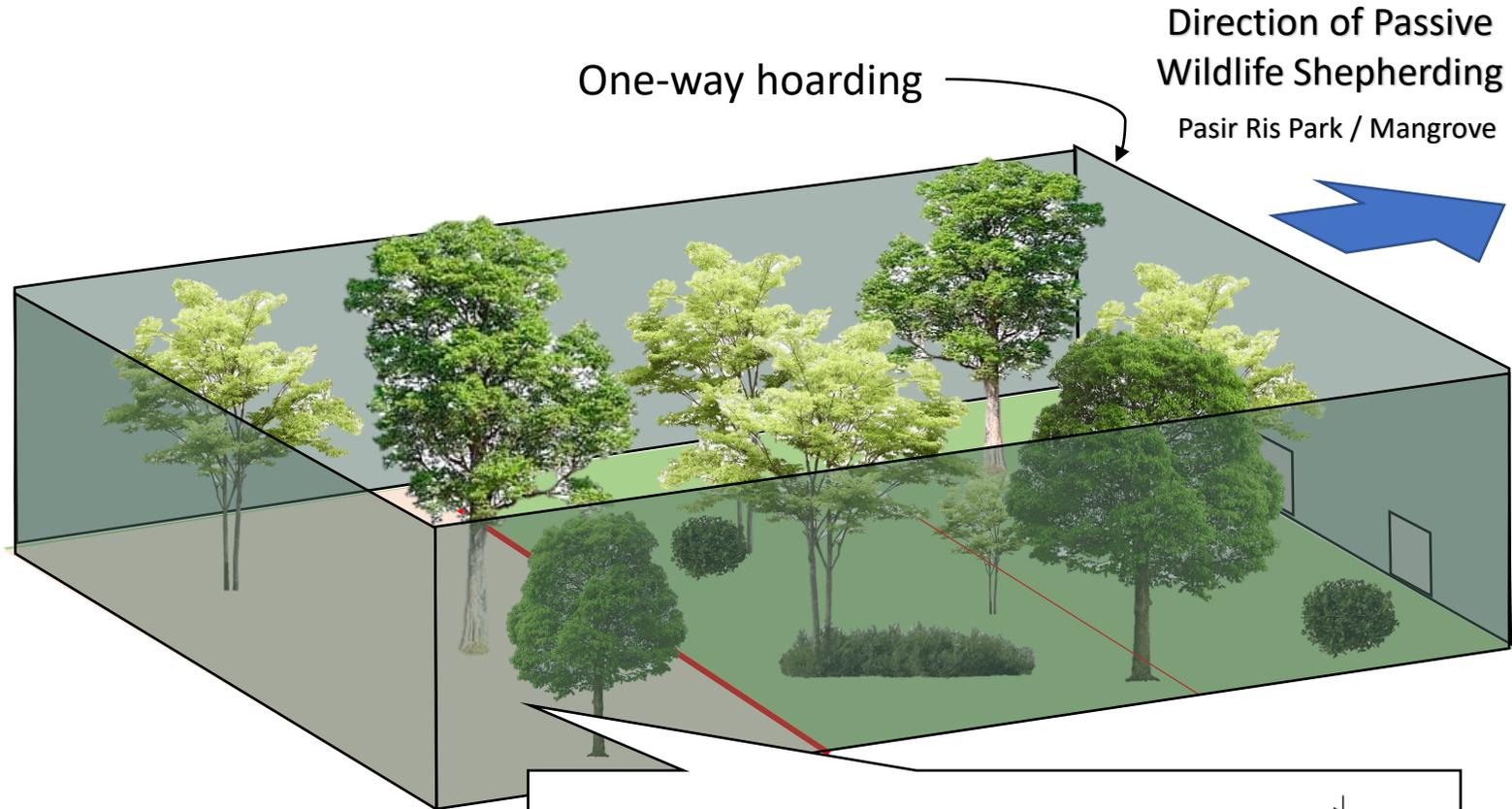


Shepherding Steps

Step 2: Clearing of Undergrowth

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.



Passive Wildlife Shepherding

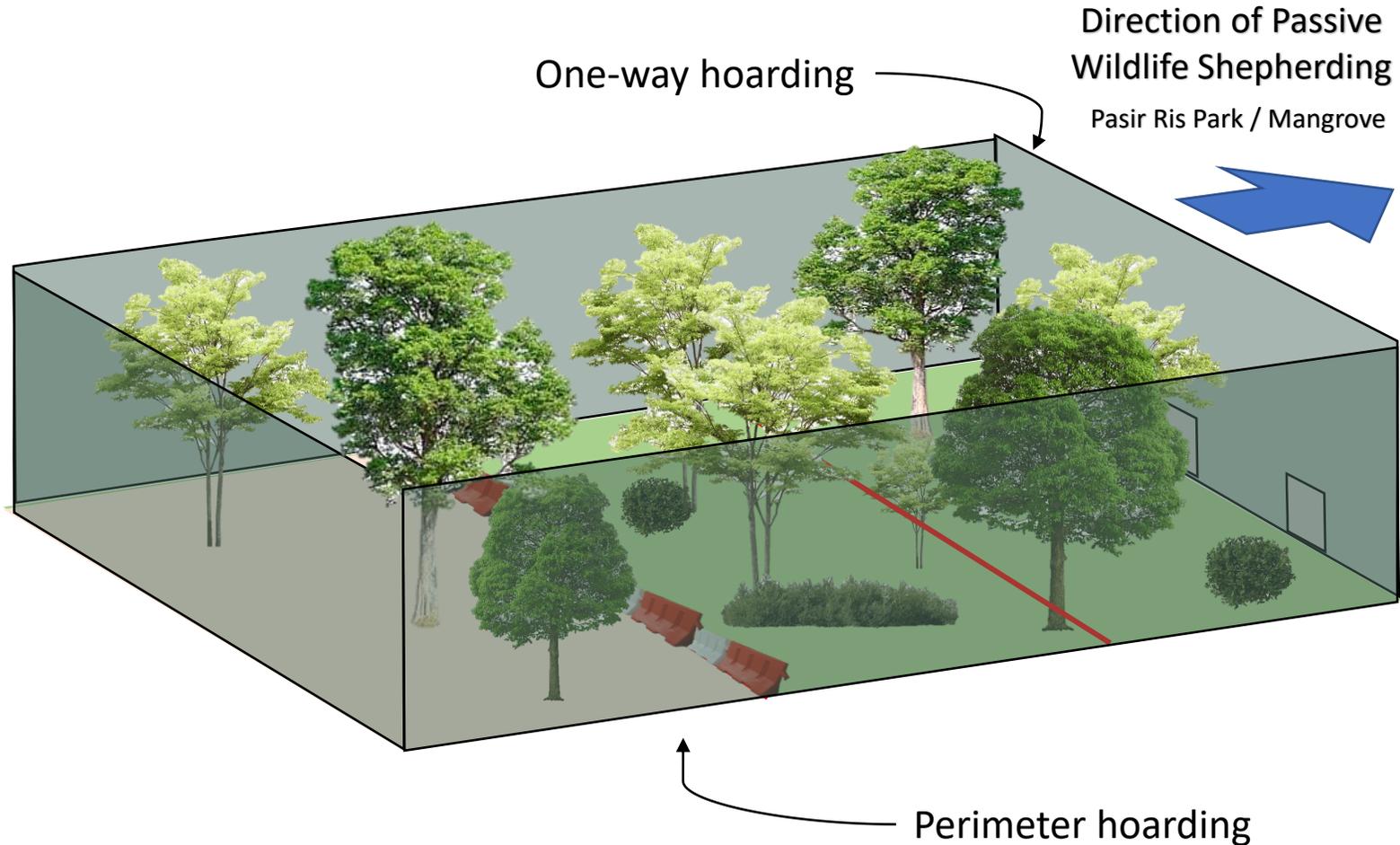


Shepherding Steps

Step 3: 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.



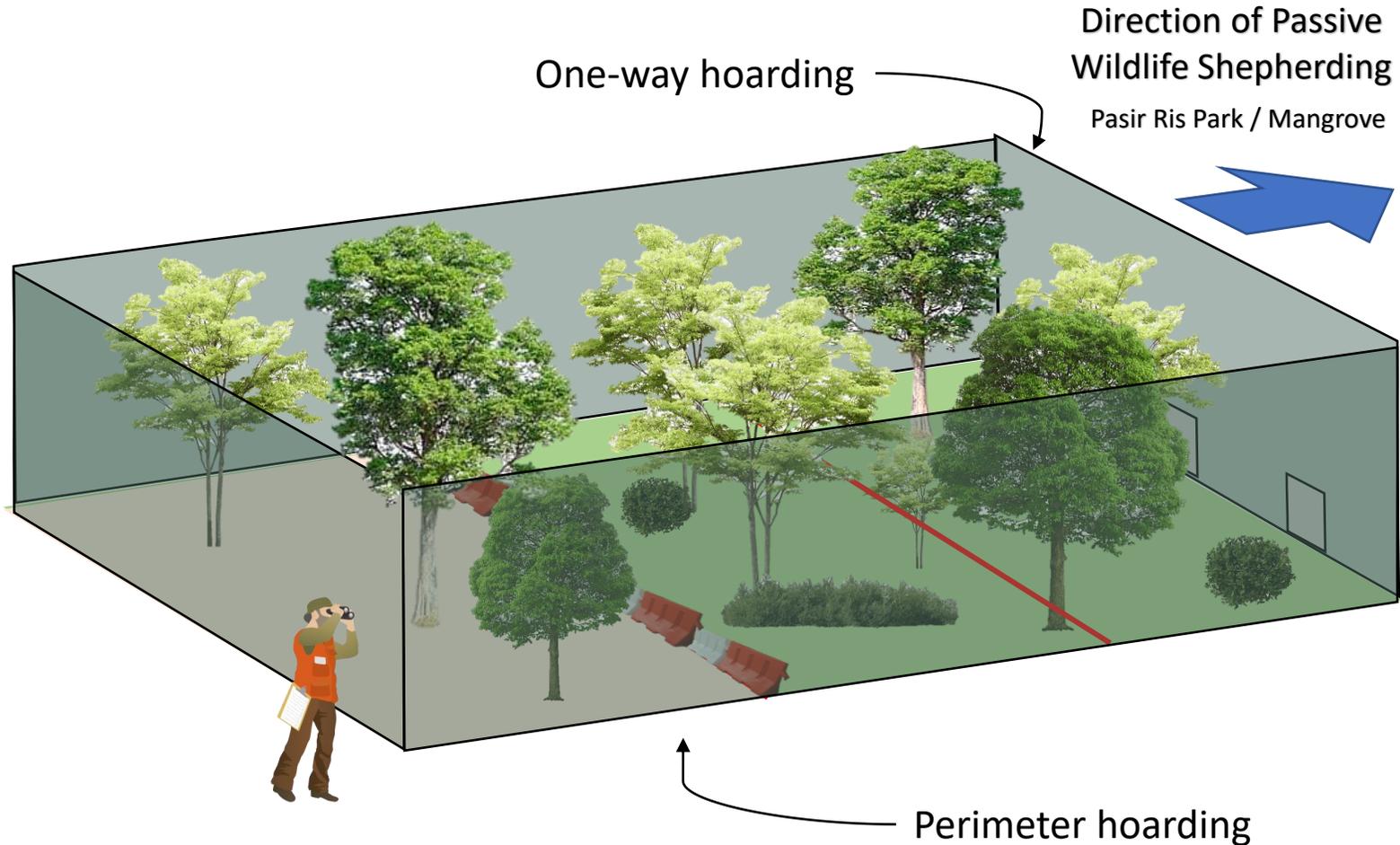
Passive Wildlife Shepherding



Shepherding Steps

Step 4: Pre-Felling 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.



Passive Wildlife Shepherding

Shepherding Steps

Step 4: Pre-Felling Check

- Some examples of nest, burrows, and wildlife detected.



Critically Endangered Bamboo bats living within the bamboo internodes



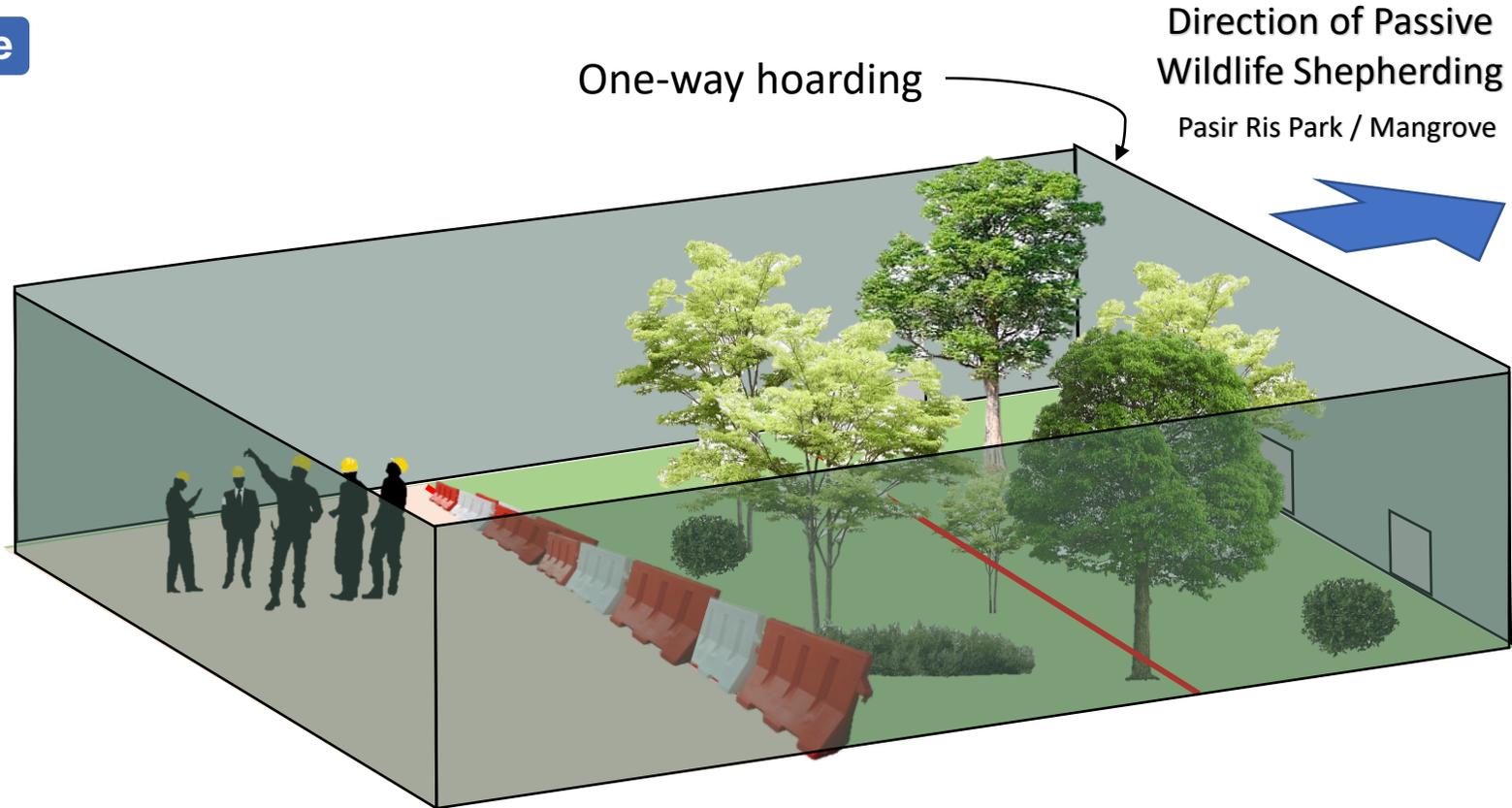
Passive Wildlife Shepherding



Shepherding Steps

Step 5: Clearing of Trees and Hoarding of site

- After buffer period and pre-fell checks, trees can be felled.
- Felled trees should be removed
- Should a nest be discovered during this stage, works are to halt.
- 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.
- Water barriers may be used as a temporary barrier to prevent wildlife entry into cleared sites



Passive Wildlife Shepherding

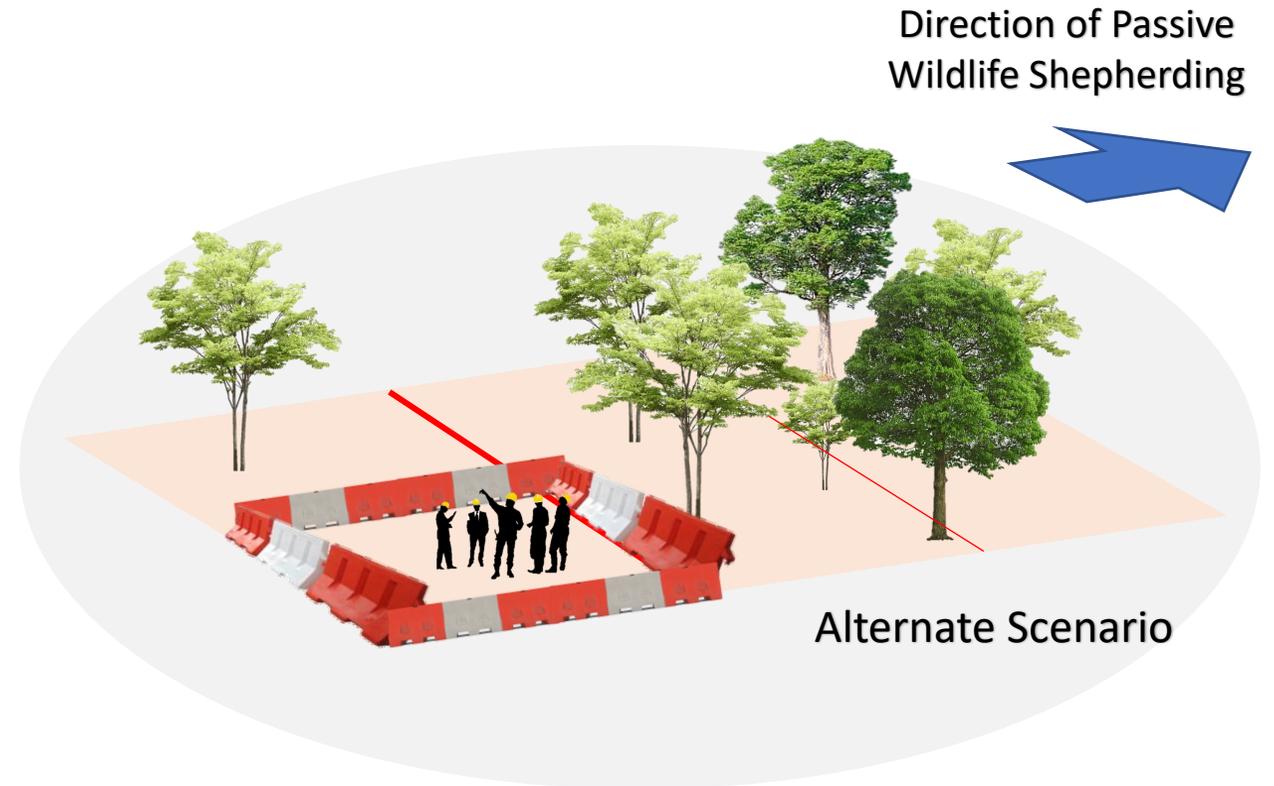


Shepherding Steps

Step 5: Clearing of Trees and Hoarding of site

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.



Simple Progress Illustration



Legend:

1	4
2	5
3	6

Sections

Undergrowth Clearing

3-Days Buffer
(movement through the section by workers / excavators are allowed)

Tree-Felling

Earthworks

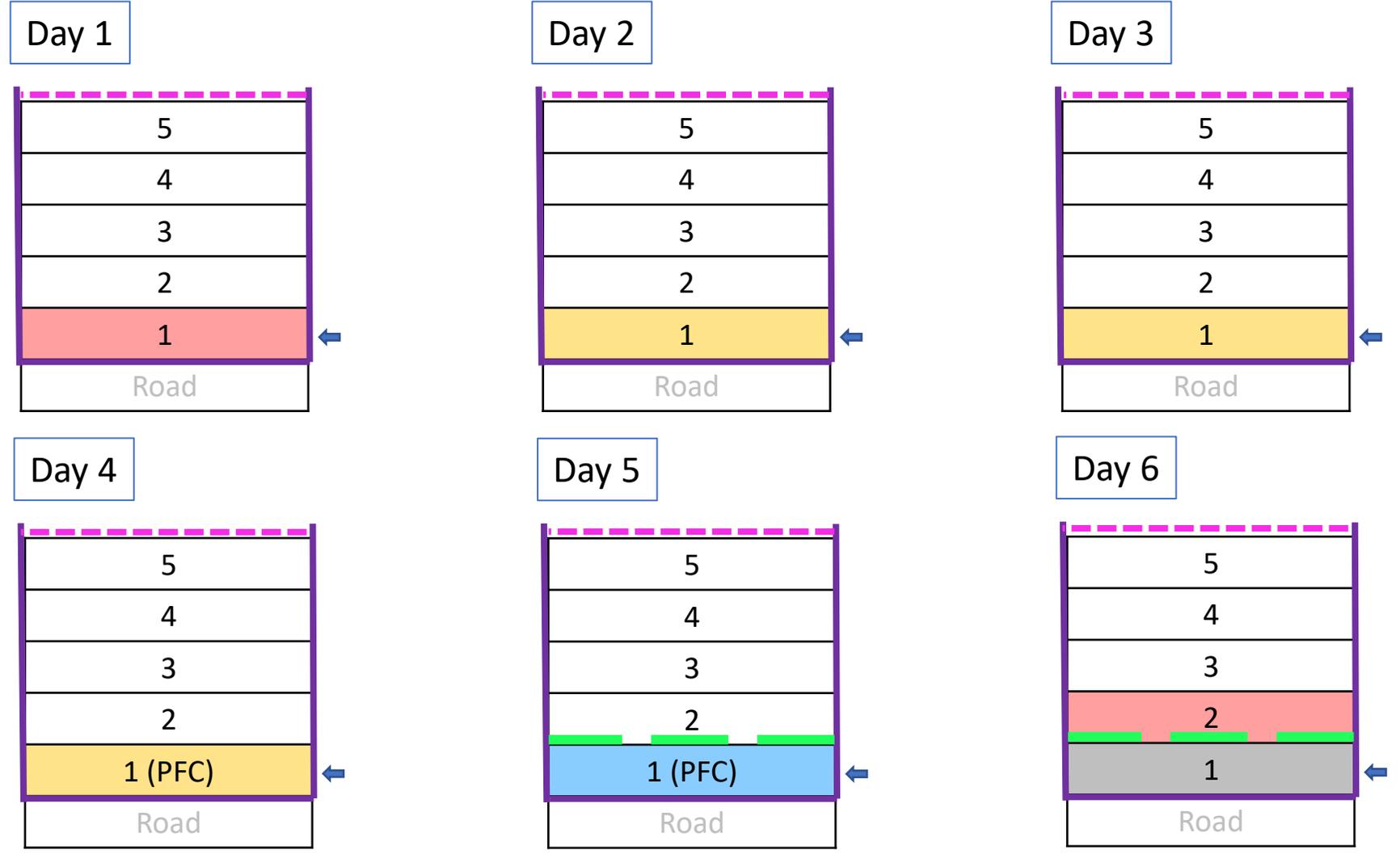
Perimeter Hoarding

Temporary Hoarding
(at the end of the day)

One-way Hoarding

Access Road

PFC Pre-Fell Checks



Note:
 Each section should be fully closed off after all biological components is cleared from that section (e.g. undergrowth, trees, felled trees).
 Temporary hoarding can be used in-placed of permanent hoarding while the permanent hoardings are being installed.
 Clearing should always be conducted from the direction of most risk (i.e., roads, residential facilities).

Tree Protection Zones (TPZ)



Several trees within the Project site have been identified for potential retention for landscaping.

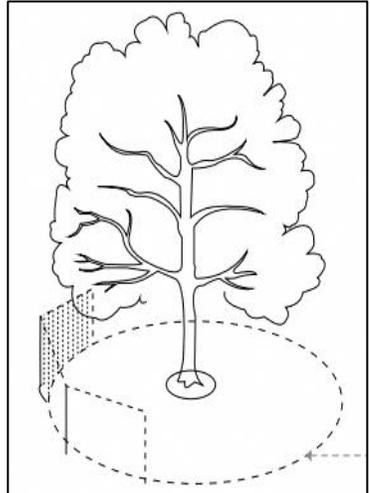
No	Tree ID	Botanical Name	Latitude	Longitude	Buffer Size	Physiological Health	Tree Structure
1	209	Terminalia mantaly	1.375834	103.951739	3	Good	Good
2	210	Terminalia mantaly	1.375901	103.951729	3	Good	Good
3	211	Terminalia mantaly	1.375879	103.951790	2	Good	Good
4	213	Terminalia mantaly	1.375903	103.951897	2	Good	Good
5	219	Terminalia mantaly	1.376003	103.951814	4	Good	Good
6	N21	Terminalia catappa	1.376205	103.950444	2	Average	Fair

Tree Protection Zones (TPZ)

Example of a Good Tree Protection Hoarding



Example of a Poor Tree Protection Hoarding



Erosion Control Blankets



Only 100% biodegradable erosion control blankets (ECBs) allows to be used to prevent injury to wild animals.



Non-biodegradable ECBs such as with nylon nets could trap or cause injury to small wild animals such snakes, pangolins, porcupines, and frogs

Things to Note



- Perimeter Hoarding, Perimeter Cut-off Drain, ECMs, Silt Fences should be set up prior to any shepherding to prevent silty water discharge (especially towards the mangrove direction).
- Access Gates should have silt fence lined along the bottom. Any openings should be less than 50mm, if possible, to prevent wildlife from escaping / re-entering the site through these gaps.
- Working space used to erect the hoarding prior to wildlife shepherding should be less than 5 m.
- Perimeter Cut-off Drains should be built in tandem with the Perimeter Hoarding to minimise the necessary work area.
- Shepherding works are limited to 8 am – 6 pm.

Documentation and Checks

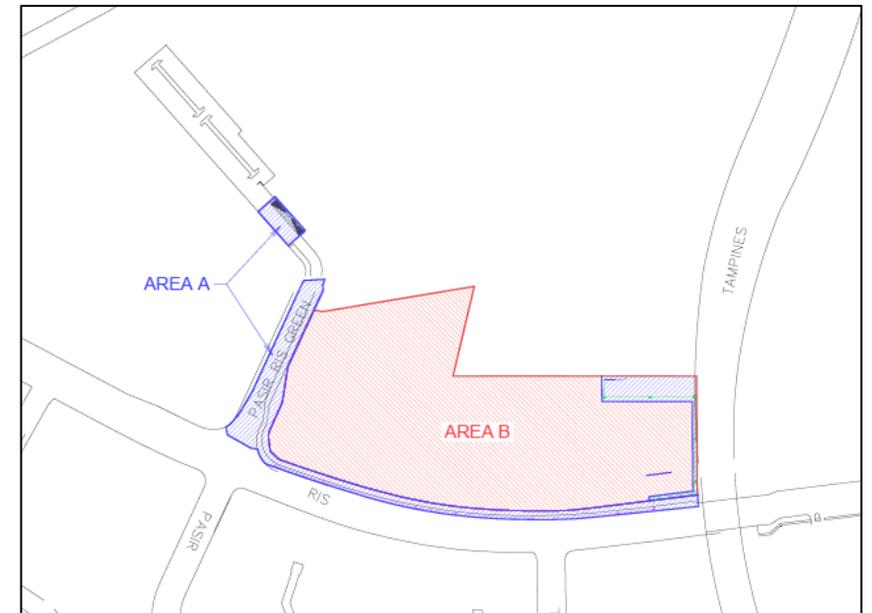


- **Daily** Checks by Contractor for wildlife entrapped within the development site (conducted at the start of the day).
- These checks should be along drains and at areas where ECBs are utilized.
- If trapped animal is found, proper procedure should be followed (refer to Appendix VI).
- **Daily** Checks 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).
- These checks should be along major road.
- If carcass is found, proper disposal and reassessment of the mitigation measures (refer to Appendix VI).

Daily Checks by Contractor



- Within development site
- Adjacent Roads and Access Road



Documentation and Checks



- 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.

Weekly Wildlife Shepherding and Inspection Report

Checks-List		Conducted by:	Date				
Hoarding and ECMs Pre-Felling Check		xxx	20/12/2023				
Hoarding and ECMs 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



SINGAPORE ENVIRONMENTAL CONSULTANCY AND SOLUTIONS PTE LTD

APPENDIX II

CONTRACTOR'S ORGANISATIONAL CHART



大方圓土木工程私人有限公司

WFY CIVIL ENGINEERING PTE LTD

Company Reg. No. & GST Reg. No.: 201309374W

Management Team

S/N	Personnel Info			
1		Mr Wang Fayin	Project Director	9021 8446
2		Mr Zhuang Xianglin	PM	9083 6623
3		Ms Wang Yisang	APM/PRO	9187 6828
4		Mr Durai	WSHO/ECO	9180 9712
5		Mr Vinoth	Site Engineer	8523 7987

Safety & Environment Team

S/N	Personnel Info			
1		Mr Kannan	EMMP Team Lead	8144 8400
2		Mr Hemel	WSHC	9372 9019
3		Mr Ambi	Safety Supervisor	9140 9593

Site Works Team

S/N	Personnel Info			
1		Mr Yang Wenyi	Trunk Sewer Site Manager	9028 6192
2		Mr Jakir	Confined Space Supervisor	9372 9019

3		Mr Jin Zhiye	Drain & Road Work Site Manager	8124 3763
4		Mr Nurul	Site Supervisor	8215 4603
5		Mr Muni	Earth Work Site Manager	8359 4591
6		Mr Gandhi	Site Supervisor	8345 2166
7		Mr Shi Yanhui	Steel Work Site Manager	9103 9022

APPENDIX III
METHOD STATEMENT FOR
HOARDING AND TREE FELLING
WORKS



大方圓土木工程私人有限公司

WFY CIVIL ENGINEERING PTE LTD

Company Reg. No. & GST Reg. No.: 201309374W

Contract No.: **D/513/23**

Project Title:

INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT (EASTERN)

(A) EARTHWORKS AT PASIR RIS N5 (PHASE 2)

(B) WIDENING OF PASIR RIS GREEN

(C) CONSTRUCTION OF TRUNK SEWER

(D) RELOCATION OF DROP-OFF PORCH

**METHOD STATEMENT FOR
HOARDING WORKS**

Revision Note:

Rev	Date	Description
0	18 OCT 23	Initial Release
1	19 OCT 23	Amended Type 2 Hoarding

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2. Manpower & Equipment

S/N	Designation	Manpower	Remarks
1	General Workers	4	
2	Welder	2	
3	Excavator Operator	1	
3	Safety Supervisor	1	
4	Site Supervisor	1	
S/N	Type of Equipment/ Machinery	No. of Unit(s)	
1	Excavator (Mini / SK135)	2	
2	10 Ton Lorry Crane	1	
3	Tipper Truck	1	
4	Boom Lift	1	
5	Portable Gen Set	1	
6	Welding Machine	1	
7	Electrical Hand-held Tools	2	

3. Sequence of Works

To submit PE endorsed Hoarding Design and materials (hoarding sheet, sound barrier panel and one-way flap) for approval before commencement of works. Surveyor to mark-out proposed hoarding line based on TOL coordinates.

Sequence of construction of hoarding as follows:

1. Type 1 (2.4m Hoarding with 300mm embedment) along Pasir Ris Green, Pasir Ris Drive 3 and PCN along Sungei Tampines
2. Type 2 (2.4m Noise Barrier with 300mm embedment to top up to 12m after Shepherding) near Public Toilet and Piai Plaza
3. Type 4 (2.4m Noise Barrier with 300mm embedment and One-Way Flap every 20m to top up to 12m after Shepherding) at Northern Boundary
4. Type 3 (2.4m Hoarding with 300mm embedment) along existing 2.4m Hoarding by LTA Contractor

3.1. Type 1 Hoarding

- Surveyor to mark-out the proposed hoarding line based on TOL coordinates.
- With the pegs in place, determine the location of the hoarding post.
- Check for surrounding TPZ before commencing work. Hoarding and posts to skirt around TPZ if affected.
- Excavate footing and 300mm depth trench with a mini-excavator.
- Install precast footing and 300mm height metal sheet.
- Install hoarding post and check for verticality and alignment.
- Install inclined steel supports to refrain movement.
- Weld-in the rectangular hollow sections across the poles for intermediate support.
- Install 2.4m hoarding sheets onto the RHS/Pole using electric drill and screws.
- Follow proper lapping for each of the hoarding sheet installed.

3.2. Type 2 Hoarding

- Surveyor to mark-out the proposed hoarding line based on TOL coordinates.
- With the pegs in place, determine the location of the hoarding posts.
- Check for surrounding TPZ before commencing work. Hoarding and posts to skirt around TPZ if affected.
- Excavate footing and 300mm depth trench with SK135 excavator.
- Construct cast in-situ RC footing and installation of 300mm height metal sheet.
- Install 12m high hoarding post based on approved PE design and check for verticality and alignment.
- Install inclined steel supports to refrain movement.
- Weld-in the rectangular hollow sections across the poles for intermediate support.
- Install noise barrier panels up to 2.4m onto the Hoarding posts.
- After completion of shepherding, install noise barrier panels up to 12m height with boom lift.

3.3. Type 4 Hoarding

- Surveyor to mark-out the proposed hoarding line based on TOL coordinates.
- With the pegs in place, determine the location of the hoarding posts.
- Check for surrounding TPZ before commencing work. Hoarding and posts to skirt around TPZ if affected.
- Clear undergrowth (<3m height) in location of proposed hoarding and hoarding posts manually or with mini excavator.
- Excavate footing and 300mm depth trench with SK135 excavator.
- Construct cast in-situ RC footing and installation of 300mm height metal sheet.
- Install 12m high hoarding post based on approved PE design and check for verticality and alignment.
- Install inclined steel supports to refrain movement.
- Weld-in the rectangular hollow sections across the poles for intermediate support.
- Install noise barrier panels up to 2.4m onto the Hoarding posts.
- Install noise barrier panel with one-way flap (as per EMMP design) every 20m.
- After completion of shepherding, remove noise barrier panels with one-way flap and replace with normal noise barrier panel.
- Install noise barrier panels up to 12m height with boom lift.

3.4. Type 3 Hoarding

- Existing 2.4m hoarding by LTA contractor onsite
- To coordinate with LTA contractor
- After removal of existing hoarding by LTA contractor, to construct 2.4m hoarding as per Type 1 Hoarding.

4. Reference

5. Appendix

5.1. Appendix A: Hoarding Plan

5.2. Appendix B: Hoarding Detail

5.3. Appendix C: One-Way Flap Door Detail

5.4. Appendix D: Risk Assessment



大方圓土木工程私人有限公司

WFY CIVIL ENGINEERING PTE LTD

Company Reg. No. & GST Reg. No.: 201309374W

Contract No.: **D/513/23**

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INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT (EASTERN)

(A) EARTHWORKS AT PASIR RIS N5 (PHASE 2)

(B) WIDENING OF PASIR RIS GREEN

(C) CONSTRUCTION OF TRUNK SEWER

(D) RELOCATION OF DROP-OFF PORCH

**METHOD STATEMENT FOR
TREE-FELLING**

Revision Note:

Rev	Date	Description
0	18 OCT 23	Initial Release

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1. Scope of Work

This method statement presents the outline method and procedures for tree-felling works.

2. Manpower & Equipment

S/N	Designation	Manpower	Remarks
1	General Workers		
2	Lifting Supervisor		
3	Working at Height Supervisor		
4	Lorry Crane Operator		
5	Rigger / Signalman		
6	Excavator Operator		
7	RES		
S/N	Type of Equipment/ Machinery	No. of Unit(s)	
1	Lorry Crane		
2	Chain Saw		
3	Leaf Blower		
4	Excavator		
5	Webbing Sling		
6	2-legged Metal Chain Sling		

3. Sequence of Works

3.1: Method of Tree-Felling (Single Lorry Operation)



- When the lorry is in position, the lorry will unload the man-lift cage and workers to attach the man-lift cage on to the boom arm of the lorry crane.
- Once the man-lift cage is attached, worker in the man-lift cage is to put on full body safety harness and anchor the 2 lanyards to the man-lift cage and boom arm before cage is lifted.
- Before any tree cutting, supervisor to cordon off the tree felling zone area and ensure that workers are clear from the felling area before commencement of branch cutting.
- After branches are cut, ground workers will cut felled branches into smaller pieces, stack them together, secure with webbing sling and the crane operator will load the stacked debris into the slip tank.
- Once all branches are cleared from the tree ($5\text{m} < \text{Trunk Height} < 6\text{m}$), workers to attach webbing sling to the tree trunk to secure it using the lorry crane. When the trunk is secured, tree cutter will begin to cut at the tree collar close to the ground.
- After the tree has been cut to the ground level, the lorry crane is to slowly lower the trunk to the ground. Ground workers will cut the trunk into smaller pieces, stack them and secure it with webbing sling to be loaded into the slip tank by the lorry crane.
- The process is repeated till all trees in the work area are felled. Workers to clear and tidy up work area before moving to the next work zone.

3.2: Method of Tree-Felling (Double Lorry Operation)



- For Double Lorry Operation, one vehicle will be responsible for the tree cutting while the other vehicle will be responsible for supporting larger branches when cutting.
- Man-lift cage to be attached to the lorry responsible for tree cutting. If the trees are located near to the roadside, maximum extension of boom length from the road kerb to the tree to be 5-7m.
- Once the man-lift cage is attached, worker in the man-lift cage is to put on full body safety harness and anchor the 2 lanyards to the man-lift cage and boom arm before cage is lifted.
- Before any tree cutting, supervisor to cordon off the tree felling zone area and ensure that workers are clear from the felling area before commencement of branch cutting.
- For smaller branches, the worker will allow the cut branches to fall onto the grass to prevent branches from bouncing off to the roadside or onto the pedestrian path, causing danger to the public.
- For larger branches, branch to be secured with webbing sling attached to lorry crane before cutting. This will support the larger branch during cutting and allow it to be lowered to the ground after it is cut off.
- If the tree branch encroaches a live road, the tree cutter will signal to the traffic controller to get ready to stop traffic once the branch is properly secured with webbing sling. After the traffic is stopped, the traffic controller will signal the crane operator to swing the tree cutter out to perform the cutting of the branches. Once the branch is ready to be hoisted in, the crane operator will swing the man-lift cage and tree cutter to a safe distance before the other lorry crane hoists the tree branches in. When the tree branches are hoisted in and safely lowered to the ground, the traffic controller will open up the live road and allow the traffic to flow again.
-

- Ground workers will cut felled branches into smaller pieces, stack them together, secure with webbing sling and the crane operator will load the stacked debris into the slip tank.
- Once all branches are cleared from the tree ($5\text{m} < \text{Trunk Height} < 6\text{m}$), workers to attach webbing sling (Tree Girth $< 2.0\text{m}$) / metal chain (Tree Girth $> 2.0\text{m}$) to the tree trunk to secure it using the lorry crane. When the trunk is secured, tree cutter will begin to cut at the tree collar close to the ground.
- After the tree has been cut to the ground level, the lorry crane is to slowly lower the trunk to the ground. Ground workers will cut the trunk into smaller pieces, stack them and secure it with webbing sling to be loaded into the slip tank by the lorry crane.
- The process is repeated till all trees in the work area are felled. Workers to clear and tidy up work area before moving to the next work zone.

3.3: Method of Tree-Felling in Forested Area

1) Pre-Felling Procedures

- SECS to conduct Pre-Fell Check to survey area to be cleared for any wildlife or nests before tree-felling. If nest/wildlife is detected, further assessment and cordoning off area from tree-felling.
- Once Pre-Fell check is completed, supervisor to brief the team on scope of works. The briefing to include a walkabout to show boundary of tree-felling and locations of trees to be protected.
- During the site walkabout, supervisor to indicate and mark out to team the trees that are too tall/big to be felled by excavator.
- After the site walkabout, the excavator operator to prepare the excavator and wait for instruction for work commencement.
- Before the commencement of work, the supervisor, banksman and foreman to scout the area to make sure tree felling zone is clear from any human and wildlife.
- Banksman to signal the excavator operator to commence work for tree felling once all the areas are cleared.

2) Tree Height $< 5\text{m}$

- The excavator operator will first clear off smaller trees (Ht: $< 5\text{m}$) to create a clear line of sight within the area.
- The excavator operator shall operate cautiously and fell the trees in a controlled manner.
- The excavator operator will begin by clearing off trees at the boundary of the work area to demarcate the area before moving inward to fell trees within the work area.

3) $5m < \text{Tree Height} < 7m$

- For trees of $5m < \text{Ht} < 7m$, tree to be felled using a Notch Cut. The foreman shall determine the direction of felling and ensure that it does not cause injury or fall on trees and vegetation not marked for felling.

<p>Tree Felling through Notch Cut</p>	<p>Determine the direction of fall</p>
<p>** Note: The illustration is not drawn to scale</p>	
<p>Position of excavator to support the tree while tree cutter perform Third Cut Work</p>	<p>Third Cut and Felling Direction</p>
<p>** Note: The illustration is not drawn to scale.</p>	

- To avoid tree lean (tree did not fall in the intended direction when performing the third cut), the excavator will assist to prevent fall back and guide the tree to fall into the intended direction.
- Once the tree is felled, tree cutter will cut the trunk into shorter lengths for easier loading when clearing the debris.

4) $\text{Tree Height} > 7m$

- For trees of $\text{Ht} > 7m$, tree height to be reduced before felling using a lorry crane.
- Access to the tree location to be prepared and access ground to be firm to allow lorry crane to deploy the outrigger.

- When access is ready, lorry crane to enter to perform crown reduction to reduce tree height to 7m to be felled by Notch Cut method. Crown reduction method stated in Method for Tree Felling (Single Lorry Operation).
- Double Lorry Operation might be adopted for the following scenarios
 - Tree Height >9m
 - Cut branch too big to manage at height
 - Branch overhanging property/tree-to-be-protected/tree-to-be transplanted
- Crown reduction method using double lorry operation stated in Method for Tree Felling (Double Lorry Operation).

5) Tree located within Tree Protection Zone

- For trees to be felled located in the Tree Protection Zone, Arborist will be consulted regarding cutting method including whether to grub up root stumps.
- General approach would be to prune all interlocking branches between tree-to-be-felled and tree-to-be-protected till there is enough space to bring down the tree-to-be-felled.

6) Debris Clearing

- Once trees are felled, the excavator will pile up all the debris properly to prepare to load into skid bin for transportation.
- When the lorry with skid tank arrives on site, lorry driver to lower the skid bin for excavator operator to load up debris into bin and supervisor to ensure that the skid bin is not overloaded and no debris is hanging out of the skid bin.

7) Tree Root Grubbing

- As Earthworks are to be done at the site after tree felling, root stumps will not be grubbed up immediately after tree-felling but removed during Earthworks stage.

4. Reference

5. Appendix

Appendix A: Risk Assessment

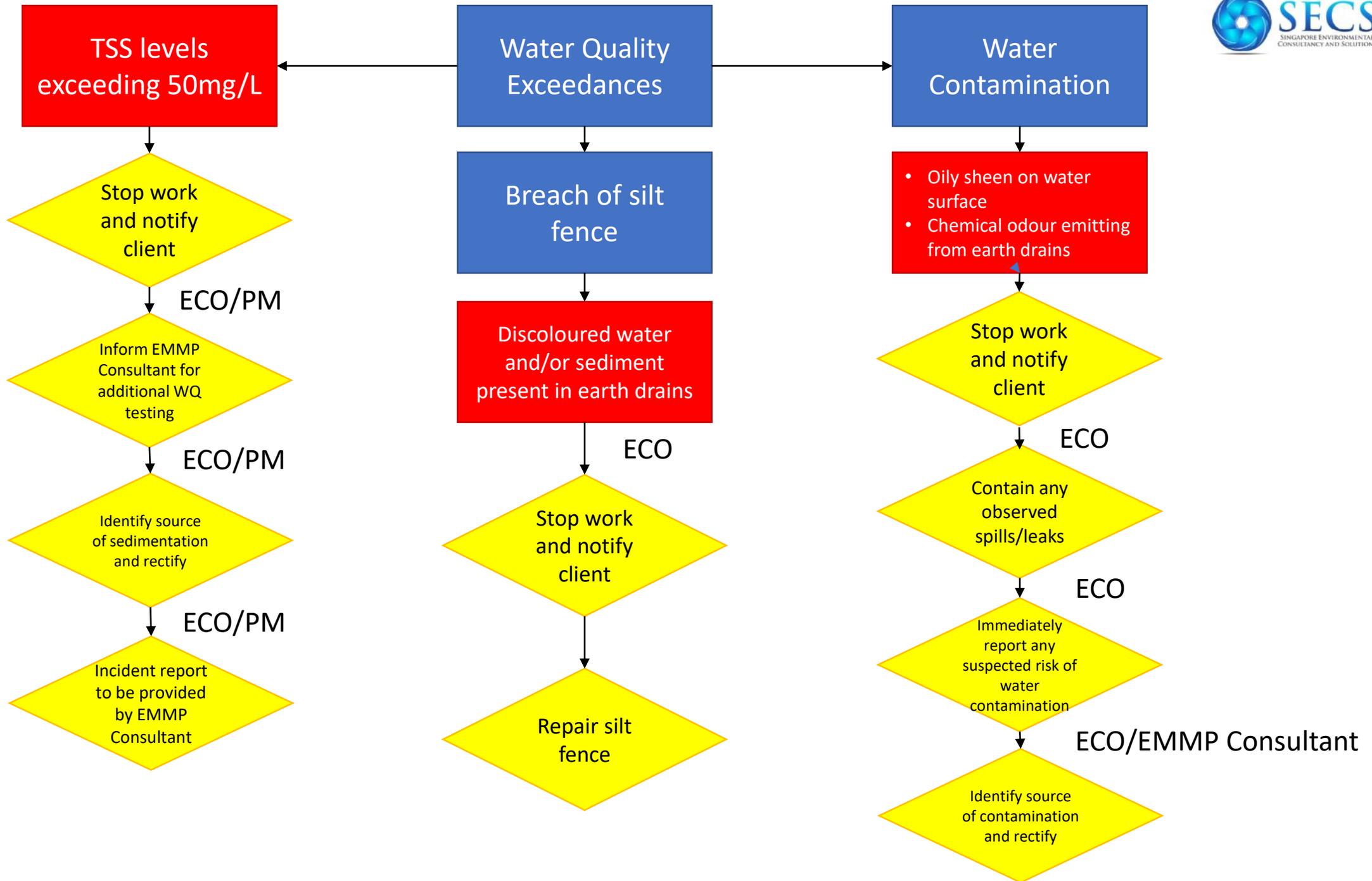
Appendix B: SWP

APPENDIX IV

SITE UTILISATION PLAN

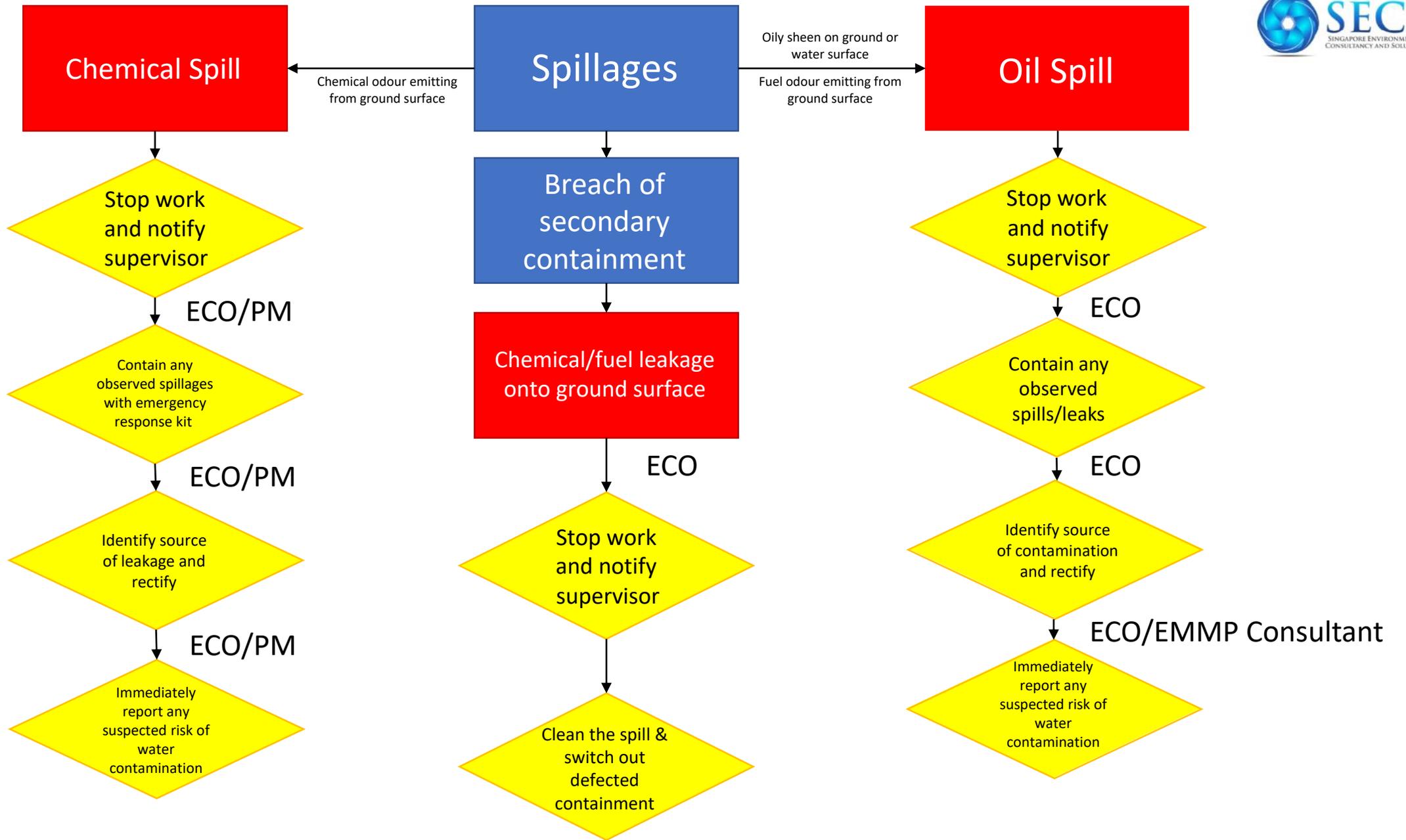
APPENDIX V

WATER QUALITY EXCEEDANCE FLOWCHART



APPENDIX VI

CHEMICAL SPILLAGE FLOWCHART

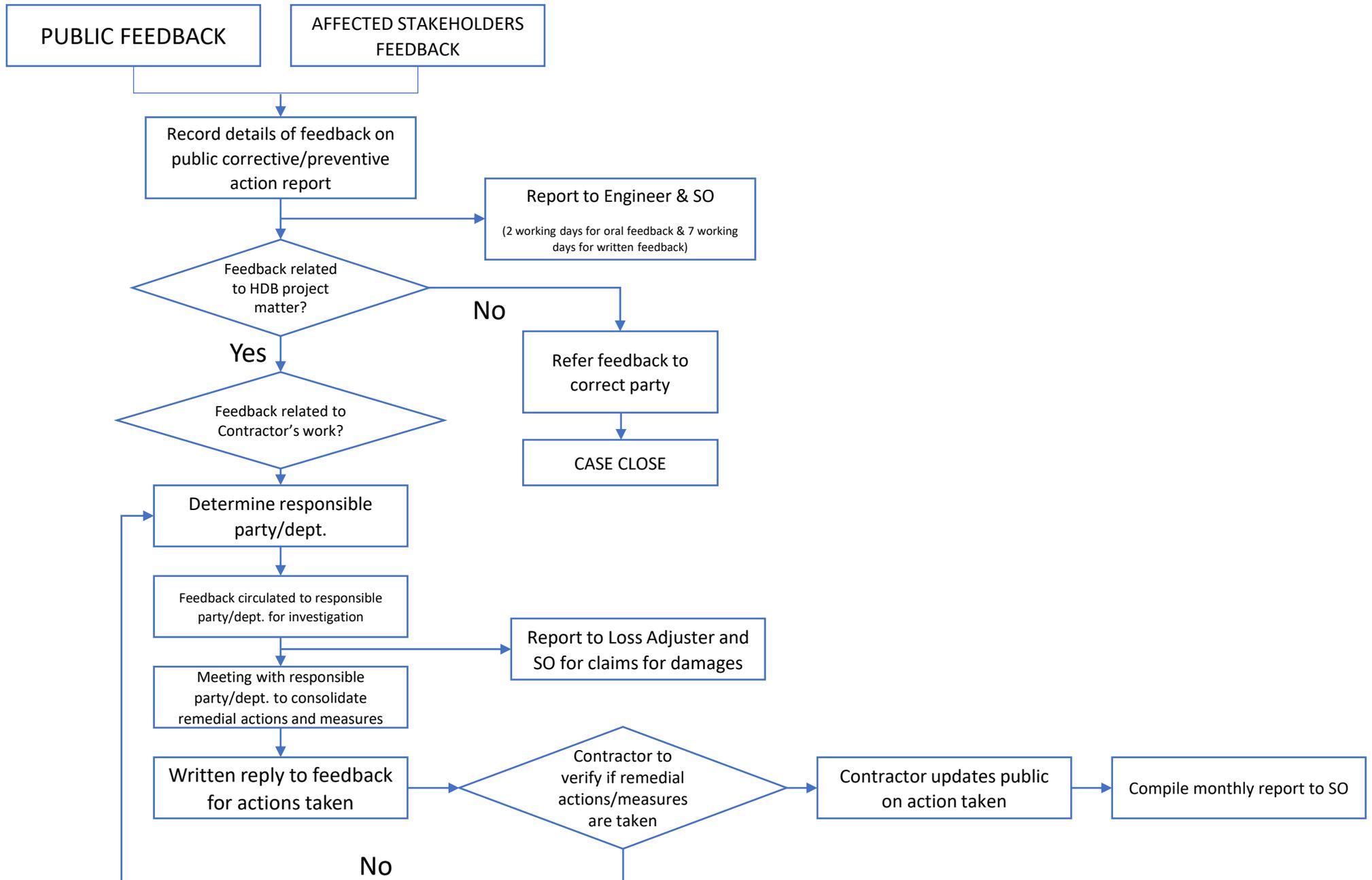




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APPENDIX VII

PUBLIC FEEDBACK RESPONSE FLOWCHART





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APPENDIX VIII
BIODIVERSITY AWARENESS TRAINING
DOCUMENTS



Wildlife Response Plan and Awareness Training

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 kill 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
- Inform person in charge
- Document (with photo/video)

1



2

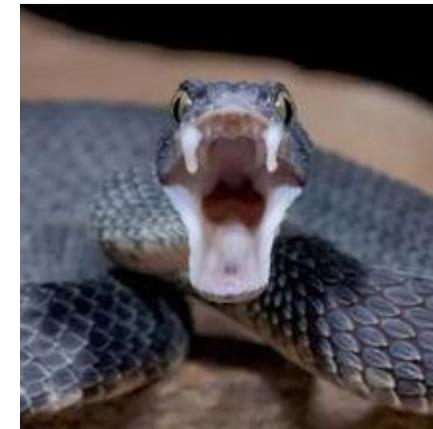


3



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, EMMP consultant will arrange a licensed wildlife contractor to relocate the snake.
- Resume work after the immediate site is cleared from snake.
- Site supervisor to inform EMMP 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



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

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**



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



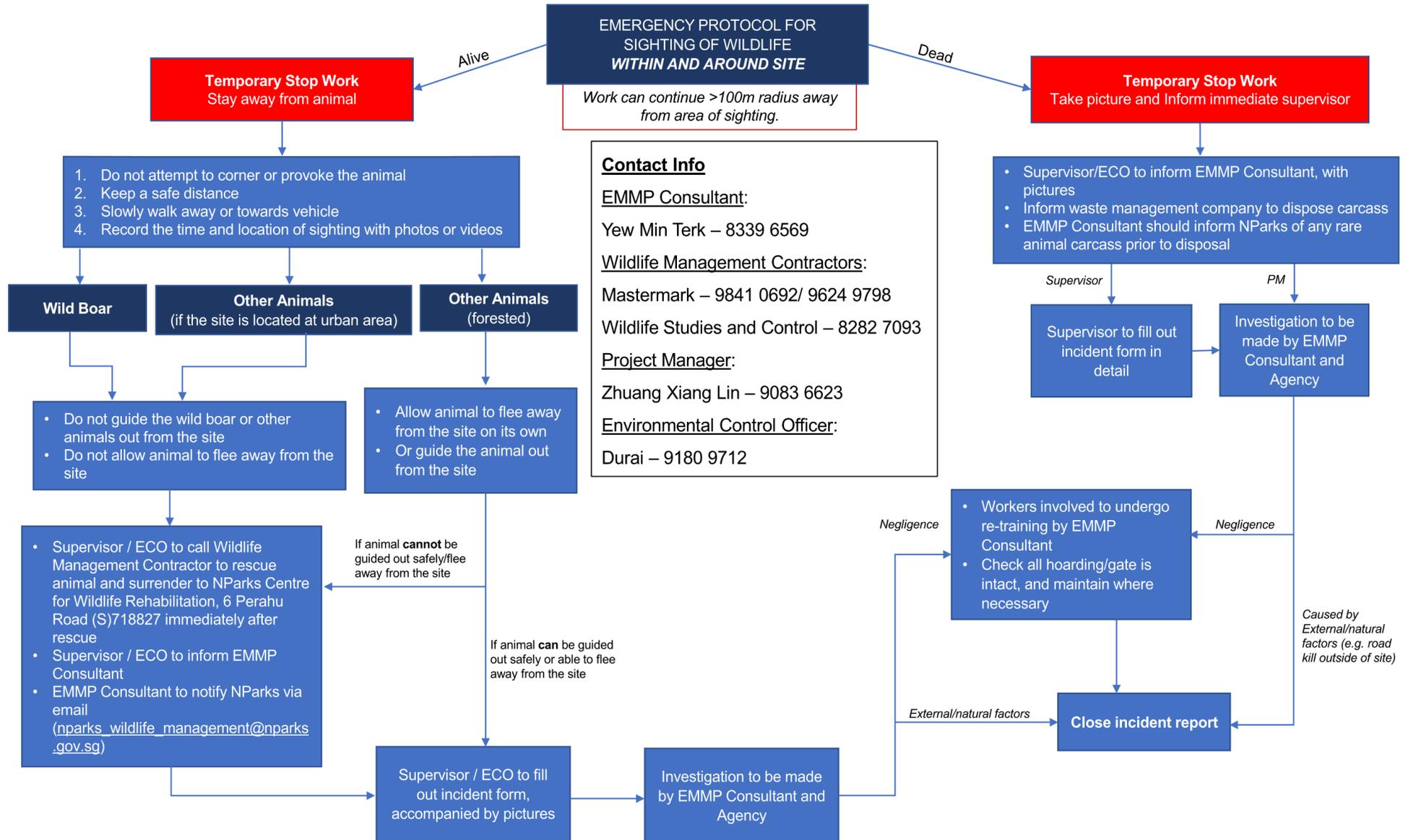
Bird Nests

If you see any bird nests,

1. Stop work
2. Inform EMMP consultant
3. EMMP consultant will arrange fauna specialist to check the nest
4. If an active bird nest is detected in a particular tree, vegetation patch at the Site at any time of the project, stop work at 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



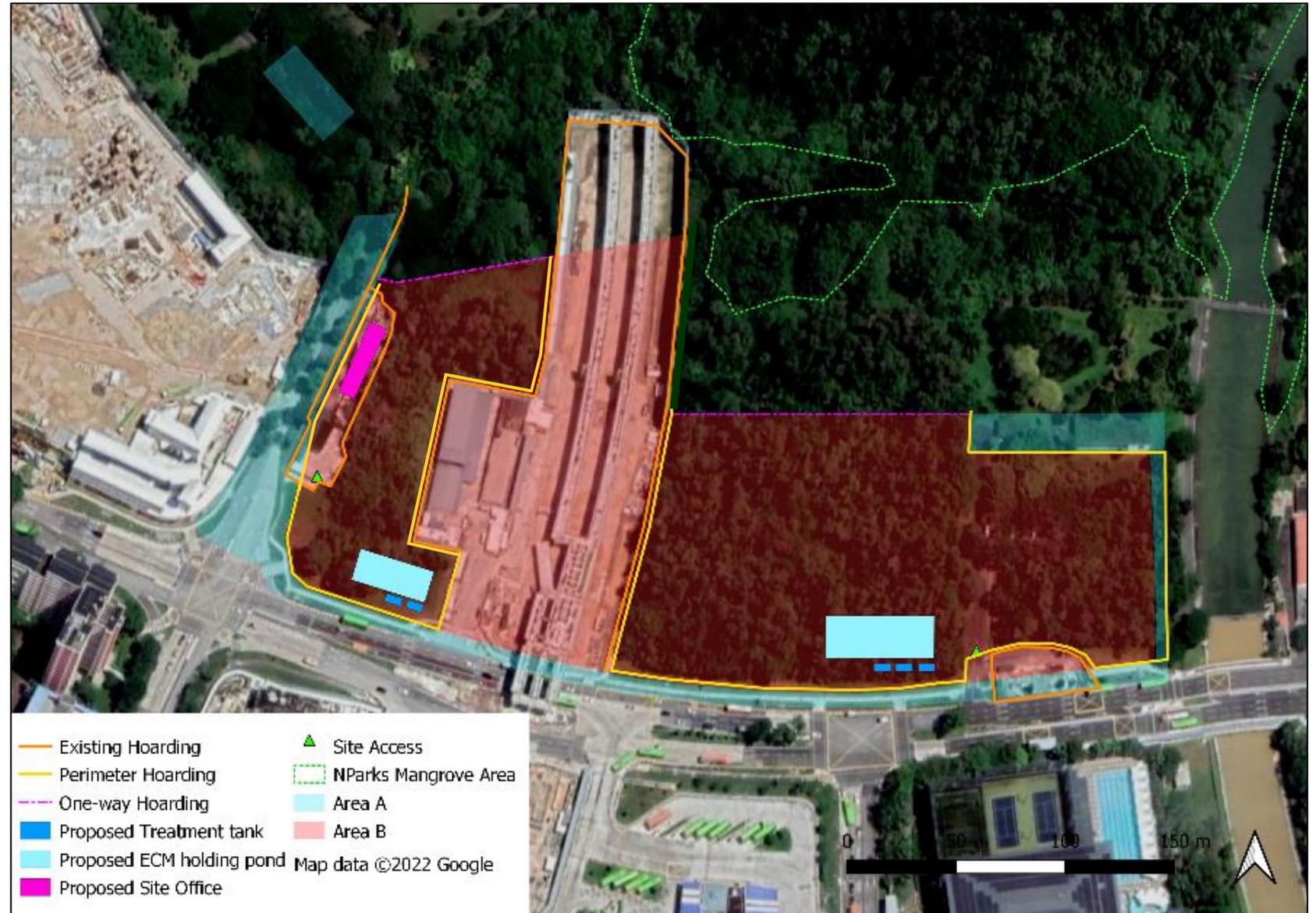
Earth Control Measures (ECM)

(Before Shepherding)

Setting up of fully operational ECM (i.e., Holding Pond, Treatment Tank, Silt Fence, Perimeter Drain)

(During Shepherding)

Holding Pond / Detention Tank should have Water Barriers to prevent wildlife from entering



Earth Control Measures (ECM)

(Before Shepherding)

Setting up of fully operational ECM (i.e., Holding Pond, Treatment Tank, Silt Fence, Perimeter Drain)

(During Shepherding)

Holding Pond / Detention Tank should have Water Barriers to prevent wildlife from entering



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 injury 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

Tree Protection Zone (TPZ)

Installation of fence around TPZ

No placement of construction materials within TPZ
(Do not use TPZ as storage)

Tree health within the TPZ to be monitored by Arborist

Refer to Arborist Report



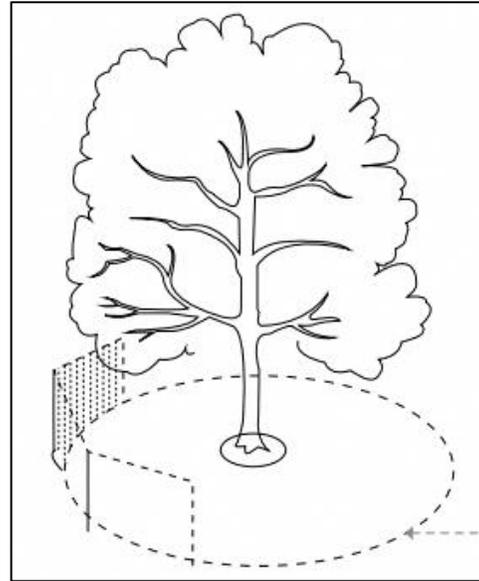
Tree Protection Zone (TPZ)

Installation of fence around TPZ

No placement of construction materials within TPZ
(Do not use TPZ as storage)

Tree health within the TPZ to be monitored by Arborist

Refer to Arborist Report



Example of a Poor Tree Protection Hoarding



Example of a Good Tree Protection Hoarding



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 Programs - Basic & Intermediate Electives (R - Reptiles, B - Birds, M - Mammals)											
S/N	Full Name of CAMS	Cert No	B	R	M	Company Name	UEN	Company Address	Company Email	Contact #	DG-approved species to trap & take
1	Agnès Teong Suan Li	CAMS20001	B								
2	Fazli Bin Buang	CAMS20002	B	R	M	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)
3	Kam Chia Huan (Gan Jialfa)	CAMS20003	B	R	M						
4	Tea Chia 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						
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 Tieng	CAMS21152	B	R	M						
13	Tan Gee Kee	CAMS21153	B	R							
14	Muhammad Dzuhairyan bin Dzulkifli	CAMS21154	B	R							
15	Ramlan Bin Mustaga	CAMS21155	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)
16	Mohammad 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 Uhaq Bin Abdul Karim	CAMS22031	B								
24	Tay Lian Chai Martin	CAMS22007	B								
25	Ng Jun Wei Dominic Pierre	CAMS22009	B			ArborCulture Pte Ltd	200209302W	53 Stirling Rd, Singapore 141053	info@arborculture.com	67920261	NIL
26	Rushan bin Abdul Rahman	CAMS22011	B								
27	Kalai Vanan	CAMS20007	B	R	M	ACRES	701500121K	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, Tree-shrew, Monkey, Culego)
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 Azhar Bin Mohamed Abdullah	CAMS22019	B			All 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@araspr.com	67822140	NIL
31	Ahmed Anik	CAMS22015	B			ARAS Development Pte Ltd					
32	Bahar Affandi Bin Abdullah	CAMS20008	B	R		Anticimex Pest Management Pte Ltd	198400909C	3A International Business Park #11-01/05, ICDN@IBP, Singapore 609935	pestfree@anticimex.com.sg	68523828	Reptiles (Lizards, Snakes, Green Iguana)
33	Mohamad Hisham Bin Noh	CAMS20009	B	R							
34	Ku Ahmad Fitri Bin Ku Azmi	CAMS20046	B								
35	Muhammad Haikal Bin Razali	CAMS20047	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)
36	Chong Ming Yan	CAMS20038	B	R	M						
37	Koh Teck Fong Terence	CAMS20039	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)
38	Adlam Shah Bin Alias	CAMS20010	B	R	M	Azartz Services Pte Ltd	201905000W	37 Delu Lane 10 #05-79 Singapore 539214	enquiries@azartz.com	62846956	Birds (All but Protected Wildlife Species), Reptiles (Lizards, Snakes, Green Iguana) Mammals (Common palm civet)
39	Muhammad Arafat	CAMS20021	B								
40	Sakthivelan S/O Narasajah	CAMS22036	B			Ban Chuan Trading and Engineering Pte Ltd	199000185N	637 Veerasamy Rd, #02-123, Singapore 200637	bantr@banchuan.com.sg	62796518	NIL
41	Soh Jun Hua, Humphrey	CAMS20011	B			Bird Management Pte Ltd	201301277E	2 Gambas Crescent #03-08, Nordcom Two, Singapore 757044	birdmanagementsingapore@gmail.com	98961191	NIL
42	Goh Joon Huat	CAMS21184	B			BION Environmental Pte Ltd	202017639C	21 Toh Guan Road East #08-03 Toh Guan Centre Singapore 608609	raymond.goh@bion.com.sg	90701438	Reptiles (Lizards, Snakes, Green Iguana)

Emergency Contacts

Incident	Responsible Party	Person-in-charge	Phone
All environment incident	<ul style="list-style-type: none"> Environmental Control Officer 	Mr Durai	9180 9712
Encounter of dead animals	<ul style="list-style-type: none"> EMMP consultant 	Mr Yew Min Terk	8339 6569
Encounter of injured animals	<ul style="list-style-type: none"> EMMP consultant Environmental Control Officer 	Mr Yew Min Terk Mr Durai	8339 6569 9180 9712
	<ul style="list-style-type: none"> Approved Wildlife Management Company 	Refer to Public Registry	Refer to Public Registry
Fire event / snake bites	<ul style="list-style-type: none"> Singapore Civil Defence Force (SCDF) 	N/A	995
Chemical / Oil Spill	<ul style="list-style-type: none"> EMMP consultant 	Mr Yew Min Terk	8339 6569

APPENDIX IX
PRE-CONSTRUCTION BASELINE SURVEY
FAUNA LIST



Brahminy Kite



Red Junglefowl



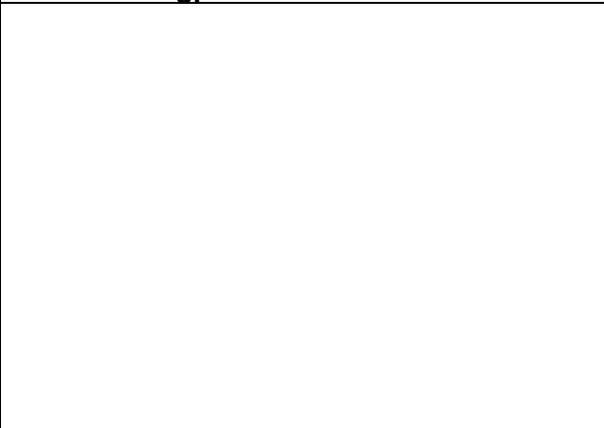
Collared Kingfisher



Oriental Magpie-Robin



Plantain Squirrel



APPENDIX X
PRE-CONSTRUCTION BASELINE SURVEY
WATER QUALITY ANALYSIS

TEST REPORT

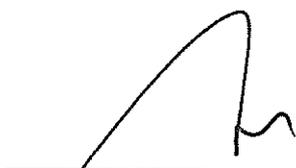
Our Reference No. : **R228099**
Project Code / Ref. : **CCECC-Gates JV**

Date Received : 14/12/2022
Date Commenced : 14/12/2022
Date Reported : 22/12/2022

Customer Ref. No. : **Pasir Ris**
Customer Name : **Singapore Environmental Consultancy and Solutions Pte Ltd**
Customer Address : **1 Sunview Road**
#08-66
Singapore 627615

Attention To : **Mr Ong Zhen Quan**
Sample Description : **3 Water samples as per received.**

RESULTS : **Refer to Page 2**



Tan Thuan Piang
Technical Manager

Terms & Conditions:

- 1) This report shall not be reproduced except in full, unless approval in writing has been given by MLS.
- 2) The results in this report only apply to the sample received/analysed.
- 3) MLS agrees to use reasonable diligence in the performance of the service.

Marchwood Laboratory Services Pte Ltd:
Main (Office and Laboratory):
Branch (Site and Laboratory):
Website:

Co. Reg No. : 201422686C
116 Tuas South Ave 2, West Point Bizhub Singapore 637163
216 Tuas South Ave 2, West Point Bizhub Singapore 637213
www.mls.sg

 : +65 6790 0118
 : +65 6262 3736 (Lab)

 : +65 6790 0091
 : +65 6262 3726 / 3776 (Site)

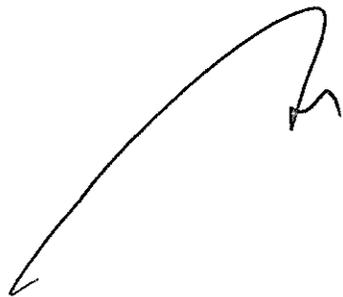
R228099

RESULTS

Test Parameter	Unit	Test Method	Sample 1	Sample 2	Sample 3	LOR
			W1	W2	W3	
			14/12/2022	14/12/2022	14/12/2022	
Biochemical Oxygen Demand, BOD5	mg/L	APHA 5210B	3.93	10.1	ND	2
Chemical Oxygen Demand, COD	mg O ₂ /L	APHA 5220D	60.3	158		25
Chemical Oxygen Demand, COD	mg O ₂ /L	Accredited In-house Method MLS-SOP-WQ-029 Rev 0 (Adapted from HACH)			30	20
Total Suspended Solids, TSS	mg/L	APHA 2540D	17.7	31.3	52.3	10
Free Chlorine as Cl ₂	mg/L	Lovibond Test Kit (DPD) Rev 1.0	ND	ND	ND	0.2
Oil & Grease (Total)	mg/L	Accredited In-house Method MLS-SOP-WQ-033 Rev 0 (adapted from APHA 5520C)	0.12	ND	ND	0.1
Aluminium as Al	µg/L	APHA 3125B	366	404	252	5
Cadmium as Cd	µg/L	APHA 3125B	ND	ND	ND	5
Copper as Cu	µg/L	APHA 3125B	ND	ND	ND	5
Lead as Pb	µg/L	APHA 3125B	ND	ND	ND	5
Nitrate as NO ₃	mg/L	APHA 4500-NO ₃ (I)	1.37	1.27	1.13	0.07
Phosphate as PO ₄	mg/L	APHA 4500-P (G)	0.17	0.19	0.20	0.025
Turbidity	NTU	APHA 2130B	16	16	17	0.05

Note:

1. APHA is a standard method for Determination of Water and Waste Water (APHA 23rd Edition, 2017).
2. LOR = Limit of Reporting. This value may also represent Detection Limit required for the project.
3. "ND" = Not detected. The data reported is less than the LOR.



SINGAPORE ENVIRONMENTAL CONSULTANCY AND SOLUTIONS PTE LTD

CHAIN OF CUSTODY FORM

14 DEC 2022

CLIENT : CCECC-GATES JV CONTACT : ADDRESS : PROJECT No. : SITE : Pasir Ris QUOTATION / JOB REQUEST / PO No. : SEND REPORT TO : Dennis REPORT NEEDED BY (DATE) : COMMENT / SPECIAL INSTRUCTION : STORAGE / DISPOSAL :					TOTAL NOs OF CONTAINERS#	STORAGE CONDITION**	ANALYSIS PARAMETER (Enter "x" below to indicate Request)							FOR LAB USE	
S/N	SAMPLE ID / LOCATION	SAMPLING DEPTH (m)	MATRIX* (Water/Sol/Sand/Sludge/Sediment)	DATE			TIME (HRS)	Chlorine, Aluminium, Lead, Cadmium, Copper	BOD, COD	Oil & Grease (low range)	NO ₃ , PO ₄	TSS	Turbidity	Reg. No.:	REMARKS / OBSERVATION
1	W1	surface	water	14/12/22	-	x	x	x	x	x	x	1228099			
2	W2	surface	water	14/12/22	-	x	x	x	x	x	x				
3	W3	surface	water	14/12/22	-	x	x	x	x	x	x				
4															
5															
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RELINQUISHED BY: Name: <u>Safiq Yusoff</u> Sign: <u>[Signature]</u> Company: <u>SECC</u>	DATE / TIME <u>14/12/22</u> <u>17.05</u> hrs	RECEIVED BY: Name: <u>[Signature]</u> Sign: <u>[Signature]</u> Company: <u>[Signature]</u>	DATE / TIME <u>14/12/22</u> <u>17.05</u> hrs	RELINQUISHED BY: Name: _____ Sign: _____ Company: _____	DATE / TIME _____ _____ hrs	RECEIVED BY: Name: _____ Sign: _____ Company: _____	DATE / TIME _____ _____ hrs	SHIPMENT BY COURIER: Courier Co. / Carrier Name: _____ Consignment Note / Airway Bill: _____
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* = For Water sample: Please Indicate FW (Fresh Water), SW (Seawater), BW (Ballast Water), DW (Drinking Water), GW (Ground water), WW (Wastewater)
 # Type of Sampling Bottles: G = Glass; P = Plastic; T = Tube; V = VOC vial, S = Sterilized bottle; B = Bag. ** Storage Condition: C = Refrigerate at 4 °C; R = Room Temperature; P = Preserved as per Lab's instruction.



SINGAPORE ENVIRONMENTAL CONSULTANCY AND SOLUTIONS PTE LTD

ANNEX I

Non-Technical Summary of Environmental Impact Study

Annex I – Non-Technical Summary of Environmental Impact Study

Pasir Ris N5 Phase 2 has been earmarked for residential development in URA's Master Plan since 2014. The future residential development site, bounded by Pasir Ris Green, Pasir Ris Drive 3 and Sungei Tampines, is located in close proximity to Pasir Ris Park and Pasir Ris Mangrove. In 2016, Ramboll Environ Singapore Pte Ltd (Ramboll Environ) conducted a joint Environmental Impact Study (EIS) for Housing and Development Board (HDB)'s residential developments and the Land Transport Authority (LTA)'s track modification project in the same area.



Figure 1. Pasir Ris N5 Phase 2 Residential Development in URA Master Plan 2014

The Study Area of the EIS is bounded by Sungei Tampines and Sungei Api Api to the east and west, respectively, the coastline to the north and Pasir Ris Drive 3 to the south. According to the findings of the EIS, the adverse environmental impacts that are expected to arise from the construction and operational phases of the proposed track modification project and residential projects can be effectively mitigated and minimized, provided that the proposed environmental mitigation measures are implemented.

The EIS report provides a baseline assessment of the project site, identifies the sensitive receptors, assesses the potential impacts, and recommends appropriate mitigation measures to reduce the residual impacts to acceptable levels during construction and operation phase. As one of the key mitigation measures implemented at the planning stage, the residential plot near to Sungei Tampines was re-orientated to be pushed further southwards and extended eastwards towards Sungei Tampines. This is to safeguard and retain the mangrove area which falls within the original proposed residential development and to accommodate wildlife corridors, as shown in Figure 2 and Figure 3 below.



Figure 2. Pasir Ris N5 Phase 2 Residential Development in URA Master Plan 2019



Figure 3. Retained Nature Area and Wildlife Corridors

By re-orientating the plot, a 20m to 50m buffer area is established between the residential development boundary and Pasir Ris Nature Area. The buffer areas will act as a wildlife corridor for local biodiversity interconnectivity (between Sungei Api Api and Sungei Tampines) and as a set-back from construction activities to protect the mangroves.

The findings, impact assessment and mitigation measures for key environmental aspects studied in the EIS are summarised in the section below. Based on the findings and recommended mitigation measures in the EIS report, a detailed Environmental Management and Monitoring Plan is developed to manage the environmental impacts from the development.

KEY ENVIRONMENTAL ASPECTS, IMPACT ASSESSMENT AND MITIGATION MEASURES

A. Biodiversity

The development site comprises mainly exotic-dominated secondary forest and some scrubland. The sensitivity of biodiversity receptors is considered to be high as Pasir Ris Nature Area comprises a mangrove forest known for its rich flora and fauna.

The vegetation clearance activities will result in major impact to flora species within the development, as the removal of flora species within the construction footprint is unavoidable during vegetation clearance. However, while there are 27 mangrove plant species of local conservation significance within the area, no loss of threatened mangrove plant species is expected. The key mitigation measure to re-orientate the residential plot near Sungei Tampines will minimize the impact on the mangrove species from major to negligible-minor.

The impact to fauna species due to loss and fragmentation of habitats is expected to be major, arising from vegetation clearance activities. This also poses a threat to woodland dependent species which make use of woodland habitats for various purposes, such as roosting and foraging. As a mitigation measure, woodland buffers are provided between Pasir Ris Park and the development projects to reduce the loss of ecological connectivity and allow for continued utilisation and passage of wildlife through the area, which will reduce the impact from major to moderate.

B. Noise

Pasir Ris Nature Area is the main noise-sensitive receiver of concern, as it comprises a mangrove forest known for its rich flora and fauna. During construction phase, noise generated from construction equipment, earthworks and piling activities could cause behavioural disturbance and auditory masking to wildlife. A 12m high noise barrier will be installed at the perimeter of northern boundary with the intent to achieve a minimum reduction of 10 dB(A). This will reduce the impact from major to moderate within the first 200m offset from the northern boundary, and further reduce the impact from moderate to minor beyond the 200m offset.

C. Water Quality

Untreated discharge of construction surface runoff, accidental discharge of chemicals and/or wastewater (from vehicle washing, from construction works and from site facilities) are expected to cause major impact due to pollution to soil and groundwater. This would affect the terrestrial species at the bottom of the food chain, such as those within the mangroves like molluscs and crustaceans, which would in turn affect predators higher up the food chain. Key mitigation measures include installation of perimeter drains and implementation of Earth Control Measures to prevent untreated discharge of surface runoff into water bodies or the mangroves. In addition, site facilities such as toilets, chemical and diesel storage locations are to be located farther away from the mangroves. With the

implementation of these mitigation measures, the significance of the residual impacts during the construction phase would be reduced from major to negligible-minor.

D. Air Quality

The sensitivity of ecological receptors to air quality impacts is high due to their proximity with the development area. During site clearance, wood wastes and top soil would be removed and disposed away from site. This is followed by earthworks which involves movement of construction vehicles and machineries handling the importing, unloading, spreading and compaction of earth to form the future development platform. These activities result in emission of dust particles, which could be carried by wind to the ecological receptors, causing major impact. With the implementation of proper dust control measures, such as covering bare earth surfaces and regular wetting of unpaved areas to minimise dust propagation, the significance of the residual impacts during construction phase could be reduced from major to moderate.

E. Light

Light pollution from the development could adversely affect light-sensitive fauna species active at night, such as bats and owls, within the Pasir Ris Nature Area and Pasir Ris Park. During construction phase, the installation of high hoardings along the northern boundary and implementation of light management plan would reduce the residual impact from major to minor. At operational phase of the development, the residual impact is reduced from moderate to negligible-minor by the re-orientation of the development boundary and provision buffers from the development to Pasir Ris Park and Pasir Ris Nature Area respectively.

Table 1. Summary of Residual Impacts

Environmental Aspects	Impact (before mitigation)	Residual Impact (after mitigation)
Biodiversity		
• Flora (non-mangrove) species	Major	Major*
• Mangrove species	Major	Negligible-minor
• Fauna species	Major	Moderate
Noise		
• First 200m (offset from northern boundary)	Major	Moderate
• Beyond 200m offset	Moderate	Minor
Water Quality	Major	Negligible-Minor
Air Quality	Major	Moderate
Light		
• Construction Phase	Major	Minor
• Operational Phase	Moderate	Negligible-minor

*Removal of flora species within the construction footprint is unavoidable during vegetation clearance and hence, cannot be further mitigated, but the loss of vegetation comprises mainly flora species from exotic-dominated secondary forest and some scrubland, which are of low conservation values.